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Abstract

The mounting evidence on the demographics of COVID-19 fatalities points to an overrepresentation of minorities and an underrepresentation of women. Using individual-level, race-disaggregated, and georeferenced death data collected by the Cook County Medical Examiner, we jointly investigate the racial and gendered impact of COVID-19, its timing, and its determinants. Through an event study approach we establish that Blacks individuals are affected earlier and more harshly and that the effect is driven by Black women. Rather than comorbidity or aging, the Black female bias is associated with poverty and channeled by occupational segregation in the health care and transportation sectors and by commuting on public transport. Living arrangements and lack of health insurance are instead found uninfluential. The Black female bias is spatially concentrated in neighborhoods that were subject to historical redlining.

JEL Codes: I14, J15, J16, J21, R38.

Keywords: COVID-19, deaths, race, gender, occupations, transport, redlining, Cook County, Chicago.

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1 Introduction

The mounting evidence on the demographics of COVID-19 fatalities points to an overrepresentation of minorities and an underrepresentation of women, but analyses at the intersection between race and gender have thus far been lacking.

The disproportionate impact of COVID-19 on African Americans has taken center stage in the debate on the socioeconomic implications of the pandemic (Kendi, 2020). The medical literature suggests that the higher risk of COVID-19 death among minority ethnic groups can only be partially explained by pre-existing health conditions, such as diabetes and obesity, that are more common among these groups possibly because of genetic and biological factors. Instead, the emerging consensus is that the observed racial differentials are also associated with socioeconomic correlates (Yancy, 2020). A large share of Black Americans is concentrated in areas characterized by widespread poverty, low housing quality, and higher prevalence of comorbidities, making low socioeconomic status a critical risk factor. Attention has also been called to the fact that racial minorities tend to hold highly-exposed jobs in health care, retail, and public transportation, and to live in crowded housing often occupied by multigenerational households. Black Americans suffer from further disadvantage in access to health care and in their ability to adhere to social distancing norms, as avoiding public transport and working from home is denied to the majority of them.[1]

Despite the above premises, race-disaggregated analyses based on individual-level data have thus far been lacking, since data are usually provided at a high degree of aggregation, such as state, county or, at best, ZIP code level. In this paper, we take advantage of an extraordinarily detailed source of information on daily deaths from COVID-19 and other causes that reports race among a wide array of other individual characteristics, including the georeferenced home address of the deceased. The data are collected by the Medical Examiner's Officer of Cook County, Illinois, the county that also includes the City of Chicago. The availability of individual-level data allows us to explore the potential intersection between race and other demographic characteristics, notably gender. While male sex is universally identified by medical research as a risk factor for death from COVID-19 (Peckham et al., 2020), what we uncover is the presence of a Black female bias, that is, the disproportionate impact on Black mortality is driven by Black women, who are hit particularly harshly in the early weeks of the epidemic outbreak.

In more detail, on the basis of the Cook County data we provide evidence on how race and gender jointly affect COVID-19 outcomes and investigate which factors and which

[1] Similar concerns have been raised with regard to minority ethnic communities in the UK (Kirby, 2020).

stage of the epidemic drive their impact. The first contribution of the paper is to document that, during the first wave of the COVID-19 epidemic (that is, cumulatively from March 16 to September 15, 2020), Black individuals have died at a rate approximately 1.2 times higher than their population share. Their overrepresentation rate, however, by April 9 was as high as 2.2, which implies that Black individuals were the first to be hit by the virus.[2] Cross-sectional regressions over individual-level data suggest that, even after controlling for age and comorbidities, the probability of dying from COVID-19 has been particularly high for Black women, while Black men were not significantly more likely to die from the disease than White men. Taken together, this preliminary evidence suggests that Black women have been more vulnerable to the risk of death from COVID-19 and that they have succumbed to the disease earlier than other groups in the population.

To establish our main results, we employ information on all deaths (from COVID-19 and any other cause) recorded by the Medical Examiner from January 1 to September 15 in 2020 and 2019 and we construct a cell-level panel, with cells aggregated at a race, census block group, week, and year level. As our main outcome of interest, we therefore rely on a measure of excess deaths for each race in a given block group and week in 2020, relative to the same race, block group, and week in 2019. Our empirical strategy is based on an event study model that captures differential trends in deaths between years, pre- and post-COVID-19 weeks, and races. We first detect a Black-White differential in excess deaths that manifests itself at the beginning of the epidemic outbreak. Next we examine how the racial differential varies by sex and uncover that Black females represent its driver, since they are hit more harshly than White women, while no significant difference emerges between Black and White males. In other words, a male bias is actually present only within the White population while, strikingly, within the Black population we do not observe any significant sex-related differences in excess deaths. Thus, the Black population is hit by COVID-19 earlier, more severely, and largely through its female component. The emergence of a Black female bias exposes an interaction between race and sex that had been thus far overlooked.

A heterogeneity analysis along physical, demographic, and socioeconomic dimensions reveals that block groups characterized by higher comorbidity, share of elderly, and poverty display sharper excess death racial differentials, and that the latter are always more pronounced for women. However, the effect of comorbidity and aging is only activated in association with poverty, suggesting that socioeconomic disparities, rather than biological ones, lie at the heart of the higher vulnerability of Black women.

We then explore which channels link poverty to the observed racial and gendered patterns in epidemic outcomes. We first look at occupational segregation and establish

[2] Both figures represent crude, that is, not age-adjusted, rates.

that Black women's vulnerability is linked with their overrepresentation in low-pay jobs belonging to two essential sectors—the health care sector and the transportation and warehousing sector—that are especially exposed to the risk of contagion and were not subject to lockdown. A second, related contributing channel is the intensity in using public transport and the length of commute to work. By contrast, we find no explanatory power for living arrangements, captured by a measure of housing overcrowding and a proxy for multigenerational family structure, and lack of health insurance coverage. Thus, the Black female bias is largely determined by a higher risk of contracting the virus at the workplace and on the way to work. Other factors that, once the virus has been contracted, could magnify its rate of transmission within the household or prevent adequate health care are instead found uninfluential.

Extensions of the main results include a falsification test that rules out analogous pre-pandemic seasonal trends; a replication of the investigation for Latinos that excludes for them outcomes similar to those we uncover for Blacks; and an analysis of deaths from other causes, such as crime or despair, that fails to corroborate the hypothesis that our findings may be driven by deaths that are indirectly related to COVID-19.

A striking characteristic of COVID-19 diffusion is its geographic heterogeneity. To explore whether the patterns we detect are concentrated in specific neighborhoods, using the georeferenced home address of the deceased we map fatalities into the areas defined by the redlining maps created in the 1930s.[3] We do find that the diminished resilience of Black women is geographically concentrated in formerly low-graded neighborhoods, thus uncovering a persistent influence of historical racial segregation.

To summarize, thanks to a unique source of individual-level data, we establish that the COVID-19 death toll in Cook County has been disproportionately imposed on Black women living in historically poor neighborhoods, because of their risk of exposure as frontline workers that were not protected by stay-at-home orders in the early weeks of the epidemic.

The paper is organized as follows. Section 2 summarizes related literature. Section 3 describes the data. Section 4 illustrates descriptive evidence on COVID-19 deaths in Cook County. Section 5 presents cross-sectional regressions. Section 6 introduces an event study approach and the corresponding triple difference-in-differences results. Section 7 is devoted to heterogeneity analysis. In Section 8 we investigate channels of transmission. Section 9 focuses on the influence of historical redlining policies. Section 10 concludes. Appendix A provides background information on redlining and Appendix B contains additional figures and tables.

[3] On historical redlining policies, see Appendix A.

2 Related literature

This paper is closely related to two parallel streams of the literature on the determinants of COVID-19 outcomes. The first has focused on race and the second on gender. We shall summarize them separately. For each one, we start by reporting relevant medical and epidemiological contributions. Next we report contributions from economics, focusing on the impact of COVID-19 both on health and economics outcomes.

COVID-19 and race Within the medical and epidemiological literature, the thus far largest study on the racial impact of COVID-19 has been performed in the UK based on the medical records of more than 17 million individuals (Williamson et al., 2020, working on behalf of NHS England). The study shows that pre-existing medical conditions such as diabetes or deprivation are linked to a higher likelihood of in-hospital death, but also that clinical risk factors alone cannot explain the observed racial/ethnic disparities.[4] A number of studies corroborate this hypothesis by showing, over different US samples, that Black Americans are overrepresented among COVID-19 patients, but do not show higher in-hospital mortality than Whites after adjusting for covariates. Thus, these findings support the conclusion that Black individuals do suffer from higher exposure to contagion due to socioeconomic status, but do not present an innate vulnerability to the virus.[5] Differential occupational risk for COVID-19 exposure according to race and ethnicity has also been acknowledged (Hawkins, 2020 and Chen et al., 2021).

Within the economics field, research on the racial impact of COVID-19 on health outcomes is still mostly confined to aggregated data. Across New York City ZIP codes, Borjas (2020), Schmitt-Grohe et al. (2020), Almagro and Orane-Hutchinson (2020), and Almagro et al. (2020) account for the racial dimension while looking at the demographic and socioeconomic correlates of COVID-19 infections—the latter two papers with specific attention to occupational segregation. Benitez et al. (2020) turn attention to deaths, again across ZIP codes, for the cities of New York and Chicago, and find that the higher death toll of COVID-19 among minorities mostly reflects higher case rates, rather than higher fatality rates among confirmed cases, thus converging with the above-cited findings from medical studies. At the cross-county level, a positive correlation between minority population shares and COVID-19 outcomes is found by Brown and Ravallion (2020), Desmet and Wacziarg (2020), McLaren (2020), and Ristovska (2020). Using the 2017 wave of the Panel Study of Income Dynamics to examine the prevalence of specific health

[4]Again for the UK, Bhala et al. (2020) confirm the relevance of socioeconomic and environmental explanations, rather than biological ones, of the racial differences in COVID-19 susceptibility.

[5]See Gu et al. (2020), Ogedegbe et al. (2020), Price-Haywood et al. (2020), and Rentsch et al. (2020), over samples respectively represented by the health care system at the University of Michigan, the New York University Langone health system, a Louisiana hospital, and a national cohort study of six million US veterans.

conditions, Wiemers et al. (2020) find evidence of large disparities across race-ethnicity and socioeconomic status in the prevalence of conditions which are associated with the risk of severe complications from COVID-19. In a long-term perspective, Bertocchi and Dimico (2020) exploit the Cook County microdata for a detailed analysis of the influence of historical redlining policies on COVID-19 fatalities.[6]

Even though our focus is on fatalities, contributions on the racial impact of the epidemic on economic outcomes are also relevant to us, since we rely on economic mechanisms—such as employment, mobility, and restriction policies—as drivers of the impact we find on fatalities. Using CPS microdata on unemployment, Couch et al. (2020) show that African Americans are only slightly disproportionately impacted by COVID-19-related layoffs, since they are heavily employed in frontline jobs, while for the UK Crossley et al. (2021) find that minority groups face a particularly large probability of job loss. Using survey data from the Occupational Information Network (O*NET), Dingel and Neiman (2020) evaluate the economic impact of social distancing measures by classifying occupations on the basis of the feasibility of working at home and find that occupations such as construction, health care, transportation, food preparation, and cleaning—where minorities are more represented—score lowest in this dimension. Relatedly, Mongey et al. (2021) establish that workers in low work-from-home and high physical-proximity jobs are less likely to be White. Goolsbee and Syverson (2021) find that shutdown orders have little aggregate impact, but do have a significant effect in reallocating consumers away from non-essential to essential businesses (e.g., from restaurants and bars toward groceries and other food sellers). A similar marginal impact of shutdowns is confirmed by Kong and Prinz (2020). Bargain and Arminjonov (2020), Barrios et al. (2020), and Durante et al. (2021) show that compliance with social distancing and health policies is largely affected by trust. In the US, the latter is particularly low among African Americans (Pew, 2019), who also have less confidence in scientists to act in the public interest (Pew, 2020). Lastly, Chun et al. (2020) uncover that minorities are more vulnerable to housing-related hardships during the pandemic.

COVID-19 and gender A parallel literature on the gendered impact of COVID-19 is also developing. While male sex is identified by medical meta-analyses as a risk factor for death from COVID-19, confirmed cases appear to be evenly distributed between men and women (Peckham et al., 2020). Virologists and epidemiologists have proposed several explanations of the mortality advantage held by women, ranging from biological and genetic factors to epidemiological and behavioral ones (Wenham et al., 2020). The male bias has been linked to a smaller incidence among women of comorbidities such as

[6] With reference to the UK, Platt and Warwick (2020), Sa (2020), and White and Nafilyan (2020) report descriptive evidence on vulnerability factors, infections, and deaths among ethnic minorities.

chronic heart and lung diseases, or differentiated immune responses (Scully et al., 2020). Other risk factors such as smoking, drinking, and drug abuse—that tend to be ingrained in cultural norms—also predict higher risk of comorbidities among men (Purdie et al., 2020).

Research within economics has focused on female labor market outcomes as an explanation for variation that does emerge in women's susceptibility to infection. Bertocchi (2020) argues that the fact that working-age women turn out to be more susceptible than men can be explained by their higher representation in jobs that are more exposed to contagion. Adams (2020) and Sobotka et al. (2020) refer to female labor participation to explain cross-country variation in the share of COVID-19 deaths among women.

Beside its direct effect on health, the COVID-19 epidemic is exerting a gendered impact on much broader realms that in turn may channel its impact on health. This growing literature, including Adams-Prassl et al. (2020), Alon et al. (2020), Dang and Nguyen (2020), Del Boca et al. (2020), Farré et al. (2020), Hupkau and Petrongolo (2020), and Sevilla and Smith (2020), has looked both at job losses due to the economic downturn and at redistribution of family burdens following school closures, with mixed results depending on the country. O*NET data are used by Barbieri et al. (2020) and Mongey et al. (2021), who provide a sectorial analysis of disease exposure and physical proximity that also accounts for the gender dimension, and by Albanesi and Kim, (2021) who specifically focus on the gendered impact of the COVID-19 recession on the US labor market, stressing how occupational segregation is behind women's disproportionate job losses and how limited availability of childcare explains their exit from the labor force. A parallel strand has focused on the heterogeneous impact of lockdown policies and compliance to them. Caselli et al. (2020) and Galasso et al. (2020) show that, out of a higher fear of being infected, women tend to adhere more closely to restraining measures.

Our contribution to the above literature is two-fold. First, we use finely disaggregated data at the individual and cell level and, second, thanks to these data we uncover an interaction between race and gender that results in a previously undetected Black female bias.

3 Data

We use information from deaths collected by the Medical Examiner's Officer and made available by the Government of Cook County, Illinois.[7] Daily information is reported

[7]See Cook County Medical Examiner Case Archive at https://datacatalog.cookcountyil.gov/Public-Safety/Medical-Examiner-Case-Archive/cjeq-bs86.

about those deaths that are under the Medical Examiner's jurisdiction. In addition to deaths from diseases threatening public health such as epidemics, the data include deaths related to trauma, injury, violence, accident, suicide, homicide, and other specific reasons, as well as cases when individuals die suddenly when in apparent good health or without medical attendance preceding death.[8] In 2019, the Cook County Medical Examiner recorded 6,272 deaths, out of 40,771 in the county.[9] In addition to the cause of death, the Medical Examiner provides information about sex, age, race, potential comorbidities, and residence (home address, city, ZIP code, and geographical coordinates) for each individual whose death is under his jurisdiction.[10] A death is recorded as a COVID-19 death when COVID-19 is reported among either primary or secondary causes.[11]

We spatially merge the death data from the Medical Examiner with census block group boundary files[12] and, for the analysis in Section 9, with the redlining maps produced by Home Owners Loan Corporation in the 1930s and recently georeferenced by American Panorama at the University of Richmond.[13]

For our analyses we construct two datasets. The first includes individual-level information on deaths from COVID-19 and any of the causes that fall under the jurisdiction of the Medical Examiner, together with individual-level characteristics, and covers the period from January 1, 2020, to September 15, 2020. We choose the latter date since mid-September roughly marks the end of the first wave of the epidemic in Cook County.[14] This first dataset will be used for the descriptive evidence in Section 4 (where we confine it to COVID-19 deaths) and the cross-sectional analysis in Section 5. The second dataset includes deaths from any cause under the Medical Examiner's jurisdiction that were recorded during the first 37 weeks of 2020 and 2019, that is, from January 1 to September 15, and is structured as a cell-level panel, where a cell refers to a race, block group, week, and year. This second dataset will be employed for the event study analysis introduced from Section 6. For the event study analysis, we also exploit block group-level

[8]See https://www.cookcountyil.gov/agency/medical-examiner.

[9]Since geographical coordinates and/or information about race are missing for some individuals, our sample includes 5,584 deaths.

[10]Information is reportedly obtained from vital records, hospitals, and families.

[11]Operationally, the Medical Examiner's Officer looks for references to COVID-19 in any of these fields: Primary Cause, Primary Cause Line A, Primary Cause Line B, Primary Cause Line C, or Secondary Cause. Information on COVID-19 fatalities may temporarily differ from that provided by the departments of public health because of time lags in notification and coincides with that provided by the Johns Hopkins University & Medicine Coronavirus Resource Center at https://coronavirus.jhu.edu/.

[12]See IPUMS NHGIS at https://www.nhgis.org/ and Manson et al. (2020). A block group represents a combination of census blocks and a subdivision of a census tract, and is defined to contain between 600 and 3,000 individuals. In the 2010 Census Cook County comprises of 3,993 block groups, to be compared with only 164 ZIP codes.

[13]See Nelson et al. (2020) and https://dsl.richmond.edu/panorama/redlining/.

[14]Data until September 15 were downloaded on November 6, 2020.

information provided by the 2014-2018 American Community Survey (ACS) for a large set of socioeconomic controls including the age structure of the population, poverty, employment by gender in 20 separate occupational sectors, public transport use, commuting distance, occupants per room, households with co-living relatives, and individuals with no health insurance coverage.[15]

4 COVID-19 Deaths in Cook County: Descriptive evidence

With over five million residents in 2019, Cook County is the most populous county in Illinois and the second most populous in the US after Los Angeles County, California.[16] The county is highly urbanized and densely populated. According to the ACS, non-Hispanic Whites, Blacks, Hispanics, and Asians are the most represented racial and ethnic groups, respectively with 41.4, 26.8, 23.5, and 6.2 percent of the population. Ever since the outbreak of the COVID-19 epidemic, the county has ranked among the top in terms of cases and deaths,[17] despite a strict stay-at-home order issued early on by Illinois Governor Pritzker on March 20 (effective March 21), four days after the first COVID-19 death and when the death toll was still limited to five.

This preliminary section is restricted to a description of COVID-19 deaths alone. The Medical Examiner recorded the first COVID-19 death in Cook County on March 16, 2020. By September 15, 2020, the death toll from the epidemic has reached 5,685 individuals—1,812 of whom Black (that is, 32.08 percent). Missing geographical coordinates and/or information about race reduce the sample to 5,162 deaths—1,712 (33.40 percent) of Blacks, during the first wave of the epidemic.[18]

Figure 1 shows the spatial distribution of the COVID-19 deaths in our sample, by mapping each fatality into a specific block group on the basis of the georeferenced home address of the deceased. The figure reveals a concentration of COVID-19 deaths in the central areas of the county, that roughly correspond to the City of Chicago.

Figure 2 plots the daily number of COVID-19 deaths in our sample, overall and separately for Blacks and non-Hispanic Whites (hereafter, Whites). In the early phase of the

[15] See the U.S. Census Bureaus (2014-2018) American Community Survey 5-year estimates at https://api.census.gov/data.html.

[16] Over 40 percent of all residents of Illinois live in Cook County. The largest of the county's 135 municipalities is the City of Chicago—the third most populous US city—followed by the City of Evanston.

[17] See the Johns Hopkins University & Medicine Coronavirus Resource Center at https://coronavirus.jhu.edu/.

[18] The racial distribution remains very similar, whether or not individuals with missing information are included.

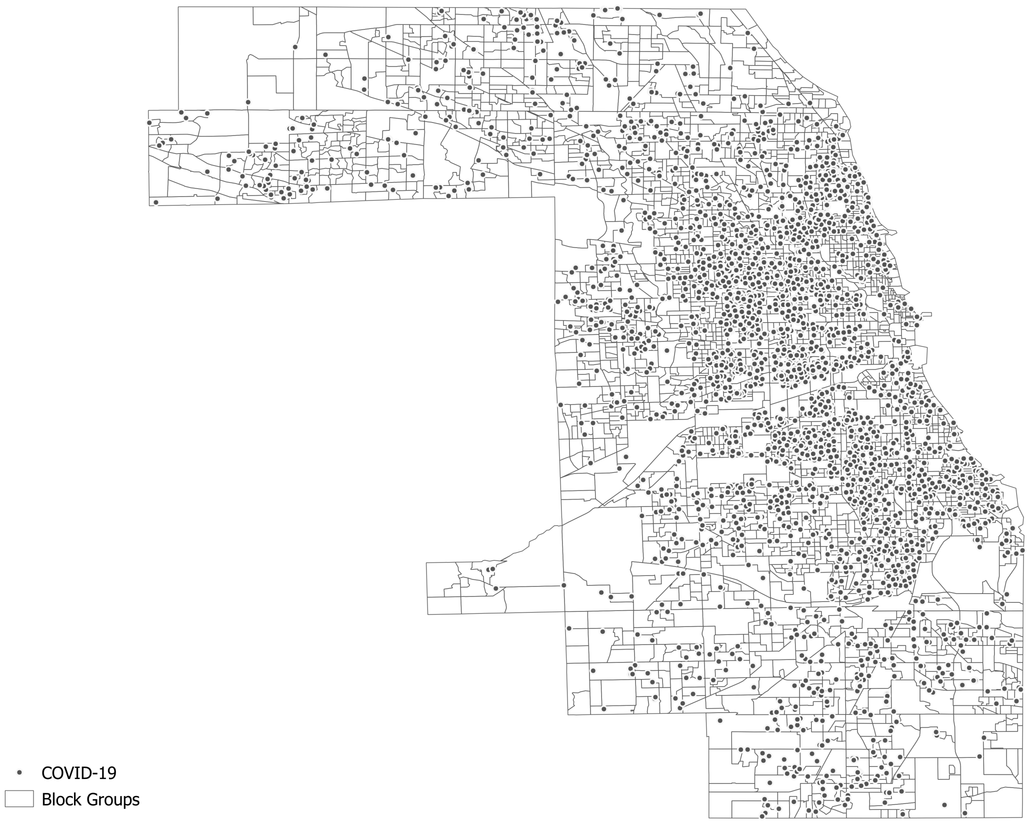

Figure 1: Cook County map and COVID-19 deaths

Note: The map indicates census block group boundaries. The sample refers to COVID-19 deaths recorded by the Medical Examiner in Cook County, March 16-September 15, 2020.

epidemic, up to mid-April, the daily number of Blacks dying from COVID-19 is above the number for Whites, although the share of the Black population is much smaller. By April 9, the cumulative share of Blacks who have died from COVID-19 represents almost 58 percent of total COVID-19 deaths. The daily number of deaths among Blacks remains high through mid-May and then starts decreasing at a slow pace. For Whites and overall, the shape of the epidemiological curve is quite different, with a delayed peak. By May 16, the cumulative share of Black COVID-19 deaths is down to about 39 percent, to decrease to 33 by September 15. In other words, cumulatively to the end of the sample period, Blacks in our sample are dying at a rate approximately 1.2 times higher than their share in the population, while the same ratio was as high as 2.2 on April 9.[19]

The above data show that Blacks are overrepresented in terms of COVID-19 deaths. Furthermore, they document that Blacks were the first to be hit and started to die before the rest of the population, with a consequent decline in the share of cumulative Black

[19]These crude measures of racial disparities are lower than those reported by the Centers for Disease Control and Prevention, since the latter are age adjusted. See https://www.cdc.gov/nchs/nvss/vsrr/covid19/health_disparities.htm.

