Social Science & Medicine 340 (2024) 116405

Contents lists available at ScienceDirect

Social Science & Medicine

journal homepage: www.elsevier.com/locate/socscimed

Racial disparities in Death rates and Death incidences in Xinjiang: A study of multilevel ecological mechanisms

Xiaozhao Yousef Yang [a,*], Scott Schieman [b]

[a] Sun Yat-sen University, Guangzhou, 510000, China
[b] University of Toronto, Canada

ARTICLE INFO

Handling Editor: Susan J. Elliott

ABSTRACT

Health disparities based on racial status are well-researched by social scientists, but this field of knowledge has rarely been investigated beyond the Western context. As the largest province in China, Xinjiang has over 50% non-Han populace—and this group is subjected to various forms of inequalities. The current study is the first to quantitatively demonstrate the disparity in mortality between the Han majority and Turkic minority in Xinjiang. We have developed a theory-driven framework to approach race as a fundamental cause of mortality disparity through both individual and context-level pathways that trigger the proximate determinants of death. We compiled the 2015 China Microcensus with the Sixth Decennial Census (2010) and web-extracted point-of-interest information for data at different ecological levels. The results reveal that the mortality rate is significantly pronounced for Turks at the county-level and Turks' death incidence is elevated at the household level. The inclusion of variables at the individual- and context-level explains about 38% of the mortality disparity between Han and Turks, but the significant disparity remains strong after considering the covariates, the "healthy migrant" scenario, geographical clustering, and exposure risk. We cautiously suggest the remaining unexplained portion of the mortality disparity may be due to unobserved racial inequity and urge the academic community to further investigate this underexplored subject.

1. Introduction

Race and ethnicity capture variable connections to power, resources, and legitimacy, which collectively affect morbidity and mortality through multiple pathways (Brown, 2018; Dressler et al., 2005; Phelan and Link, 2015; Williams et al., 2019). In developing countries, race's impact on health is overlooked due to the misperception that economic and developmental issues are greater obstacles to public health than racial disparities and the false impression that developing countries, such as China, are racially homogenous compared to Western multiracial democracies (Zang, 2015).

But race does matter in its less expected context of China. The Chinese state in today's form inherited its territory mostly from the multiethnic Qing Empire established by the Manchu banner lords in the 18th century (Perdue, 2009). One of these regions became known as the Xinjiang Uyghur Autonomous Region (XAUR), which is the largest province with a strong presence of Turkic population (over 50%) who exhibit distinct sociocultural traits. The most famous and largest Turkic group in XAUR is Uyghur, but there are also other Turkic groups that are heavily represented: Kazakh, Uzbek, Kirgiz, Tatar, and Salar. The Turks in XAUR differ from the Han majority in linguistic, religious, and genetic compositions (Du et al., 1997).

Racial statuses have morphed into inequality gradients in the population health of China. Schuster (2009) found the elevated death rate among Uyghurs cannot be explained by the two group's different socioeconomic statuses. Hao (1990) found in the 1980s that infant mortality attributed to Uyghur mothers is the highest in China. A meta-analysis by Huang et al. (2018) found that Uyghurs were only 39% as likely as Han to use healthcare services. There are several shortcomings in the existing literature. Other than Schuster (2009), most studies relied on community or clinical samples. In addition, nearly all prior studies have compared health indicators between the Han majority and Uyghur while neglecting other Turkic groups. This simplified view of racial categories overlooks that the historical boundary between different Turkic groups has been largely arbitrary (Gladney, 1998; Ubiria, 2016). Third, most prior studies have an epidemiological orientation, resulting in few studies guided by a theory-driven explicatory framework.

* Corresponding author.
E-mail address: yosefyang@outlook.com (X.Y. Yang).

https://doi.org/10.1016/j.socscimed.2023.116405
Received 24 April 2023; Received in revised form 8 October 2023; Accepted 6 November 2023
Available online 15 November 2023

Our study is the first to investigate mortality with nationally representative census data that cover Xinjiang with a sufficiently large sample for advanced between-group analyses. In the following section, we leverage the insights of fundamental cause theory, neighborhood effect hypotheses, and race theories to argue that racial/ethnic identity in XUAR constitutes an upstream factor that ultimately influences mortality inequality via both individual- and context-level pathways.

2. Literature review

Race and ethnicity[1] are an upstream *fundamental cause* of health inequality. An upstream determinant of health structurally organizes and produces the more proximate etiologies of morbidity and mortality (Weitz, 2009). Race is an upstream determinant because 1) as an ascribed status, individuals cannot easily control or manipulate their officially designated racial identity; 2) it affects all individuals subsumed under the same category despite within-group heterogeneity; 3) it further manufactures other fundamental causal factors of health as indexed by SES and related advantages. Although racial identity is ascribed to individuals, the way it affects individuals lies beyond personal control but operates in conjunction with the context that produces racial identities (Brown, 2003; Brown, 2018; Dressler et al., 2005; Mays et al., 2007).

Race as an upstream determinant also aligns with fundamental cause theory, which argues that individuals' social statuses shape the amount of flexible resources they can mobilize to achieve a better health (Link and Phelan, 2010; Link and Phelan, 2010). According to Phelan and Bruce (2015), a fundamental cause embodies a set of flexible resources. A racial group that tends to have more of these resources will likely develop better health outcomes—both through SES and independently of it. The sociology of race argues that race, along with other ascribed statuses, is a preeminent condition encompassing a wide range of behavioral and social outcomes (Brown, 2003; Collins and Bilge, 2016).

In the case of the Turkic populace in XUAR, such racial identities became the most salient fundamental cause under the structural configuration of multiracial lives in contemporary China. First, racial identities are more rigid and inflexible in China under the Stalinist classification adopted in the 1950s (Gladney, 1998; Ubiria, 2016). Second, as we have described above, racial identity is associated with levels of education, income, occupational status, and a range of other social and demographic factors. Third, by being uniformly labeled by an immutable ethnic identity, the Turkic populace is subjected to targeted policies that set them apart from Han (e.g. affirmative action, anti-terrorism law), which caused spatial and social segregation despite individual heterogeneity (Legerton and Rawson, 2009; Yee, 2003). These social-structural conditions situate race as a fundamental cause of the more "downstream" proximate determinants of health in XUAR.

Race acts as a fundamental cause of the mechanisms that produce health outcomes downstream through proximate determinants. Racial identity does not affect health outcomes as a trigger event in an experiment setting. Instead, it operates as a structural constraint that channels various proximate determinants to affect health outcomes. Several of these determinants have been identified in the literature. We classify these determinants into two types according to whether the mechanisms happen at the individual- or context-level and further differentiate compositional effects from contextual effects at the context-level. In Fig. 1, we delineate the conceptual pathways for race to facilitate these proximate determinants of health through both individual-level mechanisms and the context-level configuration of effective compositional and contextual factors. In this manner, race as an ascribed status possesses the causative power to bring together the facilitative conditions from which the health inequalities between Han and Turks might emerge.

Individual-level: the determinants of health with race as the *radix causa* at the individual-level derive from (1) interpersonal interactions or relations and (2) from possessing a particular racial identity. For example, interpersonal conflicts and the ensuing injuries require multiple actors to participate, but the low income associated with a specific racial identity is independent of how well-off people from other races are. For individual Turks in XUAR, racial identity patterns are the regularity of interaction between ingroup and outgroup members, and these patterns shape the collateral consequences associated with a racial/ethnic identity. Medical professionals may use perceived racial stereotypes as criteria for diagnosis and treatment, biasing the delivery of health services (Roberts, 2008). Adverse interpersonal encounters may threaten the mental and physical health of minorities via proximate determinants such as stress, allostatic load, and physical violence (Mays et al., 2007; Takeuchi et al., 2010). Research has demonstrated that discrimination experiences, daily hassles, and implicit bias are all associated with worse health outcomes among minorities (Brown, 2003; Chae et al., 2008; Dressler et al., 2005; Williams and Williams-Morris, 2000; Williams et al., 2019).

Moreover, Turks in XUAR tend to possess lower levels of SES (Hannum and Xie, 1998; Wu and Song, 2014; Zang, 2015). In particular, income is widely found to be associated with better health outcomes, typically by shifting the distribution of stressors, health resources, and toxins across different income strata (Link and Phelan, 2010; Mirowsky and Ross, 2003; Ross and Mirowsky, 2010; Wilkinson and Pickett, 2006). Other than income, Turks in XUAR face barriers in the education system as their native language differs from Mandarin (Hannum and Xie, 1998; Li and Chang, 2015). Because a significant part of cultural capital that embodies health knowledge and health lifestyle, including dietary habits and risk-taking behaviors, are reproduced in the education institution (Elo, 2009; Pinxten and Lievens, 2014), the Turks' health may not benefit as much from the educational system as the Han majority do. These individual-level pathways are depicted in the left panel of Fig. 1.

