Accounting for Social Risk Does not Eliminate Race/Ethnic Disparities in COVID-19 Infection Among Insured Adults: a Cohort Study

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BACKGROUND: Communities of color have been disproportionately impacted by the COVID-19 epidemic in the USA.

OBJECTIVES: To examine the relationship of self-reported social health needs with SARS-COV-2 infection by race/ethnicity among insured adults with access to high-quality health care.

DESIGN AND PARTICIPANTS: A prospective cohort study of 26,741 adult Kaiser Permanente Northern California members insured by Medicaid and 58,802 Kaiser Permanente Colorado members insured by Medicare Advantage who completed social risk assessments prior to the onset of the COVID-19 pandemic.

MAIN MEASURES: We examined the independent relationships of demographic, medical, and social factors on SARS-COV-2 testing and positivity between March 1, 2020, and November 30, 2020, by race/ethnicity.

KEY RESULTS: Findings were similar in the two cohorts, with Latino (16–18%), Asian (11–14%), and Black (11–12%) members having the highest prevalence of SARS-COV-2 infection (ORs adjusted for age, gender, and use of interpreter ranging from 1.68 to 2.23 compared to White member [7–8%], $p < 0.001$). Further adjustment for medical comorbidity (e.g., obesity, diabetes, chronic lung disease); neighborhood measures; and self-reported social risk factors (e.g., trouble paying for basics, food insecurity, housing concerns, transportation barriers) did not appreciably change these results.

CONCLUSIONS: Compared to non-Latino White members, members of other race/ethnic groups had higher positivity rates that were only minimally reduced after controlling for medical and neighborhood conditions and self-reported social risk factors. These findings suggest that traditional infection transmission factors such as essential work roles and household size that have disproportionate representation among communities of color may be important contributors to SARS-COV-2 infection among insured adults.

KEY WORDS: COVID-19; Socioeconomic factors; Disparity; Race; Ethnicity.

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INTRODUCTION

The COVID-19 epidemic has further exposed the chronic problem of race/ethnic health disparities in the USA, with some of the highest SARS-COV-2 infection and mortality rates within Latino and Black communities.^{1–3} Inadequate access to high-quality health care has been posited as a major factor driving health disparities,^{4–6} although more recent literature has focused on socially determined risk factors^{7,8} and structural racism^{9–11} as important contributors to health disparities. Social risk factors (e.g., financial need, transportation barriers, food insecurity, social isolation, and/or mental stress) are disproportionately experienced by low-income communities of color and these factors are associated with poorer health outcomes.¹² Structural racism is the term used to describe the underlying, long-standing societal factors that are a root cause of disproportionate social risks.^{13–15} Particularly relevant to the spread of SARS-COV-2 infection, Latino Black and Asian Americans are more likely to live in multi-generational housing.¹² Latino and Black Americans are also more likely to work in lower-income service industry jobs that may not offer sick leave and have been deemed essential during the pandemic.^{13–15}

Understanding contributing factors to race/ethnic disparities in SARS-COV-2 infection rates is an important step towards identifying potential solutions to reduce the impact of this epidemic and to prepare more effectively for the next one. We hypothesized that among adults with similar access to high-quality health care, social risk factors would help explain the association of race/ethnicity with COVID-19-related disparities. We therefore examined the association of SARS-COV-2 testing and positivity with race/ethnicity, socioeconomic status, and self-reported social factors among insured patients within two large, integrated care systems.

We investigated the extent to which observed disparities in SARS-COV-2 infection among non-White race/ethnic groups reflected differences in disease burden and comorbidities, neighborhood measures, and self-reported social risk factors. In examining the contribution of social risk, our intent was to improve understanding of how socially driven barriers to care contributed to health inequity during the pandemic so that

health systems can better tailor care delivery to meet the current and future needs of these high-risk populations.

