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INCOME INEQUALITY AND HEALTH

The association between state income inequality and worse health is not confounded by race

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Background The relationship between income inequality and health across US states has been challenged recently on grounds that this relationship may be confounded by the effect of racial composition, measured as the proportion of the state's population who are black.

Methods Using multilevel statistical models, we examined the association between state income inequality and poor self-rated health. The analysis was based on the pooled 1995 and 1997 Current Population Surveys, comprising 201 221 adults nested within 50 US states.

Results Controlling for the individual effects of age, sex, race, marital status, education, income, health insurance coverage, and employment status, we found a significant effect of state income inequality on poor self-rated health. For every 0.05-increase in the Gini coefficient, the odds ratio (OR) of reporting poor health increased by 1.39 (95% CI: 1.26, 1.51). Additionally controlling for the proportion of the state population who are black did not explain away the effect of income inequality (OR = 1.30; 95% CI: 1.15, 1.45). While being black at the individual level was associated with poorer self-rated health, no significant relationship was found between poor self-rated health and the proportion of black residents in a state.

Conclusion Our finding demonstrates that neither race, at the individual level, nor racial composition, as measured at the state level, explain away the previously reported association between income inequality and poorer health status in the US.

Keywords Income inequality, self-rated health, race, multilevel analysis, US

While the ecological association between life expectancy and income inequality at the cross-national level was introduced more than 25 years ago,[1,2] empirical investigations of this issue began in earnest following the 1992 paper by Wilkinson[3] that re-introduced the topic to public health. Since then the issue has continued to arouse controversy. Growing evidence to support this claim from the US[4–8] has been countered by contradictory evidence elsewhere.[9–13]

Some recent editorials and commentaries have concluded that the support for the income inequality hypothesis is 'dissipating'[14] or that we have possibly arrived at 'the end of the story'.[15] The basis for such conclusions seems to be grounded on the following. First, the empirical evidence from countries other than the US, comprised mainly of OECD countries, has failed to confirm an association between income inequality and worse health status. We have argued elsewhere[8] that negative tests of the income inequality hypothesis were mostly conducted in countries that are more egalitarian than the US, such as Sweden,[12] Japan,[11] Canada,[9] Denmark,[10] and New Zealand.[13] In countries that are more unequal than the US, such as Chile, we have found an association between income inequality and worse health.[16,17] Secondly, the ecological association between income inequality and health has been challenged on the basis of residual confounding by individual income[18] or educational attainment.[19] However, in US data at least, appropriate multilevel models that controlled for individual income and educational attainment have ruled out potential confounding by these variables as a plausible explanation for the association between state income inequality and worse health.[4–8]

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Most recently, it has been argued that the relationship between income inequality and poor health is an artefact of race.[20,21] It is well established that black Americans have worse health status compared with white Americans, due to the effects of persistent racism and more limited economic opportunities.[22] It has also not escaped notice that the US states with higher levels of income inequality also tend to have higher proportions of black residents.[23] These states tend to be clustered in the American Southeast, and no doubt reflect the enduring legacies of slavery, segregation, and continuing disparities in opportunities for black residents in those states. Importantly, we, as well as others, have established that the association between state income inequality and poor health is not confounded by *individual* race.[4–8] In other words, controlling for individual race does not remove the effect of state income inequality on morbidity and mortality. Higher income inequality is associated with worse health for *both* the white and black residents of a state.

However, it has been argued recently that researchers have neglected to additionally control for the racial composition of the state, i.e. the proportion of a state's residents who are black. It has been contended that controlling for 'per cent black' at the state level removes the effect of income inequality on health. This is a different criticism from the one concerning potential confounding by *individual* race, for it contends that racial composition as a *contextual* variable confounds the association between state income inequality and health. Once the fraction black is included in the regression, the effect of income inequality on health disappears. As Deaton and Lubotsky[21] have stated:

> The obvious interpretation of these results is that the effect of inequality on health is spurious, reflecting a failure to control for race, or something that is correlated with race—though not income inequality.

Deaton and Lubotsky[21] go on to report that mortality among whites is higher in states where a larger fraction of the population is black. They suggest that:

> Some of the discussions of why inequality affects health—lack of social cohesion, lack of trust, the heterogeneity of tastes that reduce the ability to provide public goods—might provide starting points for a discussion of why white mortality is higher when whites live in states that are more racially mixed.