Context-level: Determinants of population health that operate at the context level, such as in neighborhoods and counties, can be classified into two types: those that originate from the compositional traits of a place and those that originate from the contextual traits of a place. Scholars have generally reached the consensus that compositional effects, as aggregated characteristics of the individual constituents of a place, should be differentiated from contextual effects—effects generated by the environment of a place but are not derivatives of its population characteristics (Duncan et al., 1998; Ross and Mirowsky, 2008). For comparison, the average household income *in* a county produces a compositional effect, whereas the tax revenue *of* that county is considered a contextual effect.

The rich research on the neighborhood effect demonstrates that compositional factors, including low average income, rapid turnover of local residents, and low collective efficacy among residents are associated with the increased rates of health-risk behaviors and mortality and may partly explain the racial health disparity thereof (Sampson, 2012; Shaw and McKay, 1969; Wen et al., 2003; Williams and Williams-Morris, 2000). Regarding compositional effects, racial minorities may live with variable levels of segregation and diversity, which are determined by the size of other groups and their own. According to the moral community hypothesis, the level of diversity and co-ethnic concentration may affect the local pro-health culture and diffuse health behavior norms beyond an individual's characteristics (Nie and Yang, 2019). For example, one study finds that when the geographical clustering of ethnic groups is accounted for, the observed ethnic differences in smoking disappear (Yang et al., 2021). Other studies on population composition and health outcomes show that areal racial diversity is associated with health for minorities (English et al., 2014; Hunt et al., 2007; Lu and Yang, 2020; Yang et al., 2019).

[1] Scholars have debated the ambiguous distinction drawn between the notions of race and ethnicity, inconclusively tracing their foundation in the biological and social construction processes. From this point forward in the paper, we will use the term "race" when describing Han and Turks for convenience.

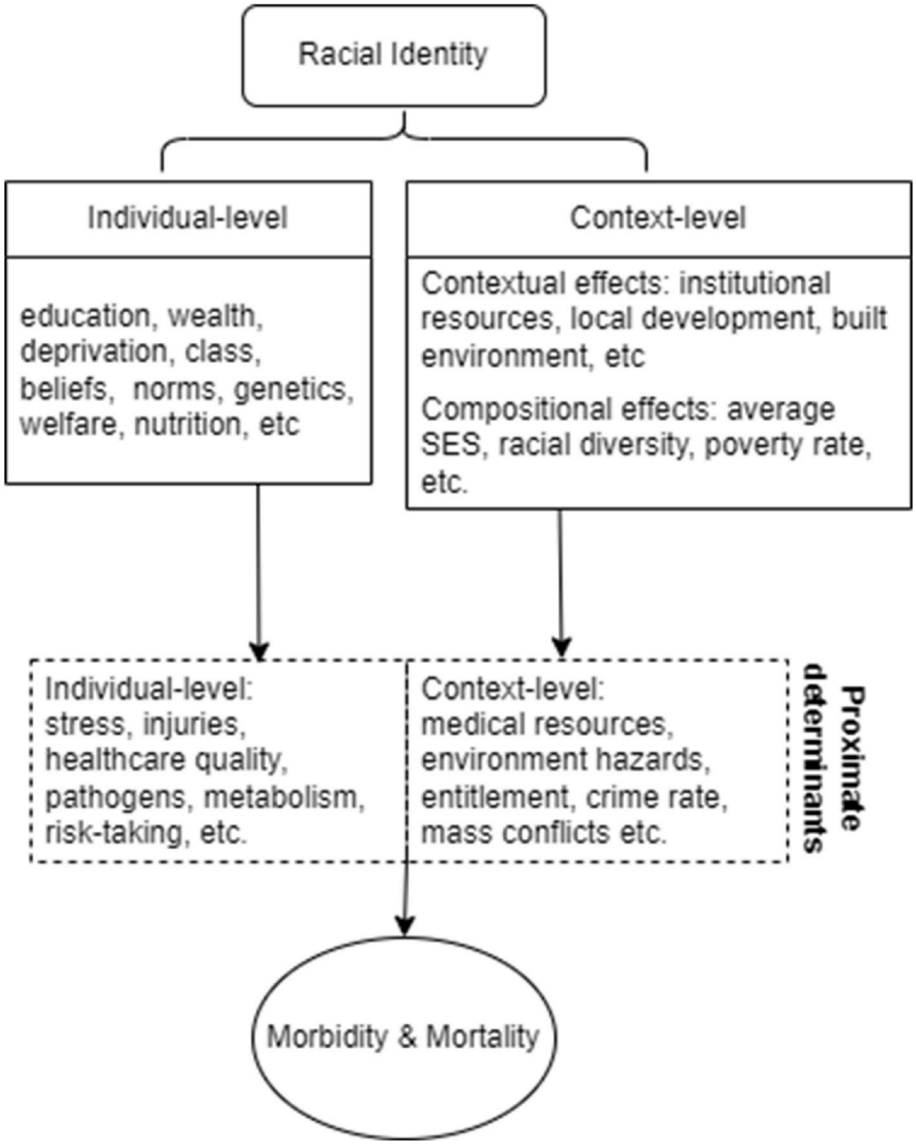


Fig. 1. Conceptual pathways of race as a fundamental cause of health.

Various contextual effects may arise in a higher-level ecological unit and affect the people inhabiting this context. For example, the built environment of a healthcare facility, with its embedded medical amenities, is a contextual variable that hosts different racial groups and offers health benefits for its inhabitants. Architects and social geographers understand that the built environment comes from the reproduction of existing human relations and reflects the ongoing construction of social identities (Guo, 2021; Neely and Samura, 2011; Pearce et al., 2012). The race with more advantageous resources often enjoys greater access to quality hospitals, parks, and security venues; racial minorities not only lack access to these higher quality services, but they often are subjected to the contextual effects of venues with detrimental health impacts, such as tobacco outlets, polluting industries, and landfills (Pollock and Elliot Vittas, 1995). Empirical studies show that health-enhancing venues are associated with improved health status and behavior among older adults in the U.S. (Li et al., 2005; Spring 2017). Different scenescapes are associated with exercise and dietary routines, at-risk behaviors, and stress (Silver and Clark, 2016). The presence of alcohol and tobacco venues in a context is associated with increased smoking and binge drinking rates after controlling for individual characteristics (Barnett et al., 2017; Gruenewald, 2007).

Besides the built environment, scholars have researched contextual socioeconomic indicators and policy measures as determinants of health disparities (Miao and Wu, 2016; Ross and Mirowsky, 2008; Yang, 2017). In terms of policy measures, Lu and Yang (2022) found that religious minorities across the world suffer from worse health only under autocratic regimes. These contextual factors may affect health outcomes through various more proximate possibilities, as delineated in the right panel of Fig. 1.

2.1. Study design

This study has two main aims. The first is to reveal the extent of health inequality between Han and Turks living in XUAR as indexed by household death incidence and county death rate. We will first demonstrate the crude death rate at the county-level for Han and Turks and contrast their difference. Second, we will proceed to analyze death incidence data at the individual-level. This study tests the sets of variables corresponding to the conceptual pathways outlined in Fig. 1 on how racial/ethnic identity affects mortality. Having the proportion of variance in health inequality explicable by the known factors, we may then infer how much of the health inequality is additionally caused by unjust differential treatment (aka. “inequity”) and other non-observed factors.

2.1.1. Sample

Nationally representative surveys in China are rarely regionally representative of XUAR or tend to exclude XUAR entirely. The decennial censuses do not contain detailed information beyond basic demographics. The analytical objectives of this study require representative data from XUAR comprised of death indicators and relevant social and physiological measures. The most recent Microcensus from 2015 is the best available data source to test our research question. We analyze the XUAR subset of the 2015 China Microcensus. The China Microcensuses are a series of intercensal surveys that sampled 1% of all populations from a representative sampling frame every ten years. The China Microcensus collects samples from every sub-municipal unit in both rural and urban areas; then, multiple sites at the street and village-level are sampled within each sub-municipal unit and households from each site were visited. The 2015 China Microcensus started on November 1, 2015 and was completed on November 15,2015.[2] With the centralized coordination of a widespread network comprised of 7 million surveyors across the country, its coverage is the largest among all surveys except for the decennial census.

The population in 2010 XUAR was 21.82 million, and the total sample size in the original Microcensus is about 1% of that population. Our analysis is based on a 15% random sample (N = 34,516) drawn and released by the State Statistical Bureau using interval selection. This practice is conventional (Zhu et al., 2014). For our analyses, we excluded respondents younger than 15 years old because they did not compete the full survey (n = 6684). Fig. 2 shows the samples on the map of XUAR. All municipals and populated areas have been sampled, while the uninhabited areas (e.g., desert and mountain areas) have relatively few or no cases.