METHODS

Setting and Study Population

We conducted this study within two integrated care delivery systems with membership representative of the larger communities they serve—Kaiser Permanente Northern California (KPNC) and Kaiser Permanente Colorado (KPCO).¹⁶ Eligible study members included adults aged 18 years or older on March 1, 2020, who completed a Medicaid new member survey within the past 2 years (KPNC) or an annual Medicare Health Risk Assessment survey (KPCO) within the past year. These member surveys are administered by health system staff and documented in the member's electronic health record captured member-identified health status, living situation, and social risk factors including food insecurity, financial strain, and housing concerns.

We measured SARS-CoV-2 testing and positivity rates between March 1, 2020, and November 30, 2020. Member survey responses, demographics, diagnoses, and laboratory results were extracted directly from the KPNC and KPCO EPIC-based electronic medical record systems and from each site's Virtual Data Warehouse, a research database that aggregates member health data in a consistent, standardized format from multiple internal sources and externally billed claims.¹⁷

Exposure and Covariates

The primary exposure was self-reported race/ethnicity. Member race/ethnicity and need for interpreter services were captured at the time of health plan enrollment or by medical assistants and clerks during outpatient or inpatient care contacts. We determined chronic medical conditions using the ICD-10 diagnosis code list from the Centers for Medicare and Medicaid Chronic Conditions Warehouse, and we calculated the Elixhauser comorbidity score using 2 years of historical visit information.¹⁸ We defined members as obese based on body mass index $> 30 \text{ kg/m}^2$ as calculated from most recent visit height and weight measurements. Social factors were coded from responses to member health assessment questions about worry related to food running out; eating fewer than two meals a day; trouble paying for basics such as food, housing, and utilities; concerns about housing safety, affordability, or transience; lack of transportation to make medical appointments or do activities of daily living (ADLs; e.g., getting out of bed or chair, bathing/showering/dressing/eating); and limitations on performing ADLs and instrumental ADLs (IADLs; e.g., managing medicines and finances, shopping for groceries). Responses also provided information about the presence of others in the household or if the member did not live independently.

The U.S. Census-based Social Vulnerability Index (SVI) score and component measures were obtained from the CDC and linked to member geocoded addresses.¹⁹ The SVI composite sum score ranges from 0 to 15 and incorporates measures of census tract demographics, socioeconomic status, and housing factors such as unemployment, poverty, and proportion of residents living in crowded housing.

Outcomes

Our primary outcomes were SARS-CoV-2 testing and infection between March 1 and November 30, 2020. We designated members as tested if their electronic medical records contained a completed SARS-CoV-2 PCR test or outpatient and inpatient visit with a COVID-19 screening ICD-10 diagnosis. Among the tested members, we classified those with a positive result for SARS-CoV-2 laboratory test or a confirmed COVID-19 diagnosis as positive for COVID-19 infection.

Analytic Approach

We used a staged modeling approach to describe differences in testing and positivity by race/ethnicity, and we examined the contribution of measured social risk factors to these differences. We assessed the baseline cohort characteristics on March 1, 2020.

We performed logistic regression on the dichotomous outcomes of having been tested (entire cohort) and of testing positive (among those who were tested). To obtain risk estimates, we fit a population-average model with generalized estimating equations and an independent correlation structure. This approach appropriately accounted for the within-cluster correlation in covariates measured at the census tract-level (Social Vulnerability Index score) among members residing within the same census tract and is robust to misspecification of the working correlation structure.²⁰ Model 1 is adjusted for age, sex, and need for an interpreter. Model 2 represents added medical and mental health conditions that are risk factors for poor COVID-19 outcomes or are potential confounders due to their influence on the likelihood a medical provider would order testing and the members' ability to obtain testing.²⁵ Conditions included diabetes, chronic obstructive pulmonary disease, asthma, hypertension, cardiovascular disease, hyperlipidemia, depression, anxiety, Alzheimer's disease, and related dementias, and the Elixhauser score for a measure of overall comorbidity burden. The final model, Model 3, represents added dichotomous self-reported social factors and the continuous neighborhood-level SVI score. Social factors in the KPNC models included living with others, children in household, education less than high school, trouble paying for basics, food insecurity, housing concerns, and help needed with ADLs. Social factors in the KPCO models included education less than high school, not living independently, food insecurity, and limitations in ADLs and limitations in instrumental ADLs.^{26,27} All descriptive and statistical analyses were performed using SAS 9.4. Our research was approved by the

Kaiser Permanente Institutional Review Board and all procedures followed were in accordance with the ethical standards of the IRB and the Helsinki Declaration of 1975, as revised in 2000.

