RESEARCH REPORT

Neighbourhoods and homicide mortality: an analysis of race/ethnic differences

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Objective: To examine whether measures of neighbourhood economic deprivation, social disorganisation, and acculturation explain homicide mortality differentials between Mexican Americans, non-Hispanic black Americans, and non-Hispanic white Americans, net of individual factors.
Design: Prospective study, National Health Interview Survey (1986–1994) linked to subsequent mortality in the National Death Index (1986–1997).
Setting: United States of America.
Participants: A nationally representative sample of non-institutionalised Mexican Americans, non-Hispanic black Amricans, and non-Hispanic white Americans, aged 18–50 at the point of interview.
Analysis: Cox proportional hazard models estimate the risk of death associated with various neighbourhood and individual factors.
Main results: Both individual and neighbourhood risk factors partially account for race/ethnic disparities in homicide. Homicide mortality risks are between 20% and 50% higher for residents of areas that have economic inequality of 0.50 or greater based on the coefficient of variation, or where 4% or more of the residents are Mexican American, 10% or more of the residents are non-Hispanic black, or 20% or more of the households are headed by single parents ($p \leqslant .05$). But residents of areas where 10% or more of their neighbours are foreign born have 35% lower mortality risks than people living in areas with fewer foreign born people ($p \leqslant 0.05$). These differences persist even after controlling for individual level risk factors.
Conclusions: The findings support economic deprivation, social disorganisation, and acculturation theories, and suggest that both neighbourhood and individual risk factors affect race/ethnic differences in homicide mortality. Public health policies must focus on both individual and neighbourhood factors to reduce homicide risks in vulnerable populations.

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Homicide was the 15th leading cause of death and the 4th leading preventable cause of death in the US in 2000, and Hispanic and non-Hispanic black men aged 18 to 50 comprised a disproportionate share of those deaths.[1 2] Although much research focuses on black/white differences in homicide mortality,[3–8] little work examines homicide mortality among Hispanics or Hispanic subgroups.[9–13] Mexican Americans are the largest Hispanic subpopulation and the most numerous foreign born population in the US.[13 14] Over 10% of the US population is foreign born, of which nearly one third hails from Mexico.[15] Thus, we examine whether neighbourhood characteristics affect Mexican American, non-Hispanic black, and non-Hispanic white differences in homicide mortality, net of individual factors.

Three theoretical perspectives suggest that neighbourhood factors might be associated with homicide mortality. Firstly, economic deprivation theories posit that concentrated poverty and economic inequality may provide people with scant resources to achieve culturally valued goals including high levels of education; safe, secure, and comfortable housing; and well lit, maintained, and patrolled neighbourhoods.[5 6] Residence in areas marked by economic deprivation may hinder the ability of people to obtain loans, gain access to high quality jobs, and receive high quality education.[16–18] Communities that lack sufficient economic resources to improve material and social conditions for their residents may confer higher risks of homicide mortality.[7]

Secondly, social disorganisation theories posit that concentrations of single parent households or racial and ethnic segregation may be associated with lower levels of social control. Social control allows communities to mitigate violent crime by regulating activities within their neighbourhoods through participation in formal and informal organisations.[19] Single parent households may have fewer resources to invest in community participation or volunteer organisations, and provide fewer adults who can monitor neighbourhood activities, intervene in local disturbances, question strangers, and potentially thwart criminal activities.[20 21] High levels of race/ethnic segregation partially derive from past discrimination by the real estate industry, federal housing policy, banking institutions, and neighbourhood organisations that restricted minorities to undesirable residential areas.[17 22–25] Highly segregated areas often have poorer schools, higher taxes, more dilapidated buildings, less political power, and are targeted by alcohol advertisers and display higher rates of drinking than their levels of poverty would suggest—factors that are associated with high levels of violence.[7 17 19 22–30] Areas marked by racial and ethnic segregation and high concentrations of single parent families may provide few resources for achieving social control and political power, assets that could reduce homicide.