2.1.2. Subpopulations in the sample

The full census dataset consists of 40.3% Han (n = 13,898), 53.1% Turks (n = 18,332), and 6.6% others (n = 2276). We combine Kazakh, Kirgiz, Uzbek, Tatar, and Salar with Uyghur to form the Turk group. After excluding other racial/ethnic groups and respondents younger than 15 years old, the analytical sample sizes are 44% Han (n = 10,885) and 46% Turks (n = 12,293). In subsequent analyses, inequality in death rates is compared between Han and Turks. In Fig. 2, Turkic samples are denoted by turquoise dots and Han samples by red dots.

2.1.3. Measurements

Deaths: This study estimates the household-level death incidences and county-level crude death rates. Each household was assessed by the question: "Has a member in the household died in the past 12 months since November 1, 2014?" The number of deceased household members was a count variable. This quantity is the death incidence in *h*th household (m_h). The crude death rate of county *j* is calculated as $\sum_{h\in j}\frac{m_h}{n_j}*1000$, where n_j is the sample size of county *j*. For all sampled households in county *j*, the summation of death incidences divided by *j*'s sample size and multiplied by 1000 is the crude death rate per thousand people.

The 2015 China Microcensus does contain a section with information about the deceased, but that specific data is highly protected and not accessible to us. Thus, our analytical unit is not the *i*th deceased individual, but their household coresident *i'*. Although we cannot identify the probability of *i*th death given *i*th person's background with the probability of *i*th death given *i*th person's coresident's background, i.e. $P(m_i|x_i)\neq P(m_i|x_{i'})$, it is practical to estimate death incidences given *i*th deceased person's coresident's background because the deceased and alive persons share the same household information, that is $P(m_h|x_i)\approx P(m_h|x_{i'})$. This approximation depends on the degree of correlation between x_i and $x_{i'}$, Suppose $x_i = \beta x_{i'} + \epsilon$, the error term comes from the incongruence between the household members' personal characteristics that cannot be modeled by the observed variables of the alive members. Applying the causal terminology, we are essentially estimating the causal mediation effect through the coresidents of the deceased and assuming the background differences between the deceased and alive members of a household are not *systematic* at the population level, so that $m_h\{x_i, x_{i'=1}\} - m_h\{x_i, x_{i'=0}\} = m_h\{x_{i=1}\} - m_h\{x_{i=0}\} \equiv m_h\{x_{i'=1}\} - m_h\{x_{i'=0}\} = m_h\{x_{i=1}\} - m_h\{x_{i=0}\}$. With all demographic traits and socioeconomic indicators collected from the alive members, such incongruence, or ϵ, should be very limited when estimating household death incidences m_h, instead of individual death incidence m_i. In short, although a death incidence is contingent on the deceased person's traits, death incidences in a household are contingent on the traits of the household, including alive household members. County-level crude death rate ($\sum_{h\in j}\frac{m_h}{n_j}*1000$) should not be affected.

Individual-level characteristics: Several indicators of background information were assessed for each respondent and each household. We created the following variables that may reflect the underlying racial gap. Housing space per person is the division of the total floorplan by the number of household members. Education is reported at eight levels: no formal education, elementary school, middle school, high school, vocational school, college, and graduate school. The deprivation index summates without weighting the presence of undesirable assets and conditions in each household or for each respondent, which are conventionally asked in Censuses (Townsend et al., 1988): not owning a car, not having a latrine or kitchen in the house, being illiterate, and being currently unemployed. This deprivation index ranges from 0 to 5, with a mean of 2.6. We also controlled for sex and age, and set household size as an exposure factor because death incidence m_h is a function of the number of at-risk individuals.

To avoid survival bias (a.k.a. The healthy migrant effect) that conflates death incidences with the propensity of returning home to die among dying individuals, this study also considered the length of stay in one's origin place. The Microcensus asked: "How long has it been since you left the original place of hukou registration?" Response choices are: never, less than half year, half year to 1 year, 1–2 years, 2–3 years, 3–4 years, 4–5 years, 5–10 years, and more than 10 years. We will show that the death disparity between the two groups is not a result of survival bias (i.e., all Han are not immigrants who tend to leave XUAR when dying).

Context-level characteristics: Several contextual factors were measured in additional data sources and compiled into the Microcensus. In theory, contextual effects are distinguished from compositional effects by virtue of not originating from the aggregated attributes of the sampled individuals. In practice, scholars often look for contextual variables in additional data sources and match them with the original sample at the same ecological units, whereas compositional variables are generated by calculating the values in the original sample (Ross and Mirowsky, 2008). We simultaneously represent the concepts of institutional resources and built environment with the measurement of venues that tend to have important societal functions (Sampson et al., 2002; Silver and Clark, 2016). Specifically, we focus on the following venues that may impact the mental and physical health of Turks in XUAR: hospitals, parks, mosques, police stations, Halal restaurants, and Han (haram) restaurants. The Microcensus data includes the physical addresses of the interviewed households, from which we obtained geographical coordinates and then assessed the number of those venues within a 5-km range of each household's coordinates. Geo-information was then accessible by the API service from Amap,[3] from which we have conducted using a mass web-extraction approach. We also controlled for county-level urbanization rate (portion of residents with urban household-registration), the size of tertiary industry (portion of the third (service) industry in the economy), and the unemployment

[2] http://www.stats.gov.cn/ztjc/zdtjgz/cydc/.

[3] Accessible at https://lbs.amap.com/api/webservice/summary/.

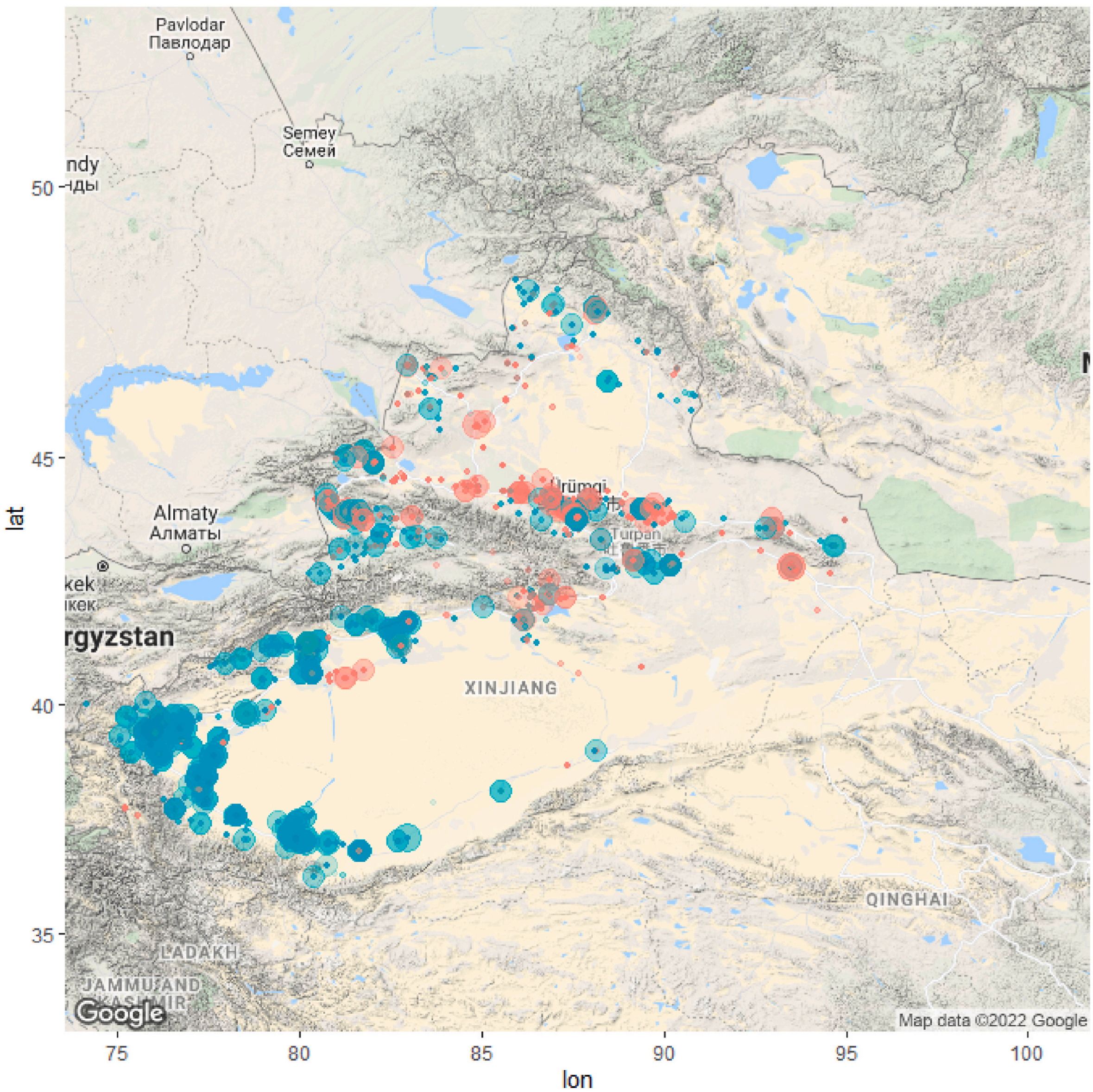


Fig. 2. Geographic Distribution of the Sample by Ethnicity and Death Incidences
Turquois denotes Turks, red denotes Han, dot size by the number of deaths (0–2) in the household in the precedent 12 months. Dots overlap if they are from the same sample site. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

rate. This county-level information was compiled from the 2010 National Census of China.