RESULTS

Cohort Characteristics

We studied 26,741 adult KPNC members insured by Medicaid in Northern California and 58,802 KPCO members in Colorado covered by Medicare Advantage who completed a member health assessment and had membership on March 1, 2020. As expected, given differences in program eligibility criteria, the Northern California Medicaid cohort was younger (age 42.7 ± 17.0 vs. 73.6 ± 6.6 years, $p < 0.001$) and more diverse (68.8% vs. 17.4% non-White, $p < 0.001$) than the Colorado Medicare cohort (Tables 1 and 2).

Nearly two-thirds (65%) of the Northern California cohort were women. Latino and Black members tended to live in neighborhoods with higher social vulnerability than Asian and White members. Latino members were most likely to live in areas with a larger proportion of crowded housing and to

report having children in their household (49%) and less than a high school education (20%). Black members reported the highest prevalence of financial need (34%), food insecurity (28%), housing concerns (23%), and transportation barriers (19%) (Table 1).

The majority (55.9%) of the Colorado Medicare cohort were women. As in the Northern California cohort, Latino and Asian members were most likely to report less than a high school education (20% and 16%). Black, Latino, and Asian members were more likely to report food insecurity (22%, 20%, and 18%) than other groups. Black members were the most likely to have difficulty with ADLs and IADLs (13% and 17%) (Table 2).

COVID-19 Testing and Positivity

In the Northern California Medicaid cohort, 7548 members (28%) were tested and of these 933 tested positive (12%) for SARS-COV-2 infection. The overall testing and positivity rates were lower in the Colorado Medicare cohort, with 8,253 members tested (14%) and of these 684 tested positive (8%). Testing and positivity rates varied significantly by race/ethnicity (Figure 1).

Table 1 Northern California—Baseline Characteristics of Patients Completing the Medicaid Onboarding Survey by Race and Ethnicity

	All patients	White	Latino/Hispanic	Asian	Black	Multi-racial/other	Unknown
Patients, n (% of cohort)	26,741	8,344 (31.2)	6,827 (25.5)	5,181 (19.4)	4,014 (15.0)	1,250 (4.7)	1,125 (4.2)
Age in years, mean (SD)	42.7 (17.0)	43.1 (16.2)	40.0 (16.6)	47.2 (18.5)	40.9 (15.8)	43.9 (18.3)	42.1 (17.0)
Women, %	65.0	61.6	69.0	62.8	70.0	67.5	54.5
Insurance type*, %							
Medicaid	74.9	73.8	76.8	71.2	78.2	71.2	79.6
Dual-eligible	12.8	12.6	10.8	15.5	12.6	17.5	8.0
Commercial	10.1	10.8	10.6	10.8	7.3	9.3	10.7
Medicare/other	2.3	2.8	1.7	2.5	1.9	2.0	1.7
Diagnoses, %							
Diabetes	15.2	12.1	15.7	18.7	15.2	19.8	14.7
COPD/asthma	20.0	21.7	19.1	13.0	28.1	6.7	9.8
Anxiety	24.8	33.0	25.5	12.4	24.6	27.2	14.1
Obesity (BMI 30+)	40.5	41.3	48.7	20.4	53.8	41.6	28.9
Depression	6,159 (23.5)	2,485 (30.3)	1,533 (22.8)	599 (11.8)	1,094 (27.7)	322 (26.0)	126 (11.9)
Elixhauser score, mean (SD)	2.2 (2.4)	2.3 (2.5)	2.1 (2.3)	1.8 (2.1)	2.6 (2.6)	2.6 (2.6)	1.2 (1.6)
Any primary care visits in prior year, %	67.7	66.2	68.7	69.9	66.4	69.0	65.0
Any hospitalizations in prior year, %	10.2	9.9	11.5	8.5	12.7	10.1	4.4
Any ED visits in prior year, %	35.4	35.5	37.5	23.5	49.8	40.7	21.2
Needs an interpreter, %	8.5	2.1	16.3	15.9	0.3	4.2	10.0
Social Vulnerability Index score, mean (SD)	7.43 (2.16)	6.80 (2.04)	7.99 (2.10)	7.20 (2.16)	8.18 (2.04)	7.39 (2.16)	7.21 (2.15)
% crowded housing, mean (SD)	6.7 (5.6)	5.0 (4.6)	8.3 (6.1)	6.7 (5.7)	7.7 (5.5)	6.4 (5.4)	6.4 (5.7)
Self-reported social context and risk, %							
Lives with others	81.6	78.1	85.3	87.0	74.3	82.0	85.5
Children in the household	40.7	33.7	49.0	38.1	44.5	37.1	45.2
Education less than high school	12.4	7.0	20.4	15.5	7.5	9.3	11.0
Trouble paying for basics	22.2	22.4	20.8	15.2	34.3	23.8	15.3
Food insecurity	18.8	17.1	19.9	14.1	27.5	20.7	12.7
Housing concerns	14.5	13.4	13.1	11.7	23.0	17.4	11.3
Transportation barriers	10.9	10.0	9.9	8.0	19.0	12.3	6.5
Needs help with ADLs	15.4	15.3	13.2	12.6	22.0	22.6	9.4