Thirdly, acculturation theories suggest that neighbourhoods with high concentrations of foreign born people may protect against homicide mortality. Mexican culture promotes norms and values that regulate activities and promote health, by limiting excessive alcohol and illegal drug use—behaviours that are often associated with homicide.[31–34] Strong social relationships within foreign born communities may emerge from shared experiences and language to help

Abbreviations: NHIS, National Health Interview Survey; NDI, National Death Index; VSA, very small area

facilitate positive economic mobilisation and discourage risky and illegal enterprises. Furthermore, although acculturation may result in higher levels of income and education and access to better jobs, as immigrants integrate into US society they adopt the less healthy norms and values of native non-Hispanic white Americans.[31 32] Acculturation may also lend insight into the epidemiological paradox: Mexican Americans often exhibit low mortality levels that parallel those of non-Hispanic white Americans, although their low levels of income and education would predict higher mortality, as found among non-Hispanic black Americans.[35 36] This paradox has resulted in speculation that neighbourhood factors, such as foreign born communities, may buffer Mexican Americans against mortality risks associated with low socioeconomic status.[31–39]

We investigate three limitations of prior research that examines race/ethnic differences in homicide. Firstly, most work examines homicide victimisation with either ecological[5–7 9 12 16 20 21] or individual level[3 8 10] data, but only one study examines homicide mortality with data from multiple levels.[11] Because both individual and neighbourhood factors associate with overall mortality,[4 40–42] we examine whether risk factors at multiple levels affect race/ethnic disparities in homicide mortality. Secondly, most nationally representative studies of homicide mortality combine multiple Hispanic subpopulations, include Hispanics with non-Hispanic black and white populations, or exclude Hispanics altogether.[3–5 8 10–13] Because some work suggests important variation in violent death among different Hispanic groups,[9] we examine Mexican American and non-Hispanic black and white disparities in homicide mortality. Finally, some research finds that areas with high concentrations of immigrants confer lower risks of overall mortality[40]; but no work examines whether that protective effect extends to homicide mortality. Thus, we examine the effect of the percentage of foreign born people living in an area on homicide mortality.

METHODS

We use the National Health Interview Survey (NHIS) for the years 1986 to 1994, linked to the National Death Index (NDI) through 1997.[43 44] The NHIS is a nationally representative annual cross sectional sample of the non-institutionalised civilian population, with a very high response rate: well over 95% of contacted people complete interviews. The NDI is a national database of deaths for adults aged 18 and older. The linked NHIS-NDI data are prospective and better allow causal inference than cross sectional data. We limit our sample to adults aged 18 to 50 because homicide mortality is very concentrated at those ages.

Individual and neighbourhood variables

The individual level variables in our analyses include self reported race/ethnicity, sex, a race/ethnicity by sex interaction, age in single years, nativity, marital status, employment status, income to needs ratio, and education. Race/ethnicity includes non-Hispanic white Americans, non-Hispanic black Americans, and Mexican Americans; we exclude other groups because of small numbers of deaths. The interaction between race/ethnicity and sex accounts for the high homicide mortality risks among Mexican American and non-Hispanic black men.[3 4] The foreign born variable includes a dummy variable for missing data because NHIS only asked this question in 1989 and later. We calculate the income to needs ratio by estimating an income value for the open ended income category in the NHIS; imputing missing income values with demographic factors; standardising income to 1995 values; and dividing the midpoint of each income category by family size. We detail the method used to impute income elsewhere.[45] Separate analyses (not shown) find that those with imputed income values have identical mortality risks as those without missing data. We exclude less than 0.8% of the cases because of missing data for key variables.

Wells and Horm of the National Center for Health Statistics developed the methodology we use to create the ''neighbourhood'' variables, using the design features of the NHIS.[46] The NHIS sampling frame, from the years 1986 to 1994, is based on census blocks and block groups. But Wells and Horm use the term ''very small areas'' (VSAs) to denote these geographical areas, because the NHIS occasionally interviews people from adjoining blocks or block groups.[46 47] Nevertheless, VSAs are marked by stable political or geographical boundaries, including major roads, rivers, or county lines, and are smaller and more homogenous than census tracts or health service areas.[47 48] Furthermore, the NHIS interviews people in all 50 states and the District of Columbia, and is designed to be geographically representative.[47]

