

# Examining Excess Mortality Among Critical Workers in Minnesota During 2020–2021: An Occupational Analysis

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**Objectives.** To understand the occupational risk associated with COVID-19 among civilian critical workers (aged 16–65 years) in Minnesota.

**Methods.** We estimated excess mortality in 2020 to 2021 for critical occupations in different racial groups and vaccine rollout phases using death certificates and occupational employment rates for 2017 to 2021.

**Results.** Excess mortality during the COVID-19 pandemic was higher for workers in critical occupations than for noncritical workers. Some critical occupations, such as transportation and logistics, construction, and food service, experienced higher excess mortality than did other critical occupations, such as health care, K–12 school staff, and agriculture. In almost all occupations investigated, workers of color experienced higher excess mortality than did White workers. Excess mortality in 2021 was greater than in 2020 across groups: occupations, vaccine eligibility tiers, and race/ethnicity.

**Conclusions.** Although workers in critical occupations experienced greater excess mortality than did others, excess mortality among critical workers varied substantially by occupation and race.

**Public Health Implications.** Analysis of mortality across occupations can be used to identify vulnerable populations, prioritize protective interventions for them, and develop targeted worker safety protocols to promote equitable health outcomes. (*Am J Public Health.* 2023;113(11):1219–1222. <https://doi.org/10.2105/AJPH.2023.307395>)

Although there is evidence of higher COVID-19 mortality among certain populations (older adults,<sup>1</sup> people of color,<sup>2</sup> and persons with certain preexisting conditions<sup>1</sup>), occupational differences remain underexplored.<sup>3</sup> This variation can be partly attributed to exposure, especially among critical workers exempt from shelter-in-place orders who could not work remotely.<sup>4</sup> We defined critical workers as workers who perform operations or offer services essential to continue critical infrastructure operations as defined by the

Cybersecurity and Infrastructure Security Agency.

We measured excess mortality—deaths beyond those expected during usual circumstances—in 2020 and 2021 among workers usually employed in critical occupations in Minnesota. Unlike aggregated death data available from most states, Minnesota makes available individual-level microdata for the entire population of deceased individuals (all death records), allowing us to disaggregate results by race and occupation-based vaccine eligibility.

## METHODS

We obtained death certificates for all decedents in Minnesota between 2017 and 2021 from the Minnesota Department of Health that included the decedent's usual occupation in free text format. We coded this into census occupation codes using the National Institute for Occupational Safety and Health's Industry and Occupation Computerized Coding System, which reports the accuracy probability of codes assigned to individual entries.

We excluded 2708 observations with a probability in the bottom fifth percentile (probability < 0.75) and manually coded 2248 observations with a probability between 0.75 and 0.90. We further aggregated census occupation codes into Minnesota's 12 predefined critical occupations and vaccine eligibility groups (listed in Table 1; detailed in Appendix Table A, available as a supplement to the online version of this article at <http://www.ajph.org>).<sup>5,6</sup>

Critical occupations in Minnesota included health care professionals,

emergency and first responders, child-care, K-12 school staff, food processing, agriculture, food service, 2 categories of transportation and logistics (T&L-1, i.e., public transit workers, airport staff, and postal service employees; and T&L-2, i.e., logistics, delivery, and infrastructure transportation), manufacturing, construction, and retail. We audited 20% of aggregated codes, resolved inconsistencies observed in approximately 20 codes (1% audited codes) through discussion, and jointly coded those (n = 50; 10% aggregated

codes) that were ambiguous to the coders. Although manually coding specific occupations with moderate match probability, we found that the aggregated occupational grouping we used in this analysis was already accurately assigned in 96.83% of cases, increasing confidence in our matches. We restricted our sample to working-age civilians aged 16 to 65 years.

