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Reparations for Black American descendants of persons enslaved in the U.S. and their potential impact on SARS-CoV-2 transmission

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ABSTRACT

Background: In the United States, Black Americans are suffering from a significantly disproportionate incidence of COVID-19. Going beyond mere epidemiological tallying, the potential for racial-justice interventions, including reparations payments, to ameliorate these disparities has not been adequately explored.

Methods: We compared the COVID-19 time-varying R0 curves of relatively disparate polities in terms of social equity (South Korea vs. Louisiana). Next, we considered a range of reproductive ratios to back-calculate the transmission rates βi→j for 4 cells of the simplified next-generation matrix (from which R0 is calculated for structured models) for the outbreak in Louisiana. Lastly, we considered the potential structural effects monetary payments as reparations for Black American descendants of persons enslaved in the U.S. would have had on pre-intervention R0 and consequently R0.

Results: Once their respective epidemics begin to propagate, Louisiana displays R0 values with an absolute difference of 1.3–2.5 compared to South Korea. It also takes Louisiana more than twice as long to bring R0 below 1. Reasoning through the consequences of increased equity via matrix transmission models, we demonstrate how the benefits of a successful reparations program (reflected in the ratio βb→w/βw→b) could reduce R0 by 31–68%.

Discussion: While there are compelling moral and historical arguments for racial-injustice interventions such as reparations, our study considers potential health benefits in the form of reduced SARS-CoV-2 transmission risk. A restitutive program targeted towards Black individuals would not only decrease COVID-19 risk for recipients of reparations, our study considers potential health benefits in the form of reduced SARS-CoV-2 transmission risk. A restitutive program targeted towards Black individuals would not only decrease COVID-19 risk for recipients of reparations, our study considers potential health benefits in the form of reduced SARS-CoV-2 transmission risk. A restitutive program targeted towards Black individuals would not only decrease COVID-19 risk for recipients of reparations, our study considers potential health benefits in the form of reduced SARS-CoV-2 transmission risk. A restitutive program targeted towards Black individuals would not only decrease COVID-19 risk for recipients of reparations, our study considers potential health benefits in the form of reduced SARS-CoV-2 transmission risk. A restitutive program targeted towards Black individuals would not only decrease COVID-19 risk for recipients of reparations, our study considers potential health benefits in the form of reduced SARS-CoV-2 transmission risk. A restitutive program targeted towards Black individuals would not only decrease COVID-19 risk for recipients of reparations, our study considers potential health benefits in the form of reduced SARS-CoV-2 transmission risk. A restitutive program targeted towards Black individuals would not only decrease COVID-19 risk for recipients of reparations, our study considers potential health benefits in the form of reduced SARS-CoV-2 transmission risk.
291,522 total deaths (Centers for Disease Control and Prevention, 2020b)—although this certainly represents an underestimate of the true number of cases given the poor scale-up of testing coupled with a high rate of asymptomatic infection (Shear et al., 2020; Day, 2020).

As has been the case in previous pandemics, communities of color are suffering from an increased incidence of COVID-19—and therefore disproportionate mortality—when compared to white people (Quinn et al., 2011; Ogedegbe et al., 2020; Rentsch et al., 2020). Early in the outbreak, the aggregated relative risk of death for Black people compared to white people was 3.57 (95% CI: 2.84–4.48) (Gross et al., 2020). Such a difference is the product of, and further contributes to, vast disparities in Black and white health that are a concatenation of legacies of enslavement, legal segregation, white terrorism (e.g., lynchings during the Jim Crow period), hyperincarceration, lethal policing, and ongoing discrimination in housing, employment, policing, credit markets, and health care (Darity and Mullen, 2020a; Noonan et al., 2016; Braithwaite and Warren, 2020; Wrigley-Field, 2020). The mismanagement of the SARS-CoV-2 response in the U.S. has exacerbated these disparities (NEJM Editors, 2020), but at the immediate outset, path-dependent structural inequalities such as overcrowded housing, concentration in frontline work, and hyperincarceration led directly to greater exposure and transmission among Black people.