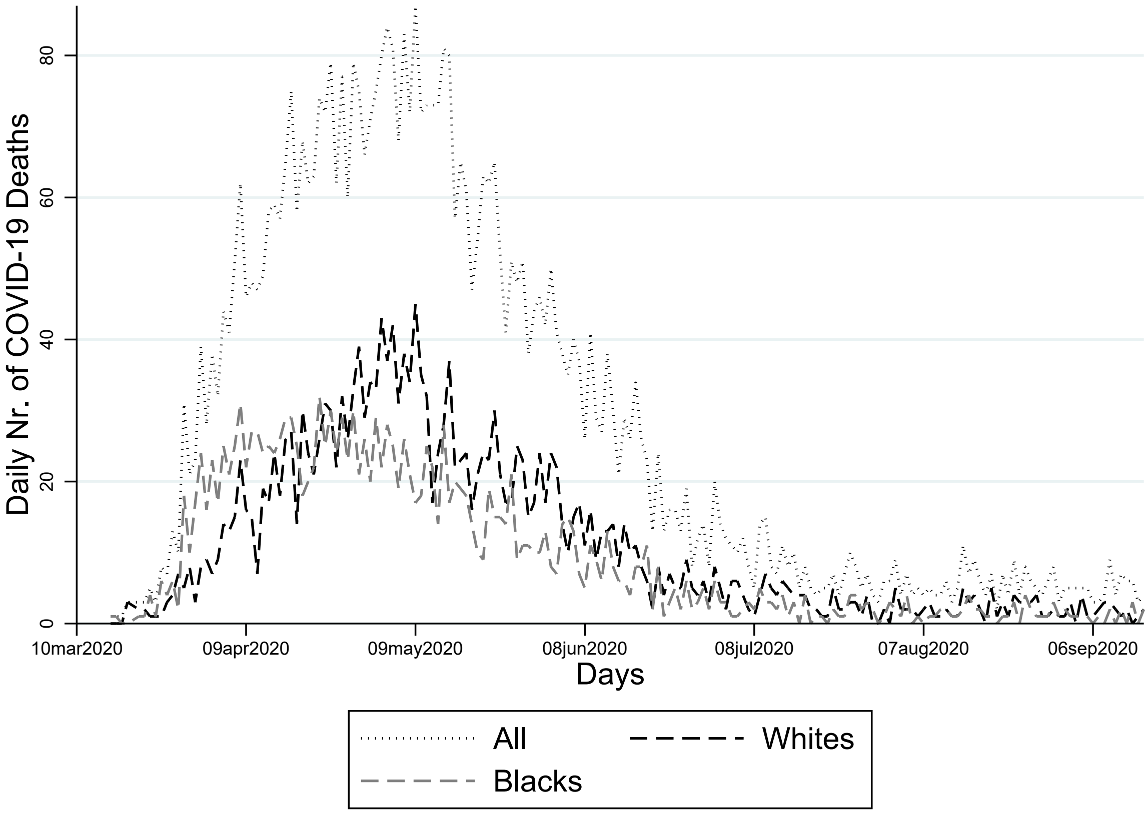

Figure 2: COVID-19 deaths, overall and for Blacks and Whites

Note: The figure reports the number of COVID-19 deaths by day, overall and separately for Blacks and Whites. The sample refers to COVID-19 deaths recorded by the Medical Examiner in Cook County, March 16-September 15, 2020.

deaths as the epidemic followed its course.[20]

Figure 3 disaggregates COVID-19 by race and sex, revealing some dissimilarities especially during the first few weeks of the epidemic, when Black women display a number of fatalities equal to or higher than that of Black men, contrary to what we observe for Whites, for whom fatalities among women are generally lower than men.

Further information on the demographic of COVID-19 fatalities is illustrated through a series of plots available in Appendix B. First we show the distribution of the raw number of deaths by age group, separately for Blacks and Whites (Figure B1). Even though they represent a much smaller share of the population, Blacks display a much larger number of deaths in working age, while the number of fatalities within the elderly population is

[20]On April 7, on the basis of the Medical Examiner's data, the Chicago Tribune (Reyes et al. 2020)—echoed by the Journal of the American Medical Association (Yancy, 2020) and the Lancet (Bhala, 2020)—reported that 68 percent of the dead in the City of Chicago involved African Americans, who represent about 30 percent of the city's population, with an implied crude overrepresentation ratio of 2.3. As of September 15, African Americans account for less than 42 percent of the deaths in Chicago, with a 1.4 ratio. Thus, the same trend can be detected both for the City of Chicago and Cook County as a whole. A similar downward trend is tracked nationwide by The Atlantic, see https://covidtracking.com/race.

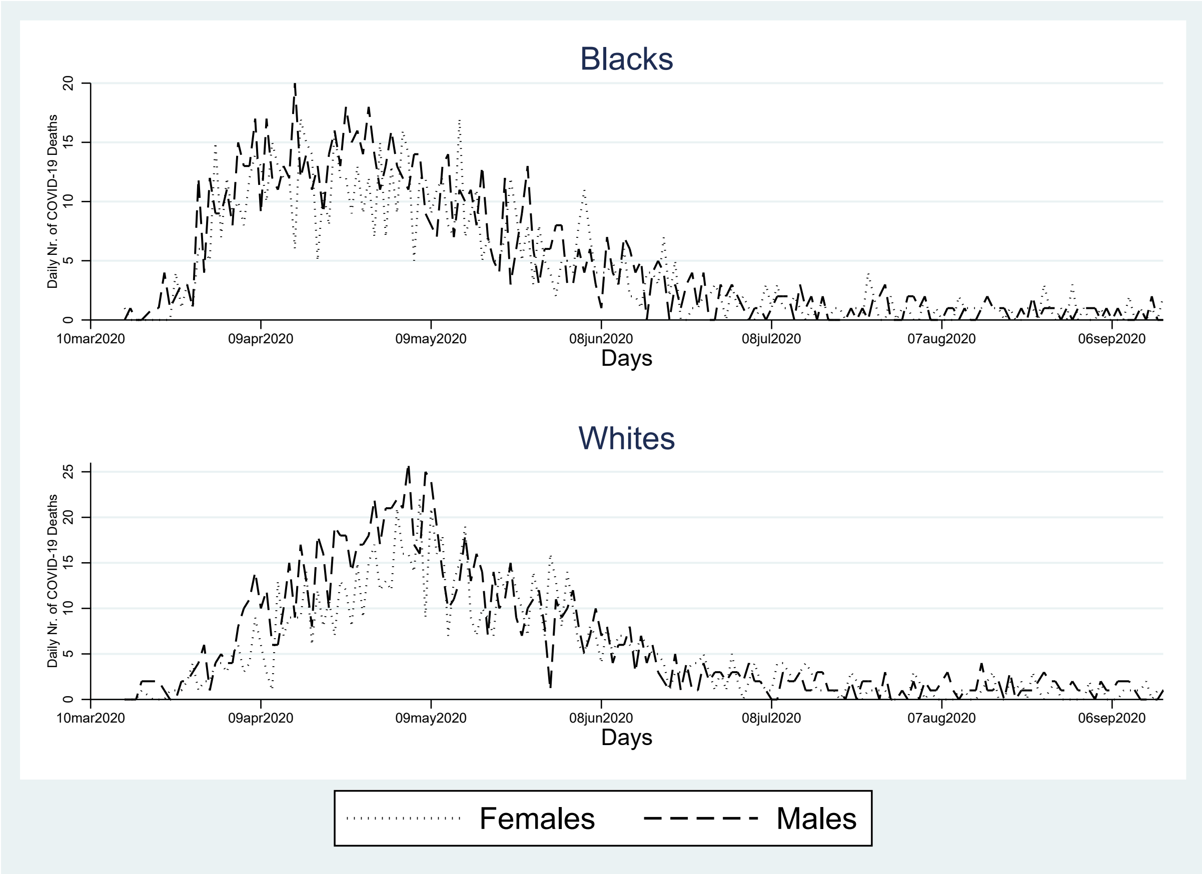

Figure 3: COVID-19 deaths by sex, for Blacks and Whites

Note: The figure reports the number of COVID-19 deaths by day, by sex for Blacks and Whites. The sample refers to COVID-19 deaths recorded by the Medical Examiner in Cook County, March 16-September 15, 2020.

larger for Whites. A breakdown by sex, again separately for Blacks and Whites (Figure B2) reveals that, compared to Whites, Blacks have a much more similar number of deaths between men and women. A breakdown by sex and age shows that women of both races are more likely than men to die from COVID-19 in old age (Figure B3). However, this phenomenon is largely driven by White women, while Black women are much more likely to die at a younger age. We extract information on comorbidities by generating a set of 14 dummy variables that take value one (and zero otherwise) when an individual who died from COVID-19 was affected by any of the following pre-existing conditions: diabetes, asthma, liver disease, cancer, hypertension, kidney disease, obesity, respiratory diseases, neuro-cardiac diseases, neuro-respiratory diseases, asplenia, immunodeficiency, transplant, and heart diseases.[21] In Figure B4 we report the percentage of COVID-19 deaths associated with the nine most prevalent comorbidities among Blacks and Whites. The ranking of comorbidities by prevalence is very similar across the two groups. Hyper-

[21]Disease groupings followed those employed by Williamson et al. (2020). Groups are not mutually exclusive.

tension and diabetes are by far the two most common comorbidities. For both, Blacks are more likely to suffer from them than Whites.

5 Cross-sectional evidence

In this section, we exploit cross-sectional information about individual deaths from any cause recorded by the Medical Examiner in Cook County in 2020 until September 15. In order to disentangle the factors affecting deaths from COVID-19 from those affecting other deaths reported by the Medical Examiner, we include all recorded death recorded from January 1, 2020. The outcome variable is represented by a dummy variable taking value one if an individual died from COVID-19 and zero if from any cause other than COVID-19. Table B1 reports variable definitions and sources. Table B2 shows that the probability of a COVID-19 death is 51.4 percent, which corresponds to 5,162 deaths out of the 10,040 deaths in the sample. The table also indicates that Blacks and females respectively represent 39.8 and 34 percent of the deceased. Therefore the sample tends to over-represent Blacks and under-represent women among those who did not die from COVID-19. Mean age is between 50 and 59. Among pre-existing conditions, the disease with highest prevalence is hypertension, that affects 28 percent of the sample, followed by diabetes with nearly 24 percent.

Our empirical strategy aims at exploiting the cross-sectional variation in mortality at the individual level. Formally, we estimate the following simple model:

$$C_i = \lambda_g + X_i'\pi + \mu_i \tag{1}$$

where C_i is a dummy taking value one if individual i died from COVID-19 and zero if individual i died from other causes; λ_g represent block group fixed effects that are meant to capture unobserved characteristics that vary at a block group level; X_i' is a vector of individual characteristics (age, sex, race, and comorbidities); and μ_i is the error term which we cluster at a block group level.

Table 1 reports OLS estimates for three variants of Equation 1, all including block group fixed effects and a set of dummies for age (the omitted one is 0-19 years of age). In Model 1 we also control for sex and race (the omitted one is White). The probability that in the period under examination a death occurs because of COVID-19 increases with age, as expected given the epidemiological literature.[22] However, contrary to what is expected, the probability of a COVID-19 death is also higher for women. Relative to Whites, the effect of race is positive for Blacks and for all the other races combined.

[22]The coefficients for the age dummies are not reported for brevity.

Table 1: COVID-19 deaths - Cross section

	(1) COVID-19 Death	(2) COVID-19 Death	(3) COVID-19 Death
Female	0.0789***	0.0450***	0.0202
	(0.0128)	(0.0159)	(0.0135)
Black	0.0384**	0.0112	-0.0181
	(0.0169)	(0.0190)	(0.0168)
Other Race	0.1792***	0.1777***	0.1247***
	(0.0209)	(0.0209)	(0.0174)
Female*Black		0.0777***	0.0462**
		(0.0244)	(0.0206)
Age groups	✓	✓	✓
Comorbidities			✓
Block group fixed effects	✓	✓	✓
Adj.R-squared	0.464	0.465	0.595
Observations	9311	9311	9311

Note: The dependent variable is a dummy variable that takes value one if an individual death is a COVID-19 death, and zero otherwise. The omitted categories are 0-19 years for age groups and White for races. The sample refers to deaths recorded by the Medical Examiner in Cook County, January 1-September 15, 2020. Robust standard errors clustered at a block group level in parentheses: *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

To explore the seemingly peculiar role that gender plays in the regression analysis, in Model 2 we add its interaction with Black. The coefficient on the interaction is positive and statistically significant, and drives away the significance of the coefficient on Black, which suggests that the probability of dying from COVID-19 in our sample is higher for Black women, while Black men are not significantly more likely to die from the disease than White men. Since men do tend to suffer more than women from medical conditions, this finding could be reversed once the latter are accounted for. Thus, in Model 3, we also control for the comorbidities recorded for all the deceased, by adding a set of 14 dummy variables that reflect the previously described classification from Williamson et al. (2020). Female per se is no longer significant, ruling out a higher risk of dying for White women. The size of the interaction between Black and Female is reduced, but the main message is not reversed, and points to a vulnerability of the Black population that is entirely captured by Black women.

Overall, these preliminary results suggest the emergence of a Black female bias in terms of COVID-19 fatalities. However, due to the limited information available from the Medical Examiner (no data on socioeconomic characteristics are provided) and to the nature of the sample (which tends to over-represent Blacks and under-represent women, among those who did not die from COVID-19) the above analysis only provides (spurious) correlational evidence lacking causal implications. This motivates the alternative empirical strategy that we develop in the next sections.

6 An event study approach

6.1 Empirical strategy

In order to exploit an event study approach, we use data on all deaths (from COVID-19 and any other cause) recorded by the Cook County Medical Examiner during the first 37 weeks of 2020 and, in order to assess their change, also during the same weeks in 2019. We map deaths into block groups using the georeferenced home address of the deceased and then we aggregate them by cell at a race, block group, week, and year level. The resulting panel provides variation across races, block groups, weeks, and years. Aggregating at a cell level has clear advantages in terms of identification, since it allows each race within a block group to display its own distribution of deaths. In the absence of specific shocks (such as COVID-19), the latter is assumed to be time-invariant. By focusing on cells and by comparing deaths for a specific race in a block group before and after the COVID-19 shock should filter out any sort of heterogeneity at a block-group and race level. The approach also allows to deal with some of the above-mentioned shortfalls in the Medical Examiner data, because the analysis will exploit changes in the distribution of deaths for specific groups which should not otherwise appear in the absence of a shock.

Table B3 reports variable definitions and sources and Table B4 summary statistics. On average, in each cell we observe a weekly growth in deaths of 2.4 percent over the previous year, of which about 37 percent is attributable to females.

Figure B5 (top panels) plots the number of deaths from any cause, separately for Blacks and Whites, in 2020 and 2019. The plots show that the number of deaths is relatively constant (i.e, it fluctuates around the mean) in 2019 and for the first ten weeks in 2020. Afterwards, consistent with Figure 1, the huge impact of COVID-19 in 2020 is clearly visualized, with deaths soaring for both groups and much more steeply so for Blacks. To be noticed is that, in 2019 and up to March 2020, the number of deaths for Blacks and Whites is similar even though Blacks represent a smaller fraction of the population, making the Black mortality rate higher in normal pre-pandemic times.

The bottom panel of Figure B5 plots the difference between the log of weekly deaths in 2020 and the log of weekly deaths in 2019, again separately for Blacks an Whites. It is on this measure of excess deaths—that can also be interpreted as the annual rate of growth of weekly deaths—that we shall focus in the implementation of our empirical strategy. For the first ten weeks, the deaths' rate of growth is relatively constant and close to zero, except for small deviations which are normally due to weekly changes in the composition of deaths. Figure B6 splits the bottom panel of the previous figure along the gender dimension and highlights further dissimilarities between races in the size and evolution of the gender gap in excess deaths. In particular, in the early phase of the epidemic, we observe a noticeable gap in excess deaths among Blacks, with Black women at disadvantage relative to Black men.

Our focus is on the racially-differentiated trend that emerges in 2020, reflecting dissimilar reactions to the epidemic in terms of excess deaths, defined as in the above figures as the difference between the log of weekly deaths in 2020 and the log of weekly deaths in 2019. As is well-known, reliance on excess deaths may imply both an overestimation and an underestimation of COVID-19 deaths. Overestimation may occur since not all the excess deaths in the weeks following the outbreak may be directly attributable to the epidemic. For instance, individuals may die from other diseases that go undetected or untreated because of the induced pressure on the health system, and from deaths of despair only indirectly related to the epidemic. On the other hand, underestimation may be induced by the fact that deaths by other manners such as accidents and crime may decline due to lockdowns. Because of these factors combined, officially reported COVID-19 deaths often do not match excess deaths. Nevertheless, because of the specific nature of the deaths under the Medical Examiner jurisdiction, for our data source the discrepancy between confirmed COVID-19 deaths and excess deaths is greatly alleviated. In particular, overestimation of natural deaths other than from COVID-19 would be contained, since they would not be recorded unless they occur under special circumstances (e.g., suddenly and without medical attendance). Moreover, we can directly check for a variety of manners of deaths potentially leading to over and underestimation, as we do in Sub-section 6.4.

To evaluate racially differentiated trends, we employ a triple difference-in-differences (hereafter DDD) estimator that exploits the difference between (the log of) deaths in 2020 and 2019 for a specific block group and week, together with differences between pre- and post-COVID-19 weeks and, lastly, between races. For most of the analysis, we focus on racial differences between Black and White individuals in the sample. The event study model to be estimated, where event time is set in terms of weeks, can be written as:

$$\Delta D_{r,g,w} = \delta_w + \gamma_g + \pi_r + \sum_{\tau=-10}^{26} \beta_{r,w} \cdot \pi_r \cdot \mathbb{1}\left(t - T_w = \tau\right) + \mu_{r,g,w} \tag{2}$$

where $\Delta D_{r,g,w} = log(0.1 + Deaths2020_{r,g,w}) - log(0.1 + Deaths2019_{r,g,w})$ represents excess deaths in 2020 relative to 2019 for race r in block group g and week w.[23] To capture permanent differences over weeks and across block groups we include week fixed effects, δ_w, and block group fixed effects, γ_g. The dummy variable π_r captures differences in excess

[23]Before taking the log, we add 0.1 to the number of deaths since the latter may be equal to zero in some cells.

deaths for Blacks relatives to Whites and controls for the fact that the overall number of deaths among Blacks is normally larger than the number of deaths among Whites (i.e., it amounts to a scale factor). The treatment variable is constructed by interacting the dummy for Blacks, π_r, with dummies for each week before and after the COVID-19 outbreak, as indicated by the event time dummy $\mathbb{1}\left(t - T_w = \tau\right)$. The latter is set equal to 1 for $\tau = -10, ..., 0, ..., 26$ weeks from the reference period T_w which corresponds to treatment initiation (that is, week 11 in the sample or, in calendar time, the week from March 11 to 17, 2020 when the first COVID-19 death was recorded on March 16). Because the first death was recorded on March 16 (one day before the end of week 11), we omit the period corresponding to week 11 (i.e., $\tau = 0$ corresponds to week 11 in the sample, which starts on March 11).[24] In this setting, the coefficient $\beta_{r,w}$ will capture the impact of the epidemic on the Black-White differential in excess deaths, or in the annual rate of growth of deaths. The error $\mu_{r,g,w}$ is clustered at a block group level.

The above estimator filters out the trend in the rate of growth of deaths among Whites and captures the differential trend for Blacks with respect to Whites. Under the assumption that both races are affected in the same way by the epidemic, we would expect no statistically significant differences to emerge both in the pre- and in the post-COVID-19 weeks.

The event study approach outlined in Equation 2 alleviates some of the shortcomings affecting the cross-sectional analysis. The inclusion of the pre-treatment period allows us to verify the parallel trend assumption, and therefore to test for potential differences in mortality between treated and control groups, and to respond to concerns about the occurrence of selection, that may lead to different rates of disease transmission between racial groups. Because the sample includes the universe of the block groups in the county, sample selection issues related to sample selection will also be ruled out. Learning and adaptation to the treatment before it kicks in, as it would otherwise occur with staggered treatment, is also unlikely given that the treatment period is constant. The only potential source of bias is therefore potentially related to measurement error, since not all the deaths that occur in Cook County are reported to the Medical Examiner.

6.2 Baseline results

Before we report estimation results for the event study in Equation 2, for illustrative purposes in the top panel of Figure 4 we start by plotting excess deaths (i.e., equivalently, the annual rate of growth of deaths) against week dummies for Blacks and Whites separately, with respect to the reference week (week 11). As a result, only the variation

[24]Results would be unchanged if we omit the previous week.

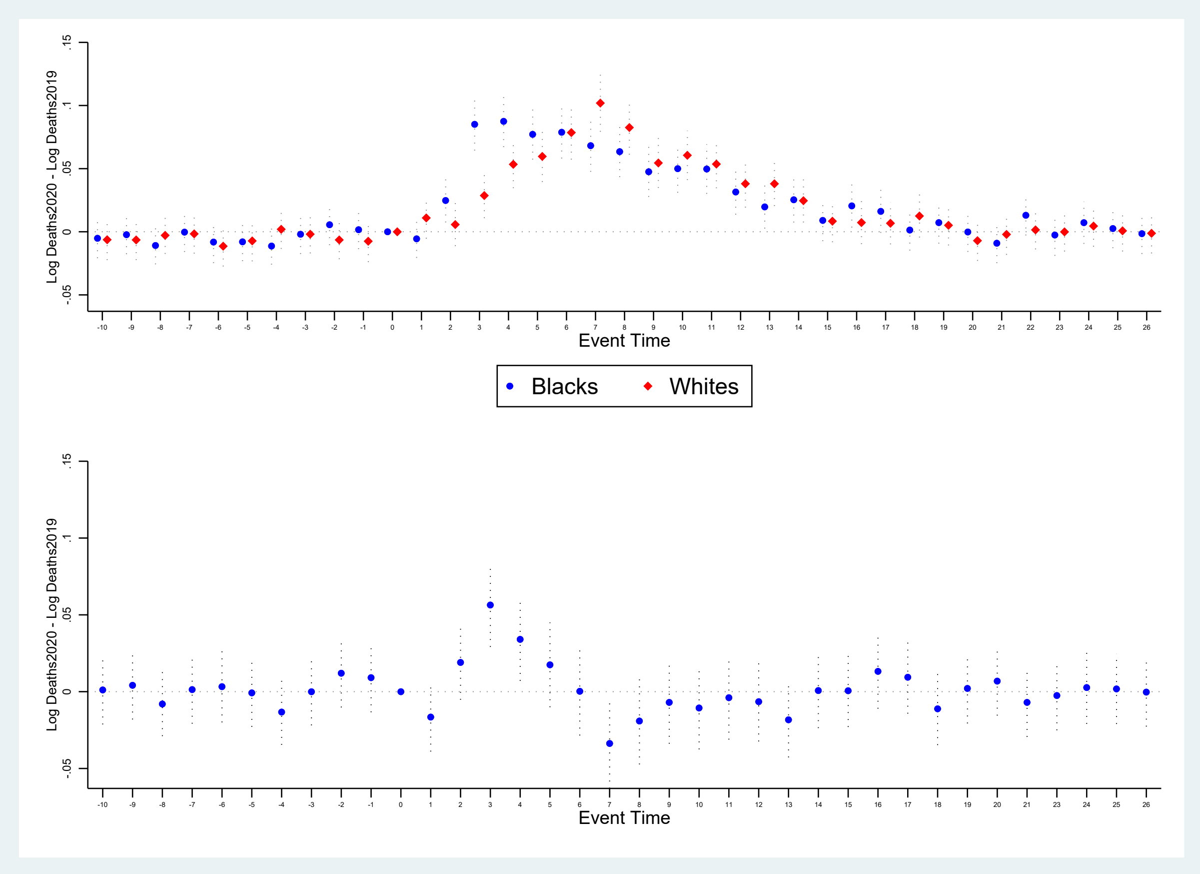

Figure 4: Excess deaths for Blacks and Whites and Black-White excess death differential

Note: The dependent variables are excess deaths for Blacks and Whites (top panel) and the Black-White differential in excess deaths (bottom panel). The coefficients are least-squares estimates of the βs. Block group fixed effects are included in both panels and week fixed effects are also included in the bottom panel. Vertical lines represent 95 percent confidence intervals based on standard errors clustered at a block group level. The sample refers to deaths recorded by the Medical Examiner in Cook County, January 1-September 15, 2020 and 2019. The omitted period is $\tau = 0$, i.e., week 10.

between the treated and untreated year and the weeks before and after the epidemic outbreak will be exploited. Week 11 is the reference period and corresponds to event time 0 on the horizontal axis. To ease the reading, the dots and diamonds respectively indicating Blacks and Whites are staggered. For these initial models, we only control for block group fixed effects in order to remove fixed characteristics that are unlikely to change over this time period.[25]

For the first ten weeks, that is, before treatment initiation, excess deaths for both races are not statistically different from zero, which amounts to a validation of the parallel trends assumption. After the COVID-19 outbreak, the plots capture the evolution of deaths and reveal sharp differences in the shape of the epidemiological curves across races. For Blacks, we observe a quick increase in deaths starting from the week of March 25 (event time 2), with a jump in the week of April 1 (event time 3), and a peak in the

[25]Formally, the underlying model is given by: $\Delta D_{r,g,w} = \gamma_g + \sum_{\tau=-10}^{26} \beta_{r,w} \cdot \mathbb{1}\left(t - T_w = \tau\right) + \mu_{r,g,w}$.

following one (event time 4). Afterwards, by late April, the deaths' growth rate starts a slow decline which can be linked to the lagged effects (by about three/four weeks) of the strict stay-at-home order put in place on March 21 and/or to the diffusion of protective devices.[26] It is only by mid-June that the effect of the outbreak vanishes. Averaging across block groups, during the initial four post-treatment weeks, that is, up to the peak of the effects, the increase in the rate of growth of deaths for Blacks, relative to the same weeks in 2019, is close to 10 percent. By contrast, the effect for Whites manifests itself a week later, grows in a much more gradual fashion, reaches its peak with a substantial delay in early May, and exhausts itself sooner.