We also created from the Microcensus sample four compositional variables to operationalize the concepts of interracial dynamics and healthcare coverage. For interracial dynamics, we measured minority share as the percentage of minorities (non-Han population) at the county-level. Then, to measure *diversity*, we adopted the Simpson dissimilarity index: $D = 1 - \frac{\sum_j n_{kj}(n_{kj}-1)}{N_j(N_j-1)}$, where n_{kj} is the population of kth race in jth county. The Simpson index has a lower and upper limit from 0 to 1. To measure *segregation*, we first calculated an Entropy Diversity $E = \sum_t \frac{n_{kt}}{N_t} * \ln\left(\frac{N_t}{n_{kt}}\right)$ for t sub-context (survey neighborhood). Then, Entropy multigroup segregation index in each county is $H = 1 - \sum_j \frac{n_j}{Nj} * E$ (Reardon and Firebaugh, 2002), which also has a lower bound of 0 and an upper bound of 1. The diversity index measures how many different ethnic groups co-exist in a county, whereas the segregation index measures the extent to which these groups concentrate in their own neighborhoods. For healthcare coverage (i.e. the uninsured share), we calculated the county-level group-mean (percentage) of individuals who were not covered by any medical insurance.

2.1.4. Analysis

We first conduct descriptive analyses of county-level crude death rates (per thousand people), stratified by race and adjusted for covariates that may confound racial inequality in the death rate. In the second part, for samples above 15 years of age, we use step-wise Poisson regressions on death incidences from the baseline model to a full model with the individual- and context-level covariates to demonstrate whether and to what extent the racial fixed-effect is explained by these variables. We also allowed the coefficient of race and the intercept to vary across all counties randomly. Poisson regression provides a reasonable approximation of the binomial distribution that describes the occurrence of low-probability events such as death. Finally, we performed a sensitivity test using per-household mortality rate as an alternative dependent variable under OLS modeling and iterative combinations of covariates to assess the coefficient stability of race. Primary analyses were conducted in R, with the addition of "lme4" package (Bates et al., 2014).

3. Results

Table 1 contains descriptive statistics for all quantitative variables with ordered intervals or continuous values. At the individual level, Han households reported an average of 0.035 deaths in the past 12 months, whereas Turkic households reported 0.116—a rate almost three times higher. Observers might anticipate this gap in Fig. 2, where the size and clustering of turquoise dots indicate more deaths among Turkic households. The crude death rate per thousand people is 5.39 among Han and 12.83 among Turks at the context level. Table 1 reports individual and contextual level differences between Han and Turks. Overall, compared to Turks, Han people are better educated (3.71 vs. 2.96), score lower on the deprivation index (2.35 vs. 2.83), have smaller households (3.43 vs. 4.75 persons) and larger dwellings (31.74 vs. 26.34 square meters), and are more likely to be migrants (1.67 vs. 1.21). The counties (qu/xian) Han reside in more urbanized (53.08 vs. 29.52), more diverse (0.43 vs 0.30) but lower in the absolute proportion of minorities (0.36 vs 0.76), less segregated (0.58 vs 0.61), have a larger tertiary industry (36.26 vs. 20.39) and have higher rates of uninsured (0.08 vs 0.04) and unemployed (0.27 vs 0.20). In terms of functional venues and amenities, Han people have greater access to more of these resources.

Table 1
Descriptive statistics of quantitative variables by race.

Individual-level	Han (n = 10,885)		Turk (n = 12,293)		*t*-test statistic
	mean	s.d.	mean	s.d.	T, p-value
Death incidence in household	.035	.192	.116	.339	22.9, .000
Deprivation index	2.35	.98	2.83	1.12	50.7, .000
Household size	3.43	1.49	4.75	1.81	62.0, .000
Educational level	3.71	1.70	2.96	1.34	−39.3, .000
Age	38.01	19.33	29.23	19.56	−24.3, .000
Time left hukou	1.67	.94	1.21	.58	−38.2, .000
Uninsured	.089	.286	.033	.180	−15.8, .000
Marital status					16.8, .001[a]
-single	19.4%		20.0%		
-married	73.3%		71.4%		
-divorced	2.7%		3.4%		
-widowed	4.5%		5.1%		
Context-level					
Crude death rate at county-level	5.39	29.12	12.83	40.03	15.5, .000
Urbanization	53.08	18.07	29.52	19.33	−96.3, .000
Tertiary industry	36.26	18.24	20.39	15.23	−71.1, .000
Unemployed rate	.27	.06	.20	.10	−54.6, .000
Halal food	105.29	186.43	24.96	85.29	−39.3, .000
Haram food	115.07	177.67	30.67	85.48	−44.8, .000
Mosque	8.72	15.72	2.52	7.76	−35.2, .000
Hospital	16.26	27.41	7.15	15.14	−31.6, .000
Police station	54.27	78.93	19.28	40.95	−40.7, .000
Park	3.54	4.18	1.37	2.48	−47.5, .000
Simpson Diversity	.43	.17	.30	.22	−30.3, .000
Entropy Segregation	.58	.14	.61	.24	7.10, .000
Minority Share	.36	.22	.76	.24	123.8, .000
Uninsured share	.08	.05	.04	.04	−66.7, .000

[a] Test for this categorical variable is done with chi-square test of association.

3.1. Death rates

We have seen in the previous paragraph that, whether by the measure of death incidences in the household or crude death rate per county, the death rate among the Turks is exorbitantly higher than that of the Han. Further, the death gap remains strong even after we have adjusted per-county death rates for household size and the time length of migration, as shown in Fig. 3.

The first graph in Fig. 3 illustrates that even among XUAR natives (therefore without selection biases induced by migration), the death gap between Turks and Han is stable. For those who have never left their original hukou, the death rate is close to 14 among Turks and less than five among Han. Among short-term migrants who have left their original hukou for less than five years, the racial inequality in the death rate persists. On the other hand, the gap closes for longer-term migrants. Death rates stratified by migratory length partly confirm the existence of a selection effect that migrants tend to be healthier than the native-born. However, it does not explain the death gap between Han and Turks.

Death rates stratified by household size do not show a clear and consistent pattern of the racial gap in death as a function of household size. The average household size is 3.4 for Han and 4.8 for Turks, and death rates are consistently higher for Turks when the household size is smaller than 5. In rare cases of households with more than seven people, Han's death rates are higher, but we are cautious about its interpretation due to the small number of these largest households.

3.2. Death incidences in households

County-level aggregate data have demonstrated the racial disparity in death in XUAR even after adjusting for migratory length and household size. In Table 2, we report multivariate regressions on death incidences to determine the contributing factors of the disparity. The baseline Poisson logistic regression with no random effects shows the incidence rate ratio (IRR) of death induced by being Turk is 3.71. This IRR means that being a Turk increases the risk of having one more death in the household by 3.71 times ($p < .001$). The mortality gap still exists in model 2, where the effect of being Turk is allowed to vary randomly across counties, at a magnitude of 3.56 ($p < .001$). Model 3 shows that even after including a set of individual-level demographic and socioeconomic covariates, the risk of having one more death incidence in a Turkic household remains elevated at 2.39 times higher compared to Han ($p < .001$). Among those individual-level demographic and socioeconomic covariates, larger household size is associated with a higher IRR of death (1.47, $p < .001$). Longer migratory length is negatively associated with the IRR of death (0.91, $p < .05$), suggesting the effect of "healthy migrants." Compared to the never-married, the currently married are 4.46 times ($p < .001$) more likely to report one more death in their households, the divorced are 2.53 times, and the widows are 7.13 times ($p < .001$) more likely to report more deaths. Age is negatively associated with death incidences in the household (0.97, $p < .001$) after controlling for marital status.

