

Understanding the Determinants of Racial Disparities in Health: Social Science Implications for Cross-Disciplinary Computational Research

1. Introduction

Since the first arrival of slaves onto the soil that would become the United States of America in 1619—and all the way until the present time—Black people have lived shorter and less healthy lives than whites. The U.S. Department of Health and Human Services Office of Minority Health reports that African-Americans have the highest mortality rate for all cancers combined compared with any other racial and ethnic group (NCI 2020, Table 1.20). African-Americans were 30 percent more likely to die from heart disease than non-Hispanic whites in 2018 (CDC 2021, Table 10). For every 1,000 live births among African-Americans, 11 die, which is almost twice the national average of 5.8 infant deaths per 1,000 births (CDC 2019, Table 2). From 2012 to 2016, African American women were just as likely to have been diagnosed with breast cancer as white women, but almost 40 percent more likely to die from the disease (NCI 2020, Table 1.20).

Many other ethnic and racial minorities, including Native Americans and Latinx people have also routinely faced worse health outcomes and shorter life expectancies relative to whites. According to the U.S. Department of Health and Human Services, around 13.2 percent of Hispanic adults had been diagnosed with diabetes compared with 8 percent of white adults (CDC 2021, Table A-4a). Hispanic women are 40 percent more likely to have cervical cancer and 20 percent more likely to die from cervical cancer than non-Hispanic white women (NCI 2020, Tables 2.15-24.15). In 2014, Native Hawaiians and Pacific Islanders were 10 percent more likely to have coronary heart disease than non-Hispanic whites (CDC 2017, Figure 2). In 2017, American Indian

and Alaska Native adults were almost three times more likely to have diabetes than non-Hispanic white adults (CDC 2021, Table A-4a). They were also 2.5 times more likely to die from diabetes (CDC 2021, Table 10).

What accounts for the persistence of such gaps in the United States, even five decades following the promulgation of various civil rights legislation in the 1960s? Scholars and practitioners working in a range of disciplines, including public health, medicine and the social sciences have all tried to provide answers. They have offered credible propositions, including with respect to long-run social and economic inequalities that get reproduced in health-related conditions; residential patterns that pose differential environmental and health hazards, and varied access to health care; the role of historical episodes that have left lasting disparities in terms of levels of trust in medical professionals; and enduring patterns of implicit and explicit bias and discrimination in everyday life and in the health care system, which directly and indirectly lead to worse health outcomes for ethnic and racial minorities. Although recent bio-medical research raises the possibility that some types of disparities in disease vulnerability may have genetic roots, for the most part, this literature has sought to challenge a previous “pseudo-science” that linked race and health outcomes as a biological phenomenon that helped justify patterns of racial domination. By focusing on long- and short-run social, political, and economic factors as the basis of health inequalities, this broad set of scholarly contributions has led many to conclude that solutions to disparities similarly lie in these realms.

This broader group of studies is extremely varied in approach, ranging from more qualitative historical and ethnographic case studies, to quantitative analyses of surveyed populations across time and space. While all seek to isolate out the effects of specific factors that may account for some or all of the observed disparities between race groups, for the most part all share a common

limitation that makes them distinct from clinical studies in the field of medicine: for clear ethical and practical reasons, it has not been possible to randomize assignment to racial identity or exposure to all of the very diverse factors hypothesized to lead to racial inequalities; and in turn, it has been difficult to bridge the gap from plausible hypotheses and credible correlations to identified causal effects. The strong correlation between race, class, educational attainment, and various attitudes and behaviors in the American context can make it extremely difficult to rule out the influence of confounding factors in any study. Thus, a key motivation for our review is to highlight the importance of causal analysis using cutting-edge computational research as a way to advance unanswered questions from social scientists.

In this essay, we provide an overview of the key findings and contributions that emerge from leading social science journals, and also describe progress in computational research on healthcare equity as a way to identify opportunities for cross-disciplinary research in this space. While our approach shares some similarities with a conventional systematic review, our aim is to conduct a more targeted stock-taking of the existing research with an intent to educate colleagues in the social sciences and in the computational sciences on findings in the respective literatures, on where these works converge, where they deviate and what opportunities they open up for research collaborations. We think such an exercise is necessary for identifying valuable lessons learned and pressing gaps in this literature, for informing emerging research designs, ensuring that analyses of big data and computational research are not agnostic to the several decades of social science research on this topic, as well as for thinking about relevant policy interventions.

Our essay is structured as follows: the second section outlines our methodological approach and specifies the scope and goals of our review. The third section examines how social scientists have contributed to our understanding of the determinants of racial disparities in health outcomes.

We group these contributions into two categories: explanations related to *structural racism*, defined as processes of racism embedded in the laws, policies, and practices of society and its institutions, and explanations related to the persistent *norms and attitudes* that affect the health-related behaviors of citizens and medical professionals. This section concludes with a discussion of the challenges involved in the conceptualization and measurement of racial categories. In the fourth section, we offer an overview of how recent advances in computation and big data have generated research on artificial intelligence (AI) as a tool for medical practice that affects healthcare outcomes and health disparities, and not always for the better. This section goes on to discuss opportunities for social scientists to extend existing research on health disparities by examining the causes and consequences of bias in AI for healthcare through a causal inference lens. The fifth section concludes.

2. Methodology

Our goal in this essay is to identify key findings, contributions, and opportunities in the study of racial health disparities in social science, to offer an overview of advances in computational work on healthcare equity, and to highlight opportunities for interdisciplinary research on this topic. We began our review by identifying prominent questions and explanations in the broader interdisciplinary literature on racial health disparities. We identified a corpus of contributions by searching for relevant public health and medical studies in academic databases and systematic reviews.¹ After gaining familiarity with the interdisciplinary terrain, we decided to focus our inquiry on relevant research in political science, sociology and economics and compiled a list of

¹ We conducted searches in PubMed and Google Scholar using search terms related to racial health disparities. The specific terms used for the search process can be found in the appendix. To find the systematic reviews, we conducted direct searches for review articles on PubMed and Google Scholar, and also searched for related publications in *Annual Reviews*.

all publications related to racial health disparities in top-ranking journals as a way to scope our inquiry. We refer to these works as the “relevant social science research” in this essay.

We supplemented the list of works in top-ranking disciplinary journals by also searching for relevant publications in subject-specific race and health journals in these three disciplines. These journals were identified using prior knowledge and recommendations from health and race scholars across the three disciplines,² but undoubtedly some important contributions in other journals and other outlets, including edited volumes, were missed in this net. To identify the relevant studies in these social science journals, we used a series of search terms related to racial disparities in health outcomes and insurance.³ We searched only for peer-reviewed published articles, and so did not include books, working papers, or dissertations. We focused our attention on literature published between 2000 and 2021, because this time period corresponds with the emergence of research on racial health disparities in the interdisciplinary literature: while only 43 articles with this term emerged from a PubMed search of articles from 1987 to 1999, 540 such articles were published from 2000 to 2009, and 1,827 from 2010 to 2021.

The vast majority of studies in our assembled corpus are based on quantitative analyses, which is largely in line with other contributions in these journals. We should note, however, that these largely quantitative studies build on findings and insights from a long line of qualitative and historically-oriented research. We chose not to look beyond our journals for additional qualitative and historical research, because we decided that observational and experimental studies would most directly inform the application of big data to these issues. Given the relative paucity of experimental publications in our assembled corpus, we conducted an additional search in J-PAL North America’s US Health Care Delivery Initiative (HCDI), which conducts randomized

² All journals are listed in the appendix.

³ The terms used for the search process can be found in the appendix.

evaluations of efforts to increase the efficiency and equity of health care delivery in the United States.⁴

After reviewing our assembled corpus, we cross-checked our findings against systematic reviews on the determinants of racial health disparities from a range of disciplines. This search yielded 41 systematic reviews across public health, medicine, psychology, and social work.⁵ We found that scholars across these fields use similar theoretical frameworks to explain racial health outcomes and reach similar conclusions regarding the relationship between key explanatory variables and racial disparities. Throughout the piece, we use these reviews to identify how our set of social science studies builds on this larger body of interdisciplinary research on racial health inequity. In addition to these 41 studies, our search yielded a set of 44 systematic reviews outside of the scope of our study. These additional reviews can be separated into three main categories: The first are reviews that document the existence of racial disparities on a given health outcome, like obesity or mental health. The second are reviews that examine issues related to racial health disparities — like racial discrimination toward doctors, or coping mechanisms that attenuate the association between discrimination and health — but do not explicitly examine the determinants of disparities in racial health outcomes. The third category are reviews that examine racial health disparities in contexts outside of the United States.

The second part of our essay offers an overview of advances in computational research on healthcare equity and considers how social scientists can inform that work and where cross-disciplinary collaboration can emerge. Such research will have to explore how technical advances can help us better address bias, consider the ethical and societal considerations of these advances,

⁴ This search yielded only one additional publication, which we include in our corpus.

⁵ To find these reviews, we conducted direct searches for review articles on PubMed, Google Scholar, and the National Library of Medicine. We also searched for related publications in *Annual Reviews*. We provide citations for this corpus of systematic reviews in the appendix.

and examine the institutional and human oversight required for such technologies to work as intended. Though part of this research agenda will inevitably focus on the correction of algorithmic bias, insights from social science demonstrate that these corrections happen within a broader inequitable system. For this proposed cross-disciplinary research agenda to be successful, it would need to not only quantify the expected societal costs and benefits of using AI, but also be clear about unintended consequences, both positive and negative, and the downstream effects on systemic racism more broadly.

