Excess Mortality in Massachusetts During the Delta and Omicron Waves of COVID-19

The COVID-19 pandemic has produced excess deaths, the number of all-cause fatalities exceeding the expected number in any period.[1,2] Given reports that the Omicron variant may confer less risk than prior variants, we compared excess mortality in Massachusetts, a highly vaccinated state, during the Delta and initial Omicron periods.[3]

Supplemental content

Methods | We applied autoregressive integrated moving average (ARIMA) models to US Census populations (2014-2019) and seasonal ARIMA (sARIMA) models to Massachusetts Department of Health all-cause mortality statistics (from January 5, 2015, through February 8, 2020) to account for prepandemic age and mortality trends and to project the age-stratified (0-17, 18-49, 50-64, and ≥65 years) weekly population and the weekly number of expected deaths in Massachusetts during the pandemic period (February 9, 2020, through February 20, 2022), focusing on the Delta (June 28, 2021, through December 5, 2021), the Delta-Omicron transition (December 6-26, 2021), and Omicron COVID-19 periods (December 27, 2021, through February 20, 2022). Period barriers were determined by variant dominance in regional wastewater.[4]

The population of Massachusetts is approximately 6.9 million individuals. We corrected expected deaths for the decreased population owing to cumulative pandemic-associated excess deaths (eAppendix in the Supplement). Population covariates were used to calculate 95% CIs for expected deaths. Excess mortality for each period was defined as the difference between the observed deaths and point estimate for sARIMA-determined expected deaths. Incident rate ratios were calculated to compare the Omicron and Delta periods. According to the Massachusetts Department of Health, deaths recorded from 2020 to 2022 were considered provisional. Excess mortality for individuals aged 0 to 17 years was determined and included in the overall analysis, but not presented separately because the death rates were considered too small to be reliable.

Analyses were conducted with R version 4.1.2. Statistical significance was defined as a 95% CI that did not include 0. This study used publicly available data and was not subject to institutional review board approval according to the Massachusetts Registry of Vital Records and Statistics.

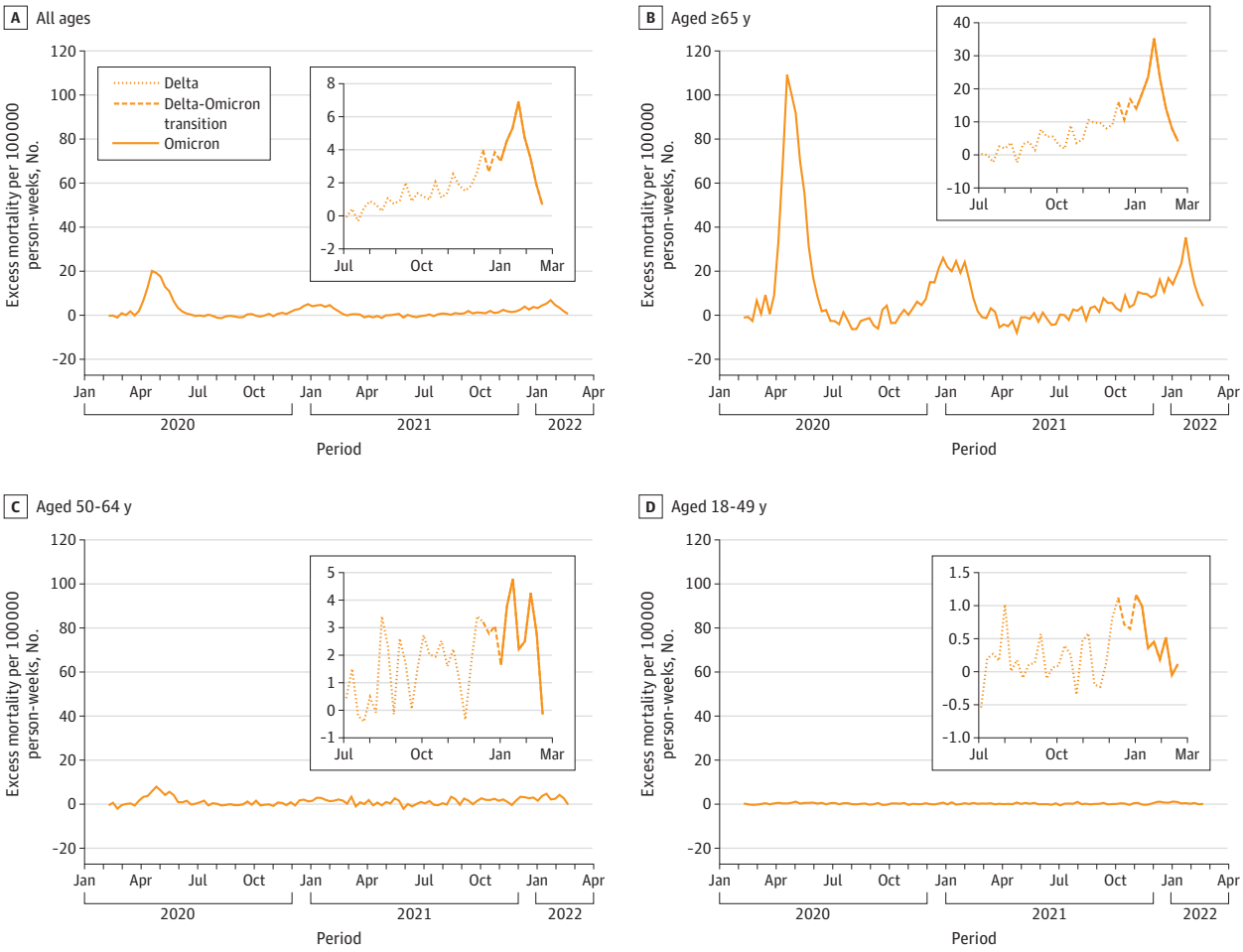
Results | During the 23-week Delta period, 1975 all-cause excess deaths occurred (27 265 observed; 25 290 expected; 95% CI, 671-3297 excess deaths). During the 8-week Omicron period, 2294 excess deaths occurred (12 231 observed; 9937 expected; 95% CI, 1795-2763 excess deaths). The per-week