In other words, it has been claimed that the effect of 'per cent black' trumps the effects of state income inequality on health, and that the real culprit behind poor health achievement is racial heterogeneity, not income inequality *per se*.

In this paper, we set out to test the claim that the racial composition of a state (defined as the proportion of the state's population who are black, and hereafter truncated to 'proportion black') confounds the association between state income inequality and individual poor self-rated health in the US using an explicitly multilevel analytical strategy.[24] While our study and that of Deaton and Lubotsky[21] are not strictly comparable in terms of the outcome studied, choice of predictors considered, or the analytical/modelling strategy adopted, we believe our findings can nevertheless inform the general discussion on the relationship between income inequality, race, and health.

While the technical criteria for confounding are themselves the subject of on-going debate, Rothman and Greenland provide reasonably normative criteria for defining confounding.[25] In the context of the analyses presented here, self-rated health and the state income inequality are the outcome and exposure of interest, respectively, while proportion black is the potential confounder. For proportion black to be a confounding variable three conditions must be met. First, proportion black must be an independent risk factor for individual self-rated poor health; second, proportion black must be associated with the exposure of interest, i.e. state income inequality; and third, proportion black must not be causally affected by state income inequality. While the last criterion is likely to be true in this setting (in that the income distribution does not 'cause' racial composition at the state level), the first two criteria are empirically testable.

Methods

Sources of data

We used pooled data from the 1995 and 1997 Current Population Surveys (CPS) conducted by the US Bureau of Labor Statistics.[26] We used the 1995 and 1997 data for two reasons. First, the CPS has collected self-rated health data since 1995. Second, each CPS respondent stays in the CPS sample for 2 consecutive years—additionally including 1996 and 1998 data would only lead to counting the same people.[27] The final sample for the data consisted of 201 221 individuals aged $\geqslant$18 residing within the 50 US states. The data for state-level characteristics came from the 1990 US Census.

Outcome variable

We used the question related to self-rated health, available on the CPS, as our outcome variable. Self-rated health was determined by an individual's response to the question, 'Would you say your health in general is excellent, very good, good, fair, or poor?' Following previous analyses,[6,7] we collapsed the five categories to form a dichotomous outcome of self-rated health: 0 for excellent, very good, and good; and 1 for fair or poor. Over 27 studies in the US and elsewhere have established that self-reported health is highly predictive of subsequent mortality, independent of other medical, behavioural, and/or psychosocial factors.[28] Approximately 15% of the sample population reported being in fair/poor health (Table 1).

Exposure variables

Table 1 provides a summary of the individual- and state-level variables used for the analysis. At the individual level, our analysis included age (centred about its mean of 45 years), sex (male, female), race (white; black; others), marital status (married/partnered; divorced/separated; widowed; single), educational attainment (graduate and above; college; high school/some college; 9–12th grade; below 8th grade), equivalized household income (>US$125 000; US$75 000–125 000; US$50 000–75 000; US$30 000–50 000; US$15 000–30 000; <US$15 000), health insurance coverage (yes; no), and employment status (employed; not employed including people who are seeking work—the unemployed, retired population, disabled population, and other residual groupings). We adopted the equivalization procedure that is used in the Luxembourg Income Study, i.e. to divide the household income by the square root of the number

Table 1 Descriptive univariate information on the pooled 1995 and 1997 Current Population Survey data sample used for the analytical multilevel models

	Response (Fair/Poor self-rated health)	
	Yes (n = 30 009, 14.9%)	No (n = 171 212, 85.1%)
Predictors		
Level-1: Individual (n = 201 221)		
Age (in years)	Mean: 45	SD: 18
Sex	Base: Male (n = 94 500, 47%)	Contrast: Female (n = 106 721, 53%)
Race	Base: White (n = 172 493, 85.7%)	Contrast: Black (n = 17 730, 8.8%) Other (n = 10 998, 5.5%)
Marital status	Base: Married (n = 120 221, 59.7%)	Contrast: Widow (n = 14 503, 7.2%); Separated/divorced (n = 23 347, 11.6%); Single (n = 43 150, 21.4%)
Educational attainment	Base: Graduate and above (n = 4259, 2.1%)	Contrast: <8 years (n = 16 658, 8.3%); 9–12 years (n = 22 700, 11.3%); 12–16 years (n = 119 644, 59.5%); College (n = 37 960, 18.9%)
Equivalized household income (US$)	Base: >125 000 (n = 1848, 0.9%)	Contrast: <15 000 (n = 58 752, 29.2%); 15 000–30 000 (n = 68 454, 34%); 30 000–50 000 (n = 47 562, 23.6%); 50 000–75 000 (n = 18 304, 9.1%); 75 000–125 000 (n = 6301, 3.1%)
Health insurance	Base: Yes (n = 147 855, 73.5%)	Contrast: No (n = 53 366, 26.5%)
Employment status	Base: Employed (n = 194 202, 96.5%)	Contrast: Not employed (n = 7019, 3.5%)
Level-2: State (n = 50)		
Gini coefficient	Mean: 0.42	SD: 0.01
Proportion black population	Mean: 0.10	SD: 0.07