2.1 Focus of Review

Our search for relevant publications revealed that relative to the persistence and societal importance of these disparities, there is a dearth of social science research on the topic in the leading outlets, with only five articles in the top-ranking journals in economics, eight in the top-ranking journals in sociology, and one in the top-ranking journals in political science from 2000 to 2021.⁶ In our examination of the broader interdisciplinary literature from public health, medicine, and social science, we found that most studies offer and evaluate explanations for these disparities. In line with this literature, the first section of this essay focuses on evidence regarding the direct determinants of racial disparities in health outcomes.

We focus only on the determinants of contemporary health outcomes (i.e., mortality, disease outcomes, risk, and insurance coverage). As a result, we exclude explanations for historical health outcomes.⁷ We only consider the health outcomes of American citizens, and therefore exclude the sizeable literature on the health outcomes of unauthorized immigrants (e.g., Marrow 2012; Portes

⁶ Racial health disparities have received a more extensive treatment in the subject-specific journals. However, this corpus is perhaps still undersized relative to the prevalence of these disparities.

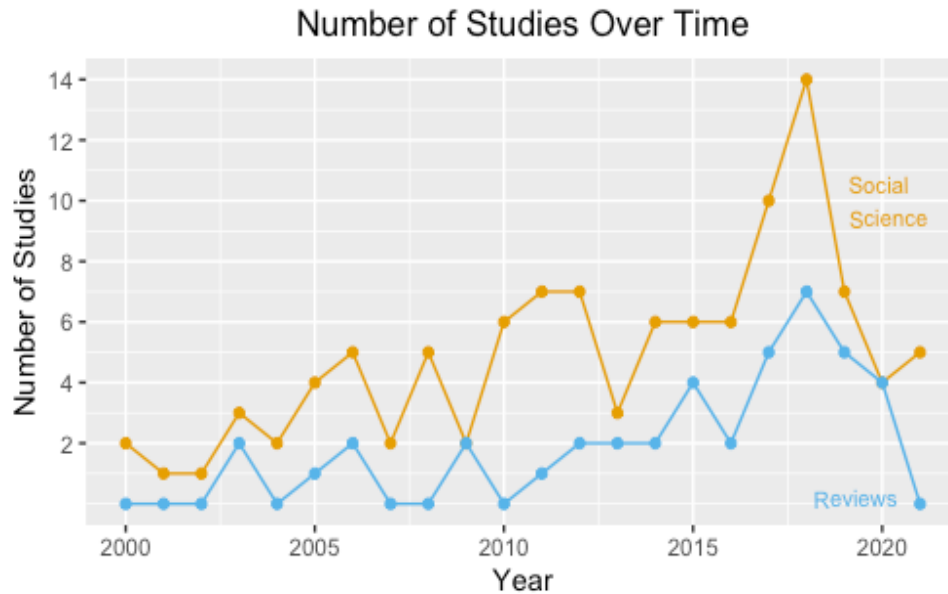
⁷ Although a growing literature addresses this topic (e.g., Black et al. 2019; Logan and Parman 2018; Elman et al. 2019).

et al. 2012; Amin and Driver 2020). We also focus only on explanations for disparities in the United States, although a growing literature considers racial health disparities in a wide variety of contexts including the United Kingdom (Johnston and Lordan 2012; Umeh 2019; Salway et al. 2016), Latin America (Saldaña-Tejeda & Wade 2018; Barber et al. 2017), and South Africa (Burgard 2004; Williams et al. 2008).

2.2 Descriptive Statistics

Perhaps the most striking takeaway from our search for literature was the relative lack of research on racial health disparities in social science journals, particularly given the relevance of these disparities for questions of disciplinary interest. Nonetheless, it is worth highlighting that social scientists have dedicated considerable attention to health and health-related outcomes since the emergence of COVID-19.⁸ This made the relative dearth of research over the past 20 years all the more striking by this current rush to study health-related issues. In Figure 1, we plot all 109 publications related to racial health disparities published between 2000 and 2021 in the reviewed journals. We also plot all 41 systematic reviews on the determinants of racial health disparities from public health, medicine, psychology, and social work.

⁸ For instance, see the Social Science Research Council's (SSRC) new [Virtual Research Center](#) on COVID-19, a hub dedicated to new social science research on the COVID-19 crisis.



As mentioned earlier, we group the proposed explanations for these disparities into two categories: first, explanations related to *structural racism*, and second, those related to *norms and attitudes* that affect the health-related behaviors of citizens and medical professionals in a more proximate manner. Research on structural racism as a determinant of health disparities links multiple mechanisms of racism to racial health outcomes, including longstanding racial inequalities in socioeconomic status, racial residential segregation, and disparate rates of incarceration, all of which can be understood as institutional legacies of slavery and racial discrimination. In research on norms and attitudes as a determinant of disparities, the most frequently proposed explanations are the deep-rooted origins of medical mistrust among racial minorities, the health effects of physician-patient racial discordance, the effects of implicit and overt discrimination by healthcare providers, the health consequences of everyday experiences of racial discrimination, and the prevalence of race-based opposition to governmental provision of health insurance.

Figure 2 provides a breakdown of these two explanatory categories by discipline. This plot shows that all three disciplines focus on explanations related to both structural racism and explanations related to persistent norms and attitudes.

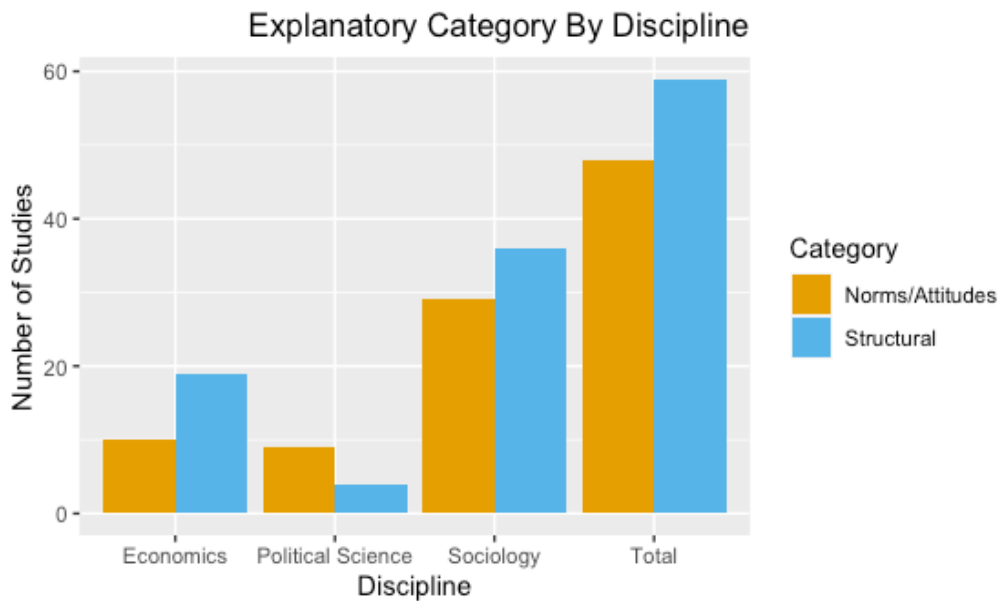
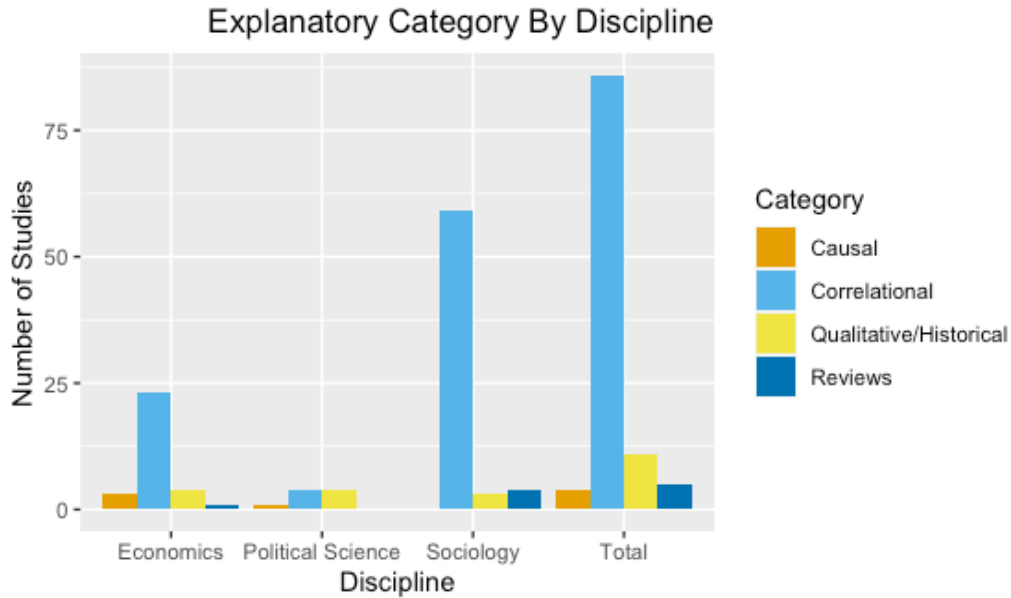


Figure 3 provides a breakdown of the methodological approach used by each discipline. The plot shows that the vast majority of studies involve correlational regressions using large-scale survey data or administrative data (e.g., health records, or census data). We found only two studies involving an experiment (Alsan, Garrick, and Graziani 2019; Tesler 2012), and only two studies using causal inference with observational data in a difference-in-difference-in-differences design (Alsan and Wanamaker 2018; Goodman-Bacon 2018). As we discuss in Section 4, this relative lack of causal and experimental work is, in part, due to the challenges that racial difference and racism present to causal inference. For ethical and practical reasons, race and racism do not readily lend themselves to manipulation and randomization, which makes it difficult to identify the counterfactuals required for causal inference.