We estimated the excess mortality rate (EMR) as excess deaths divided by the number of workers in the occupation statewide (Appendix Table B,

**TABLE 1— Excess Mortality Rate Among Civilian Workers (Aged 16–65 Years) in Minnesota: 2020–2021**

Vaccine Phase <sup>a</sup>	All, EMR (95% CI)		Non-Hispanic White, EMR (95% CI)		BIPOC, EMR (95% CI)	
	2020	2021	2020	2021	2020	2021
All workers <sup>b</sup>	3.0 (3.0, 3.1)	4.5 (4.4, 4.5)	2.7 (2.7, 2.8)	4.4 (4.3, 4.4)	4.6 (4.4, 4.8)	5.6 (5.4, 5.7)
Phase 1A	2.9 (2.7, 3.1)	3.4 (3.3, 3.5)	3.1 (3.0, 3.3)	3.6 (3.4, 3.8)	2.3 (2.1, 2.6)	2.8 (2.7, 2.9)
Health care	3.2 (3.0, 3.3)	3.3 (3.1, 3.4)	3.5 (3.3, 3.7)	3.6 (3.4, 3.8)	2.2 (2.0, 2.5)	2.6 (2.6, 2.7)
First responders	0.4 (0.0, 1.1)	4.6 (3.9, 5.5)	−0.4 (−0.7, 0.2)	4.1 (3.3, 5.2)	3.3 (1.6, 10.1)	7.5 (6.0, 9.3)
Phase 1B Tier 1	1.7 (1.6, 1.8)	2.9 (2.7, 3.0)	2.4 (2.3, 2.6)	3.4 (3.2, 3.6)	−2.1 (−1.7, −2.8)	0.1 (0.2, −0.2)
K-12 school staff	1.0 (0.9, 1.1)	1.4 (1.4, 1.5)	1.5 (1.4, 1.7)	1.9 (1.8, 2.0)	−2.6 (−1.8, −4.2)	−1.7 (−1.2, −2.6)
Childcare	3.6 (3.2, 4.1)	7.2 (6.5, 8.0)	5.2 (4.7, 5.7)	8.2 (7.3, 9.4)	−1.5 (−1.4, −1.2)	3.4 (2.7, 4.6)
Phase 1B Tier 2: food processing	9.2 (7.3, 12.2)	9.6 (8.2, 11.5)	8.6 (6.3, 12.8)	11.0 (8.8, 14.4)	9.2 (6.4, 16.1)	7.5 (5.9, 10.1)
Phase 1B Tier 3	4.9 (4.6, 5.1)	5.5 (5.3, 5.7)	3.0 (2.8, 3.2)	6.1 (5.9, 6.5)	11.0 (10.0, 12.2)	5.8 (5.5, 6.2)
T&L-1 <sup>c</sup>	1.6 (1.5, 1.7)	3.0 (2.6, 3.4)	0.9 (0.7, 1.1)	0.7 (0.3, 1.2)	2.2 (1.6, 3.5)	11.6 (8.8, 16.9)
Manufacturing	5.5 (5.0, 6.1)	5.6 (5.3, 5.9)	4.6 (4.0, 5.4)	8.0 (7.5, 8.6)	8.8 (7.6, 10.5)	4.1 (3.9, 4.3)
Food service	8.2 (7.7, 8.8)	7.6 (7.2, 8.1)	5.8 (5.2, 6.4)	7.6 (6.9, 8.3)	15.0 (13.2, 17.4)	8.6 (7.8, 9.6)
Agriculture	−4.0 (−3.9, −4.1)	2.3 (1.6, 3.3)	−5.7 (−5.4, −6.1)	2.8 (2.0, 3.9)	12.3 (7.6, 26.3)	−0.3 (−0.3, −0.2)
Phase 1C	3.6 (3.5, 3.8)	7.7 (7.5, 7.9)	2.9 (2.8, 3.1)	6.8 (6.6, 7.0)	7.1 (6.6, 7.7)	12.0 (11.1, 13.1)
T&L-2 <sup>c</sup>	7.3 (7.0, 7.6)	14.0 (13.4, 14.6)	4.8 (4.6, 5.1)	14.5 (13.9, 15.2)	16.9 (14.9, 19.4)	13.7 (12.2, 15.6)
Retail	4.1 (3.8, 4.4)	8.7 (8.2, 9.3)	4.4 (4.0, 4.8)	8.6 (8.1, 9.2)	3.5 (3.1, 4.1)	8.9 (7.4, 11.1)
Construction	2.9 (2.6, 3.2)	8.9 (8.0, 9.8)	0.5 (0.2, 0.8)	6.2 (5.4, 7.1)	17.9 (15.3, 21.6)	24.3 (19.9, 31.2)
Phase 2	1.8 (1.7, 2.0)	2.2 (2.1, 2.3)	2.1 (1.9, 2.2)	2.2 (2.1, 2.3)	1.1 (1.0, 1.2)	2.4 (2.3, 2.4)
Other essential	3.2 (3.0, 3.4)	2.5 (2.3, 2.6)	3.5 (3.3, 3.7)	2.7 (2.5, 2.8)	2.2 (2.0, 2.5)	2.0 (1.9, 2.1)
Nonessential	0.5 (0.3, 0.6)	1.9 (1.8, 2.0)	0.7 (0.6, 0.9)	1.8 (1.7, 1.9)	−0.8 (−0.7, −0.9)	2.9 (2.8, 3.1)