The bottom panel of Figure 4 reports estimation results for the βs of the fully fledged DDD in Equation 2, by plotting the racial differential in excess deaths. The figure confirms that the impact of COVID-19 on Blacks exceeds the one on Whites at the very beginning of the outbreak, an unbalance that is never offset by the subsequent epidemiological evolution despite a mild reversal in the week of April 29.

As mentioned, the measure of excess deaths that we have employed thus far (i.e., the difference between the log of the number of years in two subsequent years) has the advantage of allowing an interpretation in terms of deaths' annual rate of growth (since it is corresponds to the log of the ratio of deaths in 2020 over deaths in 2019). Several alternative definitions of excess deaths have been proposed. For instance, one could simply take the difference between the raw number of deaths in 2020 and 2019. However, this approach would not allow a proper comparison between population groups of different size, which is precisely our goal. A percentage measure, that divides the difference between deaths in 2020 and 2019 by deaths in 2019, would also be inappropriate, since the structure of our dataset involves cells associated with zero deaths. Any of the above three definitions can be computed with reference not just to deaths in 2019, but to an average of deaths in multiple previous years. Averaging over multiple years should produce an approximation of a normal year death count, and indeed it should smooth out yearly trends. However, the larger the number of years involved, the larger the weight of long-term trends in population growth or mortality that would invalidate the approximation. With this caveat in mind, in Figure B7 we show that our results are robust to a more conventional definition of excess deaths involving an average of three years prior to 2020, defined as deaths in 2020 minus average deaths in 2017-2019 (multiplied by 1,000).

The remainder of this subsection is devoted to investigating how the above results vary by gender. Generally speaking, sex is a well-established risk factor for COVID-19

[26]The timing is consistent with disease progression, as symptoms can take several days to appear after infection and the median time from the onset of symptoms to death is 19 days. See Johns Hopkins Medicine at https://www.hopkinsguides.com.

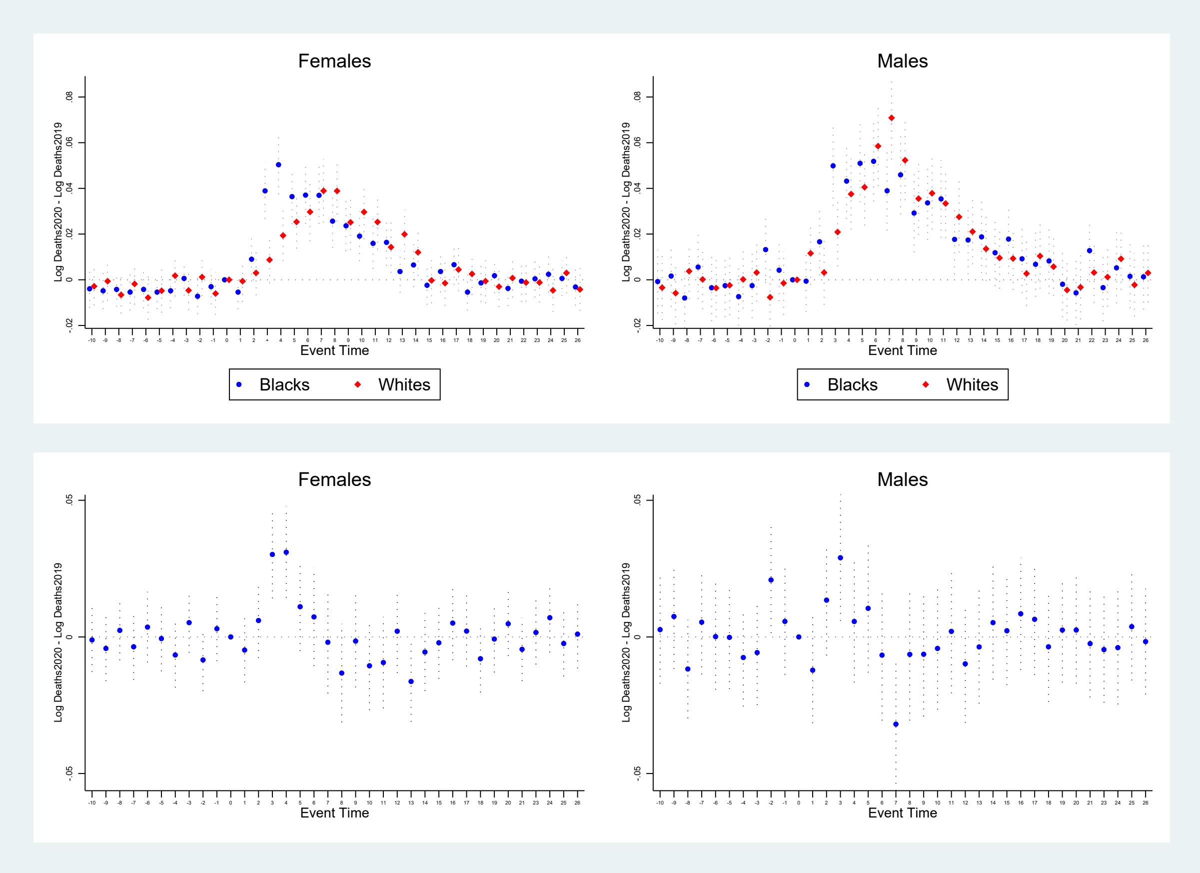

Figure 5: Excess deaths for Blacks and Whites and Black-White excess death differential, by sex

Note: The dependent variables are excess deaths for Blacks and Whites, by sex (females in top left panel, males in top right panel) and the Black-White differential in excess deaths, by sex (females in bottom left panel, males in bottom right panel). The coefficients are least-squares estimates of the βs. Block group fixed effects are included in all panels and week fixed effects are also included in the bottom panels. Vertical lines represent 95 percent confidence intervals based on standard errors clustered at a block group level. The sample refers to deaths recorded by the Medical Examiner in Cook County, January 1-September 15, 2020 and 2019. The omitted period is $\tau = 0$, i.e., week 11.

death, with men at marked disadvantage relative to women in all age groups, across countries and epidemic waves. However, our preliminary analysis suggests an interaction between gender and race that is worth investigating in more depth. In Figure 5, we explore the influence of gender and its potential interaction with race by disaggregating the results in Figure 3 for men and women. The top two panels confirm that in our sample the excess deaths are more numerous for men (top right panel) relative to women (top left panel), independently of race. However, racial differences in the timing and intensity of the effect of COVID-19 appear to be more pronounced for females rather than males. In other words, it is among females that Blacks are hit by the epidemic earlier and more severely. The same pattern is mirrored by the bottom two panels, where the racial differential in excess deaths is larger and more prolonged for females, while for males it is statistically significant only in a single week, with a compensating reversal in a subsequent one. Thus, the Black disadvantage in excess deaths that we identified in Figure 4 is largely attributable to Black females.

A companion figure (Figure B8) offers a complementary perspective on how gender and race intersects in shaping the impact of the epidemic. Each panel depicts, separately for Blacks and Whites, the sex differential in excess deaths. For Blacks, we observe no statistically significant sex differential, that is, females and males appear to be balanced (even though after treatment initiation the sign of the β coefficients tends to be negative, signalling that Black males are hit more than Black females, albeit insignificantly so). For Whites, instead, after treatment initiation not only are the βs persistently negative, but they are also significantly so in several weeks. Thus, the male bias in post-treatment mortality is exclusively driven by the White component of the sample. In other words, while among Whites men do tend to die more than women following the COVID-19 outbreak, strikingly for Blacks we do not observe any significant gender differences, which in turn suggests that the gap in deaths that appears to favor women in the general population vanishes for Black women.

Table B5 summarizes the magnitude and statistical significance of the event study estimates, overall and by sex. Model 1 corresponds to the bottom panel of Figure 4 and Models 2 and 3 to the two bottom panels of Figure 5. For the sake of brevity, even though the underlying model includes all pre- and post-treatment terms, we display only the βs for $\tau = 1, ..., 5$. Inspecting Model 1 reveals that the impact of COVID-19 on Blacks exceeds the one on Whites in post-treatment week +3 by 5.6 percentage points. As shown by Models 2 and 3, the effect is larger and more precise for females relative to males. By the following week, the racial differential—of about 3 percentage points—is exclusively borne by females.

To sum up, the evidence we thus far collected establishes that, first, the Black population in Cook County is hit by COVID-19 earlier and more severely and, second, this racial disproportion is largely due a Black female bias, uncovering an interaction between race and sex that had been up to now overlooked.

6.3 Extensions

A falsification test based on pre-pandemic trends A potential threat to the identification of the effect of COVID-19 on Blacks, and in particular on Black women, may come from the fact that the effect could be driven by endemic annual trends in mortality that would have occurred irrespectively of the COVID-19 epidemic. In order to ascertain whether the effect we detect in 2020, relative to 2019, was already present in previous years, we carry out a falsification test by re-estimating Equation 2 for 2019 relative to

2018, and again for 2018 relative to 2017. The goal is to gauge the possibility that the treatment is capturing annual trends in mortality related to the diffusion of other seasonal diseases, such as the flu. Figure B9 shows no previous effect of the treatment on the racial differential in deaths' dynamics, which confirms that our results are entirely attributable to the 2020 COVID-19 outbreak (as it should have been expected given the results in Figure B7, where the dependent variable is excess deaths relative to the 2017-2019 average).

The Latino population While our main focus thus far has been on how the Black population has been hit by COVID-19, the Latino population has also been the subject of concern, both in the media and the medical literature.[27] Indeed other minorities within the population may share similar characteristics and outcomes. Therefore, in this section, we extend the previous analysis of COVID-19 outcomes to the White Hispanic (hereafter, Latino) population of Cook County.[28] Figure B10 reports differential outcomes between Whites and Latinos. The top panel shows that the impact of the epidemic on Latinos is milder than on Whites (except for a short time in late June). The bottom panel shows that at the beginning of the epidemic both Latino males and Latino females are relatively shielded from the impact of COVID-19, relatively to White males and White females respectively, even though the effect is diluted for Latino women. Thus, the female bias we detected in the previous section appears to characterize only the Black population, and in particular Black women.

Gun-related deaths and deaths of despair As previously mentioned, reliance on excess deaths may induce an overestimation of the effects since the weeks following the outbreak may witness variation in deaths that are only indirectly linked to it. Indeed the COVID-19 epidemic and the associated lockdown measures have affected all social interactions and multiple dimensions of people's wellbeing. As a consequence, the increase in deaths we find in the data, as well as its racial differential, might be due not only to deaths directly related to the disease. The indirect effect on crime-related deaths, for instance, is potentially ambiguous: while restrictions on interactions could decrease them, socioeconomic strain could trigger an increase, with more vulnerable strata of the population being potentially more exposed.[29] In Figure B11 (top panel) we look at the Black-White differential in the increase in gun-related deaths during the period

[27]See, for instance, Singh and Koran (2020) and Yancy (2020).

[28]The Medical Examiner's racial classifications are based on US Census Bureau categories, according to which Latino, or equivalently Hispanic, is defined as ethnicity, and can therefore belong to any racial group. We focus on White Hispanics, who in Cook County represent the vast majority of Hispanics. To September 15, only 24 deaths were reported for Black Hispanics, i.e., 0.6 percent of the Black deaths, and 1.5 percent of the Hispanic deaths.

[29]See United Nations Office on Drugs and Crime at https://www.unodc.org/documents/data-and-analysis/covid/Property_Crime_Brief_2020.pdf.

under investigation, as reported by the Medical Examiner, and we find little evidence that the epidemic outbreak has modified previous trends in this dimension during the weeks in which COVID-19 hit the hardest.[30] The Medical Examiner also reports deaths from suicide and drug overdose, that is, examples of those deaths to which Case and Deaton (2020) refer to as "deaths of despair". In the critical post-treatment weeks, we spot no significant racial differences in the dynamics of suicides and opioid-related deaths (middle and bottom panels of Figure B11, respectively).[31] Collectively, this evidence fails to corroborate the hypothesis that deaths that are indirectly related to COVID-19 may be driving our results.

7 Heterogeneity

In order to evaluate factors that can explain the dissimilarities in the influence of COVID-19 along the race and gender dimensions, this section goes on to investigate how such influence may vary with other physical, demographic, and socioeconomic characteristics. We focus on comorbidities, age, and poverty.

Using the information on comorbidities associated with COVID-19 deaths provided by the Medical Examiner, we generate proxies for their incidence at a block group and week level. On the basis of the 14 afore-mentioned pathologies, we compute a rough measure of their incidence at a block group/week level as follows. First, we divide the total number of occurrences for each comorbidity in a block group by the population in that block group. Next, we carry out a principal factor analysis to generate a comorbidity severity indicator for each block group. Among the four factors with an eigenvalue above one, we use the first factor, which loads higher diabetes, asthma, cancer, hypertension, kidney disease, obesity, and respiratory, neuro-respiratory, and neuro-cardiac diseases. As shown in Figure B4, hypertension, diabetes, respiratory diseases and asthma are among the most concurrent pathologies. To be noticed is that this approach will overstate the impact of specific comorbidities, because we only use those reported for individuals who have died from COVID-19, while natural deaths associated with diseases follow under the Medical Examiner's jurisdiction only under special circumstances.

The top panel of Figure 6 reports results obtained by splitting the sample between block groups with a value of the comorbidity severity score above and below median, in order to obtain two comparable sub-samples in terms of number of block groups.

[30]This finding is consistent with Abrams (2020), who detects no effect of the pandemic onset on homicide and shooting over a sample of twenty-five US cities including Chicago, while a pronounced drop is reported for most other crimes.

[31]Mulligan (2020) reports that opioid fatalities had reached new highs already in late 2019 and continued on the same trend during the pandemic.

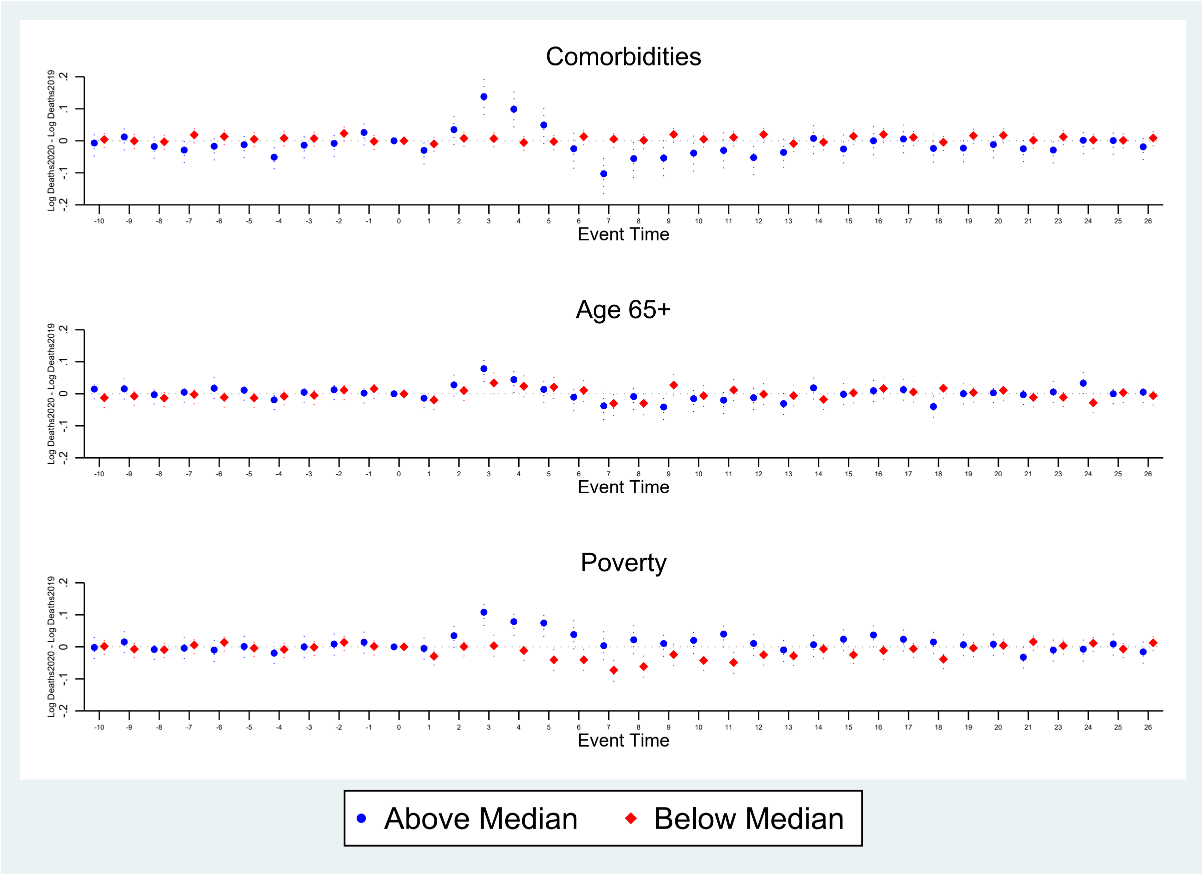

Figure 6: Heterogeneity: Comorbidities, age, and poverty

Note: The dependent variables are Black-White differentials in excess deaths. The coefficients are least-squares estimates of the βs over samples with above and below median comorbidity severity (top panel), share of 65+ (middle panel), and poverty (bottom panel). Block group and week fixed effects are included. Vertical lines represent 95 percent confidence intervals based on standard errors clustered at a block group level. The sample refers to deaths recorded by the Medical Examiner in Cook County, January 1-September 15, 2020 and 2019. The omitted period is $\tau = 0$, i.e., week 11.

Overall, the impact on Blacks relative to Whites is not statistically different from zero in low severity block groups, while the impact in high severity ones is large and significant, and precisely during the same weeks at the beginning of the outbreak on which we focus our attention. In the latter block groups, instead, the impact of the treatment for Blacks relative to Whites in the same weeks is to increase the rate of change of deaths by about 10 percent (between 15 and 9 percent depending on the week). This suggests that pre-existing health conditions may indeed explain the observed racial differences in COVID-19 mortality.

The middle panel of Figure 6 shows heterogeneity results by age, that is, obtained by splitting the sample between block groups with a share of individuals above age 65 below and above median. Again, the differential effect on Blacks relative to Whites is not statistically different from zero for a below median share of 65+, while it becomes significant above median. However, the average effect of age in the latter case is much smaller than that of comorbidities, consistent with the findings that age is a highly

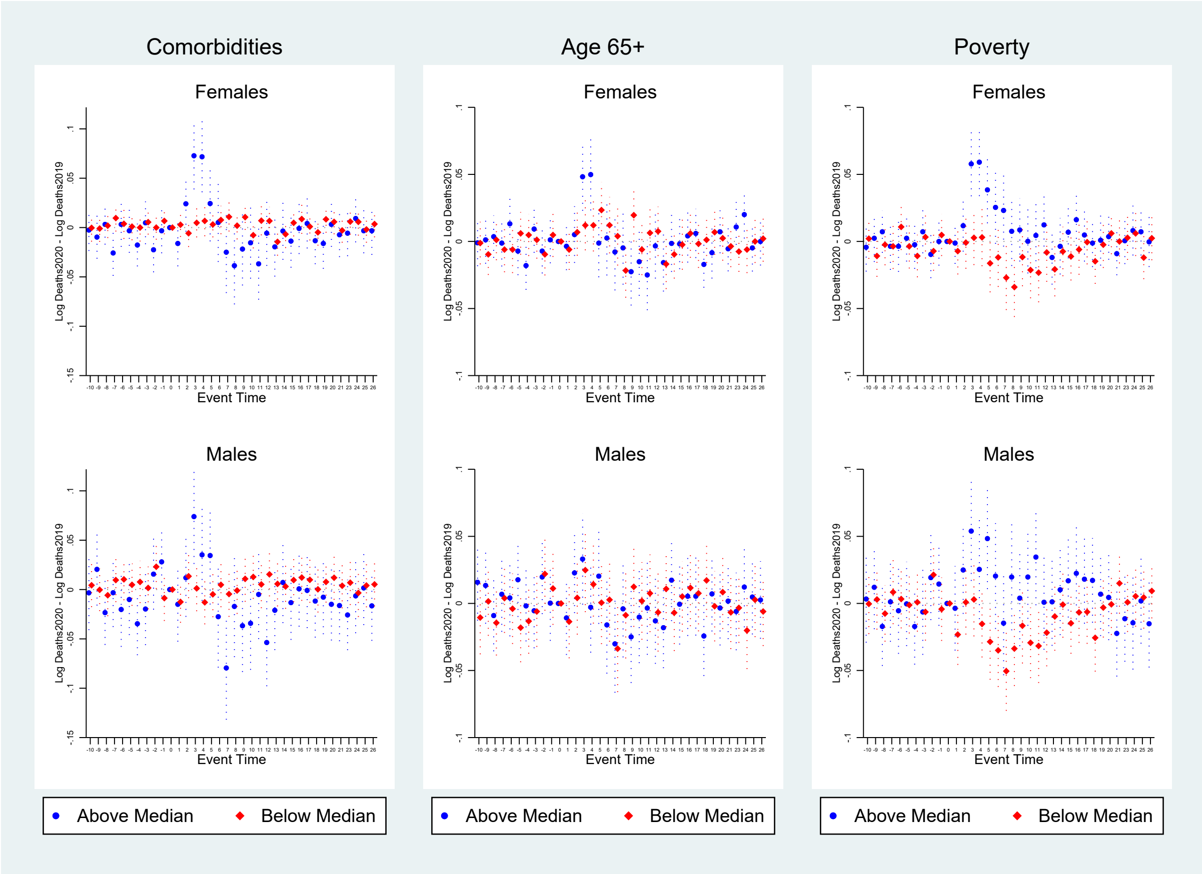

Figure 7: Heterogeneity: Comorbidities, age, and poverty, by sex

Note: The dependent variables are Black-White differentials in excess deaths, by sex. The coefficients are least-squares estimates of the βs over samples with above and below median comorbidity severity (left panels), share of 65+ (middle panels), and poverty (right panels). Block group and week fixed effects are included. Vertical lines represent 95 percent confidence intervals based on standard errors clustered at a block group level. The sample refers to deaths recorded by the Medical Examiner in Cook County, January 1-September 15, 2020 and 2019. The omitted period is $\tau = 0$, i.e., week 11.

relevant risk factor irrespectively of race.