The VSAs have unique identifiers that do not vary during the study period, allowing us to match the areas across multiple years of survey data. We estimate the VSA characteristics from the aggregated individual level characteristics of those persons living in a given geographical area, by collapsing weighted individual data within each VSA.[46] We create all of the VSA level variables, except for the percentage of immigrants living in an area (for reasons noted below), by combining the VSA characteristics for the year of interview as well as the two earlier and later years, where available.[43 46 47] For example, we estimate the VSA data for people in 1992 by averaging area characteristics from 1990 through 1994, but VSA data for people in 1986 come from combining 1986 through 1988 data. This approach allows most VSA characteristics to change over time, an advantage that census data do not provide; ensures that the estimated VSA values come from adequate numbers of people; and links the contextual data to the respondents' area of residence for the years surrounding the time of interview.[46] Wells and Horm produced stable estimates of the ecological variables with only three years of data and suggest that combining data across multiple waves of NHIS data provides a sampling fraction of over 60% of the population of the block or block group over time.[46] Our VSA data come from an average of 141 and a range of 1 to 418 people. Separate analyses (not shown) excluded the less than 0.8% of people from VSAs that contained fewer than 20 respondents, to test for bias because of poorly estimated neighbourhood data, and found results identical to those presented here.

The VSA level variables include the level of economic inequality based on the coefficient of variation; the percentage of people living in poverty; segregation measured as the percentage of Mexican Americans and non-Hispanic black Americans[4 41]; the percentage of single parent households; and the percentage of foreign born people, as shown in table 1. The coefficient of variation is calculated as the standard deviation of household income within the VSA

Key points

- Both neighbourhood and individual risk factors shape Mexican American, non-Hispanic white, and non-Hispanic black homicide mortality.
- Neighbourhood level risk factors for homicide mortality include economic deprivation and social disorganisation, although areas with high concentrations of foreign born people protect against homicide mortality.

Table 1 Descriptive statistics of individual and neighbourhood level risk factors by race/ethnicity, US adults aged 18 to 50, national health interview survey 1986 to 1994, follow up through 1997*

	Non-Hispanic black	Mexican American	Non-Hispanic white	Total
Sex				
Male	45.3	50.7	49.6	49.1
Female	54.7	49.3	50.4	50.9
Individual risk factors				
Age (mean years)	32.2	31.0	33.6	33.3
Nativity				
Native born	63.4	37.0	64.2	62.6
Foreign born	4.9	35.9	2.6	4.7
Missing	31.7	27.1	33.2	32.7
Marital status				
Currently married	42.9	64.9	66.9	63.7
Previously married	16.3	8.8	9.7	10.5
Never married	40.8	26.3	23.5	25.8
Employment status				
Employed	69.6	70.0	80.8	78.7
Unemployed	7.3	5.9	3.6	4.2
Not in the labour force	23.0	24.2	15.6	17.0
Income to needs ratio (mean)	$10727	$8784	$16817	$15591
Education				
Less than high school degree	21.4	47.1	11.4	14.7
High school degree	43.8	31.6	39.9	39.9
Any college	34.8	21.3	48.7	45.4
Neighbourhood risk factors				
Economic inequality				
<0.50	29.3	33.6	48.4	45.1
⩾0.50	70.7	66.4	51.6	54.9
Poverty				
<15%	46.6	46.4	81.3	75.0
⩾15%	53.4	53.6	18.7	25.0
Mexican American				
<4%	86.9	5.3	84.2	80.2
⩾4%	13.1	94.8	15.9	19.8
Non-Hispanic black				
<10%	8.0	81.6	87.7	77.1
⩾10%	92.0	18.4	12.3	22.9
Single parent household				
<20%	46.8	78.1	91.4	84.9
⩾20%	53.2	21.9	8.6	15.1
Foreign born				
<10%	81.4	43.5	89.2	85.7
⩾10%	18.6	56.5	10.8	14.3
Homicide deaths per 1000 interviewed	2.5	2.9	0.3	0.8
Number of homicide deaths	159	72	107	338
Number of survivors and people who died of other causes	63785	25059	336342	425186

Source: 1986–1997 NHIS-NDI linked file. *All values are percentages unless otherwise noted.