All p -values < 0.01 ; SD standard deviation, COPD chronic obstructive pulmonary disease, BMI body mass index, ED emergency department, ADL activities of daily living

*Members initially enrolled in Medicaid could subsequently change insurance type over the subsequent year

Table 2 Colorado—Baseline Characteristics of Patients Completing the Medicare Total Health Assessment Within the Past 2 Years by Race/Ethnicity

	All patients	White	Latino/Hispanic	Asian	Black	Multi-racial/other	Unknown
Patients, <i>n</i> (% of cohort)	58,802	48,587 (82.6%)	5,097 (8.7%)	938 (1.6%)	1,450 (2.5%)	1,542 (2.6%)	1,188 (2.0%)
Age in years, mean (SD)	73.6 (6.6)	73.8 (6.6)	72.5 (6.6)	73.1 (6.5)	73.6 (6.5)	73.3 (6.4)	73.0 (6.6)
Women, %	55.9	54.6	60.2	57.4	56.3	49.7	55.8
Diagnoses, %							
Diabetes	21.3	18.9	37.7	30.9	39.9	23.7	16.6
COPD/asthma	23.7	23.9	21.8	17.1	27.7	25.4	20.2
Hypertension	57.1	56.1	62.7	55.3	80.7	57.8	46.3
Cardiovascular disease	33.2	33.7	30.9	24.6	33.4	33.5	27.0
Obesity (BMI 30+)	31.2	30.8	37.6	10.2	39.9	30.3	27.2
Hyperlipidemia	76.5	76.4	79.0	77.6	79.9	76.5	66.2
Anxiety/PTSD	14.1	14.2	15.4	7.8	11.6	14.5	10.5
Depression	18.5	19.0	18.0	8.5	15.0	15.7	13.6
Alzheimer's/dementia	4.9	4.6	6.8	4.1	7.5	5.2	3.6
Elixhauser score, mean (SD)	3.1 (2.5)	3.0 (2.5)	3.4 (2.6)	2.5 (2.2)	3.8 (2.6)	3.01 (2.5)	2.5 (2.4)
Any primary care visits in prior 2 years, %	99.3	99.4	99.4	99.7	99.7	99.3	94.2
Any hospitalizations in prior 2 years, %	15.0	15.3	14	8.8	15.4	14.6	13.5
Any ED visits in prior 2 years, %	23.7	23.6	25.5	18.4	26.1	24.6	20.5
Needs an interpreter, %	0.3	0.0	2.1	5.5	0.0	0.5	0.1
Social Vulnerability Index (SVI) score, mean (SD)	6.4 (2.2)	6.3 (2.1)	7.6 (2.4)	6.4 (2.2)	7.8 (2.4)	6.6 (2.3)	6.5 (2.2)
% crowded housing, mean (SD)	2.0 (2.8)	1.8 (2.5)	3.3 (3.9)	2.0 (2.9)	3.8 (4.2)	2.1 (2.8)	1.9 (2.6)
Self-reported social context and risk, %							
Do not live independently	2.0	2.1	1.3	1.4	1.4	1.5	1.7
Education less than high school	4.9	3.0	19.7	15.6	6.1	6.1	4.1
Food insecurity	10.2	8.6	19.6	17.8	22.3	12.6	11.6
ADL limitation	7.9	7.6	9.5	7.6	12.9	9.3	7.3
Instrumental ADL limitation	11	10.5	13.9	10.9	17	11.3	8.8