The bottom panel of Figure 6 turns to poverty as another potential driver, by splitting the sample between block groups with a share of individuals in poverty above and below median. The differential impact of the treatment on Blacks relative to Whites is positive above the median and turns negative below the median.

Figure 7 replicates the heterogeneity results in Figure 6 separately for females and males, and shows that the effects of higher comorbidity severity, share of elderly, and poverty, are always much more pronounced for women.

To gather a better understanding of the potential linkages between the impact of comorbidity, aging, and poverty, we proceed by further distinguishing between samples along combinations of these factors. In Figure B12 (two top panels), we first look at the differential impact of comorbidity in block groups with a population share in poverty above and below median. Therefore, block groups with above median poverty are split between those with above and below median comorbidity score (top left panel) and the same is done for block groups with below median poverty (top right panel). In block groups with above median poverty we again detect a sizeable effect of comorbidity but, in those with below median poverty, the effect of comorbidities is not different from zero and the racial differential in excess deaths even turns negative for several weeks.

The same approach is used for the share of 65+ (two bottom panels of Figure B12). As for comorbidity, an above median share exerts an influence on the racial differential only in association with above median poverty. Thus, the impact of both comorbidity and aging appears to be activated only in relatively poor block groups, pointing to poverty as a the crucial driver of the disproportion in Black mortality following the COVID-19 outbreak. Thus, socioeconomic disparities, rather than biological ones captured by comorbidities and aging, are shown to represent the source of the higher vulnerability of Black individuals to the epidemic.

Lastly, in Figures B13 and B14 we replicate Figure B12 separately for females and males. Once more, the fact that racial differentials in the reaction to COVID-19 are driven by poverty, and by comorbidity and age only when associated with it, is largely determined by females. In other words, Blacks are disproportionately hit by COVID-19 because of the relative overrepresentation of Black women among the deceased in the poorest neighborhoods of the county.

8 Why poverty?

We have thus far provided robust evidence that the racial differential in the impact of COVID-19 on mortality is driven by Black women in a disadvantaged socioeconomic position. But why is poverty associated with the vulnerability we exposed? Which are the channels that link poverty to higher COVID-19 mortality, and especially so for Black women? In this section, we shall evaluate four potential—and not mutually exclusive—channels: the occupational structure of the labor force, the use of public transportation, the prevailing living arrangements, and access to medical care through health insurance coverage. Each factor may play a role at a different stage of disease progression: the first and the second determine the degree of exposure to the risk of contracting the virus at the workplace and on the way to work; the third can magnify the rate of transmission once the virus has been contracted; the fourth affects the individual response to the virus once contagion has occurred.

8.1 Occupations

Socioeconomic hardship in the US has often been linked to in-work poverty. Low-wage workers constitute a large share of the US workforce, and are disproportionately represented in sectors such as health care, food services, transportation, and administration (Ross and Bateman, 2019). In turn, low-paid jobs are common in sectors that need physical proximity to operate and that are more exposed to infections (e.g., health care, food, and transportation). In the face of the COVID-19 epidemic, occupations can be further disaggregated into those that have been deemed essential (health care and transportation) and those that were instead subject to lockdowns (food). The former have been associated with fewer job losses, but at a cost in term of health. The trade-off between employment risk and health risk is easier to avoid for a third type of occupations, represented by those that can be performed from home. This third type, however, is scarcely represented among low-pay jobs (perhaps with the exception of administration). Given the gendered pattern of contagion and deaths we uncovered, the fact that low-pay occupations tend to be predominantly female-dominated is also a compelling consideration.

In order to assess whether the higher risk of contracting the virus at the workplace can explain the Black female bias in COVID-19 deaths, we compute the block group-level share of women employed in each of 20 industries (as reported by the ACS), relative to the female workforce in the block group. We also compute the corresponding share for men.[32] Next, for each industry, we perform heterogeneity analysis by splitting the sample between block groups with above and below median share of women and men. In the interest of space, we report in the text results for those two sectors that do contribute to the explanation of the outcomes of interest (Figure 8). Results for all other sectors are in Appendix B (Figures B15-A18).

Visual inspection of Figure 8 reveals that health care and transportation/warehousing do explain the excess death racial differential, and they do so only for women, as a differential emerges only in block groups that exhibit an above median share of women employed in those two sectors. The effect is particularly clear-cut in health care. Instead, the relative share of men does not make a difference, consistent with the hypothesis that it is female exposure at the workplace that drives COVID-19 outcomes. By contrast, for ten other sectors (agriculture, manufacturing, retail trade, information, finance and insurance, real estate, administrative services, educations, accommodation and food, and public administration), the Black female bias emerges irrespectively of the share of women

[32] Following the US Standard Occupational Classification system, the occupational categories are agriculture, mining, construction, manufacturing, wholesale trade, retail trade, transportation and warehousing, utilities, information, finance and insurance, real estate, professional services, management of companies, administrative services, education, health care, arts and entertainment, accommodation and food, other services, and public administration.

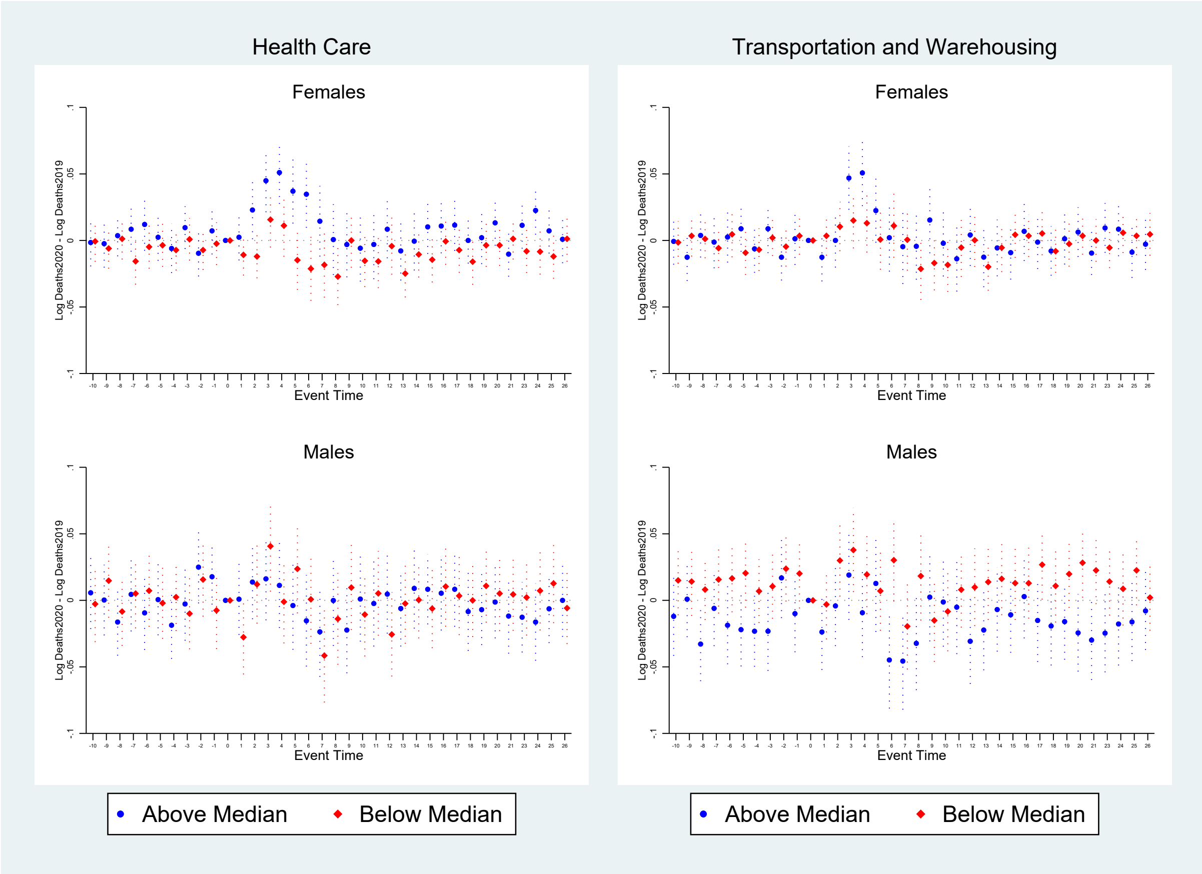

Figure 8: Occupations: Health care and transportation and warehousing

Note: The dependent variables are Black-White differentials in excess deaths, by sex, for the health care and transportation occupational sectors. The coefficients are least-squares estimates of the βs over samples with above and below median share of females in the female labor force (top panels) and males in the male labor force (bottom panels) in each sector. Block group and week fixed effects are included. Vertical lines represent 95 percent confidence intervals based on standard errors clustered at a block group level. The sample refers to deaths recorded by the Medical Examiner in Cook County, January 1-September 15, 2020 and 2019. The omitted period is $\tau = 0$, i.e., week 11.

employed, which implies that it cannot be explained by these sectors (even though in some sectors, notably education, an above median share of female employees determines considerably worse outcomes). For the residual six sectors (construction, wholesale trade, utilities, other services, professional services, and arts and entertainment), where men typically dominate the labor force, we actually detect worse outcomes for women when their share in the corresponding labor force is below median, which most likely reflects their higher representation in other, more exposed sectors.[33]

The above evidence corroborates the hypothesis that Black women's vulnerability to COVID-19 is determined by their overrepresentation in those frontline jobs, in health care and transportation/warehousing, that not only are especially exposed to the risk of contagion, but were also not shut down. This conclusion is reinforced by the fact that

[33]For two sectors, mining and management of companies, the coefficients for females cannot be estimated due to their low representation.

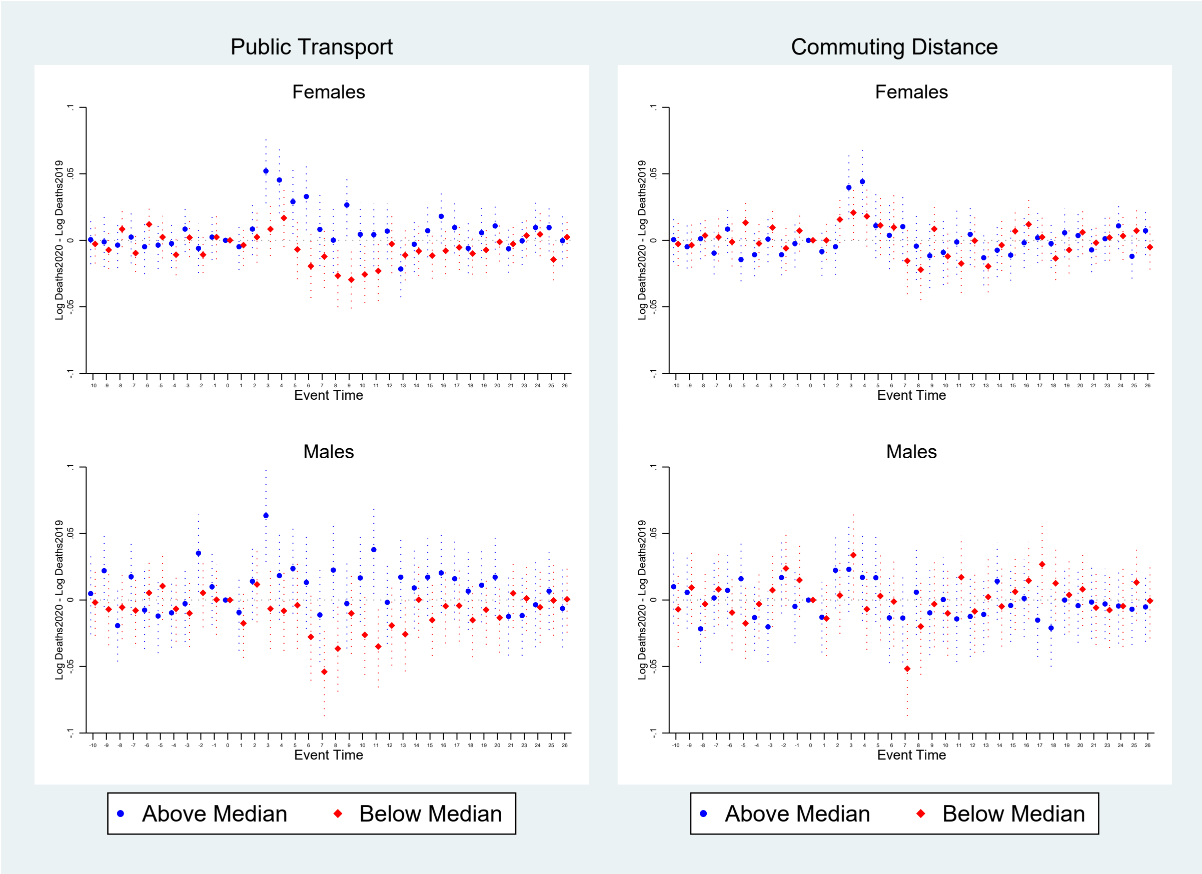

Figure 9: Public transport and commuting distance

Note: The dependent variables are Black-White differentials in excess deaths, by sex, for public transport and commuting distance. The coefficients are least-squares estimates of the βs over samples with above and below median share of individual using public transport (left panels) and commuting distance (right panels). Block group and week fixed effects are included. Vertical lines represent 95 percent confidence intervals based on standard errors clustered at a block group level. The sample refers to deaths recorded by the Medical Examiner in Cook County, January 1-September 15, 2020 and 2019. The omitted period is $\tau = 0$, i.e., week 11.

other high exposure jobs, for instance in restaurants (comprised in the accommodation and food sector, see Figure B18) where again women are heavily represented, are not a driver of the effects, since the lockdown policies—albeit at a huge cost in terms of layoffs—managed to protect workers' health. Likewise, school closures and working from home are the likely reasons why we do not detect significant effects among workers respectively in education and administrative services (Figure B17), two high exposure sectors characterized by gender segregation. To conclude, occupational segregation by race and gender emerges as a crucial driver of the higher toll in terms of COVID-19 deaths born by Black women.

8.2 Public transport

Using public transport is another COVID-19 risk factor, because of the involved physical proximity, often in crowded spaces. We capture these considerations by examining the share of individuals that use public transport and by complementing it with commuting distance to assess its intensity. Figure 9 is obtained by splitting the sample between block groups above and below median, separately for each dimension, and shows that both factors (but especially public transport) match the excess death racial differential for females (while the first factor also captures some of the effect for males). Thus, in addition to occupations, reaching the workplace emerges as another channel through which the Black female bias in COVID-19 deaths manifests itself. This is not surprising, given that frontline workers had to continue commuting during the lockdowns, likely using public transport, while working from home was rarely an option for low-pay workers.

8.3 Living arrangements

Living in crowded dwellings is yet another risk factor for COVID-19 death since it amplifies the risk to which a worker may be exposed outside the home, by transmitting the virus to family members. This source of risk is magnified when essential workers are unable to reduce workplace presence during lockdowns, when working from home is prevented by lack of space, and/or when the sick cannot properly isolate.

To assess the extent to which living arrangements may be behind the Black female bias in COVID-19 deaths, in Figure B19 (left panels) we split the sample between block groups with above and below median share of households with more than one occupant per room. Again we check the response separately for women and men. We find that this specific characteristic does not seem to explain the Black female bias, since the increase in deaths for Black women following the epidemic outbreak occurs irrespectively, even though the increase is more pronounced when crowding is above median. Another factor having to do with living arrangements is the underlying family structure. Belonging to a multigenerational household tends to expose to a high risk of contagion elderly family members. In Figure B19 (middle panels) we split the sample between block groups with above and below median share of households with co-living relatives. We find that this specific characteristic also fails to explain the Black female bias.

To sum up, we find no evidence that the pattern of COVID-19 outcomes along the race and gender dimensions can be explained by factors that through living arrangements could contribute to the spread of the epidemic once the virus is contracted at the workplace.

8.4 Health insurance coverage

Once the virus is contracted, access to medical care is another potential channel through which socioeconomic conditions may determine COVID-19 mortality, and the availability of health insurance is key to obtain such access. To explore this channel, we collect block group-level data on the share of individuals who are uninsured. Inspection of Figure B19 (left panels) reveals that heterogeneity along this dimension does not explain the pattern of the epidemic outcomes.

To conclude, the occupational structure of the labor force, with the overrepresentation of Black women in high exposure frontline jobs, together with the additional risk represented by the use of public transportation to commute to work, jointly explain the disproportionate racial impact of the COVID-19 epidemic, as well as its timing, with Black women starting to succumb to it earlier than other groups.

Generally speaking, in the evaluation of the determinants of the eventual decline in fatalities, as the epidemiological curve followed its course, one should keep in mind the simultaneous influence of lockdown policies and behavioral changes such as the use of personal protective equipment (PPP) and spontaneous self-isolation. The latter practices may have anticipated the effect of lockdowns, while in principle a refusal to comply may have undone it. In the case of Cook County, the stay-at-home order was put in place on March 21 but, even after considering its lagged (by about three/four weeks) impact on fatalities, it cannot explain the drop in fatalities among frontline workers since they were not directly protected by it. Thus, the inversion of the epidemiological curve can only be accounted for by a combination of factors. On the one hand, health care workers were at some point equipped with PPP that was initially unavailable even in hospitals. On the other, a combination of PPP use and lockdown-induced mobility slow-down can explain the inversion for transportation workers, with a further beneficial effect of the reduction of overcrowding on those health care workers using public transport.

9 Where is poverty?

A striking characteristic of COVID-19 diffusion is its geographic heterogeneity. Many factors have been proposed to explain this pattern, including population density, cultural differences, and public policies. Within metropolitan areas, the varying degree of diffusion of COVID-19, and the higher death toll paid by Black Americans, has been linked to the redlining policies introduced by the Home Owners Loan Corporation (HOLC) in the 1930s.[34] These policies are believed to have favored the development of segregated

[34]See Eligon et al. (2020) in The New York Times.

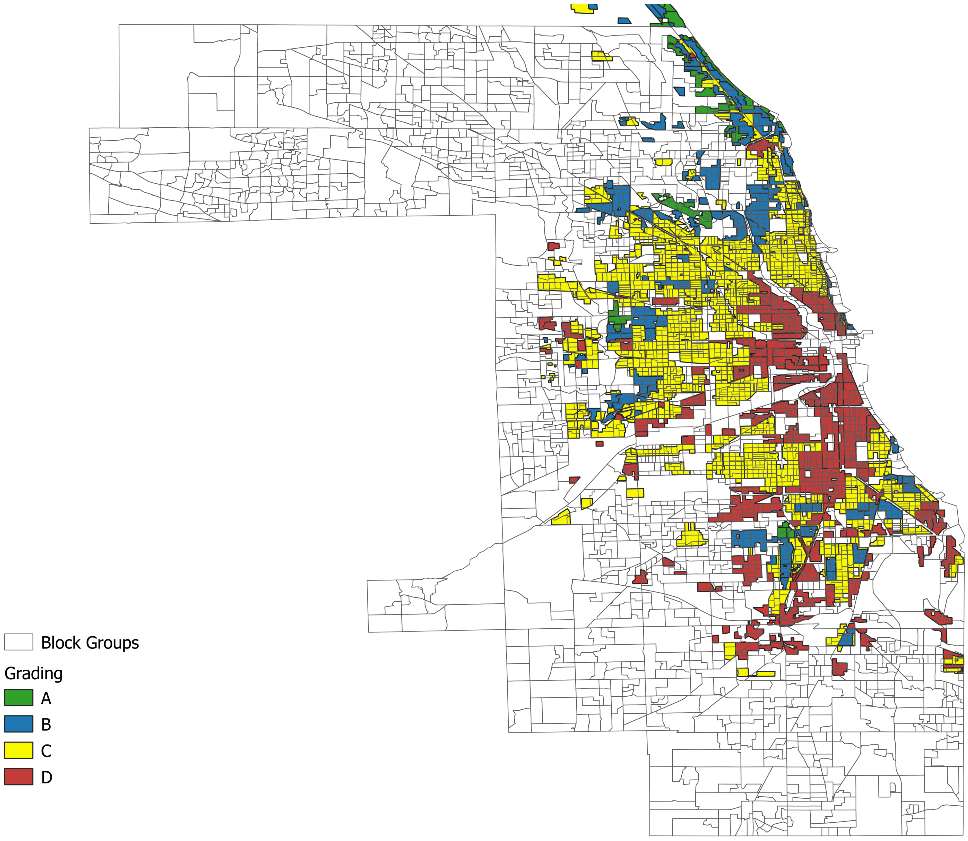

Figure 10: Cook County map and HOLC-graded areas

Note: The map indicates boundaries for census block groups and HOLC graded areas, with green, blue, yellow, and red denoting respectively A-, B-, C-, and D- graded neighborhoods.

neighborhoods plagued by poverty, low housing quality, and unhealthy living conditions.[35]

By combining the georeferenced information on COVID-19 fatalities in Cook County with the redlining maps produced by HOLC for the Chicago area, we can assess the explanatory power of these policies that are rooted in history. In order to map each individual death into a specific HOLC area, using the same procedure applied for block groups we refer to the georeferenced home address of the deceased and we generate a dummy for whether a block group falls predominantly in a specific HOLC area. Figure 10 shows the result of the spatial merge. HOLC areas are identified by the colour, with green, blue, yellow, and red denoting respectively grade A, B, C, and D, where red highlights the lowest graded D areas.[36]

[35]See Appendix A for a history of redlining policies and Bertocchi and Dimico (2020) for an extended analysis of their link with COVID-19 outcomes. On other long-term socioeconomic influence of redlining, see for instance Zenou and Boccard (2000) and Aaronson et al. (2017). Within the medical literature, Krieger et al. (2020a, 2020b) and Nardone et al. (2020) respectively associate redlining with racial and ethnic disparities in terms of preterm birth, cancer, and asthma.