divided by the mean household income (mean = $38 695; SD = $24 350; for the full sample in 1995 dollars).[49] This measure provides estimates that are similar to other inequality measures, including the Gini coefficient (results not shown). Because of missing data prior to 1989, we estimate the percentage foreign born in a VSA using data from 1989 and later, rather than allowing the level to vary across the year of interview as with the other VSA variables. Separate analyses (results not shown) included the median age in the VSA, but we dropped it from our final models because it was neither significant nor theoretically important. We code the VSA variables dichotomously to ensure adequate numbers of deaths in each category, minimise their skewed distributions, and limit multicollinearity. Correlations among the neighbourhood variables were 0.47 or below, lower than those reported in other studies.[11 42] We tested various logical cut off points for the variables to ensure than each category contains adequate numbers of people and that those within each category face statistically similar homicide mortality risks.

The dependent variable for this analysis is risk of death from homicide. We code homicide according to the E-codes in the Ninth Revision of International Classification of Diseases and include E960–E969.[44] The NDI is highly reliable and may more accurately assess homicide mortality than the Uniform Crime Reports, another major database that records US homicide deaths.[50] We drop 2.8% of the NHIS respondents that are termed ''ineligible'' because they lack key information that could link them to future death records; otherwise they would appear immortal. Among eligible people, women and Hispanics are less likely to be matched to future mortality than men and non-Hispanics, because of name changes from marriage, or misspelling of Hispanic names and lower reporting of social security numbers, respectively.[44] These differences in the likelihood of being matched to prospective homicide mortality may slightly inflate sex differentials and deflate race/ethnic differentials.

Statistical analyses

To estimate hazards of death attributable to homicide over the follow up period, we create a duration variable that measures the time between the month of interview and the month of death. Those surviving the entire follow up duration are right censored, and those who die from causes other than homicide are censored at the time of death. We estimate the risk of death for up to 144 follow up months using Cox proportional hazards models and report all coefficients as hazards ratios. Tests indicate that our models meet the proportionality assumption. We use Stata software

Table 2 Hazard ratios of homicide mortality risks, US adults aged 18 to 50, national health interview survey 1986 to 1994, follow up to 1997*

	Model 1		Model 2		Model 3		Model 4	
	HR	95% CI	HR	95% CI	HR	95% CI	HR	95% CI
Race/ethnicity								
Non-Hispanic black	5.60	3.47 to 9.03	3.31	1.97 to 5.57	3.14	1.87 to 5.26	2.34	1.38 to 3.96
Mexican American	3.13	2.30 to 4.25	1.85	1.38 to 2.47	2.41	1.68 to 3.47	1.66	1.18 to 2.33
Non-Hispanic white	ref		ref		ref		ref	
Sex (male = 1)	2.38	1.97 to 2.86	2.45	2.01 to 2.99	2.41	1.99 to 2.92	2.47	2.01 to 3.03
Sex by race/ethnic interactions								
Non-Hispanic black by male	1.49	0.86 to 2.56	1.56	0.89 to 2.78	1.54	0.90 to 2.54	1.58	0.90 to 2.79
Mexican American by male	2.81	1.73 to 4.54	3.02	1.84 to 4.98	2.82	1.75 to 4.53	3.03	1.86 to 4.95
Non-Hispanic white by male	ref		ref		ref		ref	
Individual risk factors								
Age (continuous)			0.98	0.97 to 1.00			0.98	0.97 to 1.00
Nativity								
Native born			ref				ref	
Foreign born			1.10	0.80 to 1.51			1.24	0.88 to 1.76
Missing			1.06	0.91 to 1.24			1.06	0.91 to 1.24
Marital status								
Currently married			ref				ref	
Previously married			1.83	1.33 to 2.50			1.76	1.29 to 2.40
Never married			2.63	1.82 to 3.81			2.61	1.79 to 3.81
Employment status								
Employed			ref				ref	
Unemployed			1.87	1.39 to 2.52			1.84	1.37 to 2.48
Not in the labour force			1.76	1.42 to 2.17			1.75	1.43 to 2.16
Income to needs ratio			0.99	0.98 to 0.99			0.99	0.98 to 0.99
Education								
Less than high school degree			2.02	1.46 to 2.81			1.93	1.41 to 2.66
High school degree			1.65	1.51 to 1.79			1.60	1.46 to 1.74
Any college			ref				ref	
Neighbourhood risk factors								
Economic inequality								
<0.50					ref		ref	
⩾0.50					1.48	1.12 to 1.95	1.31	1.01 to 1.71
Poverty								
<15%					ref		ref	
⩾15%					1.21	1.12 to 1.30	0.92	0.83 to 1.02
Mexican American								
<4%					ref		ref	
⩾4%					1.37	1.09 to 1.72	1.39	1.03 to 1.86
Non-Hispanic black								
<10%					ref		ref	
⩾10%					1.49	1.21 to 1.83	1.46	1.18 to 1.80
Single parent household								
<20%					ref		ref	
⩾20%					1.36	1.25 to 1.48	1.19	1.09 to 1.30
Foreign born								
<10%					ref		ref	
⩾10%					0.67	0.52 to 0.86	0.65	0.49 to 0.86
Log likelihood	−2436		−2351†		−2418‡		−2342§	