All *p*-values < 0.01; SD standard deviation, COPD chronic obstructive pulmonary disease, BMI body mass index, ED emergency department, ADL activities of daily living

We adjusted these results using our staged modeling approach (Tables 3 and 4). The observed univariate relationship of a greater likelihood of testing and positivity remained among Latino members across all adjusted models in both cohorts (Medicaid cohort: RR 1.60, CI 1.32–1.94; Medicare cohort: RR 1.81, CI 1.48–2.22) compared to the White referent group controlling for age, sex, chronic conditions, socioeconomic and household, and self-reported social risks. Asian and Black Medicare members were also at elevated risk for infection (RR 1.90, CI 1.10, 3.28, and RR 1.46 CI 1.04, 2.05). Inclusion of self-reported social risk factors to our fully adjusted model did not significantly attenuate these disparities.

In the Medicaid cohort, additional factors associated with a higher risk of SARS-CoV-2 infection included younger age, children in the household, and social vulnerability (Appendix). In the Medicare cohort, additional factors associated with higher risk of COVID-19 infection included having less than a high school education, social vulnerability, requiring help from others for daily living, and diagnoses of COPD, obesity, or Alzheimer's disease (Appendix).

DISCUSSION

In this cohort of insured adults, self-reported race/ethnicity was the strongest contributor to differences in SARS-CoV-

2 testing and infection after controlling for age, gender, language barriers, underlying health conditions, and census tract household- and neighborhood-level measures. The novel contribution of this analysis is that additional adjustment for self-reported social risk factors did not materially change these associations. After additional adjustment for self-reported social risks, we found that Latino members from both our Medicaid and Medicare populations had a significantly higher risk of infection despite having similar access to care. Among older adults insured by Medicare, we found that Black and Asian members were also at elevated risk of contracting SARS-CoV-2 infection compared to White members.

Race/ethnic COVID-19 disparities have been reported in other US contexts. For example, a nationwide study involving over 5 million mostly male (91%) individuals receiving care via the US Department of Veterans Affairs also found double the rates of SARS-CoV-2 infection among non-White compared to White recipients even after adjusting for demographic and medical comorbidity differences.²¹ This study was not able to measure and account for social risk. Another study by Vahidy et al. using medical and census-level data from a large medical center in Houston found that living in high population density neighborhoods at least partially mediated the relationship between non-White race/ethnicity and SARS-CoV-2 infection.²² This analysis also lacked individual respondent self-reported social risk factors.

Figure 1. COVID-19 testing and positivity rates by race/ethnicity. A Medicaid—Northern California Cohort (n=26,741 Total; n=7,538 Tested). B Medicare—Colorado Cohort (n= 58,802 Total; n=8,254 Tested). Testing for COVID-19 includes patients with a diagnostic COVID-19 lab result or an encounter with a COVID-19 screening or lab confirmed COVID-19 diagnosis. “*” indicates unadjusted *p*-value <0.05 in comparison to the White referent group.