Note. BIPOC = Black people, Indigenous people, and other people of color; CI = confidence interval; EMR = excess mortality rate; T&L = transportation and logistics. The table represents the EMR among White people and BIPOC who usually work in critical occupations in Minnesota. Most of these estimates are significantly different from zero. *P* values are reported in Appendix Table E (available as a supplement to the online version of this article at <http://www.ajph.org>).

<sup>a</sup>The vaccine eligibility tiers in Minnesota were based on critical occupations, as detailed in Appendix Table A (available as a supplement to the online version of this article at <http://www.ajph.org>).

<sup>b</sup>All civilian workers aged 16–65 years.

<sup>c</sup>T&L-1 includes public transit workers, airport staff, and postal service employees. T&L-2 includes those who work in logistics, delivery, and infrastructure transportation.

available as a supplement to the online version of this article at <http://www.ajph.org>.<sup>7</sup> Excess deaths (Appendix Table C, available as a supplement to the online version of this article at <http://www.ajph.org>) represent differences between observed deaths and expected deaths. To measure expected deaths, we multiplied the average baseline occupation-specific mortality rate by the size of the occupation in 2020 and 2021 to adjust for changes in occupation size.<sup>8</sup> We used the American Community Survey (2017–2021) to estimate year-specific employment.

We also conducted a sensitivity analysis using prepandemic occupation sizes as denominators (presented in Appendix Table D, available as a supplement to the online version of this article at <http://www.ajph.org>). To compare excess mortality across racial groups, we aggregated non-White and Hispanic decedents into 1 category. This aggregation is warranted because individual Hispanic people and Black people, Indigenous people, and other people of color (BIPOC) subpopulations were too small to disaggregate further, and all BIPOC subpopulations had substantially higher COVID-19 mortality than did White Minnesotans.<sup>7</sup>

## RESULTS

Workers experienced increased mortality during the COVID-19 pandemic in Minnesota (EMR = 3.0/10 000 persons in 2020 and 4.5 in 2021). Decedents usually employed in noncritical occupations experienced lower excess mortality than did critical workers. In 2020, the highest EMR was observed in food processing (9.2/10 000 workers) followed by food service and T&L-2. In addition to these occupations, construction and retail experienced high EMR in 2021.

Excess mortality among workers increased from 2020 to 2021. For workers in vaccination phase 1A, EMR increased from 2.9 deaths per 10 000 workers in 2020 to 3.4 in 2021. EMR for occupations in phase 1B, tier 1 increased from 1.7 per 10 000 workers to 2.9. Phase 1B, tiers 2 and 3, and phase 1C also experienced a large increase in excess mortality from 2020 to 2021, with the numbers in phase 1C more than doubling.