Within the structural racism category, we highlight evidence from our assembled corpus regarding the health impact of three frequently proposed mechanisms of structural racism: racial inequalities in socioeconomic status, residential segregation, and unequal treatment by the criminal justice system. Regarding the measurement of these mechanisms, most publications related to residential segregation used fraction or percentage black to measure segregation across a range of geographic units, including census tract, city neighborhood, and county. Measures of socioeconomic status were relatively consistent across our studies, with most studies using some combination of family educational attainment, family income, and net worth. While there were relatively few quantitative analyses of the health impacts of incarceration, the studies that did examine these effects used measurements designed to capture “exposure to incarceration,” including incarceration as a binary indicator and length of incarceration.

In the norms and attitudes section, we focus on five frequently proposed mechanisms: the historical origins of medical mistrust among racial minorities; the health effects of patient-physician racial discordance; the role of discrimination by healthcare providers; the health

consequences of everyday racial discrimination; and race-based opposition to governmental provision of health insurance.

Regarding the measurement of these mechanisms, our racial concordance publications either used survey data to ask patients about physician race, or experimentally assigned patients to concordant or discordant physicians. While most studies of physician discrimination in public health use the Implicit Association Test (IAT) to measure physician bias, studies of this mechanism in our sample pursued a more varied approach, with one study using survey questions to measure the political ideology of medical students (Burgess et al. 2019), and another using electronic medical records and radiology records to investigate differences in communication between concordant and discordant provider-patient interactions (Schut 2021). Our single study on medical mistrust used survey data on whether individuals trust a doctor's judgment and whether they suspect that the medical establishment will deny them necessary treatment or services.

Most articles on the health consequences of interpersonal discrimination used the Everyday Discrimination Scale and the Major Experiences of Discrimination Scale, which ask respondents about generic experiences of bias (such as being fired, being denied a promotion, or being abused by the police), and then ask a follow-up to ascertain the expected reason. Participants who report a discriminatory event and attribute it to race, ancestry, or skin color are classified as having experienced racial discrimination. The studies on racial attitudes and insurance preferences used racial attitude measures drawn from national survey data, like the American National Election Study (ANES) or the General Social Surveys (GSS). The most commonly used measure of white racial attitudes was the Kinder and Sander (1996) racial resentment scale, which captures respondent perceptions of Black individuals' work ethic, experiences with discrimination, and deservingness. Several studies supplemented this measure with additional indicators of racial

attitudes, including a 7-point assessment of the intelligence and work ethics of racial and ethnic groups (Tesler 2012). To measure respondents' favorability toward publicly funded health care, these studies used a variety of agree/disagree and Likert scale survey questions drawn from the ANES and GSS surveys.

In what follows, we highlight evidence from our selected social science articles regarding the health effects of mechanisms related to structural racism and to norms and attitudes held by citizens and medical professionals. We conclude with a broader discussion of the challenges involved in the conceptualization and measurement of race and racial categories.

3. Determinants of Racial Disparities in Health Outcomes

3.1 Mechanisms of Structural Racism

Structural or institutional racism refers to processes of racism embedded in laws, policies, and practices of society and its institutions that provide advantages to certain racial groups, while differentially oppressing or disadvantaging others (Reskin 2012). These processes maintain “white privilege” through the systematic exclusion of racial minorities from institutions and arise from historical practices and policies of racial discrimination including Jim Crow laws maintaining segregation, and overt discrimination in housing, employment, and schooling. These and other discriminatory policies contribute to keeping many members of racial and ethnic minorities in concentrated poverty with decreased access to educational opportunities, jobs, and money. For example, historical practices such as “redlining” (denying loans to poor Black communities) contributed to impoverishing Black communities in the United States, and this poverty has been transmitted through generations. And while the Civil Rights Act of 1964 might have eliminated overt discrimination, experimental audit studies clearly identify the legacies of these

discriminatory practices in areas of housing and the workplace, where covert discrimination remains significant (Ross & Turner 2005).

Systematic reviews from a range of disciplines have identified multiple mechanisms of structural racism as a fundamental cause of racial health disparities (Castle et al. 2019, Williams et al. 2019, Phelan and Link 2015, Forde et al. 2019). Among the most frequently proposed are racial inequalities in socioeconomic status, residential segregation, and unequal treatment by the criminal justice system – all of which are arguably legacies of slavery and longstanding patterns of racial discrimination. In this section, we highlight evidence from our selected social science articles regarding the health impact of these three mechanisms of structural racism. For each, we provide an overview of key findings and empirical approaches in this literature, followed by a more in-depth discussion of several articles that represent the frontier of this research.

Socioeconomic Status

Given the well-known benefits of socioeconomic resources for nutrition, healthcare, and lower stress levels, it is perhaps unsurprising that racial disparities in socioeconomic status (SES) are consistently linked to such disparities in scholarly research. In a recent systematic review of sociology and public health studies, Phelan and Link (2015) summarize the theoretical relationship between structural racism and health disparities in two stages. First, mechanisms of structural racism—including domination by whites of government and commercial institutions and discrimination in housing, employment, and schooling policies—produce profound racial differences in every measure of SES. Second, higher-SES people are more likely to know about the risks and have the necessary resources of money, knowledge, power, and social connections to

engage in prevention or treatment. In this way, forces of structural racism facilitate the reproduction of health inequalities by race.

The corpus of studies we identify provide considerable quantitative evidence of the relationship between racial differences in SES and racial health disparities. Most of these studies use cross-sectional and longitudinal analyses using survey data, and nearly all use some combination of educational attainment, family income, net worth to measure SES.

Within sociology, Sudano and Baker (2006) conduct a large-scale cohort study and find that SES is associated with higher mortality rates and declining self-reported health outcomes among Blacks and Hispanics as compared to whites. Hummer and Chin (2011) use the National Health Interview Survey-Linked Mortality Files from 1997 to 2004 to make adult mortality comparisons among non-Hispanic Blacks, Mexican Americans, Mexican immigrants, and non-Hispanic Whites. The authors find that the majority of the Black-white mortality gap can be accounted for by racial differences in socioeconomic resources. The authors also find that Mexican Americans and Mexican immigrants exhibit significantly lower mortality risk than non-Hispanic Whites when controlling for socioeconomic resources. While Sudano (2006) and Hummer and Chin (2011) do not empirically explore the mechanisms behind the association between SES and racial health, these authors reference a range of possible explanations, including the poor environmental living and working conditions faced by lower-SES individuals, and the accumulation of stress and disadvantages over the life-course, whereby a “weathering” of health leads to morbidity and/or mortality and becomes especially notable in older age (Geronimus 1992; Lynch, Kaplan, and Shema 1997). These findings concur with social science research linking SES to disparities across multiple health outcomes, including self-rated health (Link et al. 2017; Boen 2016), stress (Dowd

et al. 2014), low birthweight (Lhila and Long 2012), and high blood pressure (McGrath et al. 2006).

Our studies also point to a relationship between socioeconomic status and racial disparities in health insurance coverage. Economists Pylypchuk and Selden (2008), for instance, analyze data from the 2004–2005 Medical Expenditure Panel Survey (MEPS) and find that the private coverage rate was 70.5% among white children, versus 40.7% among black children and 30.0% among Hispanic children. Although public coverage filled much of these gaps, 21.3% of Hispanic children remained uninsured, versus 11.6% of black children and only 8.8% of white children. The authors find that around 70% of the remaining disparities in coverage can be explained by differences in socioeconomic factors like poverty, parent education, and parent employment.

At the frontier of this research, however, are efforts to understand the potentially varied health benefits of SES for racial minorities as compared to whites. One particularly compelling recent finding concerns the limited health returns to upward mobility for racial minorities. Colen, Krueger, and Boettner (2018) use 20 waves of data from the Panel Study of Income Dynamics (PSID) to estimate the magnitude of the Black-white gap in self-rated health among middle-income and working-age adults. Colen and coauthors find that intragenerational gains in family income result in significantly smaller improvements in self-rated health for middle-class African-Americans than similarly situated whites. The authors do not examine the mechanisms behind the limited health returns for upwardly mobile minorities, but in a separate study, Colen et al. (2017) find that upwardly mobile African-Americans and Hispanics are more likely to experience discrimination than their more socioeconomically stable counterparts. They conclude that the health benefits typically associated with gains in SES appear muted for racial minorities due to their continued exposure to race-based discrimination, which has long been linked to adverse

health outcomes (Pascoe and Richman 2009). Although the authors do not investigate the determinants of this finding, they suggest that nonpoor African Americans might be more likely to notice unfair treatment than their poor counterparts (Hudson et al. 2012), and thus that differences in discrimination across SES might be driven more by disparate reporting than actual unequal exposure. As another possible explanation, they also point to the frustration experienced by higher status minorities unable to socially and economically benefit from upward mobility to the same extent as similarly situated whites (Colen 2011; Lewis et al. 2015).