While frameworks for understanding the mechanisms through which biosocial forces become embodied as pathology are inchoate, allostatic load (the physiological profile influenced by repeated or chronic life stressors) can be used to demonstrate how the continuous trauma of oppression can lead to disparities in health by race (Farmer, 2001; Green and Darity, 2010; Crimmins and Seeman, 2004; Richardson et al., 2016; Bailey et al., 2017; Duru et al., 2012; Gravelle et al., 2005; Beatty Moody et al., 2019). The causes of health disparities are also locked in a pernicious feedback loop with wealth, wherein forms of ongoing discrimination deprive the Black population of the assets and generational wealth that they might use to ameliorate the sources of these health disparities (Darity and Mullen, 2020b).

The potential health impacts of racial-justice interventions, including reparations payments, have not been adequately explored (Morgan and Reid, 2020; Bassett and Galea, 2020). Mathematical and computational models of infectious disease transmission dynamics are increasingly being used to determine the potential impact of interventions on incidence and mortality (Kelly et al., 2019). Fundamental to this work is calculation of the basic reproductive number $R_0$, which is defined as the expected number of secondary cases caused by a typical infected individual in a fully susceptible population (Heesterbeek, 2002). While $R_0$ provides theoretical information about an epidemic, practical control ultimately depends on the expected infections generated later in the outbreak prompting epidemiologists to utilize the effective reproduction number $R_t$ (i.e., the average number of secondary cases generated by an infectious individual at time $t$), which obviates the assumption of a fully susceptible population and allows for the temporal dynamics to be followed in the setting of various interventions (Liu et al., 2018).

Models must make assumptions about how people interact with others (Holmdahl and Buckee, 2020), but they rarely account for social forces like institutional and cultural racism that structure such interactions (Williams and Mohammed, 2013). Therefore, they can obfuscate such forces in their attempts to describe outbreak transmission dynamics (Levins and Lewontin, 1965; Farmer, 2005; Richardson, 2019, 2020a).

Nonetheless, it is possible to incorporate risk heterogeneities into models and to use this information to identify more just measures for disease prevention/control (Keeling and Rohani, 2007; Jones and Brown, 2008; Koopman et al., 1991; Koopman and Lynch, 1999; Morris, 1993). For example, Black workers are overrepresented in front-line sectors like food service and delivery, healthcare, and child-care, which places them at higher risk of SARS-CoV-2 infection. Black individuals also have a higher likelihood of living in dense, precarious housing where effective social distancing is hindered. These risks are structural—that is, not determined by personal choice or rational assessment, as models often assume (what Koopman and Longini refer to as “the erroneous attribution of individual effects” (Koopman and Longini, 1994)) (Diez-Roux, 1998; Farmer et al., 2006); they can therefore benefit from structural interventions.

2. Methods

For a representative inegalitarian state in the U.S., we chose Louisiana as a unit of analysis due to the availability of COVID-19 data compiled by race. Louisiana has one of the highest GINI coefficients (a measure for household income distribution inequality—a value of 0 represents total income equality [all households have an equal share of income], while a value of 1 represents total income inequality [one household has all the income]) among the American states (0.5) (Gusman, 2017), has a very small population of non-Black people of color (Supplemental Materials Section 3), is highly segregated between Black and non-Black populations (Supplemental Materials Section 4), has significant differences in the average number of persons per room (PPR: a measure of overcrowding (Blake et al., 2007) that recent reports indicate might be more important for risk of infection than urban density (Corine, 2020)) for Black and non-Black populations (Fig. 1; see also Supplemental Materials Section 5), and areas with higher Black populations also have higher proportions of frontline workers (Supplemental Materials Section 6).

We focus on the early part of the epidemic, during the first wave of infection in Spring 2020. By May 28, 2020, the state had reported 38,802 SARS-CoV-2 infections (Louisiana Department of Health, 2020). We estimated time-varying $R_t$ using the method of Wallinga and Teunis (2004), which uses a probability distribution for the serial interval (i.e., the time, in days, between symptom onset in an index case and symptom onset in a person infected by that index case). Confidence intervals for $R_t$ were calculated using a normal approximation for the estimated number of secondary cases per case (i.e., approximating the 95% confidence interval by the expected value $R_t \pm 1.96$ times the standard error). Following current best estimates of the serial interval, we chose a gamma distribution with a mean of 5 and standard deviation of 2 days (Li et al., 2020; He et al., 2020). (While one would expect a longer serial interval for Black people given the structural barriers to care outlined in

![Louisiana overcrowded housing, by Census tract](image-url)

**Fig. 1.** Fitted 95% confidence intervals for the ratio of the population in overcrowded housing to total population by Louisiana Census tract. In tracts where overcrowded housing is documented, the estimated ratio of Black population in overcrowded housing to total Black population is 0.0565, double that of the non-Black population (0.0263).
the background, our analysis aims to capture the beginning of the outbreak in Louisiana, before therapies shown to potentially shorten the course of COVID-19 such as dexamethasone (The RECOVERY Collaborative Group, 2020) and remdesivir (Beigel et al., 2020) were in use; presentation to care at that time improved an individual’s chance of survival, but likely did not shorten their recovery from SARS-CoV-2 infection per se.)