of household members. At the state level, we included the Gini coefficient (a standard measure of income inequality); and the proportion of black residents within each state; both variables stemming from an independent data source, the 1990 US Census.

Statistical and methodological framework

The statistical modelling framework in this paper anticipates that individual poor self-rated health is clustered within the spatial context of the state to which they belong. Given our primary interest in the state-level variables associated with the Gini coefficient (and proportion black), the clustering of outcomes is not a nuisance that needs to be minimized, adjusted, or corrected. Rather, the idea is to 'explain' the state-level clustering of poor self-rated health. This spatial clustering in the outcome was modelled by explicitly partitioning the individual and state-based sources of variation. Failure to differentiate the level-contingent nature of different exposures may lead to under- or over-estimation of the regression coefficients as well as the standard errors. Multilevel statistical techniques provide a technically robust framework to analyse the dependent nature of the outcome variable.[29] The principles underlying multilevel modelling procedures have been extensively discussed elsewhere.[24]

At the risk of simplifying, the multilevel techniques allow estimation of: (1) the average relationship between poor self-rated health and individual exposures across *all* states ('fixed parameters'); (2) the variation between states that cannot be accounted for by individual factors ('random-parameters'); and (3) the effect of state-level predictors on poor self-rated health ('fixed parameters') and the extent to which they explain between-state variation ('random parameters'). The multilevel modelling of 201 221 individuals (at level-1) nested within 50 states (at level-2) was achieved through the multilevel binomial non-linear logit link model using Predictive/Penalized Quasi-likelihood Procedure (PQL) second approximation procedures.[30] Models were calibrated using the Restricted Maximum Likelihood procedure as implemented within *MLwiN* software version 1.6[31] that utilizes the Restrictive Iterative Generalized Least Squares algorithm.[29] Estimates from the different calibrated models are presented in Table 2. Essentially, the aim of the models was to ascertain the extent to which the fixed state-level effects contribute to the improved prediction of self-rated poor health, rather than exploring the differential partitioning of variation in self-rated poor health. Our modelling strategy, meanwhile, is geared towards testing specifically the extent to which an unadjusted coefficient of state income inequality gets attenuated by including the different individual- and state-level covariates that have been identified as potential confounders to the relationship between state income inequality and health.

Results

Model 1 in Table 2 provides the results of our baseline model. The model estimated the bivariate multilevel relationship between state income inequality and individual poor self-rated health. We found that for a 0.05-increase in state Gini coefficient, the odds ratio (OR) for reporting poor health increased by 1.68 (95% CI: 1.48, 1.90). In subsequent models (Models 2, 3, and 4 in Table 2), we examined the extent to which the baseline OR for state Gini coefficient changes once we control for different individual- and state-level confounding variables.

Model 2 in Table 2 conditions the relationship between poor self-rated health and Gini coefficient on a wide range of potential individual covariates. We found a statistically significant effect of state Gini coefficient (OR for 0.05-increase in Gini = 1.39; 95% CI: 1.23, 1.58) independent of age, sex, race, marital

status, educational attainment, household equivalized income, access to health insurance, and employment status. In others words, these individual variables do *not* explain the independent and unique multilevel relationship between state income-inequality and poor self-rated health.

Model 3 in Table 2 considers the potential confounding effect of a state's racial composition but omits the individual race-effects on poor self-rated health. This simulates the logic underlying the model presented by Deaton and Lubotsky,[21] although our multilevel model is not strictly comparable to the ecological model reported by Deaton and Lubotsky.[21] The results for the Gini coefficient in Model 3 (Table 2) suggest that the statistically significant and independent effect of state income-inequality (OR for 0.05-increase in Gini = 1.29; 95% CI: 1.11, 1.49) remains even after accounting for the state's racial composition, proportion black, contrary to what was reported by Deaton and Lubotsky.[21] At the same time, we also found a marginally significant effect for proportion black (OR for 0.05-increase in proportion black = 1.05; 95% CI: 1.02, 1.08).