In the context of homeownership, Finnegan (2014) provides additional evidence of this nonlinear relationship between SES and racial health by showing that the homeowner health advantage is greater for whites than all other racial groups. To explain these racially stratified health returns, Finnegan points to research showing that minorities are more likely to buy in segregated areas with low quality housing and services (Flippen 2001; Friedman and Rosenbaum 2004), and that minority homeowners may be less able to accumulate wealth due to discrimination in lending (Rugh and Massey 2010) but does not explore these mechanisms empirically.

Taken together, these findings suggest that there may be limited health returns to upward mobility for racial minorities. They further highlight that researchers and policy-makers should be aware that racial health disparities would likely remain even if inequalities in SES were to dissipate. Considerable research is required to identify the factors that shape and mediate the relationship between SES and health outcomes for racial minorities.

Racial Residential Segregation

In a recent systematic review of public health research on racism and health, Williams et al. (2019) identify racial residential segregation as a fundamental cause of racial health disparities.

Several key studies support this claim, with quantitative analyses identifying a clear association between racial segregation and health inequities across a range of geographic units, including the zip code, VSA, and census tract. Finch et al. (2008), for instance, estimate the contribution of residential segregation to racial disparities using data from the National Health Interview Survey, and find that residential context accounts for roughly 15 to 76 percent reduction in black-white disparities in self-rated health. Economists Alexander and Currie (2017) use the health records of children born between 2006 and 2010 in New Jersey and find that conditioning on whether a child lives in a “black” zip code causes racial differences in asthma among low-birth weight children to entirely disappear. Additional analyses point to proximity to polluting facilities and highways as the mechanism linking segregation to the disparate rates of asthma. These findings demonstrate the clear association between racial segregation and health and are consistent with social science research linking segregation to disparities in self-rated health (Subramanian et al. 2005; Do et al. 2017), hypertension (Thorpe et al. 2008), the quality of nursing homes (Mor et al. 2004; Rahman and Foster 2015), preterm birth (Reagan and Salsberry 2005), among other outcomes.

At the frontier of this research on racial segregation are efforts to identify the mechanisms linking segregation to racial health disparities. In public health research, the most frequently proposed mechanisms include the role of segregation in creating communities with poor quality housing, adverse environmental conditions, and reduced access to quality education and employment opportunities (Williams and Collins 2001; Kramer and Hogue 2009; White and Borrell 2011). Public health studies also provide strong correlational evidence that segregation can adversely affect the availability and affordability of high-quality primary and specialty care (White et al. 2012).

Several publications in our corpus of studies further our understanding of these mechanisms. In an analysis of over one million blood tests administered to Chicago children from 1995-2013, Sampson and Winter (2016) find higher rates of toxic lead exposure among children in Black and Hispanic neighborhoods relative to white neighborhoods, due to their disproportionate proximity to manufacturing plants and freeways. In a similar finding, Crowder and Downey (2010) use data from the nationally-representative Panel Study of Income Dynamics (PSID) to provide evidence of profound racial differences in proximity to industrial pollution, even when accounting for household differences in socioeconomic resources. This research is consistent with studies linking segregation to neighborhood disparities in air pollution (Kravitz-Wirtz et al. 2016; Alexander and Currie 2017). Taken together, these findings suggest that environmental conditions are at least somewhat responsible for the well-documented association between segregation and racial health.

While most studies in our sample use cross-sectional regressions using survey and census data, several studies used qualitative methods to examine mechanisms beyond adverse environmental conditions. In a case study of Detroit, Schulz et al. (2002) identify multiple mechanisms through which segregation shapes racial health outcomes, including reduced access to employment, education, and recreation, poor housing quality, and the increased risk of crime and other social stressors. Using focus groups in predominantly Black neighborhoods in South Carolina, Child et al. (2019) identified safety concerns related to drugs and crime as barriers to recreation and physical activity. Keene et al. (2014) consider how the burden of poor health can itself produce housing insecurity among African-Americans. The authors conduct in-depth interviews with middle and working-class African-American homeowners, and find that many experienced mortgage strains after expensive health-related events. In this way, poor health among minorities could itself generate the kinds of housing fragility which, in turn, produce negative consequences

for mental and physical wellbeing. Future research could build on these in-depth qualitative examinations with quantitative examinations of these and other mechanisms.

Incarceration

A growing number of studies considers the health consequences of racially disparate interactions with the criminal justice system (Wang et al. 2009; Wang et al. 2015; Wildeman and Wang 2017). In a systematic review of interdisciplinary research on the health effects of incarceration, sociologists Massoglia, Schnittker, and Uggen (2011) conclude that incarceration appears to adversely impact the health of current and formerly incarcerated people, and that a disproportionate effect on African-American health is likely due to higher rates of incarceration among this population.

Importantly, however, Massoglia and coauthors note that claims of causality are complicated by the forces of selection into prison, given that many inmates arrive in prison with preexisting conditions, and many more are at risk for poor health by virtue of their education levels, poverty, and background. Moreover, the authors note that incarceration may have some positive health effects, particularly if the quality of healthcare available to inmates before incarceration is low. Although the quality of prison health care services is heterogeneous and perhaps low in general (Restum 2005), prisons do provide access to legally-mandated healthcare and make available many medical diagnostic and treatment services. At least 70% of prisoners with a medical problem report seeing a medical professional while incarcerated, and slightly more report receiving a medical exam or blood test since admission (Maruschak et al. 2010). Prisons are also contexts that “level the playing field” with respect to racial differences in nutrition, exercise, and health care access. Consistent with these claims, Patterson (2010) uses data from the U.S. Bureau of Justice Statistics

and Census Bureau to estimate the death rates of working-age prisoners and non-prisoners by race, and finds that the mortality rate of African-American men in prison is actually *lower* than outside prison and, further, that the Black-white mortality gap essentially disappears in prison.

The relationship between incarceration and racial health has only recently received empirical attention in the journals we reviewed. In their study of 302 men and women recently released from prison in New Haven, Blankenship et al. (2018) find that relative to whites, Blacks reported a larger impact of criminal justice involvement on major social determinants of health (education, employment, housing, relationships, and service use). Drawing on nationally-representative inmate survey data, Porter et al. (2021) find that whites exhibit fewer mental health symptoms at longer exposures to prison, while Blacks exhibit more symptoms. While suggestive of racially disparate health impacts of incarceration, many questions remain regarding the nature of the relationship between incarceration and racial health, both in terms of health outcomes during and after incarceration, and the potential for disparate health effects on families and communities.

3.2 Mechanisms Related to Norms and Attitudes

In this section, we describe a set of studies that examine the health impact of the *norms and attitudes* held by citizens and medical professionals—i.e., the racist ideologies and attitudes in the values, language, behaviors, and unstated assumptions of society that can produce explicit and implicit racial bias and contribute to an ideological environment that undergirds discrimination and that leads to the internalization of racial/ethnic stereotypes. The broader interdisciplinary literature identifies multiple pathways through which these norms and attitudes can operate to produce inequities, including the role of racial discrimination as a harmful psychological stressor that affect one's physical and mental health (Doleszar et al. 2014; Pieterse et al. 2012; Paradies et

al. 2006; Paradies et al. 2015), and the potential for clinician decision-making to be influenced by implicit biases and explicit stereotypes in ways that contribute to racial inequities in the quality and provision of care (Maina et al. 2015; Hall et al. 2015)

In this section, we focus our attention on five of the most frequently proposed mechanisms related to norms and attitudes: first, the historical origins of medical mistrust among racial minorities; second, the health effects of patient-physician racial discordance; third, the effects of implicit and overt discrimination by healthcare providers; fourth, the health consequences of everyday experiences of racial discrimination; and fifth, race-based opposition to government-provided health insurance.

Historical Origins of Medical Mistrust

A considerable body of public health and medical studies report higher levels of mistrust in healthcare institutions among racial minorities, and among African-Americans in particular (Kinlock et al. 2017; Nanna et al. 2018; Hammond et al. 2010). Such attitudes have been consistently linked to reduced probabilities of preventive and early-stage disease and lower rates of treatment adherence among African-Americans (Hood et al. 2012; Wiltshire et al. 2011; Bogart et al. 2016; Kayaniyil et al. 2009).

Scholars and journalists have consistently pointed to the Tuskegee Study of Untreated Syphilis in the Negro Male as the source of medical mistrust in the African-American population. The Tuskegee experiment followed hundreds of black men in Tuskegee, Alabama between 1932 and 1972 for the purpose of understanding the natural history of syphilis. Most of the men had syphilis and were denied treatment for their condition. When news of the study became public in 1972, the majority of the study's victims were deceased, many from syphilis-related causes. Following 1972,

the Tuskegee study emerged as an often-cited explanation for the heightened levels of medical mistrust among Black men (Corbie-Smith et al. 1999; Gaston and Alleyne-Green 2013).

Despite the considerable body of interdisciplinary research, medical mistrust among racial minorities has been relatively understudied, at least in the corpus we assembled. We found only one study across the social scientific and interdisciplinary literatures that aimed to relate racial disparities in healthcare utilization and health outcomes to medical mistrust in a quasi-experimental framework (Alsan and Wanamaker 2018). Using a difference-in-difference-in-differences model to compare older black men to other groups before and after the Tuskegee revelation, in varying proximity to the study's victims, the authors find that disclosure of the study in 1972 is correlated with increases in medical mistrust and mortality (and decreases in outpatient and inpatient physician interactions) for older black men. This study sheds light on how Tuskegee affected the relationship between black Americans and healthcare and brings important causal evidence to a mostly correlational and qualitative literature on the role of medical mistrust in racial health disparities.