To juxtapose these data with those reported from a relatively egalitarian polity, we conducted a similar analysis of the outbreak in South Korea (Korea Centers for Disease Control & Prevention, 2020), which in contrast to Louisiana, has a GINI coefficient of 0.32 (The World Bank, 2012) and no large, segregated subgroup of the population composed of the descendants of enslaved persons. South Korea nonetheless has 10 times the population density of Louisiana such that, if density by itself were the major determinant of epidemic severity, we would expect rates of infection to be much higher in the former compared to the latter, which is not the case (in Spring 2020, Louisiana reported nearly 40 times the number of cases per 100,000 people as South Korea). (Louisiana Department of Health, 2020; Korea Centers for Disease Control & Prevention, 2020; United States Census Bureau, 2019; The World Bank, 2018).

From the theory of epidemics in structured populations, we know that \( R_0 \) is given by the dominant eigenvalue of the next-generation matrix, \( G \), a \( k \times k \) matrix (Equation (1)) that accounts for the movement into and between the \( k \) infection states in the population.

\[
G = \begin{pmatrix}
\beta_{bw} \pi_w / \gamma & \beta_{bw} \pi_b / \gamma \\
\beta_{wb} \pi_b / \gamma & \beta_{wb} \pi_w / \gamma
\end{pmatrix}
\]

The next-generation matrix analysis shows that, in a segregated society like the U.S. where SARS-CoV-2 transmission rates are disproportionate across racial groups, small changes in the ratio between \( \beta_{bw} \) and \( \beta_{wb} \) can result in large changes in the reproductive ratio for the population (Fig. 3a), due mainly to 1) the effects of high assortative mixing structured by racism on the value of \( c_{bw} \); and 2) the fact that the expected number of secondary infections generated within high-risk subgroups (i.e., the value \( g_{bw} \) in the next generation matrix—in this case driven by high relative values of \( c_{bw} \)) comes to dominate \( R_0 \) for a population (Keeling and Rohani, 2007; Caswell, 2019; Jones et al., 2020).

A program of reparations has the potential to reduce several variables that determine the COVID-19 reproductive ratio in such a segregated society. These include:

i) reducing \( c_{bw} \) significantly for Black people by decreasing overcrowded housing (this also has the benefit of improving an individual’s ability to social distance once stay-at-home orders are enacted);

ii) reducing \( \beta_{bw-b} \) as Black individuals would not be forced as frequently into high-risk frontline work—with both attendant exposure and psychosocial stress;

iii) decreasing \( r \) slightly on account of people’s ability to access preventive modalities like masks, hand sanitizer, etc.

Accordingly, the arrow in Fig. 3b shows how different assumptions regarding the effects of reparations could play out: It begins within the range of \( R_0 \) we selected from the Louisiana outbreak pre-intervention (i.e., before the stay-at-home order was enacted); it ends within our estimates for \( R_0 \) in the setting of reparations, which are consistent with early values of \( R_0 \) estimated for South Korea and are 31–68% lower than pre-intervention estimates for Louisiana. This is achieved by the transmission rate \( \beta_{bw} \) decreasing to near parity with \( \beta_{bw-b} \), which reflects the anticipated mitigation in structural racism a successful reparations program would engender.

4. Discussion

4.1. The color line

In the United States, where the problem of the 21st century is still the problem of the color line, 400 years of structural racism, violently-seized
In general, a program of reparations is intended to achieve three objectives: acknowledgment of a grievous injustice, redress for the injustice, and closure of the grievances held by the group subjected to the injustice (Darity, 2008). Potential mechanisms by which reparations—through both monetary compensation and acknowledgment of injustice—could have suppressed the COVID-19 pandemic include:

1) narrowing of the path-dependent racial wealth divide;
2) changes in the built environment, fostering the ability to social distance;
3) spreading out of front-line work across racial groups;
4) decreased race-based allostatic load.