In the final model (Model 4, Table 2) we tested whether the effect of Gini remains significant after accounting for both individual race *and* proportion black at the state level. We again found the effect of Gini coefficient to be statistically significant (OR for 0.05-increase in Gini = 1.31; 95% CI: 1.13, 1.50), independent of racial composition (*both* at the individual and the state level). The marginally significant effect of proportion black in Model 3 became statistically non-significant in this model, after taking account of individual race (OR for 0.05-increase in proportion black = 1.03; 95% CI: 0.99, 1.06). In other words, we found no independent effect of per cent black at the state level on individual health after controlling for individual race.

Although not reported here, we also examined two multilevel interaction effects on poor self-rated health: (1) between individual race categories and state proportion black; and (2) between individual race categories and state Gini. Neither of these effects was statistically significant.

Discussion

Our finding suggest that, conditioned on proportion black in a state, there remains an important association between state income inequality and individual self-rated poor health. The key results pertinent for the discussion are summarized in Table 3. Among other findings, Table 3 also presents the association between proportion black and individual self-rated health, independent of state income inequality—our first criterion to

Table 2 Multilevel logit regression estimates (along with their odds ratios [OR] and 95% CI) for Models 1, 2, 3, and 4 based on a two-level binomial logit model for self-rated poor health with a random effects component for US states

	Model 1				**Model 2**			
Fixed Parameters	Estimate	SE	OR	95% CI	Estimate	SE	OR	95% CI
Constant	–6.131	0.5453			–6.305	0.5556		
Individual predictors								
Age					0.04897	0.000478	1.63	1.62, 1.65
Sex								
Female					0.03209	0.01458	1.03	1.00, 1.06
Race								
Black					0.4321	0.02291	1.54	1.47, 1.61
Other					0.1874	0.03314	1.21	1.13, 1.29
Marital status								
Widow					–0.08606	0.02344	0.92	0.88, 0.96
Separated/divorced					0.3249	0.02088	1.38	1.33, 1.44
Single					0.2316	0.02237	1.26	1.21, 1.32
Educational attainment								
Below 8th grade					1.115	0.06754	3.05	2.67, 3.48
9–12th grade					1.007	0.06722	2.74	2.40, 3.12
High School/some college					0.4605	0.06539	1.58	1.39, 1.80
College					0.02717	0.06762	1.03	0.90, 1.17
Income (US$)								
<15 000					1.309	0.1083	3.70	2.99, 4.58
15 000–30 000					0.666	0.1082	1.95	1.57, 2.41
30 000–50 000					0.2901	0.1088	1.34	1.08, 1.65
50 000–75 000					0.04174	0.112	1.04	0.84, 1.30
75 000–125 000					0.1437	0.1194	1.15	0.91, 1.46
Health insurance								
No health insurance					0.07443	0.01665	1.08	1.04, 1.11
Employment status								
Not employed					0.006304	0.03983	1.01	0.93, 1.09
State predictors								
Gini coefficient	10.32	1.288	1.68	1.48, 1.90	6.634	1.281	1.39	1.23, 1.58
Proportion black								
Random parameters								
Level-2: Between-States	0.0305	0.0067			0.02934	0.0066		