Racial Concordance in Healthcare

A key policy recommendation put forth by the Institute of Medicine (IOM) and the American Medical Association (AMA) to address racial health disparities is to diversify the healthcare profession by increasing the number of under-represented racial minorities.⁹ Racial concordance is proposed to improve physician understanding of the social, cultural, and economic factors that influence their patients (Spevick 2003). This understanding fosters trust and communication, elements essential to an effective patient-physician relationship. However, interdisciplinary

⁹ See “Unequal Treatment: Confronting Racial and Ethnic Disparities in Health Care” (IOM 2003) and “Reducing Disparities in Health Care” (AMA 2018)

empirical evidence on whether patient and physician racial concordance improves satisfaction and health outcomes is mixed. Several recent studies have found that race-match between doctors and patients in a hospital setting reduces mortality (e.g., Hill, Jones, & Woodworth 2018). Yet Meghani et al. (2009) conduct a systematic review of thirty observational studies in public health and medicine and conclude that the evidence in favor of patient-doctor concordance is inconclusive.

While the corpus of studies we identify pays relatively little attention to patient-doctor concordance, the evidence that is put forth is also mixed and mostly focused on communication benefits with no explicit link drawn to the longstanding mistrust in a historically white medical establishment. For instance, economists Balsa and McGuire (2001) provide a theoretical model predicting that poor communication between minority groups and white physicians could result in racial disparities in the use of health resources. Sociologists Schnittker and Liang (2006), on the other hand, use nationally representative survey data to find that racial/ethnic concordance holds little salience in the minds of most black and Latino patients, and that discordance has little effect on the patient experience. Nevertheless, the authors find some evidence that concordance has a positive effect among those who prefer concordance, and thus that the effects of concordance depend enormously on patient preferences.

In a recent experimental contribution to this largely correlational literature, Alsan et al. (2020) examine whether public health messages from race-concordant physicians can affect COVID-19 knowledge and information-seeking behavior, and find that race-concordant messages increase information-seeking among Black but not Latinx participants. This finding accords with experimental work by Alsan, Garrick, and Graziani (2019), who examine whether and to what extent diversity in the physician workforce improves medical decisions and outcomes among minority populations. The authors randomize black men to black or non-black male medical

doctors in Oakland, California, and find that subjects select similar number of preventives in pre-consultation stage but are more likely to select preventive services once meeting with a racially concordant doctor. Using evidence from physician notes, surveys, and subject heterogeneity, Alsan and coauthors propose that racial discordance might pose communication problems between patient and doctor.

Discrimination by Healthcare Providers

The third mechanism considered in this section concerns the health impacts of implicit racial bias among physicians. This mechanism is frequently proposed in the interdisciplinary literature as a prominent explanation for the persistence of racial health disparities. Van Ryn et al. (2011) conduct a systematic review of these interdisciplinary findings to consider the mechanisms through which clinicians' behavior, cognition, and decision-making might contribute to racial inequities in care. They conclude that the existing research is largely supportive of claims that white clinicians (1) hold negative implicit racial biases and explicit racial stereotypes; (2) have implicit racial biases that persist independently of and in contrast to their conscious racial attitudes; and (3) that these clinicians can be influenced by racial bias in their clinical decision-making during encounters with Black patients in ways that perpetuate racial health disparities.

In the journals we reviewed, this question has only recently received empirical attention. The evidence thus far is consistent with interdisciplinary findings identifying physician bias as a mechanism through which health inequalities can persist. Burgess et al. (2019) examine how the political ideology of medical students affect their attitudes towards marginalized patients and find that a conservative political ideology is associated with greater implicit bias against Blacks, more negative explicit attitudes toward stigmatized groups, and lower internal motivation to control

racial prejudice. Schut (2021) uses electronic medical records, radiology records, and U.S. Census data to investigate racial/ethnic patterns of provider-patient communication among patients diagnosed with incidental medical findings. Indicative of clinician bias, Schut finds that providers are less likely to communicate information about incidental medical findings to patients of color relative to white patients.

Interpersonal Racial Discrimination

One of the most studied explanations for racial health disparities are the adverse health consequences of interpersonal racial discrimination, which refer to processes of “discrimination between people, with varying degrees of frequency and intensity, including manifestation from racially motivated assault to verbal abuse, ostracism, and exclusion” (Priest and Williams 2018). Such acts can reflect explicit biases and racist ideologies, as well as implicit biases of which the perpetrator may not be aware. Systematic reviews in public health and psychology consistently link experiences of interpersonal racism in everyday (i.e., not healthcare) contexts to racial health inequities, due to their role as psychological and social stressors with adverse health consequences (Paradies 2006; Priest et al. 2013; Pascoe and Richman 2009; Williams et al. 2019).

In a systematic review of this interdisciplinary literature in the *Annual Review of Sociology*, Goosby et al. (2018) conclude that interpersonal discrimination triggers a cascade of biological processes that increase sympathetic nervous system activation, increase physiological wear and tear, and elevate the risks of cardiometabolic conditions. These processes link discriminatory experiences to a range of morbidities, including low birth weight, hypertension, abdominal obesity, and cardiovascular disease. The authors focus on the health trajectories of African-Americans but note that the findings are likely relevant for other stigmatized racial/ethnic groups. These findings from public health and medical studies concur with research from social science linking

discriminatory experiences to a range of disparities, including depressive symptoms and adverse mental health outcomes (Hudson et al. 2013; Borrell et al. 2006), chronic pain (Brown et al. 2018), obesity (Hicken et al. 2018), cardiovascular disease (Chae et al. 2010), and hypertension (Din-Dzietham et al. 2004).

In our assembled corpus, most studies used cross-sectional regressions and measures of discrimination drawn from the Everyday Discrimination Scale or the Major Experiences of Discrimination Scale. These survey measures ask respondents to report various experiences of bias and ask respondents about the expected cause of these experiences. Participants who report a discriminatory event and attribute it to race, ancestry, or skin color are classified as having experienced racial discrimination. Importantly, several of our public health reviews indicated that research using self-reported discrimination measures like these have been plagued with measurement challenges that lead to an underestimation of the health effects of discrimination (Williams 2016). These challenges include capturing and adequately assessing the stressful components of interpersonal discriminatory experiences, such as their chronicity, recurrence, severity, and duration, and the difficulties involved in distinguishing incidents that are traumatic from those that are not.

An emerging frontier of this research aims to address the limitations associated with these discrimination measures with more nuanced measures of discrimination due to skin tone. Unlike the Everyday Discrimination Scale or the Major Experiences of Discrimination Scale, these measures allow researchers to understand the varied health effects of interpersonal discrimination *within* racial groups. Monk (2015), for instance, examines the relationship between perceived skin tone discrimination, and a range of health outcomes, including hypertension, reported physical health, mental health, and depression. Using a nationally representative survey of African-

Americans, Monk finds that darker skin tone is a significant predictor of perceived discrimination, and that perceived discrimination is a significant predictor of health outcomes. In a related study, Uzogara (2019) investigates the relationship between the skin tone and health among Black women and finds that darker skin predicts worse health outcomes on a range of measures, including the likelihood of hypertension, strokes, heart attacks, diabetes, and asthma. These findings are consistent with studies of the Latinx population (Calzada et al. 2019).

This more recent research on perceived skin tone discrimination convincingly demonstrates the limits of using broad census categories to study racial health inequalities and should motivate further investigation into the relationship between interpersonal discrimination and intra-racial heterogeneity in health outcomes.

Racial Attitudes and Insurance Policy

The fifth and final mechanism focuses on the relationship between racial attitudes and the politics of health insurance. Insurance and insurance policy carry enormous consequences for racial health outcomes, as evidenced by research on the health-related (and financial) benefits of insurance (McWilliams 2009; Finkelstein and McKnight 2005), and research linking the expansion of government health insurance to reduced racial health disparities (Lantz and Rosenbaum 2020, Goodman-Bacon 2018, Palmer 2020, Sommers et al. 2017).

In this section, we review a set of studies on the relationship between racial attitudes and opposition to government provision of health insurance. Although these studies focus on preferences rather than political behavior, they are guided by the assumption that race-based opposition to government insurance provision can perpetuate racial disparities in coverage.¹⁰

¹⁰ For evidence of the long-standing racial disparities in coverage, see Semyonov et al. (2011) and Gutierrez (2018)

Using a combination of experimental and survey evidence, several political science studies provide evidence that racial attitudes shape preferences toward governmental provision of health insurance. Tesler (2012), for instance, finds that American public opinion on health insurance was polarized by President Obama's key role in this sector, and mediated by race and racial attitudes. Using cross-sectional and panel data from the past two decades, Tesler finds that racial resentment was more closely aligned with attitudes against governmental provision of health insurance in 2009 than in the years before the Obama era. Embedded experiments also reveal that health care policies were significantly more racialized when attributed to President Obama than to President Clinton's 1993 reform effort. This evidence strongly suggests that racial resentment is associated with support for private insurance. Moreover, these findings support the argument that the relationship between racial resentment and support for private insurance grew stronger during Obama's presidency due to race-based opposition to a black president's agenda among some white Americans.