Table. Excess and COVID-19–Attributed Deaths in Massachusetts, June 28, 2021, to February 20, 2022

Cases by age, y	Expected deaths, No. (95% CI)	Observed deaths, No.	Ratio of observed to expected deaths (95% CI)	Excess deaths, No. (95% CI)[a]
June 28, 2021-February 20, 2022; 238 d				
Massachusetts total (all ages)	38 715 (37 258-40 127)	43 738	1.13 (1.09-1.17)	5023 (3611-6480)
≥65	30 071 (28 831-31 336)	33 823	l.12 (1.08-1.17)	3752 (2487-4992)
50-64	5528 (5323-5736)	6420	1.16 (1.12-1.21)	892 (684-1097)
18-49	2800 (2676-2922)	3103	1.11 (1.06-1.16)	303 (181-427)
Delta (June 28, 2021-December 5, 2021; 161 d)				
Massachusetts total (all ages)	25 290 (23 968-26 594)	27 265	1.08 (1.03-1.14)	1975 (671-3297)
≥65	19 514 (18 372-20 681)	20 898	1.07 (1.01-1.14)	1384 (217-2526)
50-64	3651 (3481-3817)	4107	1.12 (1.08-1.18)	456 (290-626)
18-49	1908 (1806-2008)	2026	1.06 (1.01-1.12)	118 (18-220)
Delta-Omicron transition (December 6-26, 2021; 21 d)				
Massachusetts total (all ages)	3489 (3284-3686)	4242	1.22 (1.15-1.29)	753 (556-958)
≥65	2733 (2560-2911)	3291	1.20 (1.13-1.29)	558 (380-731)
50-64	488 (432-543)	616	1.26 (1.13-1.43)	128 (73-184)
18-49	236 (199-270)	310	1.31 (1.15-1.56)	74 (40-111)
Omicron (December 27, 2021-February 20, 2022; 56 d)				
Massachusetts total (all ages)	9937 (9468-10 436)	12 231	1.23 (1.17-1.29)	2294 (1795-2763)
≥65	7824 (7412-8246)	9634	1.23 (1.17-1.30)	1810 (1388-2222)
50-64	1389 (1297-1487)	1697	1.22 (1.14-1.31)	308 (210-400)
18-49	656 (595-713)	767	1.17 (1.08-1.29)	111 (54-172)

[a] Excess deaths do not sum to total because individuals aged 0 to 17 years are not shown.

Figure. Weekly All-Cause Excess Deaths in Massachusetts per 100 000 Person-Weeks From February 9, 2020, Through February 20, 2022



Insets for each age group are enlargements of the Delta period (dotted lines), Delta-Omicron transition period (dashed lines), and Omicron period (solid lines). Baseline (0 excess deaths) was determined with seasonal autoregressive integrated moving average.

Omicron to Delta incident rate ratio for excess mortality was 3.34 (95% CI, 3.14-3.54) (**Table**).