Source: 1986–1997 NHIS-NDI linked file. *Etimates are presented as hazard ratios (HR) and 95% confidence intervals (CI); †model 2 fits significantly better than model 1 ($\chi^2 = 170$, df = 10, $p \leqslant 0.05$); ‡model 3 fits significantly better than model 1 ($\chi^2 = 37$, df = 6, $p \leqslant 0.05$); §model 4 fits significantly better than model 1 ($\chi^2 = 189$, df = 16, $p \leqslant 0.05$), model 2 ($\chi^2 = 19$, df = 10, $p \leqslant 0.05$), and model 3 ($\chi^2 = 152$, df = 6, $p \leqslant 0.05$).

Table 3 Hazard ratios of race/ethnic homicide mortality risks, by sex, calculated from interactions on table 2, US adults aged 18 to 50, National Health Interview Survey 1986 to 1994, follow up to 1997*†

	Model 1		Model 2		Model 3		Model 4	
	HR	95% CI	HR	95% CI	HR	95% CI	HR	95% CI
Men								
Non-Hispanic black	8.31	6.57 to 10.51	5.20	4.45 to 6.07	4.82	3.60 to 6.45	3.70	2.89 to 4.74
Mexican American	8.79	5.97 to 12.93	5.60	4.16 to 7.53	6.79	4.70 to 9.81	5.02	3.72 to 6.77
Non-Hispanic white	ref		ref		ref		ref	
Women								
Non-Hispanic black	5.60	3.47 to 9.03	3.31	1.97 to 5.57	3.14	1.87 to 5.26	2.34	1.38 to 3.96
Mexican American	3.13	2.30 to 4.25	1.85	1.38 to 2.47	2.41	1.68 to 3.47	1.66	1.18 to 2.33
Non-Hispanic white	ref		ref		ref		ref	

Source: 1986–1997 NHIS-NDI linked file. *Estimates are presented as hazard ratios (HR) and 95% confidence intervals (CI); †each model controls for the same variables as the respective model on table 2.

to correctly estimate the coefficients and standard errors, because of the stratified, clustered, and non-equal probability sampling frame used by the NHIS (Stata, version 8.0, College Station, TX). We also provide robust standard errors while clustering on the VSA identifier, to account for the non-independence of people within neighbourhoods.[51] Hierarchical models failed to converge because of the small number of deaths, but other studies provide reasonable estimates with the techniques we use here.[11 40–42]

Because most previous work uses either individual or ecological variables, we use a modelling strategy that allows us to examine whether individual and VSA characteristics, first separately, then jointly, account for race/ethnic differences in homicide mortality. This allows us to ascertain the advantages of using multilevel data. The G statistic tests for improvements in fit between models, calculated as $-2((\log \text{likelihood of model 1}) - (\log \text{likelihood of model 2}))$, where the distribution is χ^2 and the degrees of freedom equal the number of variables included between models.[53] To interpret the interaction terms, we calculate hazard ratios for each race/ethnic group, by sex. For example, the hazard ratio (HR) for non-Hispanic black men relative to white men, is: $HR_{black\ male} = (HR_{black}) \times (HR_{black*male})$. We also calculate the percent decrease (PD) in hazard ratios between models as: $PD = (HR_{Model\ 1} - HR_{Model\ 2})/(HR_{Model\ 1} - 1)$.