In a related study, McCabe (2019) examines the relationship between racial attitudes and public opinion on the expansion of governmental health insurance through The Patient Protection and Affordable Care Act (ACA). Using American National Election Study (ANES) surveys from 2012 and 2016, McCabe finds that Black adults are more supportive of the ACA than whites, and that racial resentment among whites is significantly associated with lower support of the ACA. These findings suggest that racial resentment among whites and racial identity among Blacks have both contributed to the persistent racial divide on the ACA.

In another recent contribution to this literature, Lanford et al. (2018) analyze the 2012 ANES survey and find that racial priming has an effect on the health policy preferences of U.S.-born Latinos that closely resembles its effect on whites. Specifically, the authors find that when Obama

is mentioned in statements about national health policy, U.S.-born Latinos with more sympathetic views toward Blacks become less antagonistic toward government health policy linked to Obama, whereas the converse is true among those with more resentful views toward Blacks. Importantly, these results suggest that increasing ethnic diversity in the United States will not necessarily produce increasingly liberal politics in the context of health, and that public opinions on healthcare policy could depend largely on the ways in which Latinos' racial resentments are mobilized.

Together, these studies provide convincing evidence of a relationship between racial attitudes and resentment and opposition to government insurance provision. With considerable evidence linking uninsurance to poor health outcomes and out-of-pocket medical expenditures, these preferences are enormously consequential for the health of racial and ethnic minorities.

3.3 Reflections on the Study of Race and Health, and the Validity of Race Data

To fully appreciate the findings contained within the important body of social science scholarship discussed above, we believe it is critical to reflect on serious concerns about the validity of “race data.” Specifically, we must consider how individuals are classified in terms of racial categories, especially within the context of research about human health. As other contributors to this volume (see especially the essay by Beltran et al.) have highlighted, false notions of biological difference were central to “race making,” particularly in the 19th century. Nonetheless, despite the absence of any biological foundations, we continue to use and to analyze health outcomes in terms of racial categories as such categories remain socially and politically relevant within American and other societies. Thus, any scholarly detailing of patterned associations between “race and health” deserves at least a prominent footnote reminding readers

of key caveats with respect to interpretation (and virtually none of the studies we reviewed contain any explicit discussion of the concerns raised here).

At issue is the fundamental question of what is race, after all? And how are individuals classified in the datasets used in the aforementioned analyses? A background assumption that undergirds virtually all high-quality social science research on race – one that we share – is that racial categories are themselves social and political constructions (Banton 1979). In other words, there is no genetic basis or other truly objective standard for deciding whether an individual is “African-American,” “white,” or “non-white Hispanic,” for example. These were invented categories used as the basis for creating social, political and economic hierarchies, and the formal and informal rules for classification have varied across time and space. For example, as Melissa Nobles demonstrates in her historical comparison of racial categories in the US and Brazilian censuses, racial categories can emerge and be deployed in different ways in different countries and periods (Nobles 2000). In the United States, where the “one drop rule” prevails, individuals with just a single African-American ancestor, have over the past several decades routinely self-identified and have been classified by others as Black or African-American (Khanna 2010). In recent years, however, more individuals have opted to be recognized in terms of “mixed” categories (Davenport 2020), with a particularly large jump evident in the recent 2020 census (Tavernise and Gebeloff 2021).

To be clear, we recognize racial categories and systems of racial classification as deeply meaningful and consequential, but also highlight that any study that seeks to analyze individual-level data about race and its correlates is profoundly affected by many arbitrary choices about which race categories to use and the processes by which anonymized data were generated in the first place. Importantly, the scoring of racial variables within health care settings may be based on

the judgments of busy medical professionals, with their own racial identities and biases; and their classifications may plausibly be at odds with the life histories and subjectively-held identities of the individuals themselves. In turn, while it might seem that the best solution would be to use self-reported racial classification – which indeed is frequently the case – this approach contains problems of its own: self-reporting might itself be a function of health status and/or other correlates of health. For example, what if wealthier and healthier mixed-race individuals were more likely to self-identify as mixed or even as white, while poorer and less healthy mixed-race individuals classified as Black? This would mechanically appear as a racial disparity in health outcomes, but the underlying reason would simply be a matter of self-selection into particular categories.

Relatedly, scholars analyzing these data must routinely make arbitrary decisions concerning whether and how to aggregate individual subjects classified (by themselves or by others) in terms of various racial categories into a subset of categories for analysis. For example, should all “non-white” respondents be collapsed into a single category (“Black”)? Or should the analysis be based on the most disaggregated categories available? Again, both solutions are associated with important shortcomings. Analyzing the data in collapsed format tends to lump together individuals who may have experienced different opportunities and constraints in their lives because of distinct racial histories – a child with one white parent, on average, might enjoy certain advantage relative to a child with zero white parents. On the other hand, many might decry the analysis of the most disaggregated categories, arguing that all people of color face qualitatively similar barriers in American society and that the analysis of a plethora of disaggregated racial categories distorts the reality of racial cleavages in the United States.

Facing such choices, researchers may understandably want to seek out the most “objective” data available, and avoid racial categories altogether. For example, some analysts have studied the

correlates of skin color (Calzada, Kim, and O’Gara 2019; Monk 2015). On the one hand, this can be a useful strategy, especially because there is good reason to believe that a degree of bias within society *is* based on skin color. However, this also presents at least three problems: First, skin color itself is not predictably an “average” of parents’ skin tones, and the inter-generational effects of racial bias may be incorrectly captured by skin color; and skin color itself may change in appearance over one’s life. Second, racial bias has indeed involved much more than color bias in the United States, and to equate the latter with the former would obscure the qualitative and categorical nature of most racial discrimination. Finally, and quite importantly, health policy researchers seeking to study “race” in the most objective manner possible could contribute to the very pseudo-scientific endeavor that was at the basis of much eugenics research. That is, by using a physical feature as the marker of race, and by documenting the correlates with other health outcomes, they could be engaging in the very types of research endeavors that contributed to the false notion of race as a biological category, and that people of certain races are intrinsically different (and inferior). Even if not intentional, such approaches risk essentialist interpretation, while continuing to suffer from the analytic shortcomings discussed above.

Along these lines, we are reminded of an article published more than two decades ago in the *British Medical Journal* (Bhopal 1997), “Is research into ethnicity and health racist, unsound, or important science?” That essay raised important questions that are in many ways still unresolved: Do “well-intentioned” studies highlighting ethnic and/or racial disparities in health outcomes in the service of spotlighting unjust inequalities inadvertently contribute to the same negative outcome as the pseudo-race science of the 19th century, used to institutionalize racial hierarchies?

In the face of the important concerns we have raised here, there are no simple answers to that difficult question, including through the use of more sophisticated computational approaches (as

discussed below). Health disparities along racial lines remain profound, and it is hard to imagine addressing these without an empirical evidence base – one which tracks the magnitude of disparities and is informative about likely causes. Nonetheless, we must collect such evidence with a keen and humble awareness of the inherent challenges, inaccuracies, and biases this research inevitably presents.

4. Computation and Opportunities for Cross-Disciplinary Research¹¹

The previous sections examined evidence published in leading social science journals regarding the determinants of racial health disparities. In line with the substantive focus of the existing literature, we focused our attention on the health effects of two categories of explanations: explanations related to structural racism, and to the norms and attitudes of citizens and healthcare providers. Despite the relatively small corpus of social science research on racial disparities, and despite the challenges inherent to measuring race and racial categories, this literature has made a significant contribution to the documentation of empirical relationships between predictors and disparities, and to the identification of the associated mechanisms.

Beyond these contributions, it remains the case that the vast majority of these studies are correlational in their empirical approach. While able to provide evidence of the empirical associations between determinants and racial disparities, they are generally unable to provide convincing causal claims. Even when considering comparisons between the health effects of particular types of institutions, such as prisons, or between particular types of discriminatory experiences, it is difficult to be certain that the effects of such exposures are truly comparable

¹¹ This section closely draws on interviews with [Prof. Regina Barzilay](#), [Prof. Dimitris Bertsimas](#), [Dr. Shalimali Joshi](#), [Prof. Marzyeh Ghassemi](#), [Prof. In Song Kim](#) and [Prof. Devavrat Shah](#).

across or within racial groups in ways that demonstrate counterfactual claims under *ceteris paribus* conditions. Many potential confounding variables loom large in these studies.

The emphasis on correlational approaches in this literature is, in part, due to the nature of the “treatment” of interest, as explanations rooted in racial difference and racism present fundamental challenges for causal inference, due to the difficulties involved in identifying the appropriate counterfactual (Sen and Wasow 2016). As outlined in the previous sections, race can affect a person’s education and neighborhood environment, their cultural and social beliefs about the medical establishment, and the likelihood that they face race-based exclusion or abuse. Even when randomization is possible, researchers often face challenges in teasing apart the mechanisms that produce and perpetuate disparities in racial health outcomes. Given the challenges that racial difference and racism present to causal inference, this section considers how the *new* and *distinct* literature on computational healthcare that has sprung out of the recent turn to big data and machine learning might complement existing social scientific approaches and shed light on remaining questions in the study of racial health disparities.