4.2. Reparations

Through a novel combination of empirical evidence and structural reasoning based on the properties of mathematical models of infectious disease, we illustrate how pandemic containment policy can go beyond the wearing of masks and stay-at-home orders: *interventions in risk structure*—that is, the way people are enabled or constrained in their associations with others—are crucial to pandemic preparedness, the ability to comply with containment policy once it is decreed, and racial justice in general. Such an amelioration of structural risk can be achieved with reparations.

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3) spreading out of front-line work across racial groups;
4) decreased race-based allostatic load.

4.3. Disproportionate incidence vs. mortality

Current explanations of excess COVID-19 risk for Black Americans focus on personal failure to follow public health advice and lifestyle choices that result in co-morbid conditions (e.g., coronary artery disease and diabetes) (Chowkwanyun and Reed, 2020). Neither, however, addresses excess exposure, which is structured by institutional racism (and captured in the parameters $\beta_{i\rightarrow j}$). Indeed, reported mortality rates up to 7 times that of white populations likely reflect considerable underdiagnosis of cases in Black communities (APM Research Lab, 2020), rather than intrinsic differences in risk of death once infected (Ogedegbe et al., 2020). In other words, while there may be some differential mortality by race for COVID-19 (exacerbated by allostatic load), incidence is likely much higher in Black communities than we appreciate.

4.4. The symbolic violence of $R_0$

Contrary to the way it is often depicted popularly, $R_0$ is not an intrinsic property of a particular pathogen (nor are mortality rates (Richardson et al., 2017a)). Rather, the reproduction ratio encapsulates social structure, behavior, and differential risk in a population (Arthur et al., 2017). Such risk is often structural (Farmer, 2004), however, and modeling studies seldom capture oppressive social forces including institutionalized racism and sexism in their emphasis on ‘objective,’ well-defined parameters. While some scholars attribute this to the inherent conservatism of causal reasoning (Schwartz et al., 2016; Ruhm, 2018), it may be more justly described as a form of symbolic violence, referring to the ways naturalized symbols and language sustain relations of oppression (Swartz, 1997; Zizek, 2008; Maxwell, 2014; Richardson et al., 2017b). In the case of epidemic modeling, we are rarely presented with racial-justice interventions as ways of preventing and containing outbreaks. And because real racial-justice interventions have been inadequately explored empirically in an anti-Black world, we need to turn to creative means of imagining alternatives (McKittrick, 2015; Mignolo and Walsh, 2018).

Since reparations had not been enacted, however, ‘reopening’ American society early (after coronavirus-forced shutdowns) had a disproportionate adverse mortality effect on Black people, an effect that
was predictable (Hsiang et al., 2020). Therefore, de facto, it resembled a modern Tuskegee experiment, since massive wealth redistribution could have averted these deaths, just as penicillin to treat syphilis would have averted deaths in the nearby state of Alabama (Alsan and Wamananaker, 2017; Brandt, 1978). As the APM Research Lab reported in August 2020, “If they had died of COVID-19 at the same rate as White Americans, almost 18,000 Black, 6000 Latino, 600 Indigenous, and 70 Pacific Islander Americans would still be alive” (APM Research Lab, 2020)—and this was before even 5% of the national population had been infected. The appalling evidence of racism embodied as disproportionate COVID-19 incidence and mortality for Black Americans should add to moral, historical, and legal arguments for reparations for descendants of people enslaved in the U.S.

5. Authors’ contributions

ETR, MMM, WAD, AKM, PEM, MTB, LW, and JHJ designed the study. ETR, MMM, WAD, AKM, MEM, MM, AM, MTB, PEM, LW, and JHJ conducted the literature search. ETR, MMM, WAD, MTB, LW, and JHJ collected data. MMM, LW, and JHJ wrote the R code. ETR, MMM, WAD, AKM, MEM, MM, AM, MTB, PEM, LW, and JHJ interpreted the results. ETR wrote the article. MMM and JHJ designed the figures. MMM wrote the Supplementary Material. ETR, MMM, WAD, AKM, MEM, MM, AM, MTB, PEM, LW, and JHJ edited and revised the article.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.socscimed.2021.113741.

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