Table 2 Continued

	Model 3				Model 4			
Fixed Parameters	Estimate	SE	OR	95% CI	Estimate	SE	OR	95% CI
Constant	–5.73	0.6223			–5.823	0.6255		
Individual predictors								
Age	0.04846	0.000475	1.62	1.61, 1.64	0.04897	0.000478	1.63	1.62, 1.65
Sex								
Female	0.03724	0.01456	1.04	1.01, 1.07	0.03204	0.01458	1.03	1.00, 1.06
Race								
Black					0.4294	0.02297	1.54	1.47, 1.61
Other					0.1877	0.03314	1.21	1.13, 1.29
Marital status								
Widow	0.0728	0.02341	1.08	1.03, 1.13	–0.08611	0.02344	0.92	0.88, 0.96
Separated/divorced	0.3553	0.02074	1.43	1.37, 1.49	0.325	0.02088	1.38	1.33, 1.44
Single	0.2795	0.02215	1.32	1.27, 1.38	0.2316	0.02237	1.26	1.21, 1.32
Educational attainment								
Below 8th grade	1.127	0.06754	3.09	2.70, 3.52	1.116	0.06755	3.05	2.67, 3.48
9–12th grade	1.027	0.0672	2.79	2.45, 3.19	1.007	0.06722	2.74	2.40, 3.12
High School/some college	0.4689	0.06539	1.60	1.41, 1.82	0.4609	0.0654	1.59	1.39, 1.80
College	0.02808	0.06763	1.03	0.90, 1.17	0.02743	0.06763	1.03	0.90, 1.17
Income (US$)								
<15 000	1.348	0.1083	3.85	3.11	4.76, 1.31	0.1083	3.71	3.00, 4.58
15 000–30 000	0.6873	0.1082	1.99	1.61, 2.46	0.6664	0.1082	1.95	1.58, 2.41
30 000–50 000	0.3045	0.1088	1.36	1.10, 1.68	0.2902	0.1088	1.34	1.08, 1.65
50 000–75 000	0.05047	0.112	1.05	0.84, 1.31	0.04162	0.112	1.04	0.84, 1.30
75 000–125 000	0.1511	0.1194	1.16	0.92, 1.47	0.1436	0.1194	1.15	0.91, 1.46
Health insurance								
No health insurance	0.08042	0.01662	1.08	1.05, 1.12	0.07427	0.01665	1.08	1.04, 1.11
Employment status								
Not employed	0.0214	0.03977	1.02	0.95, 1.10	0.006512	0.03983	1.01	0.93, 1.09
State predictors								
Gini coefficient	5.059	1.482	1.29	1.11, 1.49	5.373	1.49	1.31	1.13, 1.51
Proportion black	0.9331	0.3228	1.05	1.02, 1.08	0.5213	0.3254	1.03	0.99, 1.06
Random parameters								
Level-2: Between-States	0.02809	0.00636			0.0284	0.006384		

Note: Since state-level Gini and proportion black were specified as linear continuous predictors, exponentiating the logit coefficient in Table 2 gives us the odds ratios for change in self-rated poor health for one unit change in Gini coefficient and proportion black. However, as Gini coefficient and proportion black can range only between 0 and 1, we report the odds ratios for a 5% (or 0.05) change in Gini and proportion black.

Table 3 Summary of the key results relevant to testing the confounding bias caused due to proportion black on the relationship between state income inequality and self-rated poor health

Outcome: Self-rated poor health	**Estimate**	**SE**	**Odds ratio**	**95% CI**
State proportion black (without State Gini)[a]	1.147	0.308	1.06	1.03, 1.09
State proportion black (with State Gini, without individual black)[b]	0.933	0.323	1.05	1.02, 1.08
State proportion black (with State Gini)[a]	0.522	0.325	1.03	0.99, 1.06
State Gini (without State proportion black)[a]	6.634	1.282	1.39	1.23, 1.58
State Gini (with State proportion black)[a]	5.369	1.489	1.31	1.13, 1.51
State Gini (with State proportion black as categorical)[a]	5.201	1.528	1.30	1.12, 1.51
State Gini (with State proportion black as 3rd order polynomial)[a]	5.210	1.565	1.30	1.11, 1.51

[a] Model adjusted for individual age, sex, marital status, race, education, income, employment status, health insurance.

[b] Model adjusted for individual age, sex, marital status, education, income, employment status, health insurance.

Odds ratios for state proportion black and state Gini coefficient based on a 0.05 change.

empirically test for confounding bias due to proportion black. We can see that there is a modest independent association between proportion black and individual self-rated poor health (OR = 1.06, 95% CI: 1.03, 1.09 for a 0.05-increase in proportion black). In addition, the correlation between state income inequality and proportion black is approximately 0.5. Given this, we expect a small confounding bias in the resultant relationship between state income inequality and self-rated health. As shown in Table 3 the effect estimate (in logits) for the state Gini coefficient changes from 6.63 in a model that does not include proportion black to 5.36 in a model that includes the confounding effect of proportion black.

Furthermore, our conclusion that, conditional on proportion black, there is an independent relationship between state income inequality and poor self-rated health is robust to alternate specifications of proportion black. While specifying state proportion black as a categorical variable with cut-off points of <0.05, 0.05–0.10, 0.10–0.20, and >0.20 yields an OR of 1.30 (95% CI: 1.12, 1.51), considering a third-order polynomial effect for proportion black yields an OR of 1.30 (95% CI: 1.11, 1.51) for a 0.05 change in Gini. It can be seen that neither OR are different from the OR of 1.31 (95% CI: 1.13, 1.51) that is estimated when we specify a linear effect for proportion black.