4.1 Advances in Computational Research on Healthcare Equity

Recent advances in computing, coupled with the digitization of health records, have quickly enabled a broad range of research on artificial intelligence (AI) applications for healthcare. Though still in an early stage, the volume of work on this topic is impressive. Several researchers working on healthcare analytics have enthusiastically embraced machine learning (ML) techniques for their faster and more precise analysis of massive troves of health data. The prevalent research output in this space uses big data in healthcare settings to address clinical issues including which medicines or procedures will work best. There is also a subset of works that focuses specifically on using ML

methods to identify pre-existing biases or biases explicitly associated with the introduction of algorithms into clinical decisions. While the former set of works largely involves processes and outcomes studied by doctors and medical researchers, the latter set can lend itself to synergies with social scientists.

Although the use of ML with tabular data has offered modest improvements to the efficiency and accuracy of healthcare, it has been revolutionary in the use of image and language data. In a mere five years, computer vision has moved from a failed technology in the context of healthcare to a technology with the capacity to outperform humans. A machine trained on millions of images can identify patterns that humans cognitively cannot, leading to improved prediction in skin and breast cancer among others and identifying inequities in treatment and care (Esteva et al. 2017; Han et al. 2020; Yala et. al 2021). Higher computation has also made a difference for healthcare research using doctor's notes and other forms of language data. Natural language processing (NLP) and sentiment analysis on such data has identified inequities in diagnosis, treatment and healthcare outcomes (Chen et al. 2019; Zhang et al. 2020; Beach et al. 2021).

The palpable excitement around AI tools for healthcare research has been coupled with notable skepticism. Important concerns have been raised about algorithmic bias inadvertently entrenching racial disparities. In response, there has been an increase in research focused on AI tools for healthcare equity. These works, as discussed below, have largely focused on developing algorithms that not only better measure and describe the type and degree of racial biases and how they manifest themselves in the healthcare context, but also actively correct them. This line of work is carving out a distinct space for interdisciplinary research that could engage social scientists and computer scientists on questions of whether and how these applications can overcome biases

to improve healthcare access and outcomes; how they can be used to further build doctor-patient trust among minority communities; and how they can address privacy and accountability concerns.

4.2 Revisiting Inequity at All Stages of the Research Design

Racial disparities are an empirical regularity in healthcare outcomes and, as the first part of this essay highlights, the array of possible confounders makes it impossible to fully identify all the underlying mechanisms at work. For instance, the impact of a medical treatment on a minority patient could be confounded by socioeconomic factors like poor nutrition and poor housing conditions, the clarity of physician communication, and patient adherence to treatment. This suggests that there can be confounding both on the intervention and on the observed features of the intervention. To estimate a treatment effect, one would need a model that disentangles the different confounding factors from the actual intervention. These models require large amounts of data to more robustly assess the observed and unobserved confounding factors. In that regard, the increased use of big data and computation in the study of healthcare has offered a renewed opportunity to think about data collection, processing, and analysis in ways that not only highlight existing racial disparities in healthcare outcomes, but also identify how to fix them.

The pervasive but often subtle nature of racial biases in healthcare suggests a need to examine the multiple real-world processes that produce inequities and the associated data generated along the way (Wiens et al. 2019). As a starting point, it is critical to know when and how the data was collected and for what purpose, as well as whether it adequately represents the population it is intended to model. Given the increased ease in collecting data to scale that the computation revolution has ushered in, it is more prescient than ever to also ensure that newly collected data are both high quality and relevant, providing information on all the requisite attributes that allow

us to look for disparities and what may be driving them. For instance, it would be useful to consider how big data can help us grapple with some very strong selection effects that have plagued the study of healthcare disparities including, how people get healthcare access, how treatment pathways get determined and to what degree this is happening at a group level.¹²

Beyond offering ways to collect additional relevant data, computation can also help with data pre-processing. For instance, computation can help to identify the determinants of missing observations and the biases they introduce. Missing data is often at the heart of healthcare disparities and can result in biased inferences as this missingness is non-random. For example, missing data in a particular record may result from different reporting practices among doctors, so an estimated difference among patient outcomes may have nothing to do with what is happening to the patient, but may rather be an artifact of disparate data recording.¹³ Systematic measurement differences among subpopulations may also be driving bias in the results. Being more intentional in the pre-processing phase of these big datasets can allow us to understand what is an artifact of data collection and measurement versus what is indicative of patient behavior and how one would need to go about debiasing the data.

The long and established line of social science research on how to theorize and measure race and implicit or institutional biases can help inform what biases may have affected the different data collection processes and how and what would be the best way to proceed with missing observations.

¹² Recommended treatment pathways are not a decision that is strictly driven by the patient's condition but rather by a combination of underlying factors such as whether one has an insurance plan that covers a particular procedure.

¹³ There is an array of methods in place for how best to impute data to correct for missingness, but ethical considerations remain as to whether it is right to impute data that someone has refused to reveal about themselves. They may for instance be reluctant to reveal sexual behaviors, HIV status etc.

4.3 Auditing Model Behavior: Debiasing the Algorithm

The big promise of AI for healthcare equity has been to move away from deep-rooted and pernicious racial biases to enable algorithms that offer objective and personalized care irrespective of group identity (Chapman et al. 2013). Societal inequities have, however, crept into the healthcare datasets, as white men are still overrepresented in the medical data used to train these algorithms (Nordling 2019). As a result, machine learning tools intended to overcome explicit or implicit racial prejudice can actually perpetuate such disparities, unless there is a clear plan for the identification and mitigation of the underlying data biases (Kleinberg 2018).

Algorithmic bias is not the first time the healthcare field has had to think about data bias. Historical episodes have left lasting disparities in terms of levels of trust in medical professionals and physicians' implicit racial biases have been known to unconsciously influence treatment decisions (Chapman et al. 2013). Even randomized controlled trials for broadly used medicine were run on trial populations not always representative of the patient population, be it women or minorities. Empirically identifying and measuring these inequities is an important first step. ML researchers in this space are now trying to leverage the power of big data to audit model behavior and specifically focusing on when it has subpar performance with minority populations.

In that process they have found a lot of disparities in medical processes that have affected healthcare outcomes for minority populations. For instance, deep learning classifiers have also established race disparities as measured by false positive rates in diagnosing diseases from X-ray image classifiers (Seyyed-Kalantari et al. 2020) and in genetic tests for hypertrophic cardiomyopathy, though their genetic mutations were benign (Manrai et al. 2016). Research on chronic kidney disease shows that race-adjusted eGFR models negatively impact the care provided to African-American populations (Ahmed et al. 2021) and that black patients disease are less likely

to be aware of hospice or be communicated with about end of life preferences (Enyanya et al. 2016). Also, ML work that investigates disparities in end-of-life care, observes higher levels of mistrust for black patients than white ones (Boag et al. 2018). The inequities are not limited to clinical practice: other work finds that models intended to optimize referrals to long-term care-management programs were more likely to exclude Black patients as compared to whites with the same health conditions (Obermeyer et al. 2019).

Research using Natural Language Processing (NLP) and sentiment analysis has identified inequities in doctor's notes in their treatment of minority patients. For instance, a paper using ML on clinical and psychiatric notes to predict intensive care unit (ICU) mortality and 30-day psychiatric readmission identified bias with respect to gender and insurance type for ICU mortality and with respect to insurance policy for psychiatric 30-day readmission (Chen et al. 2019). There are also higher levels of physician disbelief reflected in clinical notes (Beach et al. 2021) and models trained on clinical notes for downstream clinical tasks also show statistically significant differences in performance by ethnicity and other patient characteristics (Zhang et al. 2020) including.

Beyond codifying these disparities, there is also research intentionally looking to create algorithms, where there is prediction accuracy when comparing different demographic groups. For example, researchers who established that existing models for atherosclerotic cardiovascular disease risk stratification have differential performance across race and gender groups, proposed a new ML model with reduced inequity (Pfohl et al. 2019). Others who showed that minority populations experience higher levels of osteoarthritic pain, which can't be explained by existing measures of disease severity, proposed an algorithmic method to address this disparity (Pierson et al. 2021). Others have developed a new mortality prediction model to prioritize the liver transplant

waitlist, creating more equitable allocation (Bertsimas et al. 2019) or a deep learning model to predict breast cancer risk based on traditional mammograms that shows consistent performance across race and ethnicity (Yala et al. 2021).

To that effect, researchers are reweighing the presence of different groups to allow for parity in outcomes (Bertsimas et al. 2019; Pierson et al. 2021), paying extra attention to ensure that there are no idiosyncratic correlations that are specific to the datasets at hand (Obermeyer et al. 2019), and explicitly accounting for known inequities—such as access to care—in algorithm development (Chen et al. 2021). In many instances, algorithmic bias is fixable if one can identify the right target variable and train the variable on metrics that are closer to outcomes.¹⁴ Getting this right will allow algorithms to contribute to fairness, thereby improving the allocation of resources and healthcare outcomes.

The work on algorithmic bias opens up several possibilities of social scientist engagement in cross-disciplinary work. The introduction of AI in this space is incredibly consequential and as such the causes and consequences of bias associated with AI should be carefully examined as has been the case with other big policy changes with racial implications such as policies around redlining or incarceration. Though important, algorithmic fairness is only a step toward addressing issues of healthcare disparities. Thinking about the bigger causal chain can help us move beyond accurate predictive inference afforded by unbiased algorithms to results that more actively consider the downstream effects on systemic racism and open further opportunities for collaboration with social scientists.