BIPOC workers experienced higher EMR (4.6 in 2020 and 5.6 in 2021) than did White workers (2.7 and 4.4, respectively), particularly in food processing, food service, construction, retail, and T&L. When aggregated by vaccine eligibility tiers, BIPOC workers had higher EMR than did White workers, especially in 2020 and in occupations included in the later vaccine eligibility tiers.

## DISCUSSION

All critical occupations experienced higher EMR than did noncritical occupations. BIPOC workers experienced higher EMR than did White workers in high-risk occupations. Across occupations, racial groups, and vaccine tiers, EMR increased from 2020 to 2021 (as occurred nationally<sup>9</sup>) even as vaccines started becoming available, and the vaccine tiers were not associated with EMR in 2020 or 2021.

Minnesota determined vaccine eligibility phases based on risks associated with age, occupation, and health conditions. Health care and childcare workers were prioritized for vaccination to reduce transmission to vulnerable populations they work with and to keep critical workers at work. However, from the perspective of allocating limited supplies to workers with the greatest risk of death, our analysis suggests that

some vulnerable groups were insufficiently prioritized. Health care workers and first responders had lower EMR despite being at risk, possibly because they were prioritized to receive protective equipment. Some vulnerable occupations (i.e., food service, construction, retail, T&L, food processing) included in vaccine phase 1B-tiers 2 and 3 tend to employ more BIPOC workers and experienced higher EMR than did workers in earlier phases. Those workers' high risk underscores the need to incentivize workplace protections such as improved ventilation, nonpunitive sick leave, and policies promoting booster uptake in such occupations.

The pandemic accentuated existing disparities. Several critical occupations are low-income jobs. High EMR observed among workers in these occupations—particularly BIPOC workers in critical occupations—could stem from socioeconomic disadvantages, including transportation modes, living arrangements,<sup>10</sup> and other factors, such as preexisting health conditions<sup>10</sup> or not having the political influence to advocate workplace safety.<sup>11</sup> Higher EMR among BIPOC Minnesotans employed in key occupations compared with workers in higher-priority, predominantly White occupations suggests that occupation-based vaccination may have prioritized lower-risk White workers above higher-risk BIPOC workers. Similar results were observed in California.<sup>8</sup> These disparities—especially in 2021, when vaccines were becoming available—suggest a failure to identify and prioritize interventions for vulnerable groups and achieve equity goals.

Like other occupational analyses, our results are constrained by the accuracy of occupational data. Death certificates record decedents' usual occupation at

the time of their death.<sup>12</sup> This may lead EMR to be overestimated if numerators include, but denominators exclude, people who are ordinarily employed but were out of work during the pandemic. Our sensitivity analysis shows that EMR estimates, mainly for BIPOC workers, are generally higher when using prepandemic occupation sizes as denominators (Appendix Table D) compared with the main results using occupation sizes in 2020 and 2021 (Table 1).

In conclusion, we identified groups of workers facing elevated risk during the pandemic. Although these results may not indicate causal effects of occupations on exposure risk, they are a good proxy to identify vulnerable individuals and locations to implement place-based interventions. In addition to vaccine prioritization, the workplace precautions that some critical occupations, such as health care, implemented to reduce the death toll of COVID-19 could be identified, adapted, and implemented in other occupations to protect critical workers. *AJPH*

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## CONTRIBUTORS

H. Karnik wrote the first draft of the article. H. Karnik and Z. Levin conducted the data analysis. E. Wrigley-Field and J. P. Leider secured data and funding. All authors contributed to study design, revised the article critically for intellectual content, and approved the final version submitted.

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## CONFLICTS OF INTEREST

The authors have no conflicts of interest to disclose.

## HUMAN PARTICIPANT PROTECTION

The University of Minnesota institutional review board determined this study to not be human participants research (IRB no. STUDY00012527).

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