Table 3 Likelihood of COVID-19 Testing and Positivity by Race/Ethnicity. Medicaid—Northern California Cohort

(A) Tested for COVID-19							(B) Positive COVID-19 Test Result					
Covariate	Model 1 RR (95% CI)	<i>p</i> -value	Model 2 RR (95% CI)	<i>p</i> -value	Model 3 RR (95% CI)	<i>p</i> -value	Model 1 RR (95% CI)	<i>p</i> -value	Model 2 RR (95% CI)	<i>p</i> -value	Model 3 RR (95% CI)	<i>p</i> -value
Race/ethnicity												
White, non-Hispanic	1.00 (referent)		1.00 (referent)		1.00 (referent)		1.00 (referent)		1.00 (referent)		1.00 (referent)	
Latino/Hispanic	1.17 (1.11, 1.22)	<0.01	1.20 (1.14, 1.26)	<0.01	1.19 (1.13, 1.26)	<0.01	1.84 (1.55, 2.20)	<0.01	1.71 (1.43, 2.04)	<0.01	1.60 (1.32, 1.94)	<0.01
Black	1.01 (0.95, 1.07)	0.69	0.99 (0.94, 1.05)	0.83	0.98 (0.92, 1.04)	0.49	1.26 (1.03, 1.55)	0.03	1.22 (0.99, 1.51)	0.06	1.22 (0.97, 1.52)	0.08
Asian	0.80 (0.75, 0.85)	<0.01	0.92 (0.86, 0.98)	0.01	0.91 (0.84, 0.97)	0.01	1.21 (0.98, 1.49)	0.07	1.07 (0.87, 1.33)	0.52	1.06 (0.84, 1.34)	0.63
Multi-racial/other	1.00 (0.91, 1.09)	0.99	1.00 (0.91, 1.09)	0.94	1.00 (0.91, 1.10)	0.96	1.40 (1.01, 1.94)	0.04	1.36 (0.99, 1.88)	0.06	1.17 (0.81, 1.70)	0.40
Unknown	0.75 (0.66, 0.85)	<0.01	0.88 (0.78, 1.00)	0.05	0.89 (0.78, 1.02)	0.09	1.76 (1.26, 2.46)	0.00	1.57 (1.11, 2.20)	0.01	1.52 (1.08, 2.15)	0.02

Model 1 controls for age, gender, and needs interpreter; Model 2 adds chronic medical diagnoses (obesity, diabetes, COPD, asthma, hypertension, hyperlipidemia, cardiovascular disease, depression, anxiety); Model 3 adds self-reported context and needs (lives with others, children in household, education less than high school, trouble paying for basics, food insecurity, housing concerns, needs help with ADLs, transportation barriers) and Social Vulnerability Index Score.

Table 4 Likelihood of COVID-19 Testing and Positivity by Race/Ethnicity. Medicare—Colorado Cohort

(A) Tested for COVID-19							(B) Positive COVID-19 test result					
Covariate	Model 1 RR (95% CI)	p-value	Model 2 RR (95% CI)	p-value	Model 3 RR (95% CI)	p-value	Model 1 RR (95% CI)	p-value	Model 2 RR (95% CI)	p-value	Model 3 RR (95% CI)	p-value
Race/ ethnicity												
White, Non- Hispanic	1.00 (referent)		1.00 (referent)		1.00 (referent)		1.00 (referent)		1.00 (referent)		1.00 (referent)	
Latino/ Hispanic	1.06 (0.98, 1.14)	0.13	1.07 (1.00, 1.15)	0.05	1.08 (1.00, 1.16)	0.05	2.23 (1.84, 2.71)	<0.01	1.86 (1.52, 2.28)	<0.01	1.81 (1.48, 2.22)	<0.01
Black	1.15 (1.02, 1.29)	0.03	1.14 (1.01, 1.28)	0.04	1.14 (1.01, 1.28)	0.04	1.68 (1.21, 2.32)	<0.01	1.49 (1.07, 2.06)	0.02	1.46 (1.04, 2.05)	0.03
Asian	0.69 (0.56, 0.84)	<0.01	0.78 (0.64, 0.95)	0.01	0.77 (0.64, 0.94)	0.01	1.97 (1.15, 3.37)	0.01	1.91 (1.11, 3.30)	0.02	1.90 (1.10, 3.28)	0.02
Multi- racial/other	0.96 (0.85, 1.09)	0.56	0.97 (0.86, 1.10)	0.65	0.96 (0.85, 1.09)	0.57	1.07 (0.66, 1.72)	0.79	1.03 (0.65, 1.65)	0.89	1.05 (0.66, 1.67)	0.84
Unknown	0.78 (0.66, 0.92)	<0.01	0.83 (0.70, 0.97)	0.02	0.83 (0.70, 0.97)	0.02	0.98 (0.52, 1.83)	0.95	1.01 (0.54, 1.88)	0.98	0.99 (0.53, 1.86)	0.98