Finally, model 4 adds context-level variables. In regard to the contextual effects, death incidence is inversely associated with the urbanization rate (0.98, $p < .01$) but is proportional to the size of the tertiary industry (1.03, $p < .01$). Among neighborhood venues, we found that after controlling for the number of other venues, the number of Halal restaurants within the 5 km range is associated with more death incidences (1.004, $p < .05$), but the number of hospitals is inversely associated with death incidences (0.98, $p < .05$). The model did not detect any significant compositional effects as healthcare coverage,

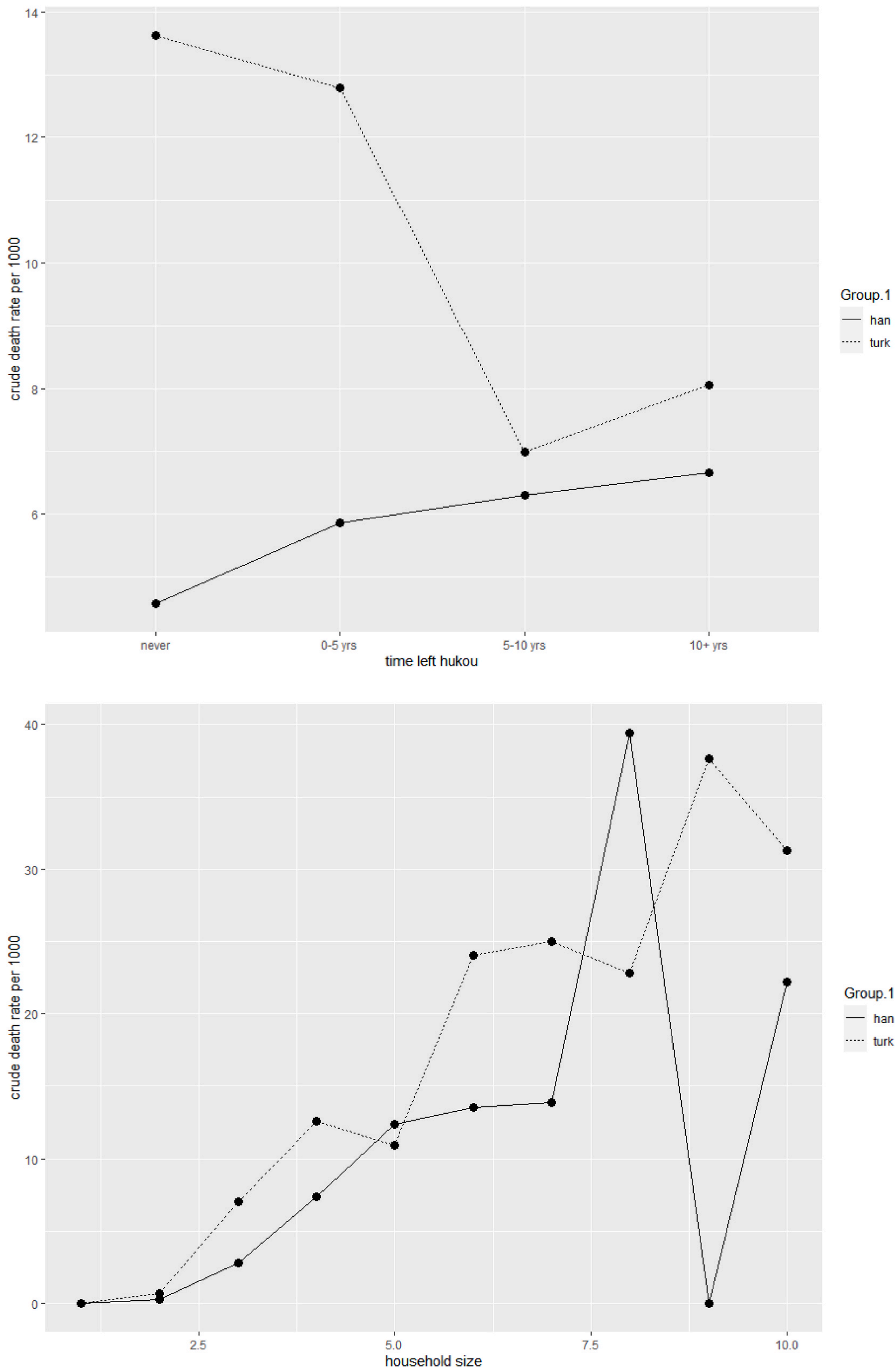


Fig. 3. County-level crude death rates stratified by race, adjusted for the migratory status and size of the household.

Table 2
Multivariate Poisson regression models of death incidences in households Configured by random effects and covariates.

DV: Death incidence	Model 1 ($n_i = 24507$, $n_j = 106$		Model 2 ($n_i = 24507$,$n_j = 106$)		Model 3 ($n_i = 24413$, $n_j = 106$)		Model 4 ($n_i = 24360$, $n_j = 98$)	
	IRR[a]	S.E.	IRR	S.E.	IRR	S.E.	IRR	S.E.
Race (Turk)	**3.71*****	**.06**	**3.56*****	**.17**	**2.39*****	**.18**	**2.24*****	**.17**
Deprivation index					.98	.03	.95	.03
Household size					1.47***	.01	1.46***	.01
Educational level					.98	.02	.98	.02
Gender (female)					.91	.05	.92	.05
Marital status (ref. = single)								
Married					4.46***	.10	4.39***	.10
Divorced					2.53***	.20	2.49***	.20
Widowed					7.13***	.19	6.97***	.19
Age					.97***	.00	.97***	.00
Time left hukou					.91*	.04	.91*	.04
Uninsured					1.07	.14	.99	.15
Context-level variables								
Urbanization							.98**	.01
Tertiary industry							1.03**	.01
Unemployment rate							.21	.97
Halal food							1.004*	.002
Haram food							.99	.00
Mosque							.98	.01
Hospital							.98*	.007
Police station							.99	.00
Park							1.03	.03
Uninsured share							6.57	2.19
Simpson Diversity							.81	.42
Entropy Segregation							1.33	.33
Minority Share							1.00	.00
Log likelihood, degree of freedom	−5541, 24506		−5338, 24502		−4687, 24398		−4635, 24332	
AIC, BIC	11086, 11103		10686, 10726		9405, 9526		9327, 9553	
Random Effects:								
Variance (Intercept)	–		1.43	1.19	1.37	1.17	1.00	1.00
Variance (Turk)	–		.95	.98	1.06	1.03	.79	.89

p level: *<0.05, **<0.01, ***<0.001. Model 1 is a baseline Poisson regression with no random effect and only race as the independent variable. Random effect varies across counties.

[a] Incidence rate ratio (IRR) is the odds that a higher count occurs on the Poisson distribution, $IRR = \exp\left[\log\left(\frac{\mu_{x+1}}{\mu_x}\right)\right] = \frac{\mu_{x+1}}{\mu_x}$.

diversity, segregation, and minority share were not associated with death incidence. With all covariates accounted for, the racial gap in death is reduced but remains significant. Being a Turk still means 2.24 times higher IRR of death compared to Han ($p < .001$).

From models 1 to 4, the AIC suggests each model improves statistical fit over the previous model. The BIC declines slightly from model 3 to model 4, implying that model 4 is not parsimonious with many non-significant covariates, albeit having increased explanatory power according to the AIC and log-likelihood. The descending random effects of the intercepts suggest that each new model subsequently explains more between-context variance in death incidences. Individual-level characteristics accounted for 33.6% (=(1.31-0.87)/1.31) of the health penalty associated with Turkic identity, and context-level factors explained another 6.9% (=(0.87-0.81)/.87).

3.3. Sensitivity tests

Analytical results are often sensitive to the quality of the dependent variable. Some readers might wonder whether the death rate measured by the Microcensus data available to us is a reliable and valid representation of the true death rate in XUAR, and whether the precedent findings based on the Microcensus would remain stable in the national decennial census. The first graph in the Appendix contains three demographic indicators at the county level from the 2010 National Census of China: birth rate, death rate, and natural growth rate. All three basic demographic indicators of XUAR are positively associated with the death rate that we computed, suggesting that the death rate in our study is a valid measure.

One of our core objectives is to document and describe the distribution of the race effect. Our main models reveal that race has a significant and non-zero effect on deaths. However, the conventional statistical approach to test a coefficient always involves randomness, and the coefficient itself could be an unstable random parameter.[4] To address this concern, we conducted bootstrap resampling of the coefficients and showed their frequency distributions in Appendix B. The 400 bootstrapped coefficients of the race variable indicate that all coefficients are above zero and normally distributed. In addition, to ensure our results are robust against different distribution functions, we used Rao's "starbility" package to repeat OLS regressions on the mortality rate per household with different combinations of the control variables. Appendix C shows that, under all possible combinations of covariates, the race variable in OLS regression is a consistent risk factor of mortality rate with a p-value always below 0.01. Therefore, we are confident about the robustness of the race coefficient in terms of its magnitude and significance under different configurations.