RESULTS

Table 1 reports descriptive statistics for the covariates by race/ethnicity. At the individual level, Mexican Americans and non-Hispanic black Americans are younger, less often married, and less economically advantaged than non-Hispanic white Americans. For example, only 35% of non-Hispanic black Americans and 21% of Mexican Americans have any college education, compared with nearly 50% of non-Hispanic white Americans. The VSA variables also show race/ethnic differences. Compared with non-Hispanic white Americans, non-Hispanic black Americans and Mexican Americans more often live in areas where economic inequality is greater than or equal to 0.50 based on the coefficient of variation, 15% or more of their neighbours live in poverty, and 20% or more of the households are headed by single parents. Moreover, compared with non-Hispanic white and black Americans, Mexican Americans more often live in areas where 4% or more of the residents are Mexican American and 10% or more of the residents are foreign born. Finally, 92% of non-Hispanic black Americans live in areas where 10% or more of their neighbours are non-Hispanic black, although only 18% of Mexican Americans and 12% of white Americans live in similar areas.

We also present crude cohort specific homicide mortality rates by race/ethnicity, calculated as the number of homicide deaths over the follow up period per 1000 people interviewed. These death rates are not fully comparable to national data because we exclude Hispanics from the black and white subpopulations; focus on Mexican Americans rather than all Hispanics; and calculate cohort rather than period specific homicide mortality rates. None the less, our rates mirror national trends: non-Hispanic black Americans and Mexican Americans exhibit much higher homicide mortality rates than non-Hispanic white Americans.[1 2] Although these rates allude to important race/ethnic disparities in homicide mortality, we now turn to the multivariate results to control for age and other risk factors.

Table 2 presents hazard ratios for the risks of homicide mortality. Model 1 shows that, at baseline, non-Hispanic black Americans, Mexican Americans, and men have higher risks of homicide mortality over the follow up period than non-Hispanic white Americans and women, respectively. Because the interaction between Mexican American and male is significant, we include the interactions in all models (table 3 provides a detailed interpretation of the interaction terms). Model 2 finds that individual risk factors affect homicide mortality. Those who are previously or never married, unemployed or not in the labour force, less affluent, or who have less education experience higher risks of homicide mortality over the follow up period than their currently married, employed, more affluent, or more educated counterparts. Furthermore, model 2 fits significantly better than model 1 ($\chi^2 = 170$, df = 10, $p \leqslant 0.05$), although it does not control for neighbourhood risk factors.

Model 3 finds that neighbourhood factors are also associated with homicide mortality. Compared with residents of neighbourhoods with less inequality or poverty, those living in areas with levels of inequality of 0.50 or greater based on the coefficient of variation have 48% higher and

Policy implications

- Public health policies must address the various individual and neighbourhood factors that are associated with high risks of homicide mortality. At the community level, policies could promote neighbourhood watch programmes, improvements in local schools, and less risky behaviours by more closely regulating alcohol use among minors and drug use among young adults.
- Public health initiatives that focus solely on individual behaviours may be poorly equipped to lower homicide mortality rates, unless they also target the fundamental socioeconomic and race/ethnic inequities that foster violence.

those living in areas where 15% or more of their neighbours live in poverty have 21% higher homicide mortality risks over the follow up period. Furthermore, relative to those in neighbourhoods with little segregation and few single parent households, those living in areas where 4% or more of the residents are Mexican American have 37% higher, those living in areas where 10% or more of the residents are non-Hispanic black have 49% higher, and those living in areas where 20% or more of the households are headed by single parents have 36% higher homicide mortality risks, over the follow up period. Finally, immigrant neighbourhoods are protective: compared with those living in areas with fewer foreign born residents, residents of areas where 10% or more of their neighbours are foreign born experience 33% lower risks of homicide mortality over the follow up period. Although model 3 fits significantly better than model 1 ($\chi^2 = 37$, df = 6, $p \leqslant 0.05$), it does not control for individual risk factors.