[36]Cook County was only partially mapped by the HOLC. Figure B20 shows the racial difference in the growth of deaths, by sex, in the sample of block groups that were mapped (top panel) and not mapped (bottom panel). Unsurprisingly given the pattern of urban development, the effect we had found over

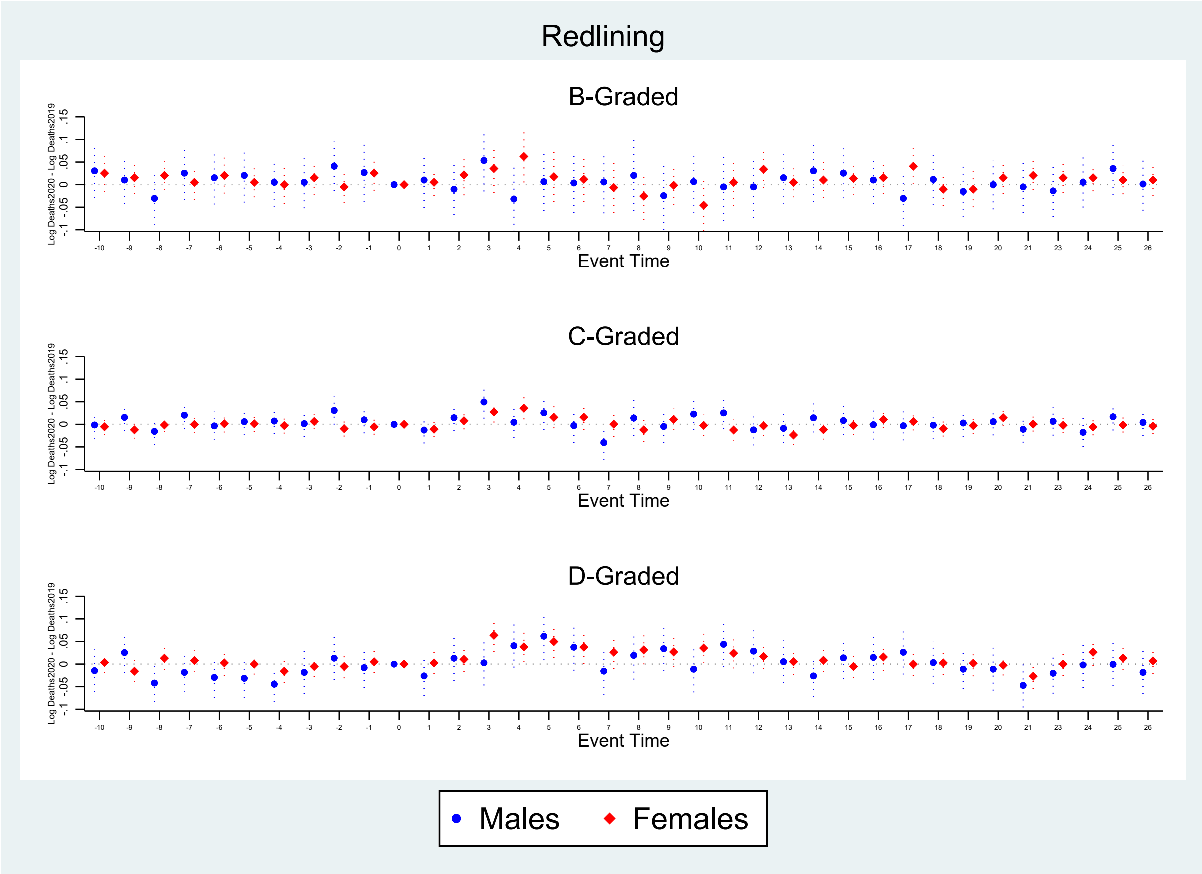

Figure 11: Historical redlining: B-, C-, and D-graded block groups

Note: The dependent variables are Black-White differentials in excess deaths, by sex. The coefficients are least-squares estimates of the βs over the sample of B- (top panel), C- (middle panel), and D-graded (bottom panel) block groups. Block group and week fixed effects are included. Vertical lines represent 95 percent confidence intervals based on standard errors clustered at a block group level. The sample refers to deaths recorded by the Medical Examiner in HOLC-graded block groups of Cook County, January 1-September 15, 2020 and 2019. The omitted period is $\tau = 0$, i.e., week 11.

Figure 11 splits the sample of HOLC-graded block groups according to their ranking (block groups that received the top grade A are not displayed because of the small sample size). The plots show that the effect of the treatment is driven primarily by D-graded block groups and, to a much smaller extent, by C-graded ones. Thus, the evidence suggests that the diminished resilience of Black women is geographically concentrated within those areas of the county that were subject to the discriminatory lending practices of the 1930s, uncovering a persistence influence of the induced racial segregation.

10 Conclusion

Not only is the United States registering a huge number of fatalities from the COVID-19 pandemic but, within the country, the death toll on Black Americans has also been

the entire county is captured by the mapped areas, which include Chicago and its surroundings.

disproportionately large. Up to now, however, lack of individual-level data has prevented a rigorous assessment of this occurrence and of its determinants. Using an extraordinarily detailed source of information on daily deaths provided by the Cook County Medical Examiner, we provide evidence on how race affects COVID-19 outcomes and we establish two striking findings, that had both been overlooked up to now.

First, we document that between March 16, 2020 (the day the first COVID-9 death was reported) until September 15, 2020 (the day that roughly marks the end of the first wave of the epidemic) Black Americans constituted 33 percent of the deceased from COVID-19, against a population share of approximately 26.8 percent. Thus, cumulatively through the sample period, they died at a rate 1.2 times higher than their population share. However, their overrepresentation rate was as high as 2.2 during the early weeks after the outbreak. Thus, not only are Black Americans disproportionately affected by COVID-19, but they also started to succumb to it earlier than other groups, which explains the consequent decline in the share of cumulative black deaths as the epidemic followed its course. What the epidemiological curve discloses is an extraordinary degree of racial segregation, with different groups displaying distinct patterns even in the timing of their exposure to the epidemic.

Second, by combining individual-level information on race and gender, we uncover a Black female bias in mortality that appears to be at odds with the well-established evidence that rather points to a male bias. We reach this conclusion through an event study design where we look at the excess death racial differential as the outcome variable. Our estimates confirm an early impact of the epidemic on Black Americans and also reveal that it is driven by Black women, who tend to be as vulnerable as Black men are—unlike White and Latino women who are more shielded than White and Latino men, respectively. Our search for the factors that determine the Black female bias paints a consistent picture, with the higher vulnerability of Black women being explained not by physical and demographic factors, such as comorbidities and aging, but rather by socioeconomic status. The impact of the latter on mortality is channeled by their overrepresentation in low-pay, high-risk, essential jobs in the health care and transportation/warehouses sectors, that they access through commute by public transport, often from the historically redlined neighborhoods where they tend to be residing. We find no evidence for a role of other potential channels that can affect contagion through the household or prevent access to health care.

Our results are subject to a number of limitations. First of all, they only cover a single county, even though it is the second most populous and contains the third largest metropolitan area in the country. Furthermore, they deal with a single epidemic outcome (deaths rather than cases or ICU occupancy), albeit the most salient one. Nevertheless, our results demonstrate the need for highly disaggregated databases along the racial and gendered dimensions combined, in association with socioeconomic information on labor market and living conditions. It is only through such data that scientists can produce evidence capable of guiding effective policy responses, including prioritization strategies for vaccination campaigns as well as tailored containment measures in case of further outbreaks of COVID-19 and other viral diseases.

REFERENCES

Aaronson D., Hartley D., Mazumder B. (2017), The effects of the 1930s HOLC "redlining" maps. Federal Reserve Bank of Chicago Working Paper No. 2017-12.

Abrams D.S. (2020), COVID and crime: An early empirical look. Faculty Scholarship at Penn Law. 2204.

Adams R.B. (2020), Gender equality in work and Covid-19 deaths. Covid Economics, 16, 23–60.

Adams-Prassl A., Boneva T., Golin M., Rauh C. (2020), Inequality in the impact of the coronavirus shock: Evidence from real time surveys. Journal of Public Economics, 189, 104245.

Albanesi S., Kim J. (2021), The gendered impact of the COVID-19 recession on the US labor market. NBER Working Paper No. 28505.

Almagro M., Coven J., Gupta A., Orane-Hutchinson A. (2020), Racial disparities in frontline workers and housing crowding during COVID-19: Evidence from geolocation data. Covid Economics, 51, 1–35.

Almagro M., Orane-Hutchinson A. (2020), The determinants of the differential exposure to COVID-19 in New York City and their evolution over time. Journal of Urban Economics, in press.

Alon A., Doepke M., Olmstead-Rumsey J., Tertilt M. (2020), The impact of COVID-19 on gender equality. COVID Economics, 4, 62–102.

Barbieri T., Basso G., Scicchitano S. (2020), Italian workers at risk during the COVID-19 epidemic. INAPP Working Paper No. 46/2020.

Bargain O., Aminjonov U. (2020), Trust and compliance to public health policies in times of COVID-19. Journal of Public Economics, 192, 104316.

Barrios J.M., Benmelech E., Hochberg Y.V., Sapienza P., Zingales L. (2021), Civic capital and social distancing during the Covid-19 pandemic. Journal of Public Economics, 193, 104310.

Benitez J.A., Courtemanche C.J., Yelowitz A. (2020), Racial and ethnic disparities in COVID-19: Evidence from six large cities. NBER Working Paper No. 27592.

Bertocchi G. (2020), COVID-19 susceptibility, women, and work. VoxEU, April 23.

Bertocchi G., Dimico A. (2020b), COVID-19, race, and redlining, Covid Economics, 38, 129–195.

Bhala N., Curry G., Martineau A.R., Agyemang C., Bhopal R. (2020). Sharpening the global focus on ethnicity and race in the time of COVID-19. Lancet, 395, 1673–1676.

Borjas G.J. (2020), Demographics determinants of testing incidence and Covid-19 infections in New York City neighborhoods. NBER Working Paper No. 26952.

Brown C.S., Ravallion M. (2020), Inequality and the coronavirus: Socioeconomic covariates of behavioral responses and viral outcomes across US counties. NBER Working Paper No. 27549.

Case A., Deaton A. (2020), Deaths of Despair and the Future of Capitalism. Princeton: Princeton University Press.

Caselli F.G., Grigoli F., Sandri D., Spilimbergo A. (2020), Mobility under the COVID-19 pandemic: Asymmetric effects across gender and age. IMPF Working Paper No. 2020/282.

Chen Y.H., Glymour M., Riley A., Balmes J., Duchowny K., Harrison R., Matthay E., Bibbins-Domingo K. (2021), Excess mortality associated with the COVID-19 pandemic among Californians 1865 years of age, by occupational sector and occupation: March through October 2020. medRxiv.

Chun Y., Roll S., Miller S., Lee H., Larimore S., Grinstein-Weiss M. (2020), Racial and ethnic disparities in housing instability during the COVID-19 pandemic. Social Policy Institute Working Paper.

Couch K., Fairlie R.W., Xu H. (2020), Early evidence of the impacts of COVID-19 on minority unemployment. Journal of Public Economics, 192, 104287.

Crossley T.F., Fisher P., Low H. (2021), The heterogeneous and regressive consequences of COVID-19: Evidence from high quality panel data. Journal of Public Economics, 193, 104334.

Dang H.-A.H., Viet Nguyen C. (2021), Gender inequality during the COVID-19 pandemic: Income, expenditure, savings, and job loss. World Development, 140, 105296.

Del Boca D., Oggero N., Profeta P., Rossi M. (2020), Women's and men's work, housework and childcare, before and during COVID-19. Review of Economics of the Household, 18, 1001–1017.

Desmet K., Wacziarg R. (2020), Understanding spatial variation in COVID-19 across the United States. CEPR Discussion Paper No. 14842.

Dingel J.I., Neiman B. (2020), How many jobs can be done at home? NBER Working Paper No. 26948.

Durante R., Guiso L., Gulino G. (2021), Asocial capital: Civic culture and social distancing during COVID-19. Journal of Public Economics, 194, 104342.

Eligon J., Burch A.D.S., Searcey D., Oppel R.A.Jr. (2020), Black Americans face alarming rates of coronavirus infection in some states. The New York Times, April 7.

Farré L., Fawaz Y., González L. , Graves J. (2020), How the COVID-19 lockdown affected gender inequality in paid and unpaid work in Spain. IZA Discussion Paper No. 13434.

Galasso V., Pons V., Profeta P., Becher M., Brouard S., Foucault M. (2020), Gender differences in COVID-19 attitudes and behavior: Panel evidence from eight countries. Proceedings of the National Academy of Sciences, 117, 27285–27291.

Goolsbee A., Syverson C. (2021), Fear, lockdown, and diversion: Comparing drivers of pandemic economic decline. Journal of Public Economics, 193, 104311.

Gu T., Mack J.A., Salvatore M., Prabhu Sankar S., Valley T.S., Singh K., Nallamothu B.K., Kheterpal S., Lisabeth L., Fritsche L.G., Mukherjee B. (2020), Characteristics associated with racial/ethnic disparities in COVID-19 outcomes in an academic health care system. Journal of the American Medical Association Network Open, 3, e2025197.

Hawkins D. (2020), Differential occupational risk for COVID-19 and other infection exposure according to race and ethnicity. American Journal of Industrial Medicine, 63, 817–820.

Hupkau C., Petrongolo B. (2020), Work, care and gender during the COVID-19 crisis. Fiscal Studies, 41, 623–651.

Kendi I.X. (2020), Stop looking away from the race of COVID-19 victims. The Atlantic, April 1.

Kirby T. (2020), Evidence mounts on the disproportionate effect of COVID-19 on ethnic minorities. Lancet Respiratory Medicine. News. May 8.

Kong E., Prinz D. (2020), Disentangling policy effects using proxy data: Which shutdown policies affected unemployment during the COVID-19 pandemic? Journal of Public Economics, 189, 104257.

Krieger N., Van Wye G., Huynh M., Waterman P.D., Maduro G., Li W., Gwynn R.C., Barbot O., Bassett M.T. (2020a), Structural racism, historical redlining, and risk of preterm birth in New York City, 2013-2017. American Journal of Public Health, 110, 1046–1053.

Krieger N., Wright E., Chen J.T., Waterman P.D., Huntley E.R., Arcaya M. (2020b), Cancer stage at diagnosis, historical redlining, and current neighborhood characteristics: Breast, cervical, lung, and colorectal cancer, Massachusetts, 2001-2015. American Journal of Epidemiology, 189, 1065–1075.

Manson S., Schroeder J., Van Riper D., Kugler T., Ruggles S. (2020), IPUMS National Historical Geographic Information System: Version 15.0 [dataset]. Minneapolis: IPUMS.

McLaren J. (2020), Racial disparity in COVID-19 deaths: Seeking economic roots with census data. NBER Working Paper No. 27407.

Mongey S., Pilossoph L., Weinberg A. (2021), Which workers bear the burden of social distancing policies? NBER Working Paper No. 27085.

Mulligan C.B. (2020), Deaths of despair and the incidence of excess mortality in 2020. Becker Friedman Institute Working Paper No. 2020-185.

Nardone A., Casey J.A., Morello-Frosch R., Mujahid M., Balmes J.R., Thakur N. (2020), Associations between historical residential redlining and current age-adjusted rates of emergency department visits due to asthma across eight cities in California: An ecological study. Lancet Planet Health, 4, e24–31.

Nelson R.K., Winling L., Marciano R., Connolly N., et al. (2020), Mapping inequality: Redlining in New Deal America. In Nelson R.K., Ayers E.L. (eds.), American Panorama: An Atlas of United States History. University of Richmond: Digital Scholarship Lab.

Ogedegbe G., Ravenell J., Adhikari S., Butler M., Cook T., Francois F., Iturrate E., Girardin J.-L., Jones S.A., Onakomaiy D., Petrilli C.M., Pulgarin C., Regan S., Reynolds H., Seixas A., Volpicelli F.M., Idit Horwitz L. (2020), Assessment of racial/ethnic disparities in hospitalization and mortality in patients with COVID-19 in New York City. Journal of the American Medical Association Network Open, 3, e2026881.

Peckham H., de Gruijter N.M., Raine C., Radziszewska A., Ciurtin C., Wedderburn L.R., Rosser E.C., Webb K., Deakin C.T. (2020), Male sex identified by global COVID-19 meta-analysis as a risk factor for death and ITU admission. Nature Communications, 11, 6317.

Pew Research Center (2020), Black Americans have less confidence in scientists to act in the public interest. August 28.

Pew Research Center (2019), Trust and Distrust in America. Washington: Pew Research Center.

Platt L., Warwick R. (2020), Are Some Ethnic Groups more Vulnerable to COVID-19 than Others? London: Institute for Fiscal Studies.

Price-Haywood E.G., Burton J., Fort D., Seoane L. (2020), Hospitalization and mortality among Black patients and White patients with Covid-19. New England Journal of Medicine, 382, 2534–2543.

Purdie A., Hawkes S., Buse K., Onarheim K., Aftab W., Low N., Tanaka S.(2020), Sex, gender and COVID-19: Disaggregated data and health disparities. British Medical Journal Global Health, March 24.

Rentsch C.T., Kidwai-Khan F., Tate J.P., Park L.S., King J.T.Jr., Skanderson M., Hauser R.G., Schultze A., Jarvis C.I., Holodniy M. et al. (2020). Covid-19 by race and ethnicity: A national cohort study of 6 million United States veterans. medRxiv.

Reyes C., Husain N., Gutowski C., St. Clair S., Pratt G. (2020), Chicago's coronavirus disparity: Black Chicagoans are dying at nearly six times the rate of White residents, data show. Chicago Tribune, April 6.

Ristovska L. (2020), Racial disparities in COVID-19 cases and deaths: Theories and evidence. Harvard University, mimeo.

Ross M., Bateman N. (2019), Meet the low-wage workforce. Washington: Brookings.

Sa F. (2020), Socioeconomics determinants of Covid-19 infections and mortality: Evidence from England and Wales. Covid Economics, 22, 47–58.

Schmitt-Grohe S., Teoh K., Uribe M. (2020), COVID-19: Testing inequality in New York City. NBER Working Paper No. 27019.

Scully E.P., Haverfield J., Ursin R.L., Tannenbaum C., Klein S.L. (2020), Considering how biological sex impacts immune responses and COVID-19 outcomes. Nature Reviews Immunology, 20, 442–447.

Sevilla A., Smith S. (2020), Baby steps: The gender division of childcare during the COVID-19 pandemic. Oxford Review of Economic Policy, 36, S169–S186.

Singh M., Koran M. (2020), 'The virus doesn't discriminate but governments do': Latinos disproportionately hit by coronavirus. The Guardian, April 18.

Sobotka T., Brzozowska Z., Muttarak R., Zeman K., di Lego V. (2020), Age, gender and COVID-19 infections. medRxiv.

Wenham C., Smith J., Morgan R., on behalf of the Gender and COVID-19 Working Group (2020), COVID-19: The gendered impacts of the outbreak. Lancet, 395, 846–848.

Wiemers E.E., Abrahams S., AlFakhri M., Hotz V.J., Schoeni R.F., Seltzer J.A. (2020). Disparities in vulnerability to severe complications from Covid-19 in the United States. NBER Working Paper No. 27294.

White C., Nafilyan V. (2020). Coronavirus (COVID-19) related deaths by ethnic group, England and Wales: 2 March 2020 to 10 April 2020. Office for National Statistics.

Williamson E., Walker A.J., Bhaskaran K., Bacon S., Bates C., Morton C.E., Curtis H.J., Mehrkar A., Evans D., Inglesby P., Cockburn J., McDonald H.I., MacKenna B., Tomlinson L., Douglas I.J., C.T., Mathur R., Wong A., Grieve R., Harrison D., Forbes H., Schultze A., Croker R., Parry J., Hester F., Harper S., Perera R., Evans S., Smeeth L., Goldacre B. (2020), OpenSAFELY: Factors associated with COVID-19-related hospital death in the linked electronic health records of 17 million adult NHS patients. Nature, 584, 430–436.

Yancy C.W. (2020), COVID-19 and African Americans. Journal of the American Medical Association. Opinion. April 15.

Zenou Y., Boccard N. (2000), Racial discrimination and redlining in cities. Journal of Urban Economics, 48, 260–285.

APPENDIX A: Historical Redlining Policies

The Home Owners Loan Corporation (HOLC) was created in June 1933 by the US Congress, in the aftermath of the Great Depression and within the first 100 days of the Roosevelt administration, as part of a key package of New Deal policies aimed at rescuing the housing and banking sectors through actions on the mortgage lending market. In the general effort to revive the economy, housing policies were viewed as critical and were therefore assigned a major role. The task of the HOLC was to refinance mortgages in default to prevent foreclosures, as a response to the banking sector turmoil and the drastic fall in home loans and ownership.[37] In 1934 the National Housing Act established the Federal Housing Administration (FHA) to reinforce previous measures and boost the market for single-family homes. With the goal of improving the accuracy of real-estate appraisal and in turn standardizing the process of mortgage lending, credit worthiness assessment, and mortgage support assignment, in 1935 the HOLC was asked to create "Residential Security Maps"of 239 cities to rank areas on the basis of default risk. The HOLC rankings were based on meticulous assessments and recording of neighborhood characteristics including population growth, class and occupation of the inhabitants, and block-by-block quality of the buildings (type, size, construction material, age, need for repair, occupancy rate, owner-occupancy rate, past and predicted property prices, rents, and sales and rental demand trends).

The resulting ranking encompassed four levels. The safest areas, mostly consisting of newly-built suburban neighborhoods, were labelled as "Best", assigned to Type A, and outlined in color green. "Still Desirable"areas were assigned to Type B and outlined in blue. The next two levels included "Definitely Declining"areas, assigned to Type C and outlined in yellow, and "Hazardous"areas assigned to Type D and outlined in red. Because of the color used to outline the worst-assessed neighborhoods, those that ended up being de facto denied any mortgage financing, the process came to be known as "redlining".

The direct and indeed intended consequences of redlining were to channel credit and investment away from poorer areas and toward more affluent ones. As a result, the former deteriorated even farther. Over time, the practice is widely believed to have contributed to the exacerbation and persistence of initial inequalities (Douglas Commission, 1968). After the Second World War, racial segregation further intensified with the "White flight"from the inner cities to the suburbs (Boustan, 2011). It was only with the Fair Housing Act of 1968, a provision of the Civil Rights Act, that housing segregation was outlawed, while specific legislation to establish fair lending practices was only enacted in the 1970s with

[37] For a history of the HOLC see Harriss (1951) and Fishback et al. (2013).

the Equal Credit Opportunity Act (1974) and the Community Reinvestment Act (1977). Throughout the process, the HOLC maps were deliberately hidden from public view, even though they may have been shared selectively with realtors and lenders (Greer, 2014). The existence of the maps emerged later on and became the subject of investigation of the National Commission on Urban Problems (Douglas Commission, 1968), created by President Johnson in 1965 to study the matter. But it was only much later that Jackson (1980), an urban historian, discovered the HOLC Residential Security Maps in the National Archives.

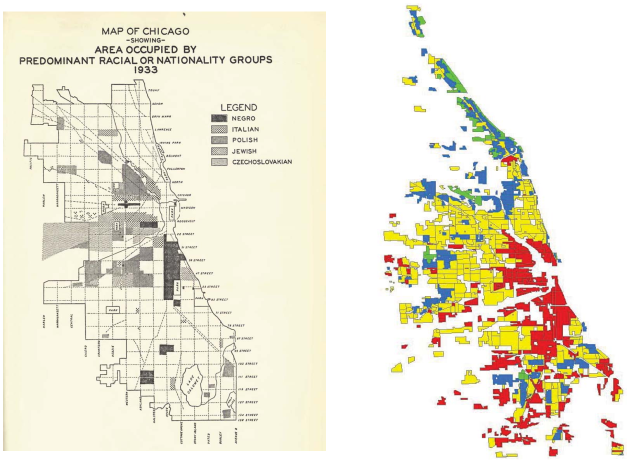

Figure A1: Historical maps of the Chicago area

Note: The figure shows, on the left panel, the "Map of Chicago Showing Area Occupied by Predominant Racial or Nationality Groups, 1933"(Hoyt, 1933) and, on the right panel, the HOLC maps for the Chicago area (Nelson et al., 2020), with green, blue, yellow, and red denoting respectively grade A, B, C, and D neighborhoods.

In his 1933 dissertation on the evolution of land values in Chicago, just before joining the FHA in 1934 as Principal Housing Economist, Hoyt (1933) produced a map of Chicago (Figure B1, left panel) that reported the areas occupied by predominant groups among the most recent immigrant waves. As the figure shows, Black immigrants were concentrated in the Chicago's South Side, where they had been forced to settle from the beginning of the Great Migration, facing squalid housing conditions and extremely high population densities (Greer, 2014). By 1940, a large portion of Cook County was mapped by the HOLC. On the right panel, Figure B2 shows the HOLC areas of Chicago as rendered in the Mapping Inequality: Redlining in New Deal America 1935-1940 dataset by American Panorama at the University of Richmond.[38] As in the other American cities, the geography of redlining had a clear racial connotation. The figure reveals that the same areas inhabited by the Black population in the Hoyt (1933) map were assigned the lowest grade and highlighted in red (Greer, 2014).