4. Discussion

Race is among the most common examples of ascribed status. It prescribes a set of conditions and constraints that affect one's health outcomes. In the far west region of China, many distinct minority groups coexist with the Han majority, but few empirical studies have explored the racial/ethnic disparity in death rates. The lack of research on racial health disparities in China falls short of satiating the growing curiosity

[4] https://statmodeling.stat.columbia.edu/2018/05/29/exposure-forking-paths-affects-support-publication/.

questioning the consequences of race relationships and dynamics in China. To address this gap, the current study used the 2015 Microcensus of China, linked it to the 2010 National Census of China, and web-scrapped geographical venue information to investigate the disparity of death incidences and death rates between Turks and Han in XUAR.

The crude death rate among Turks (12.83) is more than twice the rate among Han (5.39). Various forms of selection bias manifested as the Salmon Effect or survivor bias, may contribute to this gap because many Han people could have been immigrants who have returned to their hometowns before dying. In addition, the death incidences may non-monotonously increase with the size of the at-risk population. However, we showed that even after ruling out the healthy migrant scenario, the death rate among the Turks remains twice as high as the Han. The death gap is smaller only among migrants who had departed their original hukou more than five years ago. This reduction suggests that the healthy migrant scenario holds partially, but migratory status cannot explain the disparity of death rates between Han and Turks in XUAR. Stratifying by household size does not eradicate the death rate differential either.

Race is an upstream determinant that embodies variable resources that are beneficial to health (Ingleby, 2019; Mays et al., 2007; Phelan and Link, 2015). In Fig. 1, we divided into two ecological levels the causal pathways for racial identity to influence health outcomes: the individual- and context levels. At the individual level, people with resource advantages will likely experience better health outcomes (Phelan and Link, 2015). Minority individuals may also possess distinct cultural practices and habitus that affect their health behaviors (Dressler et al., 2005). Race as an interactive construction arising from repeated interactions and recognition between groups also involves certain attitudes and emotive states that may affect health (Brown, 2003). Interpersonal discrimination and hostility are associated with the stress level and mental health of racial minorities (English et al., 2014; Mays et al., 2007). On a higher ecological level, people of different racial groups are subjected to context-level influences, which lead to the shifting mechanisms that arrange institutional resources and distribute risks. Some of these influences occur through compositional effects—arising from the collective characteristics of the people who constitute the place, such as racial diversity, segregation, turnover rate, and so on (English et al., 2014; Hunt et al., 2007; Lu and Yang, 2020; Sampson, 1984; Yang et al., 2019). It may also occur through contextual effects that pertain to the environment and attributes of the place *per se* (Pearce et al., 2012; Ross and Mirowsky, 2008; Silver and Clark, 2016).

When we added a variety of individual and contextual covariates in a series of Poisson regression models, the race effect remained strong and significant. The effect of being Turk on the death risk decreased from 3.71 in the baseline model to 2.24 in the final model, but the coefficients were all significant at 0.001 level. This suggests Turks are, at least, more than twice as likely to have more deaths compared to Han. Additional sensitivity tests showed that the true race effect is improbably 0, no matter what configuration the model takes. Neither the covariates nor their combinations fully explained the race effect on death. Significant covariates that partially explain the death disparity include household size, marital status, and migratory length. The deprivation index, to our surprise, is not associated with death incidence, underscoring the significance of race over socioeconomic status in the death gaps between Turks and Han. At the context level, a higher urbanization rate and more hospitals are associated with fewer deaths. A higher rate of tertiary industry and more Halal eateries are associated with more deaths. We suspect such associations arise from Turks being more likely to live in areas with more Halal eateries and service jobs. These significant variables altogether accounted for 38% of the death disparity between Turks and Han ((1.31-0.81)/1.31 = 0.38). No policy may realistically induce a concomitant increase in all of these significant variables, but developers and policymakers may consider reducing death incidences by building more hospitals in the neighborhoods and accelerating urbanization.

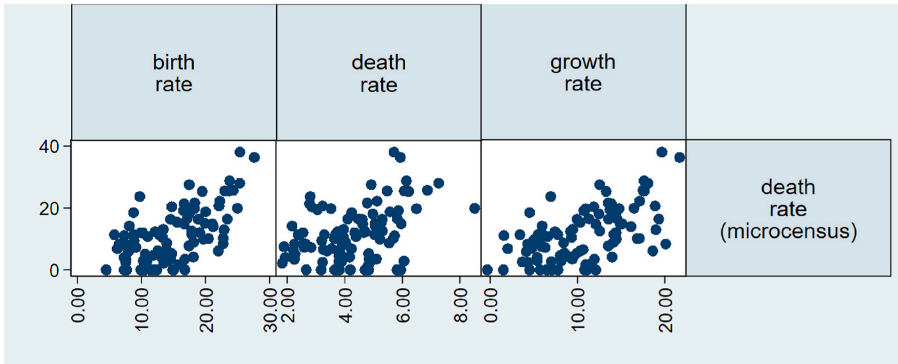
This study has achieved its goal of revealing the death disparity between races and narrowing down the contributing causes of the disparity. The causes behind health inequality can be divided into three exclusive origins: 1) that which is explicable by observed data, 2) that which is theoretically explicable but unobserved in data, and 3) that which cannot be attributed to any known pathways. Scholars consider the third type the unjust cause of health inequality and, thus, the component of health inequity. Our findings claim that the observed variables informed by our theory-driven framework can explain 38% of the death disparity. Absent are the full spectrum of possible contributing factors, and thus, our study cannot claim that the remaining 62% of the death disparity can be fully attributed to racial identity effect or discriminatory treatment. Nevertheless, our findings indicate the pure effect of race on health is rather considerable because all the observed downstream derivatives cannot even explain half of the disparity. We urge scholars to attend to this inequity and policymakers to improve the condition with evidence-based governance.

Admittedly, racial disparities lead to a series of severe social problems in the Western multicultural societies no less than that in China. These disparities often reflect broader social and economic inequities that affect different racial and ethnic groups. In the United States, for example, studies have consistently shown higher mortality rates among certain racial and ethnic groups, such as African Americans and Native Americans, compared to White Americans (Deaton and Lubotsky, 2003; Jackson et al., 2000; Phelan and Link, 2015). While social structural causes behind the racial disparities in the Western context are perennial, an intrinsic structural feature that highlights the racial disparities in health in China as a distinct case is: the Stalinist ethno-classification system deliberately assigns a fixed ethnic identity to every individual, which is shown on one's identification documents and follows throughout the entire life course. Such a fixed and prescribed racial/ethnic identity affects the full spectrum of one's social life, more often negatively (Harrell, 2012; Ubiria, 2016; Wang, 1998). As a result, a conspicuously prescribed racial status may force individuals to face qualitatively different treatments in social life and develop distinct strategies to cope with inequalities. Whereas mixed race and racially alternatively self-identification are increasingly common in Western societies, the prescribed identity system in China makes it impossible for people to break ethnic boundaries or dilute the importance of racial status in life decisions. The death gap we studied between Han and Turks is only one aspect of the importance of racial status in China.