Model 4 includes both individual and contextual factors and finds that both are associated with race/ethnic differences in homicide mortality. Indeed, net of individual level risk factors, those living in areas with economic inequality of 0.50 or greater based on the coefficient of variation, or where 4% or more of the residents are Mexican American, 10% or more of the residents are non-Hispanic black, 20% or more of the households are headed by single parents, or less than 10% of the residents are foreign born face increased risks of homicide mortality over the follow up period. But the variable for neighbourhood poverty drops from significance after controlling for individual factors. Nevertheless, model 4 fits significantly better than model 1 ($\chi^2 = 189$, df = 16, $p \leqslant 0.05$), model 2 ($\chi^2 = 19$, df = 10, $p \leqslant 0.05$), and model 3 ($\chi^2 = 152$, df = 6, $p \leqslant 0.05$).

Table 3 calculates hazard ratios for race/ethnic differences, by sex, based on the estimates from table 2. Each model in table 3 controls for, but does not show, the variables from the respective model in table 2. Model 1 finds that compared with non-Hispanic white men, non-Hispanic black men have 8.3 times and Mexican American men have 8.8 times the homicide mortality risk over the follow up period. Furthermore, compared with non-Hispanic white women, non-Hispanic black women have 5.6 times and Mexican American women have 3.1 times the homicide mortality risk over the follow up period. Compared with model 1, models 2 and 3 show somewhat smaller race/ethnic disparities in homicide mortality risks, suggesting that those disparities result, in part, from differences in individual and neighbourhood level factors.

Model 4 shows that individual and VSA level characteristics, in combination, partially account for race/ethnic differences in homicide mortality. Compared with non-Hispanic white men, non-Hispanic black men have 3.7 times and Mexican American men have 5.0 times the homicide mortality risk over the follow up period. Indeed, among men, neighbourhood and individual factors account for a 63% decrease in non-Hispanic black and a 48% decrease in Mexican American homicide mortality risks, compared with model 1. Concomitantly, compared with non-Hispanic white women, non-Hispanic black women have 2.3 times and Mexican American women have 1.7 times the homicide mortality risk—an approximately 70% decrease for both non-Hispanic black Americans and Mexican Americans, compared with model 1.

DISCUSSION

Our findings contribute to the literature on race/ethnic differences in homicide mortality in four ways. Firstly, we find support for economic disadvantage theory. Neighbourhood income inequality predicts increased risks of homicide mortality, net of neighbourhood poverty and individual factors. Others also find that neighbourhood inequality associates with homicide mortality,[5–7] probably because inequitable areas limit residents' abilities to meet valued goals including finding safe, comfortable, and affordable housing; maintaining and patrolling neighbourhoods; or reducing levels of illicit drug or excessive alcohol use.[6 7 16–19] But previous work finds that areas where 10% or more of the residents live in poverty confer increased homicide mortality risks.[6 11 12 16 22] We find no such relation, perhaps because those studies examine larger geographical areas, do not control for same neighbourhood risk factors that we use here, and seldom control for individual factors.

Secondly, our findings also support social disorganisation theory. Residents in segregated areas experience higher homicide mortality, presumably because those areas are associated with discrimination, inadequate schools, numerous alcohol outlets and abandoned buildings, and ultimately, many obstacles to economic, social, and political advancement.[5–7 11 17 22–24 27–29] Previous studies also find that areas where 10% or more of the residents are black confer higher risks of overall and homicide specific mortality, although unlike prior work, we find increased homicide mortality risks in areas where 4% or more of the residents are Mexican American, possibly because those studies combine all Hispanics.[4 11] Furthermore, areas where 20% or more of the households are headed by single parents also confer increased homicide mortality risks, probably because they provide limited numbers of people who can participate in formal and informal organisations.[19–21] Socially disorganised areas provide a dangerous mix: large numbers of potential offenders who have few opportunities other than crime, many potential victims, and few social organisations or individuals who are capable of protecting others from violence.[53]

Thirdly, areas with high concentrations of immigrants protect against homicide mortality. Previous work finds that areas where 10% or more of the residents are foreign born protect residents against overall mortality[40]; we find that this protection extends to homicide mortality. Immigrant communities foster norms and values that discourage risky activities including drug and alcohol misuse.[31–34] Neighbourhood factors might also partially explain the epidemiological paradox.[35–39] Mexican Americans often live in areas where 10% or more of the residents are foreign born (table 1), which predicts lower risks of homicide mortality net of individual economic resources.