Statistically significant excess mortality occurred in all adult age groups at various times during the study period and in each period overall (**Figure**, Table). For all adult age groups, the ratio of observed to expected excess mortality increased during the Omicron period compared with the Delta period (Table).

Discussion | More all-cause excess mortality occurred in Massachusetts during the first 8 weeks of the Omicron period than during the entire 23-week Delta period. Although numerically there were more excess deaths in older age groups, there was excess mortality in all adult age groups, as recorded in earlier waves, including in younger age groups.[5,6] Moreover, the ratio of observed to expected all-cause deaths was similar in all age groups, and increased during the Omicron period compared with the Delta period.

Others have reported that the Omicron variant may cause milder COVID-19. If true, increased all-cause excess mortality observed during the Omicron wave in Massachusetts may reflect a higher mortality product (ie, a moderately lower infection fatality rate multiplied by far higher infection rate).

This observational study was limited by use of preliminary data, although mortality reporting for the study period in Massachusetts is more than 99% complete. Also, during the early Omicron period, a small number of deaths may have been caused by Delta infections that occurred several weeks earlier. Nevertheless, the present findings indicate that a highly contagious (although relatively milder) SARS-CoV-2 variant can quickly confer substantial excess mortality, even in a highly vaccinated and increasingly immune population.

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Accepted for Publication: April 27, 2022.

Published Online: May 20, 2022. doi:10.1001/jama.2022.8045

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Conflict of Interest Disclosures: Dr Krumholz reported receiving consulting fees from UnitedHealth, Element Science, Aetna, Reality Labs, F-Prime, and Tesseract/4Catalyst; serving as an expert witness for Martin/Baughman law firm, Arnold and Porter law firm, and Siegfried and Jensen law firm; being a cofounder of Hugo Health, a personal health information platform; being a cofounder of Refactor Health, an enterprise health care, artificial intelligence–augmented data management company; receiving contracts from the Centers for Medicare & Medicaid Services through Yale New Haven Hospital to develop and maintain performance measures that are publicly reported; and receiving grants from Johnson & Johnson outside the submitted work. No other disclosures were reported.

Additional Contributions: We thank the Registry of Vital Records and Statistics, Office of Population Health, Massachusetts Department of Public Health, for assistance with data acquisition; and Zhenqiu Lin, PhD (Center for Outcomes Research and Evaluation, Yale New Haven Hospital), for statistical support without compensation.

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COMMENT & RESPONSE

A Review of Acute Cholecystitis

To the Editor We have some comments about the recent Review[1] on acute cholecystitis. When considering the timing of cholecystectomy, surgeons recognize 3 potential intervention phases. Surgery is safest before or after an inflammatory process, as anatomical detail is maximally identifiable and tissue planes are easily developed. In the early inflammatory period, although anatomical detail may be obscured and tissues may bleed on dissection, surgery is usually safe. This is followed by a phase of several weeks when local and systemic inflammatory processes peak and tissue adhesion is maximal, making dissection difficult and anatomical identification often impossible. This is the most dangerous time for surgery.

Fourteen of 15 trials comparing emergency vs delayed laparoscopic cholecystectomy for acute cholecystitis defined *delayed* as at least 6 weeks after inflammation.[2] Yet the authors of the Review,[1] when discussing treatment options, chose the exception—a trial comparing surgery before 6 days with surgery between 6 days and 6 weeks—to advocate for early surgery. They further supported their argument by citing 2 large retrospective studies that compared surgery in the first days of hospitalization with surgery later during the same hospitalization. A comparison with planned "elective" surgery was not provided.

Although a recent meta-analysis[2] found no substantial difference between early and elective surgery, the number of patients included was small. However, a large prospective study[3] of 8909 patients, of whom 16% had emergency surgery, reported a mortality of 0.2% compared with a database of 58 697 patients,[4] of whom 77% had 2 or more elevated markers of inflammation with a mortality of 1.66%. Emergency cholecystectomy is associated with an increased rate of complications and a higher incidence of conversion to open surgery, which results in higher morbidity and mortality.

Although this Review[1] stated that 2% to 15% of patients undergoing laparoscopic cholecystectomy "must be converted" to open cholecystectomy, we contend that there are safer alternatives, such as gallbladder aspiration,[5] which allows time for the inflammation to subside. This procedure permits safer laparoscopic cholecystectomy after a 6-week interval or, if dissection difficulty is anticipated, allows time for a referral to a tertiary medical center.

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Conflict of Interest Disclosures: None reported.

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