We also argue that the apparent effect of proportion black on self-rated poor health itself seems to be artefact of failing to account for the association between race and self-rated poor health at the individual level. As shown in Table 3, conditional on state income inequality, the OR for proportion black while not considering individual race is 1.05 (95% CI: 1.02, 1.08) and accounting the racial differences in health at the individual level, barely changes the point estimates, while rendering the 95% CI statistically insignificant (OR = 1.03, 95% CI: 0.99, 1.06).

What lessons can we learn from this exercise? First, our exercise highlights the need to be cautious while exploring the effects of variables that have ambiguous meaning. Variables such as proportion black in a state may be capturing a host of conditions that may or may not be pertinent for an evaluation of the potentially causal association between state income inequality and health. Deaton and Lubotsky[21] acknowledge that they had no *a priori* reasoning for including this variable in their models, when they state that, 'it remains unclear why mortality is related to racial composition'. The task of developing clear rationale and justification is critical when considering variables measured at the contextual level.

Furthermore, Deaton and Lubotsky[21] make no distinction whether proportion black was being used in a unique way that is different from controlling for confounding by individual race. If the concern is for the latter, then, within a multilevel statistical framework, we need not go beyond Model 2 that we presented, as any clustering of health outcomes *is conditional on individual race-based clustering*. On the other hand, if proportion black is being conceptualized as a *pure* contextual variable (as a proxy for some sort of 'racial miasma' effect that is independent of individual race composition) then it calls for further conceptual justification. As it turns out, there is no 'racial miasma' effect at the state level. Meanwhile, racial heterogeneity (homogeneity) as reflected through the spatial aspects of US demography (at different levels of geographical aggregation) is an important area of public health research that requires some attention and may be critical to develop a multilevel understanding of the relationship between state income inequality and health.[32]

Second, researchers must recognize the empirical limits to testing for the presence or absence of state income inequality on health. For instance, even though we considered alternate specifications for proportion black (in order to accommodate a more convincing consideration of the confounding bias) there may be serious issues of power that one should not overlook. Since there is no means to increase the sample size of US states, researchers need to consider the limits to quantitatively conduct extensive tests of ecological confounding and future research may need to consider testing the relationship in other settings.[8,16]

Third, while we have shown elsewhere that controlling for US census divisions (considered as a regional confounder) does not explain away the association between state income inequality and self-rated health,[8] future research may wish to consider investigating the *substantive* differences in the state income inequality—health relationship across regions or other sub national levels. At the same time, though, the challenge would be in conceptualizing and specifying what could constitute the 'regional' level.

Finally, given the substantial differences in state policies on direct and indirect aspects of income distribution, we believe that the causal process of income inequality is perhaps most closely related to the state level in the US. However, it is important to consider other levels (such as the census tracts or counties or metropolitan areas) as factors such as residential and racial segregation at these geographical levels may be influenced by the income inequality at the state level. Thus, besides the issue of what level matters for income inequality, the critical issue is to explore other *contextual pathways* (typically at lower levels of aggregation) that may mediate the relationship between state income inequality and individual health.

Conclusion

The focus of this paper has been to test the specific claim made by Deaton and Lubotsky[21] that the observed association between state income inequality and health can be explained by racial composition within states. While we have shown that racial composition does not fully account for the effect of state Gini on health, we also do not claim to have the final word in the income inequality debate. In particular, more work is needed to determine the specific settings in which income inequality is harmful to population health. In some settings, such as Sweden and Japan, income inequality may not be associated with health outcomes, while in others, such as Chile, the effects may be rather adverse. Even within a contextual setting the effect of income inequality can be anticipated to be different for different population sub-groups, adversely affecting some while having no impact (and perhaps even a positive impact) for others.[33] At the same time, contrary to the conclusions such as, 'we can muster little evidence to show that the extent of income inequality, *per se*, affects population health',[15] we hope that our results, at the least in the case of the US, may settle some of the current disputes.

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KEY MESSAGES

- It has been claimed that racial composition explains away the relationship between income inequality and health in the US.
- The confounding bias in the association between state income inequality and poor self-rated health caused by the proportion black in a state is relatively small.
- The association between proportion black and poor self-rated health itself seems to be a consequence of not accounting for the effects of race at the individual level.
- Conditioned on proportion black there is still an important association between state income inequality and poor self-rated health.

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