Finally, both individual and neighbourhood risk factors partially account for race/ethnic differences in homicide mortality. Models that include either individual or ecological variables alone less capably predict homicide mortality than models that include both sets of risk factors simultaneously. We build on findings from the single study that used data from multiple levels to predict homicide mortality,[11] by using a longer follow up period and specifically examining Mexican Americans and immigrant neighbourhoods.

Strengths and limitations

We contribute to the literature by using VSAs to capture neighbourhood characteristics. Although the NHIS contains confidential links to census data, estimated VSA data have several advantages. Firstly, VSAs are an important resource that allow researchers to examine both individual and ecological risk factors with nationally representative and publicly accessible data, without the expenses associated with accessing the confidentially linked census data.[46] Secondly, VSAs provide data on smaller, more homogenous areas than census tracts, which customarily have been linked to the NHIS data.[11 41 42] Finally, VSA data allow us to capture changes in area characteristics over time more accurately

than census data.[46] But VSAs are not perfect: although the NHIS systematically samples households in VSAs to maximise the variation within an area,[47] and we estimate VSA data from a large percentage of residents,[46] biases may arise if the sampled residents inaccurately represent an area. Future work could test whether our findings persist in alternate data sources.

We use VSA variables that are averaged across multiple years, and then link both individual and VSA factors to prospective mortality. But both individual and area characteristics may have changed between the point of interview and the time of death. Although neighbourhood characteristics are comparatively stable over time, both in our data and in other sources,[54] and other studies use a prospective design that is similar to ours,[11 40–42] future work with panel data could examine how changes in residence or individual risk factors affect homicide mortality risks over time. Furthermore, we have data on the area of residence, rather than the location of death. Although most homicide deaths occur close to home,[25] future work could explore whether multiple locations, including the places of work, residence, recreation, and death affect homicide mortality.

Kaufman and colleagues note the importance of residual confounding when examining race/ethnic differences in mortality.[55 56] They suggest that social and economic indicators may have different meanings for minorities, who may have suffered from discrimination in housing markets, job opportunities, or educational access, relative to white people. We partially account for their concerns by controlling for the lower levels of personal income and education among minorities, relative to white people, living in areas marked by similar levels of inequality, segregation, single parent households, and foreign born people.[30] Nevertheless, future research with more extensive data could examine more precise measures of race/ethnic discrimination.[18 24]

Policy implications

Public health policies must seek to improve both neighbourhood and individual conditions. Initiatives that focus solely on individual factors may be ineffective if they overlook the substantial neighbourhood barriers—such as discrimination, economic inequality, or norms for excessive drinking or drug use—that are associated with violence.[17–19 22–26] For example, social organisation may be enhanced by expanding resources for teacher and school development in poor or segregated areas, and increasing participation in formal and informal organisations such as neighbourhood watch programmes, block groups, civic organisations, or churches and temples.[19 57–59] Economic deprivation could be ameliorated by integrating subsidised housing into neighbourhoods and developing partnerships between businesses and schools to improve transitions to work.[60 61] Finally, tighter regulation of illicit drug sale and use, and alcohol use among minors, may confer some of the advantages provided by immigrant communities.[31–33]

Policy makers must also recognise that local and national agendas shape neighbourhoods. For example, strict sentences for drug offences may unintentionally lead to high incarcerations rates among black men, thereby increasing family and economic disruption because of the shrinking pool of marriageable and working black men.[20 21 63] Thus, policies that target the fundamental social and economic disparities among racial and ethnic minorities might lower homicide mortality more effectively than initiatives that aim solely to change individual behaviours such as drug use or abusive drinking.[18 63]

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THE *JECH* GALLERY

Healthy Cities shows the way to improve urban public health

Over half the world's population now lives in large towns and cities, some of vast size. For many families the daily reality is of slum dwelling such as this shanty town in India where open sewers, uncollected rubbish, and roaming livestock make up the neighbourhood environment. Not surprisingly, infectious diseases remain common. The World Health Organisation's Healthy Cities initiative has set out to tackle the new urban health agenda in a systematic and holistic way.

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