Declaration of competing interest

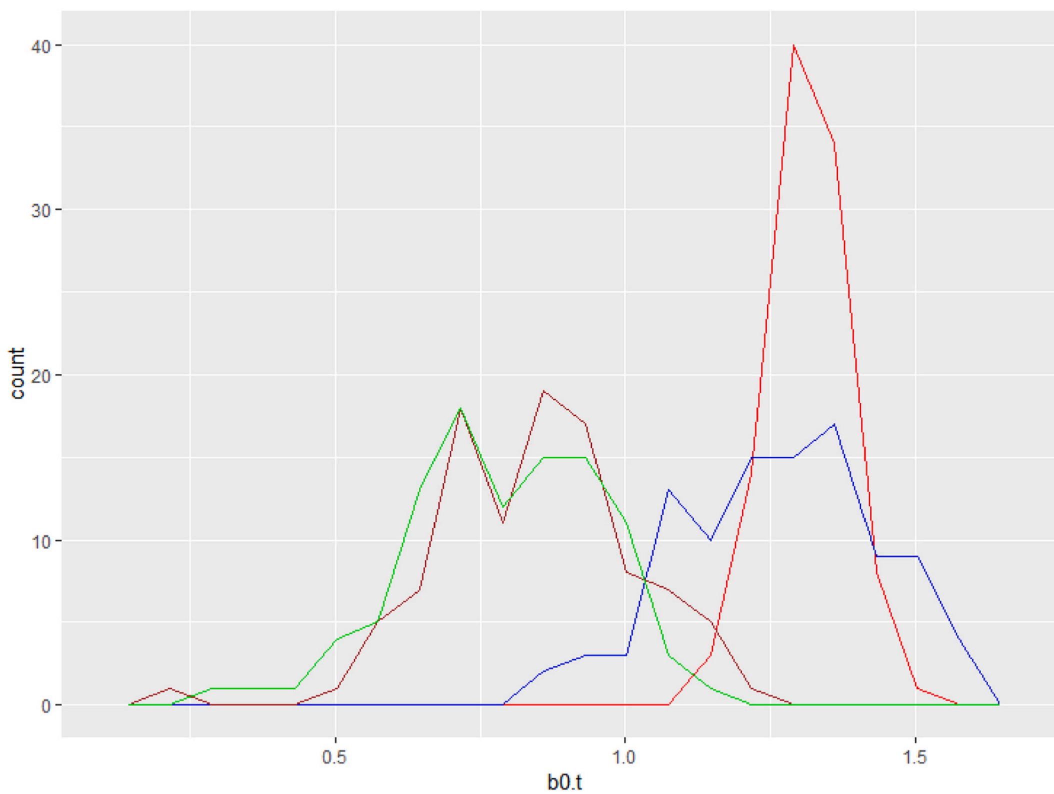
The authors claim no conflict of interest in this study.

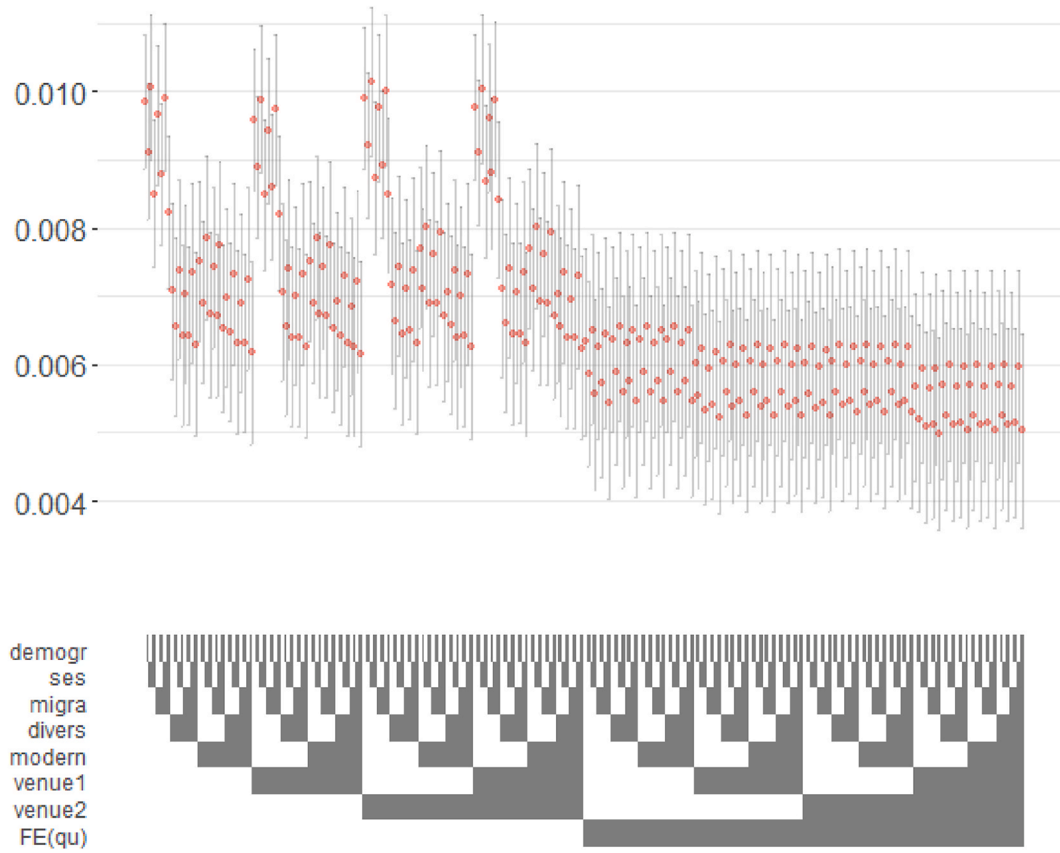
Addendum A. Correlation matrix between demographic indicators in the 2010 National Census and crude death rate in the 2015 Microcensus, each dot is a county.



Addendum B. Frequency Distribution of 400 Bootstrapped Coefficients of the “Turk” fixed effects from Model 1 to Model 4. Red = model 1, blue = model 2, brown = model 3, green = model 4.

Addendum C. Coefficient stability under different combinations of controls in OLS. Dependent variable is death rate per household, independent variable is Turk. Red denotes p < .01.





Data availability

publicly available data.

References

Barnett, Ross, Moon, Graham, Pearce, Jamie, Thompson, Lee, Liz, Twigg, 2017. Smoking Geographies: Space, Place and Tobacco. John Wiley & Sons, West Sussex, UK.

Bates, Douglas, Mächler, Martin, Ben, Bolker, Walker, Steve, 2014. Fitting linear mixed-effects models using lme4. J. Stat. Software 67 (1), 1–48.

Brown, Tony N., 2003. Critical race theory speaks to the sociology of mental health: mental health problems produced by racial stratification. J. Health Soc. Behav. 292–301.

Brown, Tyson H., 2018. Racial stratification, immigration, and health inequality: a life course-intersectional approach. Soc. Forces 96 (4), 1507–1540.

Chae, David H., Takeuchi, David T., Barbeau, Elizabeth M., Bennett, Gary G., Lindsey, Jane, Krieger, Nancy, 2008. Unfair treatment, racial/ethnic discrimination, ethnic identification, and smoking among asian Americans in the national latino and asian American study. Am. J. Publ. Health 98 (3), 485–492.

Collins, Patricia Hill, Bilge, Sirma, 2016. Intersectionality. Polity Press, Malden, MA.

Deaton, Angus, Lubotsky, Darren, 2003. Mortality, inequality and race in American cities and states. Soc. Sci. Med. 56 (6), 1139–1153.

Dressler, William W., Kathryn, S Oths, Clarence, C Gravlee, 2005. Race and ethnicity in public health research: models to explain health disparities. Annu. Rev. Anthropol. 34, 231–252.

Du, Ruofu, Xiao, Chunjie, Cavalli-Sforza, L., 1997. Genetic distances between Chinese populations calculated on gene frequencies of 38 loci. Sci. China C Life Sci. 40 (6), 613–621.

Duncan, Craig, Jones, Kelvyn, Moon, Graham, 1998. Context, composition and heterogeneity: using multilevel models in health research. Soc. Sci. Med. 46 (1), 97–117.

Elo, Irma, 2009. Social class differentials in health and mortality: patterns and explanations in comparative perspective. Annu. Rev. Sociol. 35 (1), 553–572.

English, Devin, Lambert, Sharon F., Evans, Michele K., Zonderman, Alan B., 2014. Neighborhood racial composition, racial discrimination, and depressive symptoms in african Americans. Am. J. Community Psychol. 54 (3), 219–228.

Gladney, Dru C., 1998. Ethnic Identity in China: the Making of a Muslim Minority Nationality. Harcourt Brace College Publishers Fort Worth, TX.

Gruenewald, Paul J., 2007. The spatial ecology of alcohol problems: niche theory and assortative drinking. Addiction 102 (6), 870–878.

Guo, Kecen, 2021. Structure as Spatial Generator. ISSUU, Melbourne issuu.com/yoyoguo/docs/kecen_guo_archfolio_.

Hannum, Emily, Xie, Yu, 1998. Ethnic stratification in northwest China: occupational differences between han Chinese and national minorities in Xinjiang, 1982–1990. Demography 35 (3), 323–333.

Hao, H., 1990. An analysis of discrepancies in China's child mortality rate. Chin. J. Popul. Sci. 2 (4), 339–349.

Harrell, Stevan, 2012. Ways of Being Ethnic in Southwest China. University of Washington Press, Seattle.

Huang, Y., Shallcross, D., Pi, L., Tian, F., Pan, J., Ronsmans, C., 2018. Ethnicity and maternal and child health outcomes and service coverage in western China: a systematic review and meta-analysis. Lancet Global Health 6 (1), e39–e56.