[38]See Nelson et al. (2020) and https://dsl.richmond.edu/panorama/redlining/.

REFERENCES

Boustan L.P. (2011), Racial residential segregation in American cities. In Brooks N., Donaghy K., Knaap G.-J. (eds.), Oxford Handbook of Urban Economics and Planning. New York: Oxford University Press, 318–339.

Douglas Commission [National Commission on Urban Problems] (1968), Building the American City. Washington: GPO.

Fishback P.V., Rose J., Snowden K. (eds.) (2013), Well Worth Saving: How the New Deal Safeguarded Home Ownership. Chicago: University of Chicago Press.

Greer J.L. (2014), Historic home mortgage redlining in Chicago. Journal of the Illinois State Historical Society, 107, 204–233.

Harriss C.L. (1951), History and Policies of the Home Owners' Loan Corporation. New York: NBER.

Hoyt H. (1933), One Hundred Years of Land Values in Chicago: The Relationship of the Growth of Chicago to the Rise of Its Land Values, 1830-1933. Chicago: University of Chicago Press.

Jackson K. (1980), Race, ethnicity, and real estate appraisal: The Home Owners Loan Corporation and the Federal Housing Administration. Journal of Urban History, 6, 419–452.

Nelson R.K., Winling L., Marciano R., Connolly N., et al. (2020), Mapping inequality: Redlining in New Deal America. In Nelson R.K., Ayers E.L. (eds.), American Panorama: An Atlas of United States History. University of Richmond: Digital Scholarship Lab.

APPENDIX B: Additional Figures and Tables

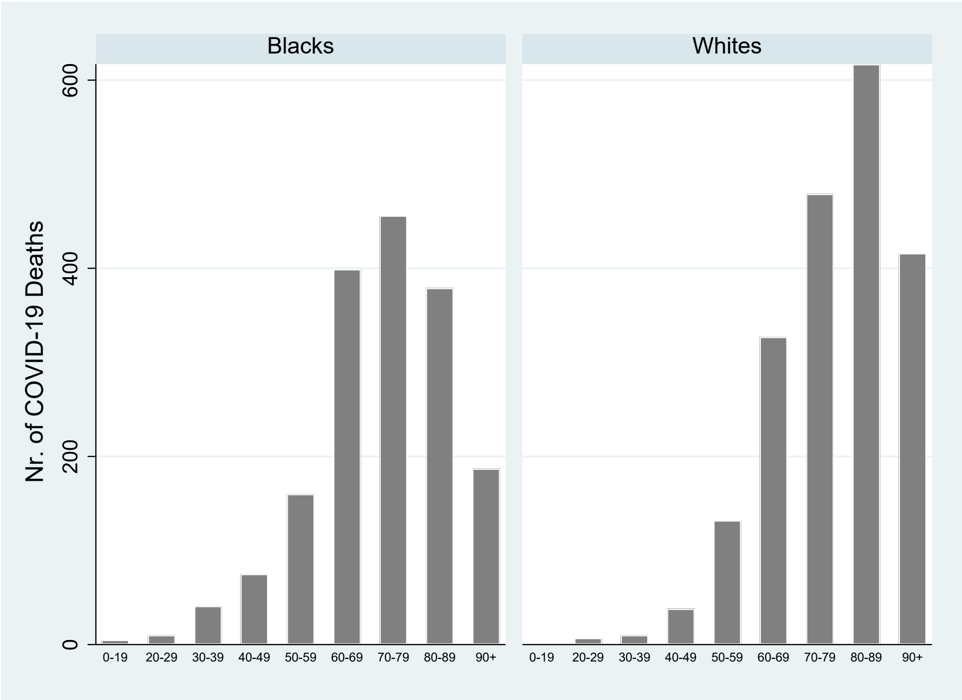

Figure B1: COVID-19 deaths by age group, for Blacks and Whites

Note: The sample refers to COVID-19 deaths recorded by the Medical Examiner in Cook County, January 1-September 15, 2020.

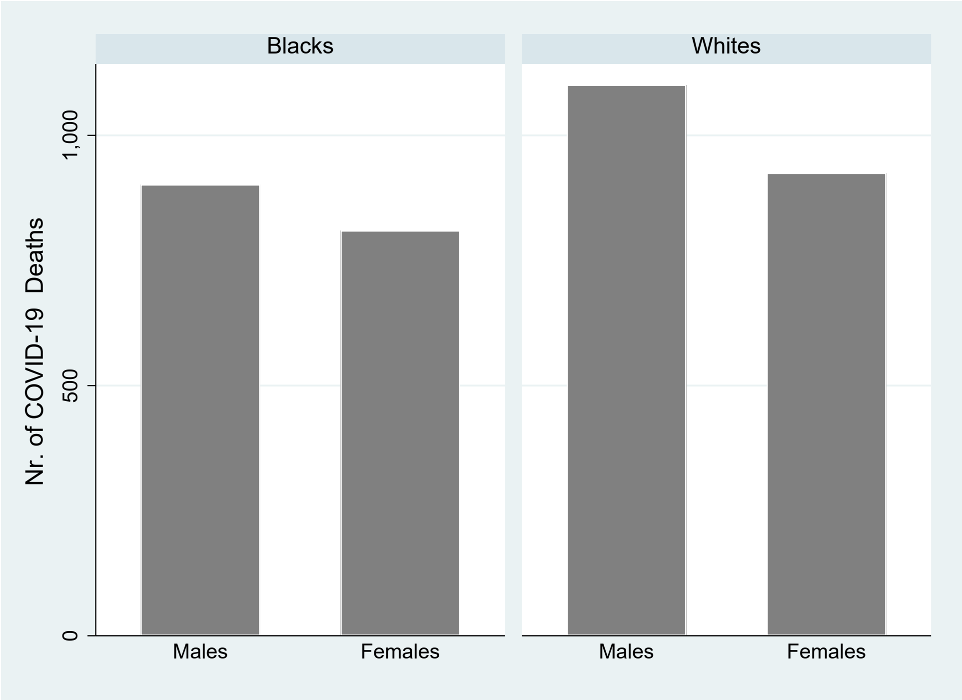

Figure B2: COVID-19 deaths by sex, for Blacks and Whites

Note: The sample refers to COVID-19 deaths recorded by the Medical Examiner in Cook County, January 1-September 15, 2020.

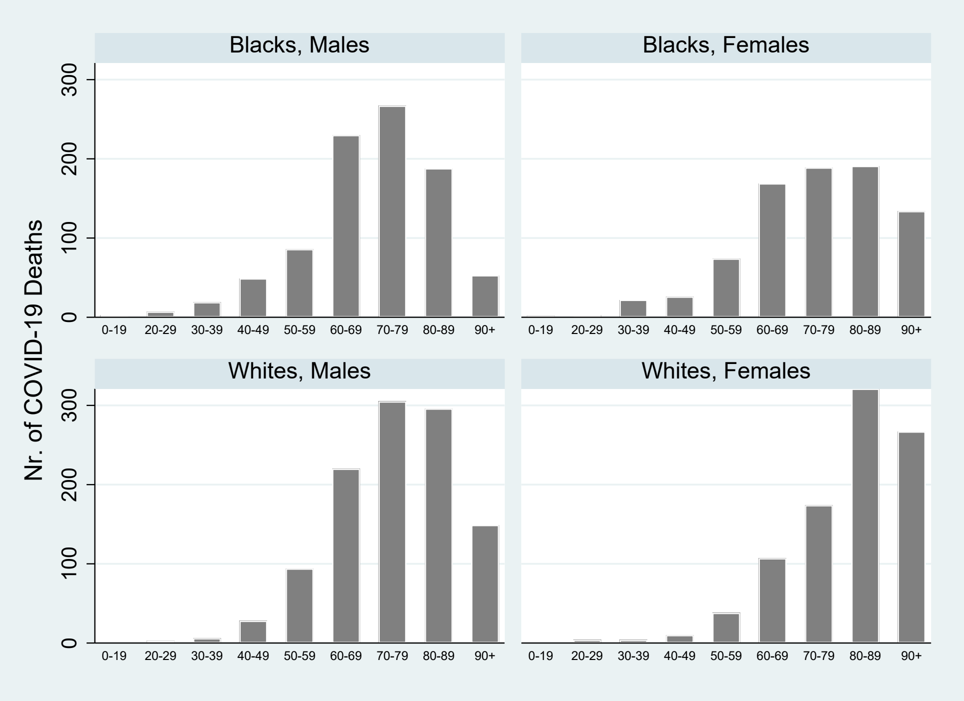

Figure B3: COVID-19 deaths by sex and age group, for Blacks and Whites

Note: The sample refers to COVID-19 deaths recorded by the Medical Examiner in Cook County, January 1-September 15, 2020.

Figure B4: COVID-19 deaths by comorbidity, for Blacks and Whites

Note: The sample refers to COVID-19 deaths recorded by the Medical Examiner in Cook County, January 1-September 15, 2020.

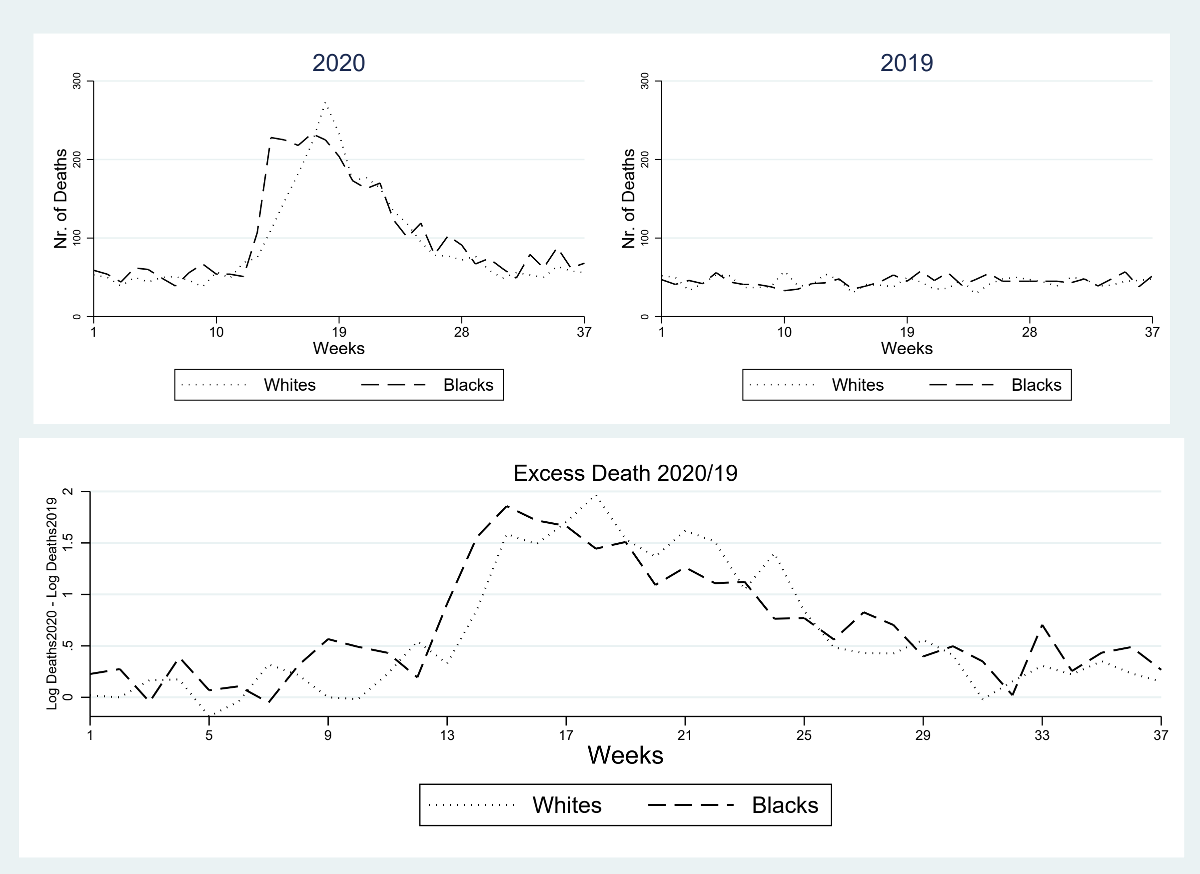

Figure B5: Deaths in 2020 and 2019 and 2020/2019 excess deaths, for Blacks and Whites

Note: The figure reports the weekly number of deaths from any cause in 2020 and 2019 (top panels) and excess deaths (bottom panel) for Blacks and Whites. The samples refers to deaths recorded by the Medical Examiner in Cook County, January 1-September 15, 2020 and 2019.

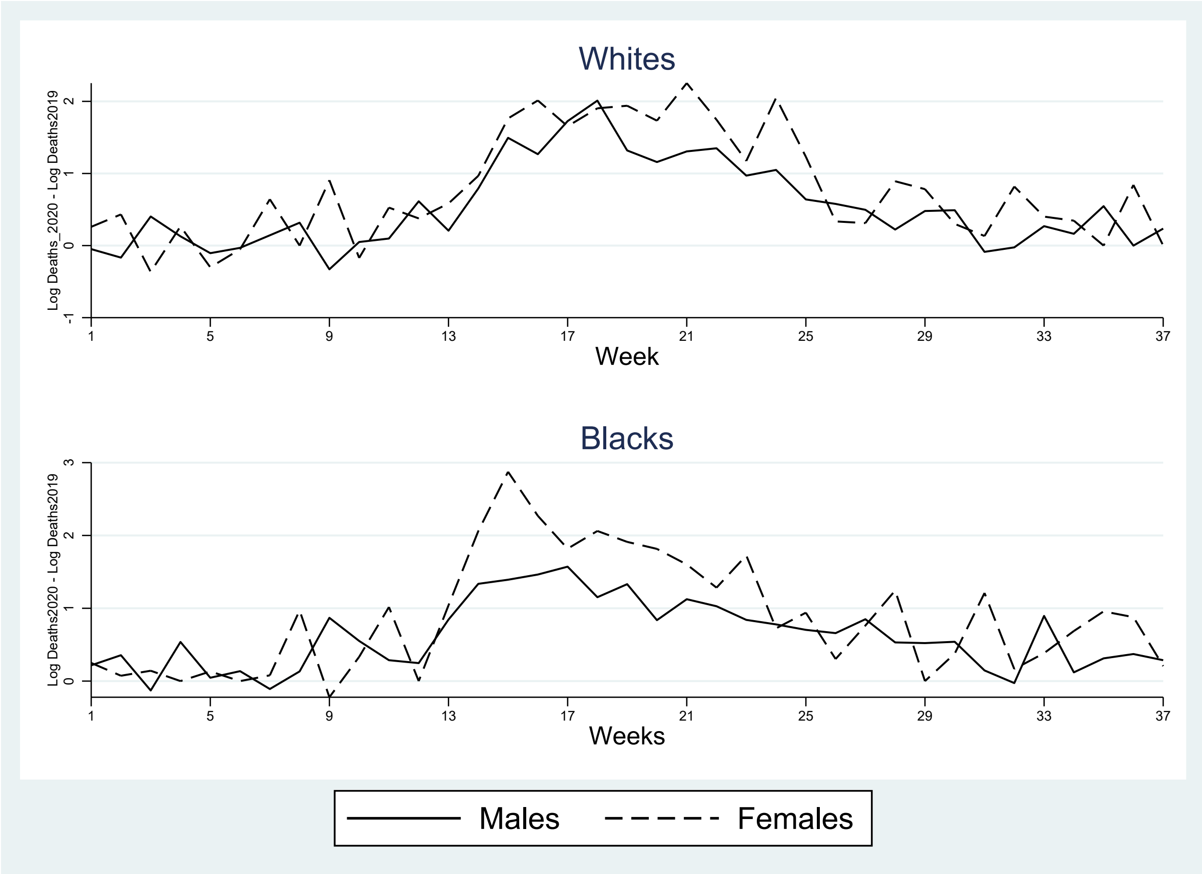

Figure B6: 2020/2019 excess deaths by sex, for Blacks and Whites

Note: The figure reports excess deaths by sex for Blacks (bottom panel) and Whites (top panel). The samples refers to deaths recorded by the Medical Examiner in Cook County, January 1-September 15, 2020 and 2019.

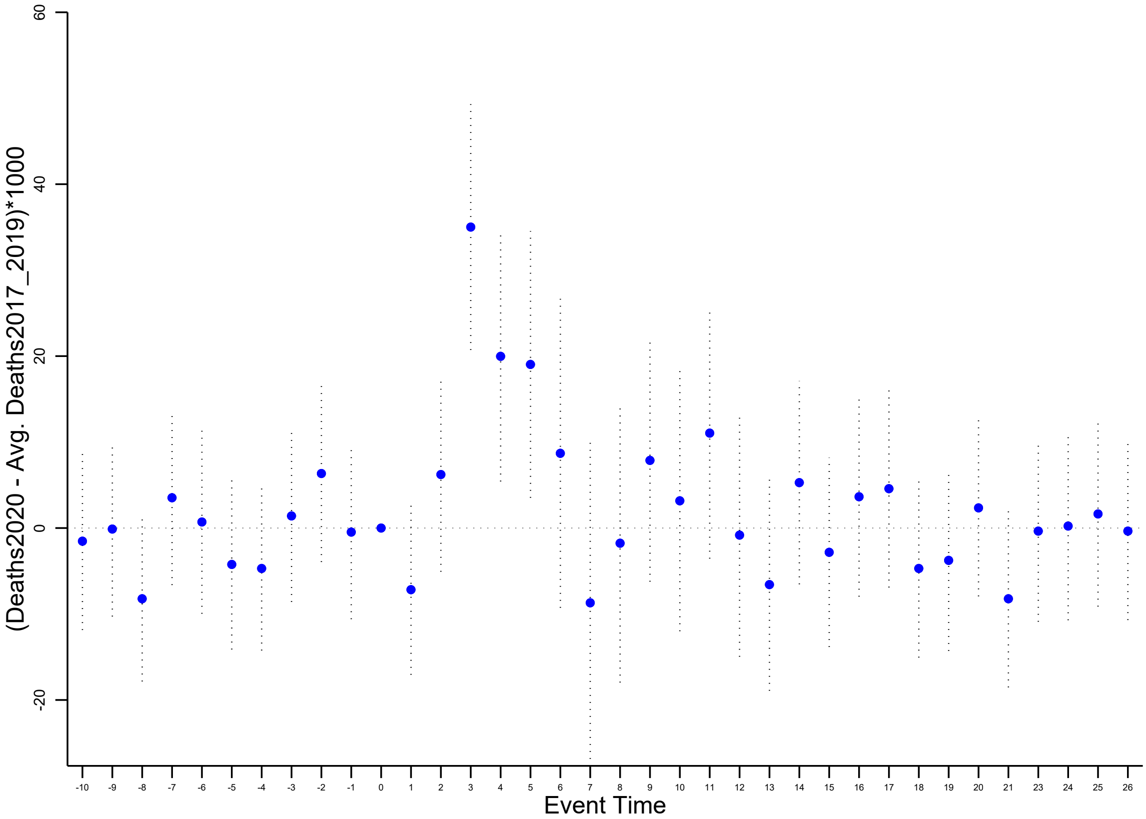

Figure B7: Black-White excess death differential relative to the 2017-2019 average

Note: The dependent variable is the Black-White differential in excess deaths in 2020 relative to the 2017-2019 average. The coefficients are least-squares estimates of the βs. Block group and week fixed effects are included. Vertical lines represent 95 percent confidence intervals based on standard errors clustered at a block group level. The sample refers to deaths recorded by the Medical Examiner in Cook County, January 1-September 15, 2020, 2019, 2018, and 2017. The omitted period is $\tau = 0$, i.e., week 11.

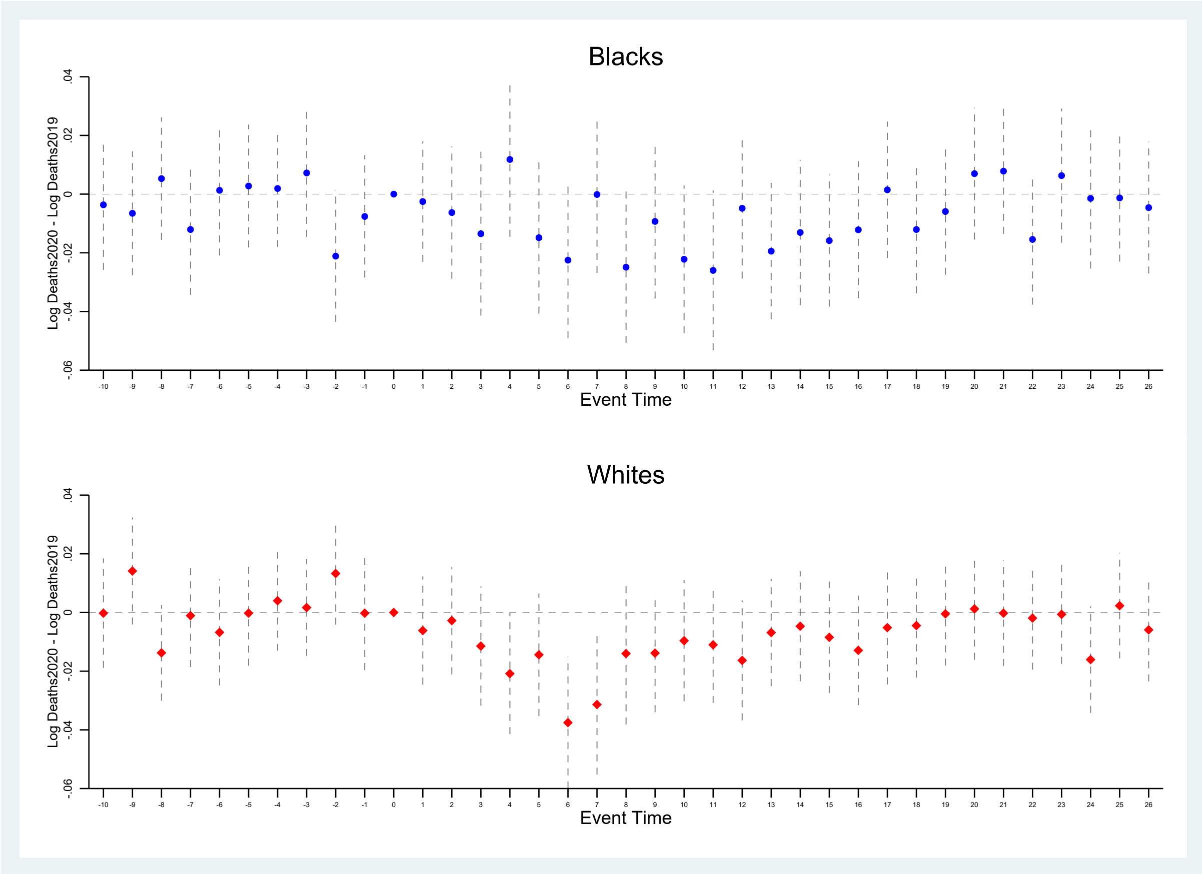

Figure B8: Female-male excess death differential for Blacks and Whites

Note: The dependent variables are sex differentials in excess deaths, for Blacks (top panel) and Whites (bottom panel). The coefficients are least-squares estimates of the βs. Block group and week fixed effects are included. Vertical lines represent 95 percent confidence intervals based on standard errors clustered at a block group level. The sample refers to deaths recorded by the Medical Examiner in Cook County, January 1-September 15, 2020 and 2019. The omitted period is $\tau = 0$, i.e., week 11.