Model 1 controls for age, gender, and needs interpreter; Model 2 adds chronic medical diagnoses (obesity, diabetes, COPD, asthma, hypertension, cardiovascular disease, hyperlipidemia, depression, anxiety, Alzheimer's/dementia, serious mental illness); Model 3 adds self-reported context and needs (living independently, education less than high school, food insecurity, assistance needed with activities of daily living (ADLs) and instrument ADLs) and Social Vulnerability Index Score

Social risk factors such as food insecurity, housing concerns, transportation barriers, and financial needs have been identified as potent contributors to race/ethnic health disparities, particularly related to chronic diseases such as diabetes and heart disease.^{23–25} Even among the insured population studied here, risk factors such as food insecurity and trouble paying for basics were prevalent (ranging from 10 to 22% overall) and much more common among non-White race/ethnic groups. The main insight from our analyses is that controlling for these race/ethnic social factor differences did not appreciably diminish the significantly higher rates of SARS-CoV-2 infection among Latinos (or older Black and Asian Medicare recipients). These findings give further weight to the impact of traditional air-borne infection risk factors, namely living and working in close proximity to others.

Prior studies have documented that lower-income working Americans were more likely to have service-related jobs deemed “essential” during the COVID-19 pandemic.^{26,27} These workplaces increase risk of infectious exposure, whereas most individuals who were able to “work from home” during the pandemic were able to substantially reduce their exposure risk. Among those aged 65 and older, Latino, Black, and Asian Americans were more likely to remain in the workforce^{28,29} and work in low-wage essential jobs than White Americans. Non-White Americans were also more likely to live in larger, multigenerational households.³⁰ Thus, our results provide further support that inability to socially distance³¹ may be the primary causal factor underlying race/ethnic SARS-CoV-2 transmission disparities.³²

Our results must be interpreted within the context of our study design. Although this is one of the largest studies to incorporate self-reported social risks, these factors were assessed up to 1–2 years prior to the onset of the COVID-19 pandemic and may potentially have changed during the course of the pandemic. In addition, we were unable to directly measure individual level exposure to traditional air-borne infection risk factors, leaving us to infer that living situation and workplace setting may explain persistent race/ethnic disparities based on census tract data. Finally, our analyses were limited to Medicaid-insured individuals in California and Medicare-insured individuals in Colorado and may not be generalizable to other regions of the country.

Our study provides further evidence of the impact of structural racism on the health of US race/ethnic minority communities during the COVID-19 pandemic.³³ We found that even among individuals with equal access to high-quality insurance, there were marked race/ethnic differences in becoming infected with SARS-CoV-2. These differences persisted after accounting for age, gender, and medical comorbidity. The lack of attenuation of infectious risk after further accounting for both neighborhood-level measures and individual, self-reported social risk factors suggest that while social conditions can play a significant role in health, our current US experience of COVID-19 may be driven by structural factors more specifically related to infection transmission such as crowded housing coupled with “essential” in-person employment during a period of rapid viral spread. These insights should inform equitable health protection efforts, namely increasing COVID-

19 vaccination rates³⁴; addressing unemployment benefit legislation, equitable housing, and workforce policy reform; and other policy measures to contain the impact of the ongoing COVID pandemic and in preparation for the next infectious disease epidemic.

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Declarations:

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