Supplemental Online Content

Kidman R, Margolis R, Smith-Greenaway E, Verdery AM. Estimates and projections of COVID-19 and parental death in the US. *JAMA Pediatr*. Published online April 5, 2021. doi:10.1001/jamapediatrics.2021.0161

eMethods

eReferences

This supplemental material has been provided by the authors to give readers additional information about their work.

eMethods

Demographic Microsimulation

We estimate how many COVID-19 deaths leave at least one 0-18-year-old child parentally bereaved by prior research generating bereavement multipliers,[1] which applies results from kinship networks for non-Hispanic White and non-Hispanic Black residents of the United States[2,3]. Our estimates are produced using demographic microsimulations, using the most widely used program for such purposes, SocSim (https://lab.demog.berkeley.edu/socsim/; for reviews, see [4-6]).

Demographic microsimulation begins with a population of agents each endowed with various attributes including, in the model we draw on: age, sex, race, number of previous children (parity), marital status (single, married, widowed, or divorced), recency of prior birth (if a woman; to model post-partum amenorrhea), and heritable individual deviations from average fertility levels (to control variance in the distribution of numbers of children and correlated, mother-daughter fertility; see [3] for details). Within the model, which iterates monthly, each person is subjected to different risks of marrying another person in the simulation, divorcing from a current partner, becoming a widow, giving birth (if a woman), fathering a child (if a man partnered to a woman who gives birth), or dying. The probabilities of each of these events occurring are defined by time-varying age-, sex-, category-specific parameters input by the researcher (with categories being defined by parity, marital status, and race in different circumstances, e.g., for men, parity is not accounted for). Over time, a kinship network is built.

Prior research has validated the demographic microsimulation model upon which we draw, including confirming its close correspondence to features of the historical and contemporary U.S. population of non-Hispanic White and Black individuals, historical and contemporary measures of numerous demographic rates in these groups, and recent estimates of U.S. kinship networks for such individuals

derived from survey data (see [1-3]). The simulation covered the period 1760-2060, though the results we focus on kinship networks circa July 2020.

Approach and Sources of Data

Input demographic parameters for the microsimulation came from various high-quality historical and projected estimates, as detailed in the appendix of Verdery and Margolis[2]. Calculation of the bereavement multiplier presented here is described in Verdery, Smith-Greenaway, Margolis, and Daw[1], and replication files (including public-use data) are available. Using that data, we calculated two quantities. First, for non-Hispanic White individuals, we calculated the parental bereavement multiplier among individuals under the age of 18, M_w. We calculated the same quantity for non-Hispanic Black individuals: M_b. We then created an additional measure, M_{avg}, reflecting the population average bereavement multiplier by weighting the two race groups according to their share of the relevant population.

We calculate the number of children, *N*, who have lost at least one parent to COVID-19 with the following general equation

$$N = M \times D \quad (1)$$

In this equation, we use the different bereavement multipliers, e.g., M_{avg} or M_w, in place of M and the different measures of deaths ("479,000 recorded COVID-19 deaths," "552,000 estimated excess deaths," and "1,500,000 COVID-19 deaths") in place of D to get measures of the estimated number of children of different races who have lost a parent under different measures of the number of COVID-19 deaths.

We obtained our estimate of 479,000 (rounded from 478,912) recorded COVID-19 deaths between Feb. 2020 and Jan. 2021 from https://www.cdc.gov/nchs/covid19/mortality-overview.htm [accessed 3/1/2021]. We obtained our estimate of 552,000 excess deaths by rounding the midpoint of the

estimated range of numbers of excess deaths in the United States from Feb. 1, 2020 to Feb. 13, 2021 provided in https://www.cdc.gov/nchs/covid19/mortality-overview.htm [accessed 3/1/2021], which contains a dashboard.

We first calculate the *N*s using the population-averaged multiplier for each death measure.

We also calculate race-specific estimates of N. We do this by using the race-specific *M*s in equation (1) and multiplying the number of deaths overall by each race group's proportionate share of the number of deaths.

$$N = M \times D \times a \quad (2)$$

where a is 0.618 for non-Hispanic White individuals and 0.147 for non-Hispanic Black individuals. We obtained estimates of the proportionate share of deaths in each race group from https://www.cdc.gov/nchs/covid19/mortality-overview.htm [accessed 3/1/2021].

These estimates suggest that using race-specific multipliers and race-adjusted death counts on only the non-Hispanic White and non-Hispanic Black populations allows us to account for 76.5% of the 37,337 (range 28,195-60,119) parentally bereaved children, according to our population-averaged estimate. Among these, there are 20,636 [range 15,110-34,156] non-Hispanic White parentally bereaved children (55.2%) and 7,571 [range 5,259-10,718] non-Hispanic Black parentally bereaved children (20.3%).

Other Racial Groups

The bereavement multipliers we use come from estimates of non-Hispanic White and Black kinship networks. An assumption we make in the results presented in Table 1 of the main text is that the population average bereavement multiplier from these groups applies to other race and ethnic groups. This assumption arises because Equation 1 above multiplies the bereavement multipliers by total deaths, regardless of the race or ethnic group in which those deaths occurred. (Note that Equation 2,

where we examine race-specific counts, does not make this assumption because it adjusts the deaths to the race-specific proportion of deaths).

Three factors make this assumption reasonable. First, the non-Hispanic Black and White multipliers (0.108 and 0.070 respectively) are highly similar (i.e., each fell within the range of estimates of the other), both overall and in terms of the parental bereavement multiplier for all age groups and for the children we focus on here (see[1]). Second, racial and ethnic groups other than non-Hispanic White and Black Americans tend to have kinship networks whose sizes fall between those of non-Hispanic White and Black Americans (Table 4[7]). Third, and finally, race and ethnic-specific demographic rates over the past twenty years, which would produce the kinship structures that we consider, are too small to yield meaningfully large differences in the bereavement multiplier (see table 1[8]; appendix 1[9]; Table B[10]).

These analyses highlight the proportion of population-averaged bereavement attributable to non-Hispanic White and non-Hispanic Black individuals based on race-specific analyses. Subtracting the estimates of these quantities from the population average estimate yields a remainder of 9,130 (24.5%), which we take to represent the approximate share of parentally bereaved children from other race and ethnic groups. An alternative way of thinking about this number is that it represents the proportion of the population-averaged estimate we are most uncertain about.

Obtaining Typical Year Parental Bereavement Estimates

To clarify the extent to which parental death has surged as a result of COVID-19, we used our data to generate an estimate of parental death in a "typical" year. Specifically we estimate the extent to which COVID-19 related parental bereavement among children may represent an increase over typical year levels of parental bereavement among children by comparing the incidence implied by the estimates presented in main text Table 1 (e.g., 37,337 parentally bereaved children under the current mortality

scenario divided by 72,877,925 children per https://www2.census.gov/programs-surveys/popest/datasets/2010-2019/national/asrh/nc-est2019-alldata-r-file22.csv, accessed 01/11/2021) to the incidence of parental bereavement of children in the demographic microsimulation over the period February 1, 2020-January 31, 2021. The ratio of these estimates informs our estimate of the proportionate increase that COVID-19 has led to compared to parental bereavement of children in a typical year.

eReferences

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