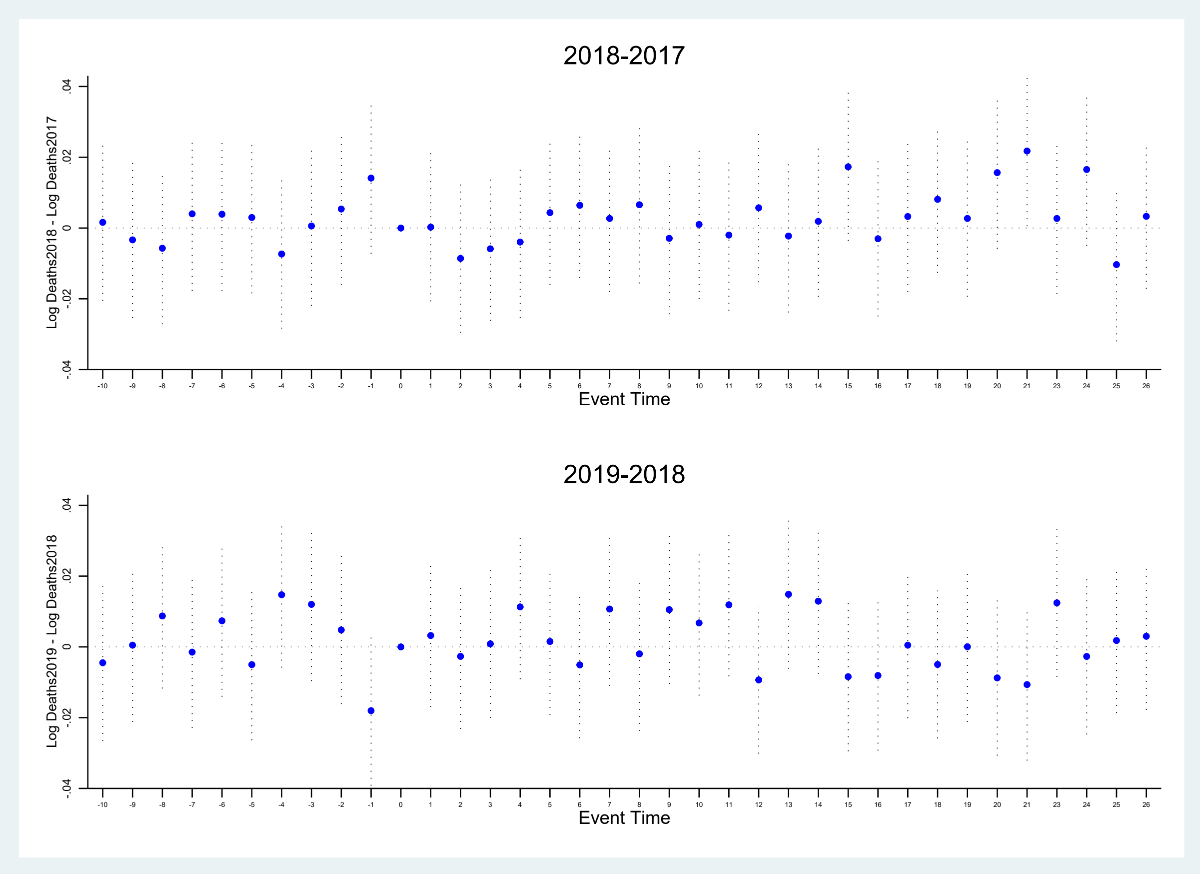

Figure B9: Black-White excess death differential, 2019/2018 and 2018/2017

Note: The dependent variables are the 2019/2018 (top panel) and 2018/2017 (bottom panel) Black-White differentials in excess deaths. The coefficients are least-squares estimates of the βs. Block group fixed effects are included in all panels and week fixed effects are also included in the bottom panels. Vertical lines represent 95 percent confidence intervals based on standard errors clustered at a block group level. The sample refers to deaths recorded by the Medical Examiner in Cook County January 1-September 15, 2019 and 2018 (top panel) and 2018 and 2017 (bottom panel). The omitted period is $\tau = 0$, i.e., week 11.

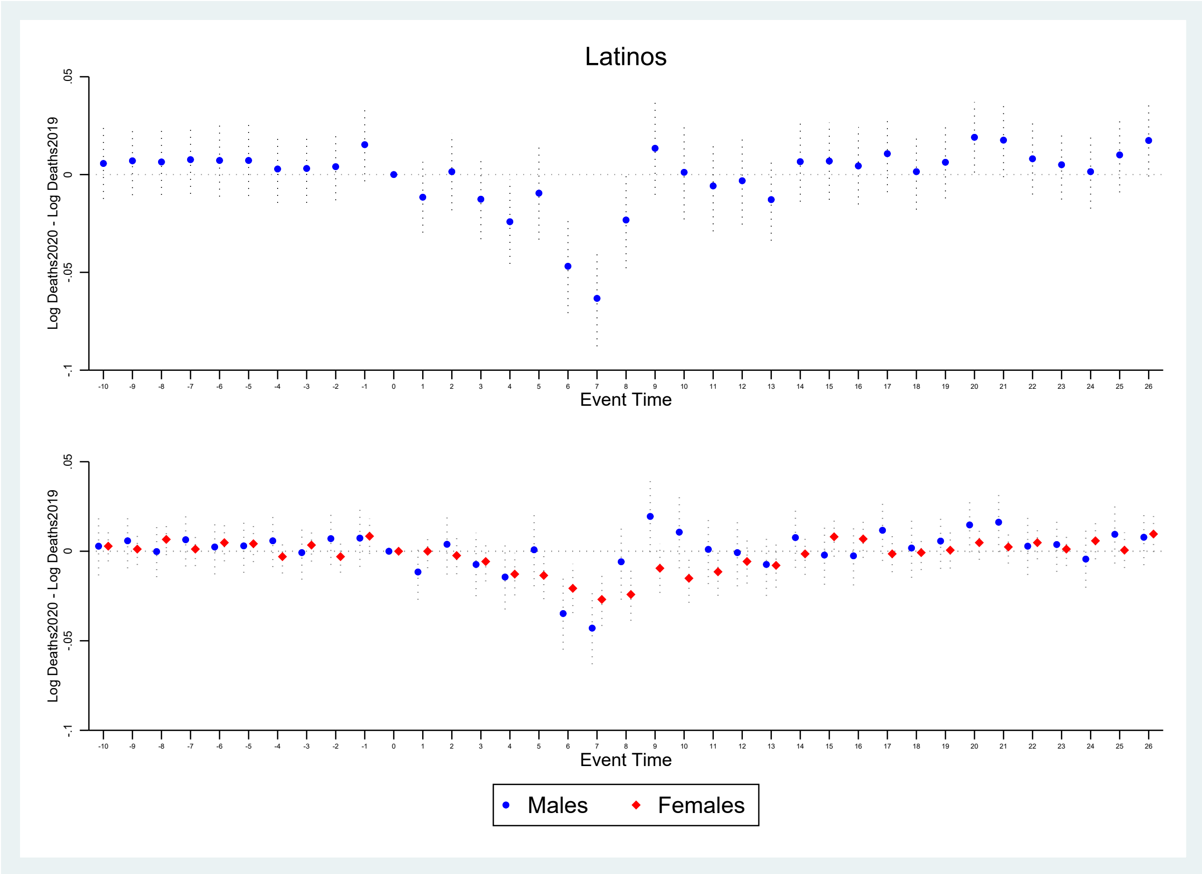

Figure B10: Latino-White excess death differential, overall and by sex

Note: The dependent variables are Latino-White racial differential in excess deaths, overall (top panel) and by sex (bottom panel). The coefficients are least-squares estimates of the βs. Block group and week fixed effects are included. Vertical lines represent 95 percent confidence intervals based on standard errors clustered at a block group level. The sample refers to deaths recorded by the Medical Examiner in Cook County, January 1-September 15, 2020 and 2019. The omitted period is $\tau = 0$, i.e., week 11.

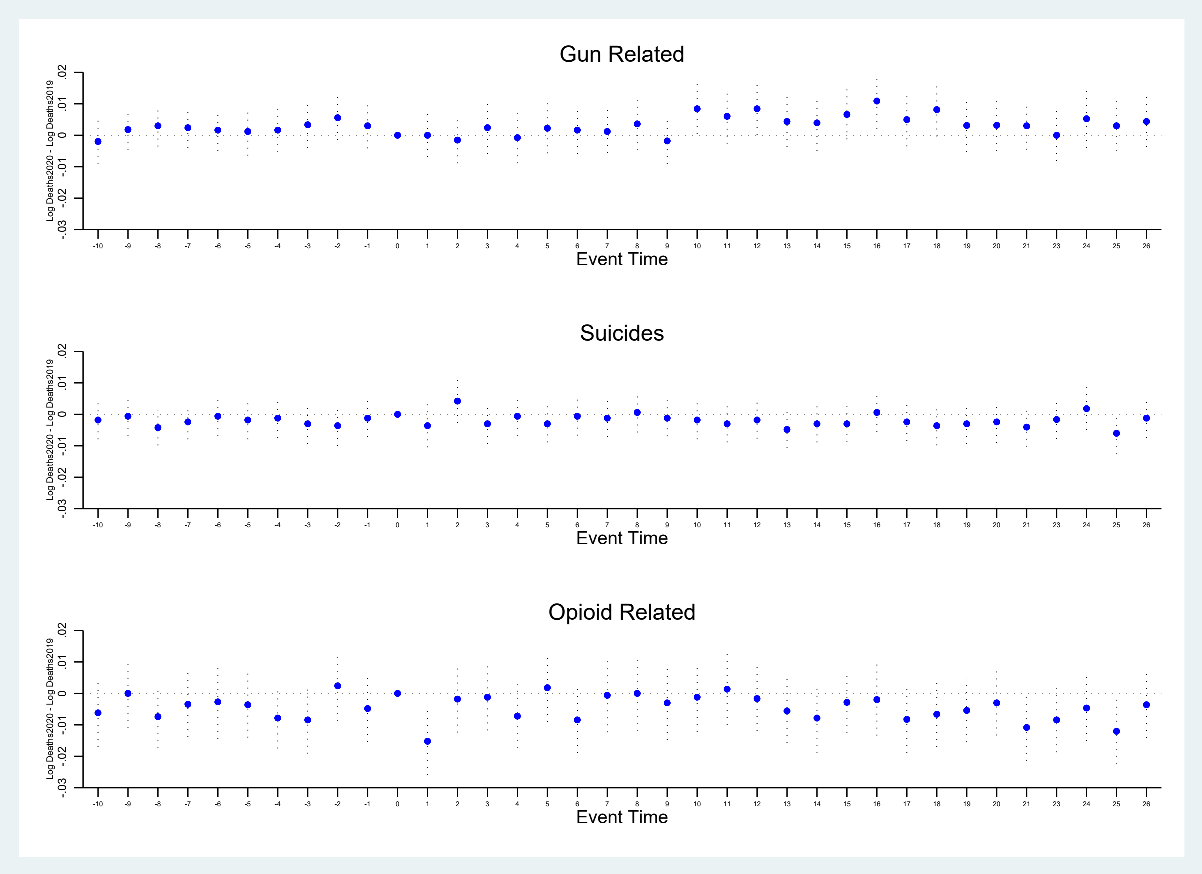

Figure B11: Black-White excess death differential for gun-related deaths, suicides, and opioid-related deaths

Note: The dependent variables are Black-White differentials in excess deaths for gun-related deaths (top panel), suicides (middle panel), and opioid-related deaths (bottom panel). The coefficients are least-squares estimates of the βs. Block group and week fixed effects are included. Vertical lines represent 95 percent confidence intervals based on standard errors clustered at a block group level. The sample refers to deaths recorded by the Medical Examiner in Cook County, January 1-September 15, 2020 and 2019. The omitted period is $\tau = 0$, i.e., week 11.

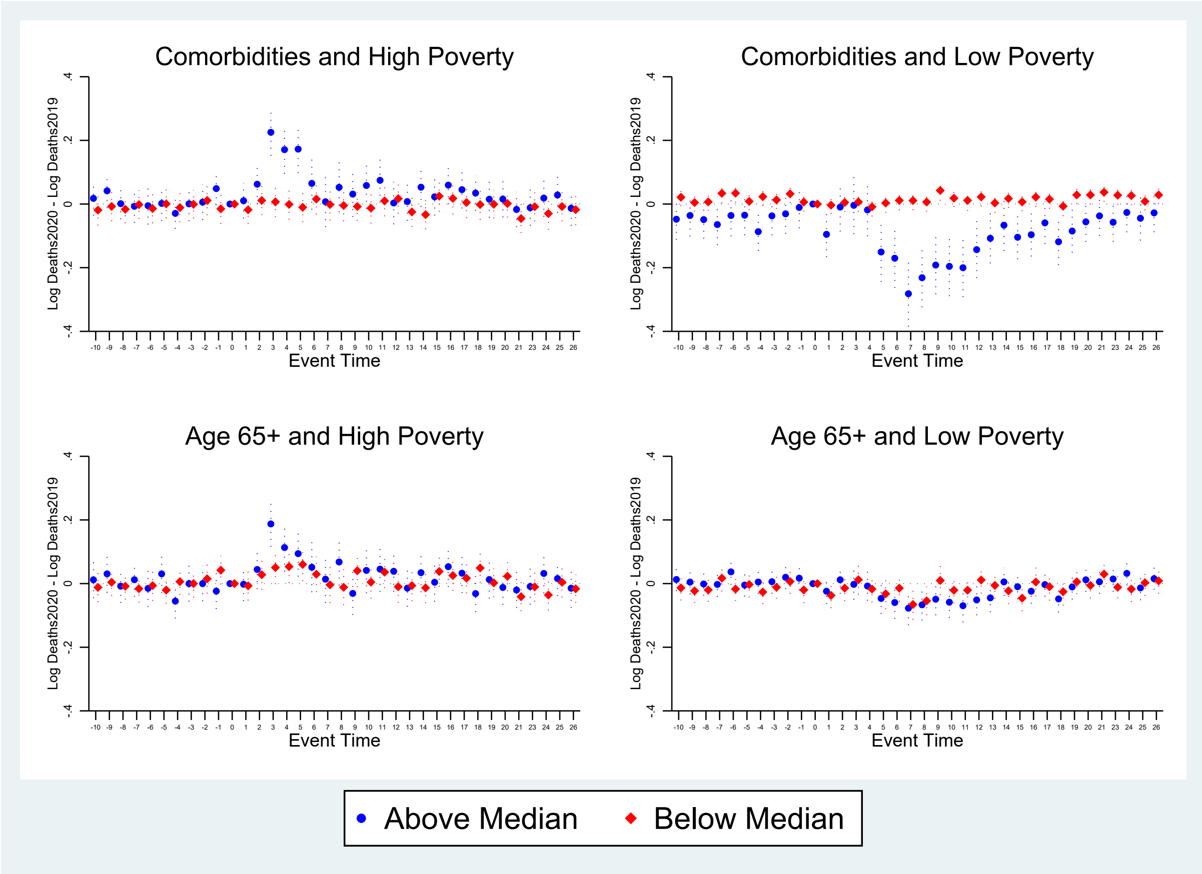

Figure B12: Heterogeneity: Comorbidities and age, by poverty

Note: The dependent variables are Black-White differentials in excess deaths. The coefficients are least-squares estimates of the βs over samples with above and below median comorbidity severity and above median (top left panel) and below median (top right panel) poverty, and with above and below median share of 65+ and above median (bottom left panel) and below median (bottom right panel) poverty. Block group and week fixed effects are included. Vertical lines represent 95 percent confidence intervals based on standard errors clustered at a block group level. The sample refers to deaths recorded by the Medical Examiner in Cook County, January 1-September 15, 2020 and 2019. The omitted period is $\tau = 0$, i.e., week 11.

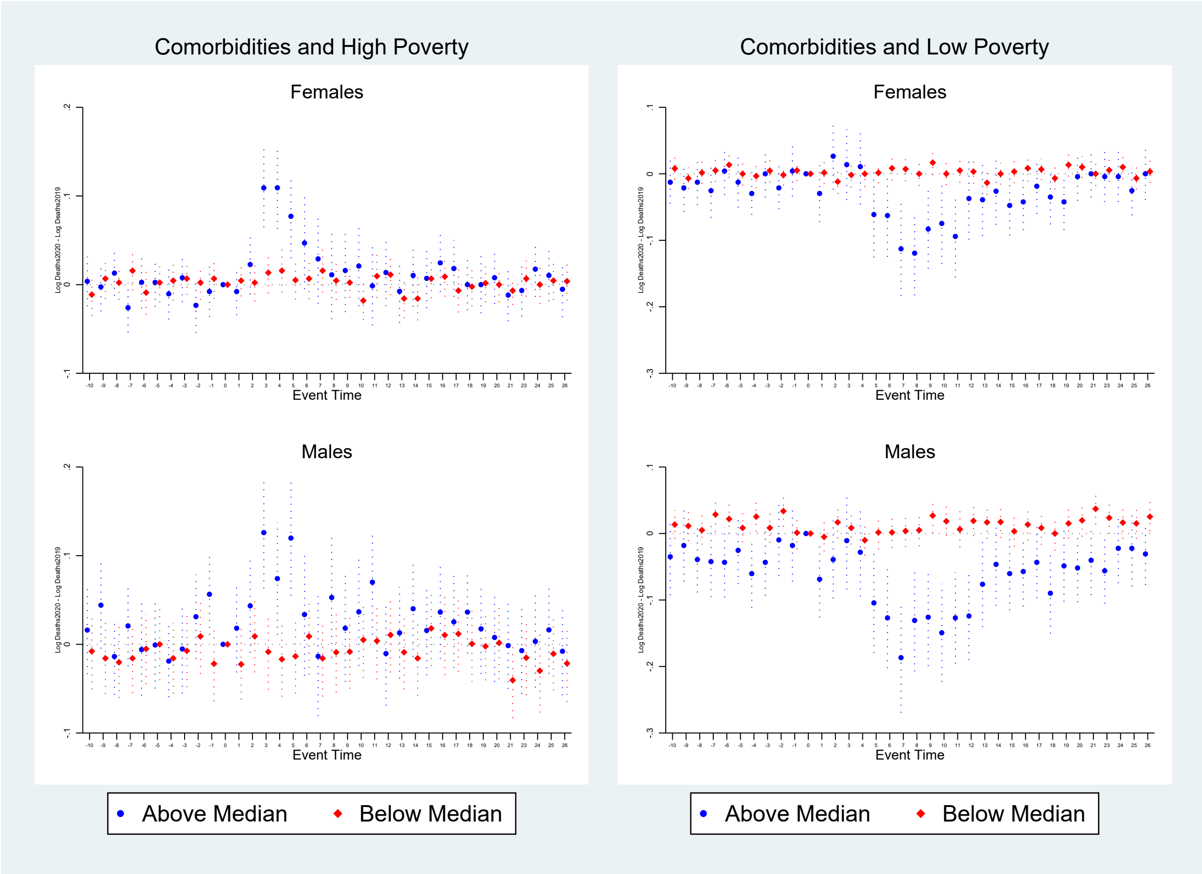

Figure B13: Heterogeneity: Comorbidities, by poverty and sex

Note: The dependent variables are Black-White differentials in excess deaths, by sex. The coefficients are least-squares estimates of the βs over samples with above and below median comorbidity severity and above median (left panels) and below median (right panels) poverty. Block group and week fixed effects are included. Vertical lines represent 95 percent confidence intervals based on standard errors clustered at a block group level. The sample refers to deaths recorded by the Medical Examiner in Cook County, January 1-September 15, 2020 and 2019. The omitted period is $\tau = 0$, i.e., week 11.

Figure B14: Heterogeneity: Age, by poverty and sex

Note: The dependent variables are Black-White differentials in excess deaths, by sex. The coefficients are least-squares estimates of the βs over samples with above and below median share of 65+ and above median (left panels) and below median (right panels) poverty. Block group and week fixed effects are included. Vertical lines represent 95 percent confidence intervals based on standard errors clustered at a block group level. The sample refers to deaths recorded by the Medical Examiner in Cook County, January 1-September 15, 2020 and 2019. The omitted period is $\tau = 0$, i.e., week 11.

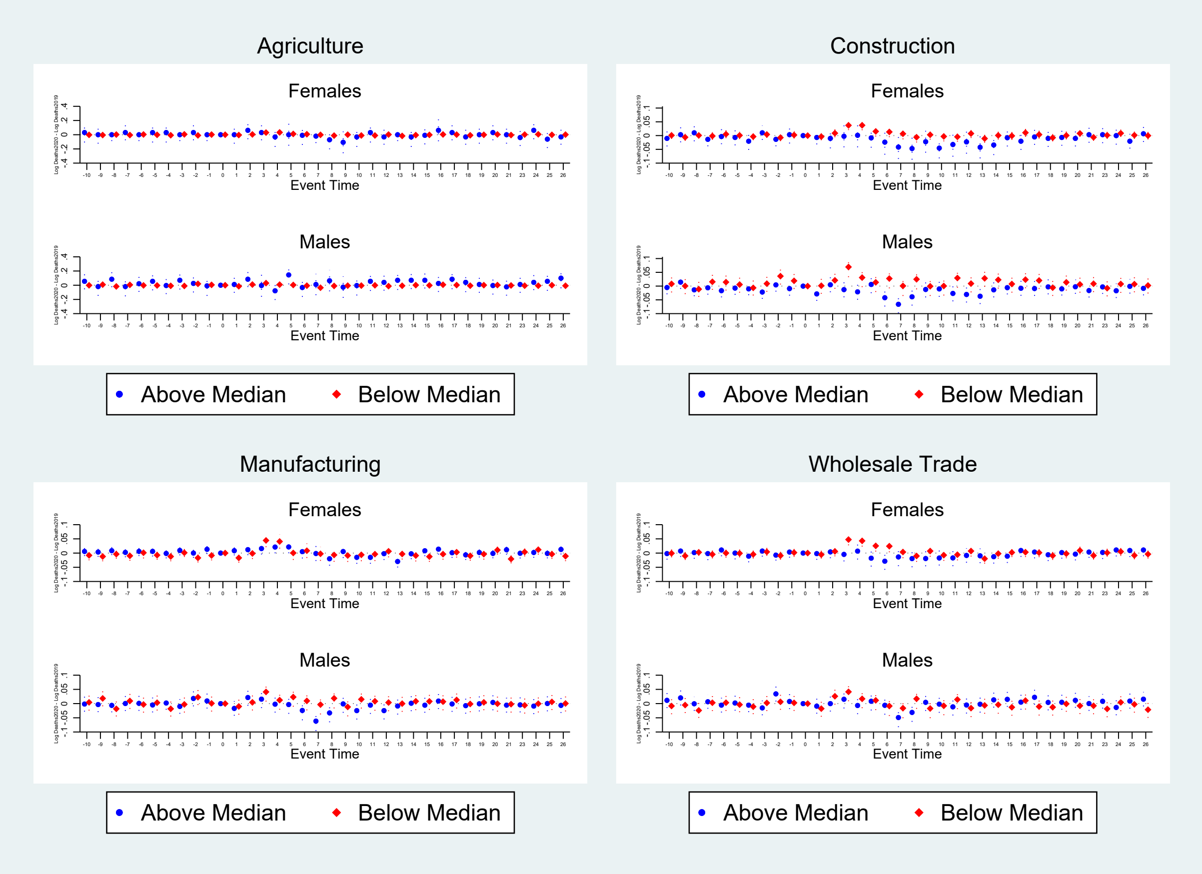

Figure B15: Occupations: Agriculture, construction, manufacturing, and wholesale trade

Note: The dependent variables are Black-White differentials in excess deaths, by sex, for the agriculture, construction, manufacturing, and wholesale trade occupational sectors. The coefficients are least-squares estimates of the βs over samples with above and below median share of females in the female labor force and males in the male labor force in each sector. Block group and week fixed effects are included. Vertical lines represent 95 percent confidence intervals based on standard errors clustered at a block group level. The sample refers to deaths recorded by the Medical Examiner in Cook County, January 1-September 15, 2020 and 2019. The omitted period is $\tau = 0$, i.e., week 11.