Hunt, Matthew O., Wise, Lauren A., Marie-Claude, Jipguep, Cozier, Yvette C., Rosenberg, Lynn, 2007. Neighborhood racial composition and perceptions of racial discrimination: evidence from the black women's health study. Soc. Psychol. Q. 70 (3), 272–289.

Ingleby, David, 2019. Moving upstream: changing policy scripts on migrant and ethnic minority health. Health Pol. 123 (9), 809–817.

Jackson, Sharon A., Anderson, Roger T., Johnson, Norman J., Paul, D Sorlie, 2000. The relation of residential segregation to all-cause mortality: a study in black and white. Am. J. Publ. Health 90 (4), 615.

Legerton, Colin, Rawson, Jacob, 2009. Invisible China: A Journey through Ethnic Borderlands. Chicago Review Press, Chicago, IL.

Li, Fuzhong, Fisher, K John, Brownson, Ross C., Bosworth, Mark, 2005. Multilevel modelling of built environment characteristics related to neighbourhood walking activity in older adults. J. Epidemiol. Community Health 59 (7), 558–564.

Li, Jianxin, Chang, Qingling, 2015. Xinjiang ge zhuyao minzu renkou xianzhuang ji bianhua tezheng. Northwest Journal of Ethnology (Chinese) 86 (3), 21–36, 47.

Link, Bruce, Phelan, Jo, 2010. Social conditions as fundamental causes of health inequalities. In: E Bird, Chloe (Ed.), Handbook of Medical Sociology, Peter Conrad, Allen M Fremont, and Stefan Timmermans. Vanderbilt University Press, Nashville, TN.

Lu, Yun, Yang, Xiaozhao Y., 2020. The two faces of diversity: the relationships between religious polarization, religious fractionalization, and self-rated health. J. Health Soc. Behav. 61 (1), 79–95.

Lu, Yun, Yang, Xiaozhao Y., 2022. Health disparities between religious majority and minority: a cross-national analysis. Rev. Relig. Res.

Mays, Vickie M., Cochran, Susan D., Barnes, Namdi W., 2007. Race, race-based discrimination, and health outcomes among african Americans. Annu. Rev. Psychol. 58, 201–225.

Miao, Jia, Wu, Xiaogang, 2016. Urbanization, socioeconomic status and health disparity in China. Health Place 42, 87–95.

Mirowsky, John, Ross, Catherine E., 2003. Social Causes of Psychological Distress. Aldine de Gruyter, Hawthorne, NY.
Neely, Brooke, Samura, Michelle, 2011. Social geographies of race: connecting race and space. Ethn. Racial Stud. 34 (11), 1933–1952.
Nie, Fanhao, Yang, Xiaozhao Y., 2019. The moral community divide: underage marijuana use across religious contexts. J. Sci. Stud. Relig. 58 (1), 153–173.
Pearce, Jamie, Barnett, Ross, Moon, Graham, 2012. Sociospatial inequalities in health-related behaviours. Prog. Hum. Geogr. 36 (1), 3–24.
Perdue, Peter C., 2009. China Marches West: the Qing Conquest of Central Eurasia. Harvard University Press, Cambridge, MA.
Phelan, Jo C., Bruce, G. Link, 2015. Is racism a fundamental cause of inequalities in health? Annu. Rev. Sociol. 41 (1), 311–330.
Pinxten, Wouter, Lievens, John, 2014. The importance of economic, social and cultural capital in understanding health inequalities: using a Bourdieu-based approach in research on physical and mental health perceptions. Sociol. Health Illness 36 (7), 1095–1110.
Pollock, Philip H., Elliot Vittas, M., 1995. Who bears the burdens of environmental pollution? Race, ethnicity, and environmental equity in Florida. Soc. Sci. Q. 76 (2), 294–310.
Reardon, Sean F., Firebaugh, Glenn, 2002. Measures of multigroup segregation. Socio. Methodol. 32 (1), 33–67.
Roberts, Dorothy E., 2008. Is race-based medicine good for us?: African American approaches to race, biomedicine, and equality. J. Law Med. Ethics 36 (3), 537–545.
Ross, Catherine E., Mirowsky, John, 2008. Neighborhood socioeconomic status and health: context or composition? City Community 7 (2), 163–179.
Ross, Catherine E., Mirowsky, John, 2010. Why education is the key to socioeconomic differentials in health. In: E Bird, Chloe (Ed.), Handbook of Medical Sociology, Peter Conrad, Allen M Fremont, and Stefan Timmermans. Vanderbilt University Press, Nashville, TN.
Sampson, Robert J., 2012. Great American city: Chicago and the Enduring Neighborhood Effect. University of Chicago Press, Chicago, IL.
Sampson, Robert J., 1984. Group size, heterogeneity, and intergroup conflict: a test of blau's inequality and heterogeneity. Soc. Forces 62 (3), 618–639.
Sampson, Robert J., Morenoff, Jeffrey D., Gannon-Rowley, Thomas, 2002. Assessing "neighborhood effects": social processes and new directions in research. Annu. Rev. Sociol. 28, 443–478.
Schuster, Brenda L., 2009. Gaps in the silk road: an analysis of population health disparities in the Xinjiang Uyghur autonomous region of China. China Q. 198, 433–441.
Shaw, Clifford R., McKay, Henry D., 1969. Juvenile Delinquency and Urban Areas: a Study of Rates of Delinquency in Relation to Differential Characteristics of Local Communities in American Cities. Unversity of Chicago Press, Chicago.
Silver, Daniel Aaron, Clark, Terry Nichols, 2016. Scenescapes: How Qualities of Place Shape Social Life. University of Chicago Press, Chicago, IL.
Spring, Amy, 2017. Short- and long-term impacts of neighborhood built environment on self-rated health of older adults. Gerontol. 58 (1), 36–46.
Takeuchi, David T., Walton, Emily, Leung, ManChui, 2010. Race, social contexts and health: examining geographic spaces and places. In: Chloe E Bird, Peter Conrad, Allen M Fremont, and Stefan Timmermans. Vanderbilt University Press, Nashville, TN, pp. 92–105. Handbook of medical sociology.
Townsend, Peter, Peter, Phillimore, Beattie, Alastair, 1988. Health and Deprivation: Inequality and the North. Routledge, London.
Ubiria, Grigol, 2016. Soviet Nation-Building in Central Asia: the Making of the Kazakh and Uzbek Nations. Routledge.
Wang, Mingke, 1998. From the Ch'iang Barbarians to Ch'iang Nationality: the Making of a New Chinese Boundary. Institute of Ethonology, Academia Sinica, Taipei.
Weitz, Rose, 2009. The Sociology of Health, Illness, and Health Care: A Critical Approach. Cengage Learning, Boston, MA.
Wen, Ming, Browning, Christopher R., Cagney, Kathleen A., 2003. Poverty, affluence, and income inequality: neighborhood economic structure and its implications for health. Soc. Sci. Med. 57 (5), 843–860.
Wilkinson, Richard G., Pickett, Kate E., 2006. Income inequality and population health: a review and explanation of the evidence. Soc. Sci. Med. 62 (7), 1768–1784.
Williams, David R., Williams-Morris, Ruth, 2000. Racism and mental health: the african American experience. Ethn. Health 5 (3–4), 243–268.
Williams, David R., Lawrence, Jourdyn A., Davis, Brigette A., 2019. Racism and health: evidence and needed research. Annu. Rev. Publ. Health 40 (1), 105–125.
Wu, Xiaogang, Song, Xi, 2014. Ethnic stratification amid China's economic transition: evidence from the Xinjiang Uyghur autonomous region. Soc. Sci. Res. 44, 158–172.
Yang, Xiaozhao Y., 2017. How community-level social and economic developments have changed the patterns of substance use in a transition economy? Health Place 46, 91–100.
Yang, Xiaozhao Y., Hu, Anning, Scott, Schieman, 2019. Relative deprivation in context: how contextual status homogeneity shapes the relationship between disadvantaged social status and health. Soc. Sci. Res. 81, 157–169.
Yang, Xiazhao Y., Barnett, Ross, Yang, Tingzhong, 2021. Geographical context and cultural practices affecting smoking. In: In Smoking Environments in China, Edited by Ross Barnett, Tingzhong Yang, and Xiazhao Y Yang. Springer, Zurich, pp. 141–174.
Yee, Herbert S., 2003. Ethnic relations in Xinjiang: a survey of uygur-han relations in urumqi. J. Contemp. China 12 (36), 431–452.
Zang, Xiaowei, 2015. Ethnicity in China: A Critical Introduction. Polity Press, Cambridge.
Zhu, Yushu, Fu, Qiang, Ren, Qiang, 2014. Cross-city variations in housing outcomes in postreform China: an analysis of 2005 microcensus data. Chinese Sociological Review 46 (3), 26–54.