4.4 From Prediction to Causality

¹⁴ Prof. Ziad Obermeyer, Presentation at AI for Healthcare Equity Conference, MIT, 12 April 2021.

Healthcare research has been largely driven by an interest in predicting answers to important questions: Who is going to get cancer? Which medication will work? As such, ML tools developed for pattern recognition have been very well-suited to predicting patient outcomes based on prevention or treatment protocols or more recently targeted toward personalized medicine. Though higher predictive inference in this space contributes to lowering incidence of disease and death, the established correlations are not necessarily causal.

In response, a set of prominent and powerful works has emerged, offering models that leverage causal inference as another way, beyond just algorithm debiasing, to address confounders and to make things more equitable. These causal models generalize better when the model is out of distribution which is often the case in health, and are preferred for their fairness, interpretability and ability to generalize.

Specifically, researchers in this space have been exploring the great power and high potential impact of combining causal inference methods and experimental design from the social sciences with modern machine learning pipelines intended to reliably model complex data. They have been examining when and how the strong fundamentals of causal inference can help inform ML practices in all stages of its development, leading to improved outcomes. Not only can causal considerations produce more accurate predictions, making models robust to confounding,¹⁵ but they can also ensure fairer predictions, identifying biases in both the training data and model output (Dai and Stultz 2020).

Even in cases where there is no experimental design or no clear exogenous variation, ML researchers have been using the large amounts of data available to them to come up with more flexible models to estimate the counterfactual and resultant outcomes and to move beyond

¹⁵ Causal Bootstrap Paper

estimating the average treatment effect to also get at heterogeneous effects. Machine learning tools, like neural networks and random forests, coupled with granular measurement can be used to estimate individual treatment effects (Shalit et al. 2017; Wager and Athey, 2017), enabling personalized medicine where physicians can tailor treatment regimens to individuals given their history and background. Frequency of measurement can also help us get at causal effects. Panel data is notably better when it is multi-dimensional, as its effectiveness grows with its size. In the context where the time dimension is available there are also identification strategies for before and after treatment offering a more precise difference-in-differences estimate that better addresses the validity of the parallel trends' assumption.

Big data has also enabled us to think about other threats to inference such as interdependencies across units which have been largely ignored either because of methodological limitations or simply because we didn't observe them. As such, researchers are now able to better explore both spillover effects (the effect of other treatments on my outcome) and peer effects (the effects of other outcomes on my outcome). Relatedly, big data forces us to think harder about violations of exogeneity and identification strategies and offers more opportunities to model the bias and correct for it. For instance, if a network effect is a confounding factor, we can now observe it and directly incorporate it in our estimation. Big data also allows us to evaluate assumptions made by existing theories (such as homogenous treatment effects or simplified patterns in existing models or theoretical frameworks) more directly as we now have data and this better measurement that can readily help us evaluate the appropriateness of these assumptions.

Most methods of causal inference with observational data rely on the ignorability assumption, that is, that there are no unobserved confounders. This assumption is impossible to verify, and may not hold true in many healthcare settings, where many unobservable variables can impact patient

outcomes. However, modern machine learning methods offer potential avenues to infer causality even when ignorability may not hold. One such approach involves using variational autoencoders to infer and control for unmeasured confounders using proxy variables (Louizos et al. 2017). Another method relies on multiple causes: in settings where we are interested in the causal effects of many treatments, it may be possible to use latent variable models to obtain causal estimates in the presence of unobserved confounding (Wang and Blei 2019). It is also possible to estimate bounds on individual causal effects under certain violations of unconfoundedness, allowing researchers to infer heterogeneous treatment effects (Kallus et al. 2018).

ML and causal inference can work best when there is very good knowledge about the data generation process.¹⁶ There are also opportunities for such research in clinical trial optimization such as through “synthetic clinical trials” that correct for lack of diversity in sample recruitment. Though big data improve on the accuracy of the method, they work best in the presence of a well-defined domain specific problem where the researcher has solid structured insights into the problem. As such, causal inference focused on healthcare outcomes would arguably be the most fruitful space for cross-disciplinary research engaging social scientists with those working on computational healthcare research.

5. Conclusion

The COVID-19 pandemic has heightened public awareness of the wide racial disparities in health outcomes long recognized by medical professionals, public health experts and various social scientists (Kakani et al. 2020). The first section of this review identifies key findings and contributions to the study of these disparities from leading social science journals. The exercise

revealed that relative to the societal importance of these disparities, there has been a dearth of social science research. Further, the ethical and practical challenges involved in randomizing race and racism have made it difficult to identify the counterfactuals required for credible causal evidence. As a result, the vast majority of our reviewed studies rely on correlational rather than experimental approaches. While we might expect the number of experimental studies to increase—particularly given the recent upswing in health-related RCTs in the social sciences (Cavanaugh et al. 2021)—it remains the case that most of the claims in this literature are based on correlational empirical evidence.

What *is* clear from this literature, however, is that racial disparities remain significant across a range of health measures and outcomes. In a context of intensified concern about racial injustice, citizens, political leaders, and health professionals are demanding action to flatten these important disparities. And yet, if “solutions” are to be found in better understanding the “causes” of these disparities, it is clear that more research is needed to identify which factors actually reinforce or exacerbate such patterns; and whether they can be addressed through policy and practice.

The troves of additional data created by new computational resources offer some promise in this regard both in the study of AI as medical practice and most relevantly for the scholarship of AI in healthcare. In the second section of this paper, we suggest that big data and machine learning might offer greater insights concerning the sources of bias generated by various social and political structures. Though AI has incredible potential to materially affect healthcare equity, challenges remain. The use of ML algorithms in clinical care settings are *themselves* potentially important sources of bias because of racial disparities in the data sources used to train these models. And of course, these disparities can be linked, at least in part, to the structural, normative, and attitudinal factors discussed in the first section of this paper.

There are no easy solutions to these problems. Big data, AI and fair algorithms are only part of a broader system that needs to address sociopolitical realities and structural inequities. In thinking of how to address inequities, it is important to target the right problems, where good research can lead to policy change. There also has to be a focus on building confidence with minority patients that the introduction of these AI tools will result in overall better and more equitable care. It is particularly important to be transparent about what the use of AI in health means for the individual patient, as well as assuage data privacy and other concerns of patients from minority populations who often lack trust in a “well-intentioned” health care system, given historical transgressions against them. Working closely with the industry, clinicians and patients, government agencies would also have to monitor through data and patient experience the actual effectiveness of AI tools in addressing health care disparities on the ground, and be attuned to improving them. At the very least, a degree of modesty and recognition of the role researchers can play in how we understand the root causes of systematic biases could help to contribute to important and impactful research programs that attack some of the gravest injustices in America’s history.

6. Appendix

6.1 Economics Journals

Top-Ranking Economics Journals

1. Review of Economic Studies
2. Journal of Political Economy
3. Journal of Economic Literature
4. Econometrica
5. American Economic Review
6. Quarterly Journal of Economics
7. Annual Review of Economics

Subject-Specific Economics Journals

1. Journal of Health Economics
2. Health Economics
3. Milbank Quarterly

6.2 Political Science Journals

Top-Ranking Political Science Journals

1. American Political Science Review
2. American Journal of Political Science
3. Journal of Politics
4. Perspectives on Politics
5. Annual Review of Political Science

Subject-Specific Political Science Journals

1. Journal of Health Politics, Policy, and Law
2. Journal of Race, Ethnicity, and Politics
3. Politics, Groups, and Identities
4. National Political Science Review

6.3 Sociology Journals

Top-Ranking Sociology Journals

1. American Sociological Review
2. American Journal of Sociology
3. Annual Review of Sociology

Subject-Specific Sociology Journals

1. Social Science & Medicine
2. Du Bois Review: Social Science Research on Race
3. Ethnic and Racial Studies

4. Ethnicity and Health

6.4 Search Terms for Racial Disparities in Health Outcomes

1. “race + health”
2. “racial + health”
3. “health + disparity”
4. “racial + disparity”
5. “discrimination + health”
6. “health + equity”
7. “health + inequity”
8. “racism + health”

6.5 Search Terms for Racial Disparities in Insurance Coverage

1. “race + health + policy”
2. “racial + health + policy”
3. “racism + health + policy”
4. “health + disparity + policy”
5. “race + health + insurance”
6. “racial + health + insurance”
7. “racism + health + insurance”
8. “health + disparity + insurance”

6.6 Systematic Reviews

1. Annual Review of Sociology
2. Annual Review of Law and Social Science
3. Annual Review of Public Health
4. Annual Review of Anthropology
5. American Journal of Public Health
6. Social Science & Medicine
7. Journal of Racial and Ethnic Health Disparities
8. Race and Social Problems
9. Ethnicity & Health
10. Ethnicity & Disease
11. Health Equity
12. American Journal of Men's Health
13. Psychological Medicine
14. Health Psychology
15. The Counseling Psychologist
16. Journal of Counseling Psychology
17. Journal of Midwifery & Women's Health

18. American Journal of Hypertension
19. Social Psychiatry and Psychiatric Epidemiology
20. Annals of Epidemiology
21. The Journal of Developmental and Behavioral Pediatrics
22. Journal of Palliative Medicine
23. BMC Medical Ethics
24. PLOS One
25. Annals of Behavioral Medicine
26. International Journal of Epidemiology
27. Clinical Pediatrics
28. Academic Emergency Medicine
29. Journal of General Internal Medicine

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