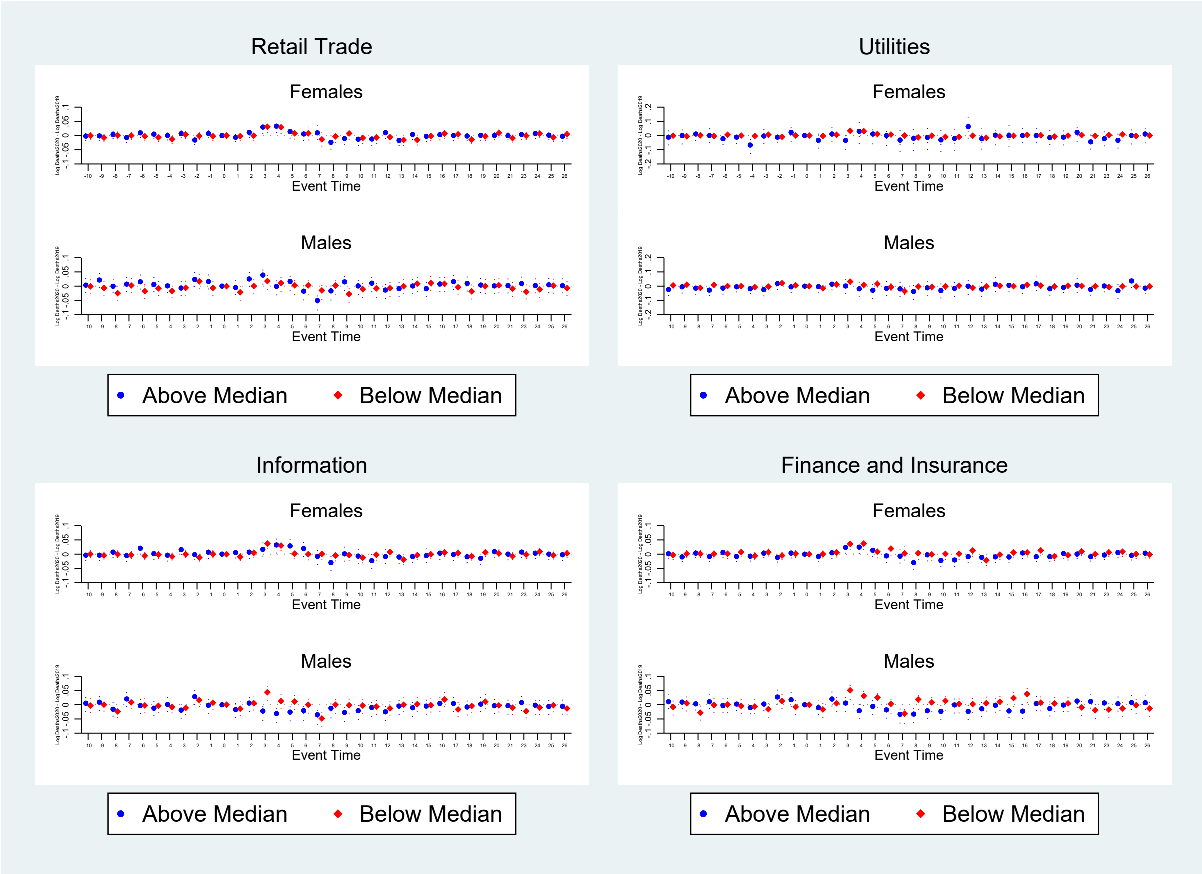

Figure B16: Occupations: Retail trade, utilities, information, and finance and insurance

Note: The dependent variables are Black-White differentials in excess deaths, by sex, for the retail trade, utilities, information, and finance and insurance occupational sectors. The coefficients are least-squares estimates of the βs over samples with above and below median share of females in the female labor force and males in the male labor force in each sector. Block group and week fixed effects are included. Vertical lines represent 95 percent confidence intervals based on standard errors clustered at a block group level. The sample refers to deaths recorded by the Medical Examiner in Cook County, January 1-September 15, 2020 and 2019.. The omitted period is $\tau = 0$, i.e., week 11.

Figure B17: Occupations: Real estate, professional services, administrative services, and education

Note: The dependent variables are Black-White differentials in excess deaths, by sex, for the real estate, professional services, administrative services, and education occupational sectors. The coefficients are least-squares estimates of the βs over samples with above and below median share of females in the female labor force and males in the male labor force in each sector. Block group and week fixed effects are included. Vertical lines represent 95 percent confidence intervals based on standard errors clustered at a block group level. The sample refers to deaths recorded by the Medical Examiner in Cook County, January 1-September 15, 2020 and 2019.. The omitted period is $\tau = 0$, i.e., week 11.

Figure B18: Occupations: Arts and entertainment, accommodation and food, other services, and public administration

Note: The dependent variables are Black-White differentials in excess deaths, by sex, for the arts and entertainment, accommodation and food, other services, and public administration occupational sectors. The coefficients are least-squares estimates of the βs over samples with above and below median share of females in the female labor force and males in the male labor force in each sector. Block group and week fixed effects are included. Vertical lines represent 95 percent confidence intervals based on standard errors clustered at a block group level. The sample refers to deaths recorded by the Medical Examiner in Cook County, January 1-September 15, 2020 and 2019. The omitted period is $\tau = 0$, i.e., week 11.

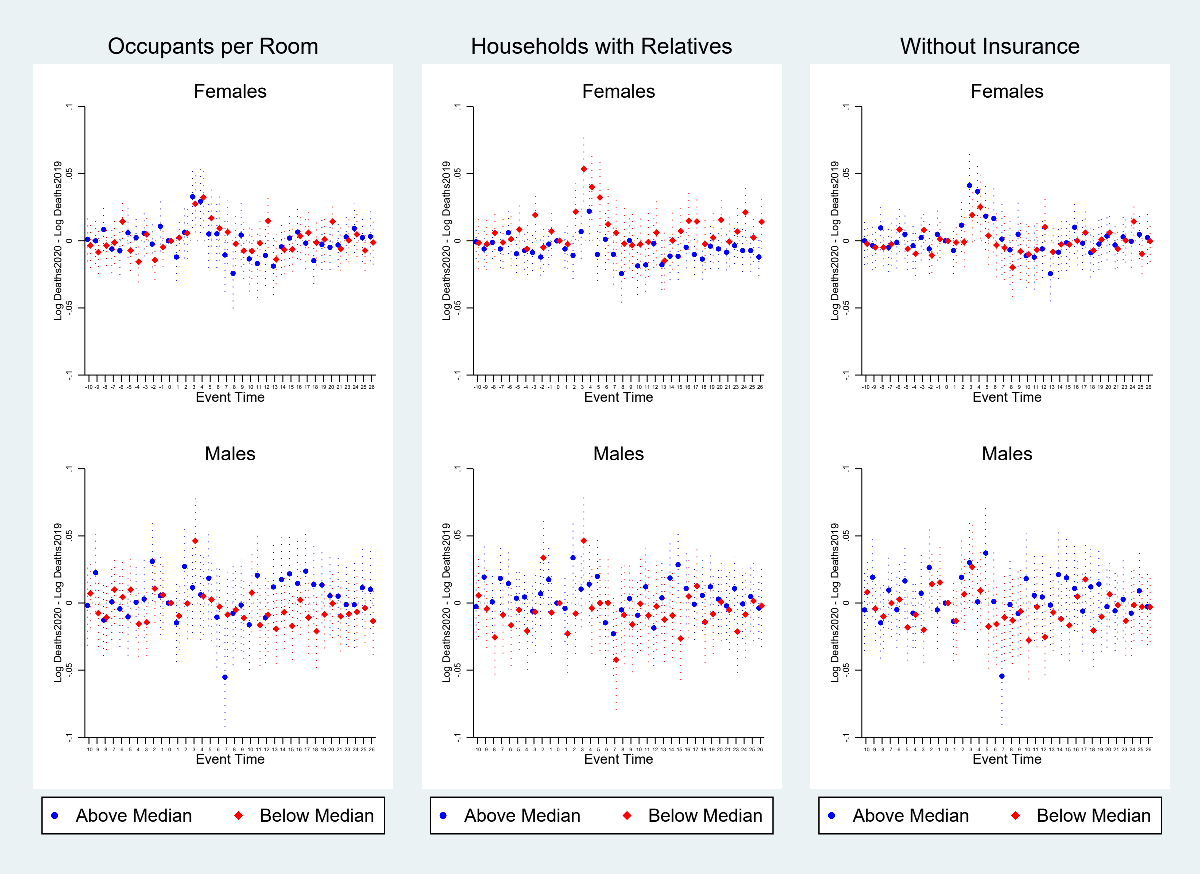

Figure B19: Occupants per room, households with co-living relatives, and individuals with no health insurance

Note: The dependent variables are Black-White differentials in excess deaths, by sex. The coefficients are least-squares estimates of the βs over samples with above and below median occupants per room (left panels), share of households with co-living grandparents (middle panels), and share of uninsured 19+ individuals (right panels). Block group and week fixed effects are included. Vertical lines represent 95 percent confidence intervals based on standard errors clustered at a block group level. The sample refers to deaths recorded by the Medical Examiner in Cook County, January 1-September 15, 2020 and 2019. The omitted period is $\tau = 0$, i.e., week 11.

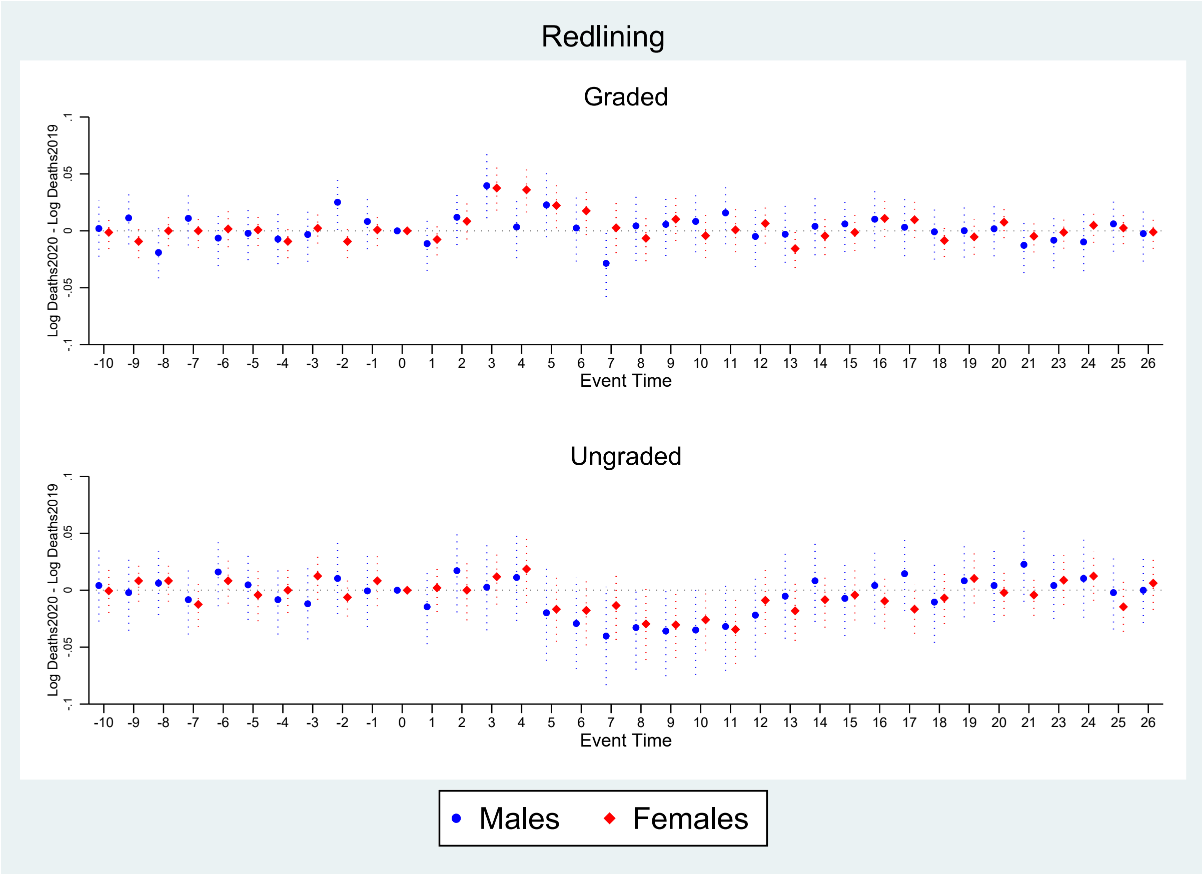

Figure B20: Historical redlining: Graded and ungraded block groups

Note: The dependent variables are Black-White differentials in excess deaths, by sex. The coefficients are least-squares estimates of the βs over the sample of block groups that were graded (top panel) and not graded (bottom panel) by the HOLC. Block group and week fixed effects are included. Vertical lines represent 95 percent confidence intervals based on standard errors clustered at a block group level. The sample refers to deaths recorded by the Medical Examiner in Cook County, January 1-September 15, 2020 and 2019. The omitted period is $\tau = 0$, i.e., week 11.

Table B1: Variable definitions and sources - Cross section of deaths from any cause, January 1, 2020 - September 15, 2020

Variable	Definition	Source
COVID-19 Death	Dummy variable taking value one if an individual died from COVID-19, and zero if an individual died from any other cause	Cook County Medical Examiner's Officer
Age Groups	Set of nine dummy variables taking value one if an individual who died from any cause was respectively aged from 0-19 up to over 90, and zero otherwise	Cook County Medical Examiner's Officer
Female	Dummy variable taking value one if an individual who died from any cause was female, and zero otherwise	Cook County Medical Examiner's Officer
Black	Dummy variable taking value one if an individual who died from any cause was Black, and zero otherwise	Cook County Medical Examiner's Officer
White	Dummy variable taking value one if an individual who died from any cause was non-Hispanic White, and zero otherwise	Cook County Medical Examiner's Officer
Other race	Dummy variable taking value one if an individual who died from any cause was of race other than Black and non-Hispanic White, and zero otherwise	Cook County Medical Examiner's Officer
Comorbidities	Set of 14 dummy variables that take value one (and zero otherwise) when an individual who died from any cause was respectively affected by diabetes and/or asthma, liver disease, cancer, hypertension, kidney disease, obesity, respiratory diseases (including cystic fibrosis, pulmonary and lung diseases), neuro-cardiac diseases (including cardiovascular disease, stroke, and dementia), neuro-respiratory diseases (including sclerosis, Parkinson, myastenia, palsy, hemiplegia, quadriplegia, brain and cerebellum diseases), asplenia (including spenectomy, spleen and sickle cell disease), immunodeficiency (including HIV, immunosuppression, and anaemia), transplant, and heart diseases (including valve disease).	Cook County Medical Examiner's Officer

Table B2: Summary statistics - Cross section of deaths from any cause, January 1, 2020 - September 15, 2020

	count	mean	sd	min	max
COVID-19 Death	10040	0.514	0.500	0.000	1.000
Age Groups	10040	5.801	2.085	1.000	9.000
Female	10040	0.340	0.474	0.000	1.000
Black	10040	0.398	0.490	0.000	1.000
White	10040	0.381	0.486	0.000	1.000
Other Race	10040	0.215	0.411	0.000	1.000
Diabetes	10040	0.236	0.425	0.000	1.000
Asthma	10040	0.023	0.149	0.000	1.000
Liver Diseases	10040	0.004	0.065	0.000	1.000
Cancer	10040	0.016	0.127	0.000	1.000
Hypertension	10040	0.280	0.449	0.000	1.000
Kidney Disease	10040	0.059	0.236	0.000	1.000
Obesity	10040	0.068	0.252	0.000	1.000
Respiratory Diseases	10040	0.094	0.292	0.000	1.000
Neuro-cardiac Diseases	10040	0.058	0.234	0.000	1.000
Neuro-respiratory Diseases	10040	0.018	0.132	0.000	1.000
Asplenia	10040	0.001	0.026	0.000	1.000
Immunodeficiency	10040	0.001	0.032	0.000	1.000
Transplant	10040	0.003	0.056	0.000	1.000
Heart Diseases	10040	0.001	0.039	0.000	1.000

Table B3: Variable definitions and sources - Panel of deaths from any cause, January 1, 2020 - September 15, 2019-2020

Variable	Definition	Source
Excess Deaths	log (0.1+deaths in 2020) - log (0.1+deaths in 2019)	Cook County Medical Examiner's Officer
Excess Deaths, Females	log (0.1+female deaths in 2020) - log (0.1+female deaths in 2019)	Cook County Medical Examiner's Officer
Excess Deaths, Males	log (0.1+male deaths in 2020) - log (0.1+male deaths in 2019)	Cook County Medical Examiner's Officer
Excess Deaths, Gun-Related	log (0.1+ gun-related deaths in 2020) - log (0.1+gun-related deaths in 2019)	Cook County Medical Examiner's Officer
Excess Deaths, Suicides	log (0.1+ suicides in 2020) - log (0.1+suicides in 2019)	Cook County Medical Examiner's Officer
Excess Deaths, Opioid-Related	log (0.1+ opioid-related deaths in 2020) - log (0.1+opioid-related deaths in 2019)	Cook County Medical Examiner's Officer
Comorbidity Score	Indicator for comorbidities associated with COVID-19 deaths	Cook County Medical Examiner's Officer
Age 65+	Share of individuals of age 65 and above	2014-2018 American Community Survey
Poverty	Share of individuals in poverty	2014-2018 American Community Survey
Industry of Occupation, Females and Males	Share of females over female labor force and share of males over male labor force in the following 20 industries: agriculture, mining, construction, manufacturing, wholesale trade, retail trade, transportation and warehousing, utilities, information, finance and insurance, real estate, professional services, management of companies, administrative services, education, health care, arts and entertainment, accommodation and food, other services, and public administration	2014-2018 American Community Survey
Public Transport	Share of individuals using public transport	2014-2018 American Community Survey
Commuting Distance	Distance from workplace	2014-2018 American Community Survey
Occupants per Room	Share of households with more than one occupant per room	2014-2018 American Community Survey
Households with Relatives	Share of households with co-living relatives	2014-2018 American Community Survey
Uninsured	Share of individuals without health insurance coverage	2014-2018 American Community Survey
HOLC Graded and A-, B-, C-, and D-graded	Block groups respectively graded and graded A, B, C, and D by HOLC	University of Richmond American Panorama

Table B4: Summary statistics - Panel of deaths from any cause, January 1, 2020 - September 15, 2019-2020

	count	mean	sd	min	max
Excess Deaths	443112	0.024	0.389	-3.434	4.710
Excess Deaths, Females	443112	0.009	0.221	-3.045	4.111
Excess Deaths, Males	443112	0.016	0.327	-3.045	4.511
Excess Deaths, Gun-Related	443112	0.001	0.120	-3.045	3.714
Excess Deaths, Suicides	443112	-0.000	0.086	-3.045	2.398
Excess Deaths, Opioid-Related	443112	0.002	0.175	-3.045	3.045
Comorbidity Score	442002	-0.000	1.000	-1.673	16.158
Age 65+	442002	12.259	7.358	0.000	83.258
Poverty	442113	0.151	0.131	0.000	0.816
Agriculture, Females	442113	0.000	0.003	0.000	0.067
Agriculture, Males	442113	0.001	0.006	0.000	0.179
Construction, Females	442113	0.004	0.013	0.000	0.127
Construction, Males	442113	0.042	0.051	0.000	0.708
Manufacturing, Females	442113	0.031	0.038	0.000	0.358
Manufacturing, Males	442113	0.064	0.060	0.000	0.407
Wholesale Trade, Females	442113	0.009	0.018	0.000	0.178
Wholesale Trade, Males	442113	0.018	0.028	0.000	0.484
Retail Trade, Females	442113	0.049	0.048	0.000	0.481
Retail Trade, Males	442113	0.049	0.050	0.000	0.708
Transportation and Warehousing, Females	442113	0.021	0.037	0.000	0.541
Transportation and Warehousing, Males	442113	0.051	0.055	0.000	0.554
Utilities, Females	442113	0.001	0.008	0.000	0.264
Utilities, Males	442113	0.003	0.011	0.000	0.160
Information, Females	442113	0.009	0.019	0.000	0.294
Information, Males	442113	0.011	0.021	0.000	0.312
Information, Females	442113	0.009	0.019	0.000	0.294
Information, Males	442113	0.011	0.021	0.000	0.312
Finance and Insurance, Females	442113	0.028	0.034	0.000	0.320
Finance and Insurance, Males	442113	0.026	0.038	0.000	0.320
Real Estate, Females	442113	0.009	0.024	0.000	1.000
Real Estate, Males	442113	0.012	0.022	0.000	0.232
Professional Services, Females	442113	0.038	0.044	0.000	0.376
Professional Services, Males	442113	0.047	0.055	0.000	0.410
Administrative Services, Females	442113	0.022	0.034	0.000	0.424
Administrative Services, Males	442113	0.028	0.040	0.000	0.452
Education, Females	442113	0.061	0.053	0.000	0.451
Education, Males	442113	0.030	0.040	0.000	0.420
Health Care, Females	442113	0.112	0.074	0.000	0.714
Health Care, Males	442113	0.032	0.040	0.000	0.465
Arts and Entertainment, Females	442113	0.010	0.019	0.000	0.242
Arts and Entertainment, Males	442113	0.012	0.023	0.000	0.293
Accommodation and Food, Females	442113	0.036	0.043	0.000	0.500
Accommodation and Food, Males	442113	0.039	0.049	0.000	0.558
Other Services, Females	442113	0.027	0.033	0.000	0.409
Other Services, Males	442113	0.022	0.032	0.000	0.313
Public Administration, Females	442113	0.018	0.029	0.000	0.296
Public Administration, Males	442113	0.021	0.039	0.000	1.000
Public Transport	442113	0.196	0.162	0.000	1.000
Commuting Distance	442002	9.010	3.521	0.723	25.921
Occupants per Room	442113	0.034	0.051	0.000	0.382
Households with Relatives	442113	0.781	0.157	0.000	1.000
Uninsured	442224	0.093	0.078	0.000	0.570
HOLC Graded	443112	0.289	0.453	0.000	1.000
HOLC A-graded	443112	0.013	0.087	0.000	1.000
HOLC B-graded	443112	0.100	0.252	0.000	1.000
HOLC C-graded	443112	0.393	0.439	0.000	1.000
HOLC D-graded	443112	0.205	0.372	0.000	1.000

Table B5: Black-White excess death differential, overall and by sex

	(1) All	(2) Females	(3) Males
$\pi_r \cdot \tau = 1$	-0.0165	-0.0048	-0.0122
	(0.0114)	(0.0059)	(0.0099)
$\pi_r \cdot \tau = 2$	0.0190	0.0060	0.0135
	(0.0124)	(0.0070)	(0.0103)
$\pi_r \cdot \tau = 3$	0.0564***	0.0302***	0.0290**
	(0.0139)	(0.0080)	(0.0118)
$\pi_r \cdot \tau = 4$	0.0340**	0.0310***	0.0057
	(0.0138)	(0.0084)	(0.0114)
$\pi_r \cdot \tau = 5$	0.0175	0.0111	0.0105
	(0.0141)	(0.0084)	(0.0120)
π_r	✓	✓	✓
Block group fixed effects	✓	✓	✓
Week fixed effects	✓	✓	✓
Adj.R-squared	0.018	0.017	0.009
Observations	295408	295408	295408

Note: The dependent variables are the Black-White excess death differential, overall (Model 1), for females (Model 2) and for males (Model 3). Standard errors clustered at a block group level in parentheses: *** p<0.01, ** p<0.05, * p<0.1. The sample refers to deaths recorded by the Medical Examiner in Cook County, January 1-September 15, 2020 and 2019.