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Homicide Risk Across Race and Class: a Small-Area Analysis in Massachusetts and Rhode Island

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ABSTRACT *Areas with higher absolute poverty and higher income inequality have been associated with higher risk of homicide victimization. In addition, studies of differential homicide rates have indicated that black persons are at a higher risk of homicide compared to white persons. However, few studies directly compared risk of homicide offending or victimization between Hispanic persons and non-Hispanic white persons, and few studies have attempted to examine the interaction between race and residential neighborhood socioeconomic measures on homicide risk. This population-based retrospective study comprised all white, black, and Hispanic 15- to 44-year-old men included in the 1990 US Census as Rhode Island or Massachusetts residents. Vital statistics registries were linked to 1990 US Census data to provide information on small-area characteristics. Overall, we observed a trend of increasing homicide risk as block-group socioeconomic position descended. The data indicated that block-group poverty, female-headed households, home ownership, and higher education were all strongly associated with homicide risk after stratifying by race and age of victim and adjusting for other block-group socioeconomic characteristics. Race was a strong modifier for absolute risk difference for the relation between risk of homicide and socioeconomic surroundings. Our analyses suggested that area-based interventions that would improve neighborhood social and economic conditions would be effective in decreasing risk of homicide for men.*

KEYWORDS *Class, Geocoding, Homicide, Race.*

INTRODUCTION

In the United States, risk of homicide varies according to age, race, and gender.[1–4] Generally, homicide victimization risk is higher for adolescents and young adults, black persons and Hispanic persons, and men (except in the context of domestic violence, for which women have a notably higher homicide victimization risk than men).[1,5] Since 1935, homicide risks have been highest among persons 25–34 years old[2]; however, in the late 1980s and early 1990s, risk for persons 15–24 years old outpaced the rise of homicide risk of the 25–34 age group.[2,6]

Studies of differences in homicide victimization have consistently shown higher risk of homicide among black populations compared to white populations.[7,8] Although homicide risks do vary over time, risk of homicide for black people has

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remained approximately six times that for white people.[1] Homicide is responsible for a significant amount of the difference in life expectancy between black men and white men. In 1998, homicide was the third leading cause of this life expectancy differential and accounted for 9.7% of the 6.4 years longer that white men live compared to black men.[9] This increased risk has been attributed to the economic inequality experienced by black persons.[10–12]

Although risk of homicide tends to be greater among the lowest of socioeconomic groups regardless of race and greater among black persons compared to white persons in general,[13] economic effects are often confounded by race because black persons in the United States are more likely to live in poverty than white persons and are more likely to encounter greater difficulties in improving their socioeconomic conditions.[14] In addition, although findings are not consistent,[15] areas with higher absolute poverty[16–20] and higher income inequality[10,11,20–23] both have been associated with higher homicide risks. Yet, few studies have attempted to examine interaction between race and residential neighborhood social and economic measures on homicide risk.[7] Among the few population-based studies that have investigated this interplay, the results have been inconclusive.

We define *race* as a social construct indicating which populations have access to social and economic opportunities that provide for meeting fundamental human needs, community well-being, and political participation.[24–26] Race as used in this article is a marker for relative social and economic advantage with respect to exposure to economic and noneconomic forms of racial discrimination that affect education, wealth, stability of employment, and health across the life course,[27–29] even among people living in neighborhoods with similar socioeconomic characteristics.[30–32]

Some studies have shown that white populations have higher risks of homicide at lower levels of neighborhood socioeconomic conditions compared to black populations[33]; yet other studies have been inconclusive.[34–36] As well, increasing homicide risks for black compared to white populations have been reported in relation to decreasing neighborhood socioeconomic conditions.[21,37] Differences in study findings may be a result of different levels of geographical aggregation (census tract,[34–37] health service area,[21] or cities[33]). In addition, some studies examined homicide perpetrators[33,37] or required information on both perpetrators and victim to be known,[35,36] resulting in a less-complete set of homicide cases because not all homicide cases are solved. Estimates of risk for Hispanic persons are less available primarily because of lack of consistent data recording Hispanic origin.[38] One of the few studies to examine Hispanic homicide rates and socioeconomic conditions found that living amid economic inequality and low educational attainment were positively correlated with homicide risk.[39]

Given the paucity of research on Hispanic population experience and the mostly inconclusive findings of the studies noted above, we designed our study to estimate effects of residential neighborhood-level social and economic conditions, as modified by individual-level racial category, on risk of homicide victimization.

METHODS

Study Population

In this population-based retrospective study of a dynamic cohort, the study base comprised all 1,593,256 black, Hispanic, and white men aged 15–44 years included in Summary Tape File 3A of the 1990 US Census as Rhode Island or Massachusetts residents.

Outcome

We measured homicides from cause of death records maintained by the Rhode Island and Massachusetts Health Departments. Deaths coded as *International Classification of Diseases, Ninth Revision* (*ICD-9*), external classification of disease 960.0 to 969.9 qualified as homicides. We identified 418 male homicide victims who died between January 1, 1989, and December 31, 1991; who were residents of Massachusetts or Rhode Island; whose residential address could be geocoded to block-group level; aged 15–44 years; and identified as black, Hispanic or white. The years 1989, 1990, and 1991 were selected to increase the number of homicides and remain temporally close to the dates during which the denominator data were obtained. Rhode Island and Massachusetts were selected because the authors knew these states had death certificate data geocoded to the block-group level.

Determinants

We measured victim's race and ethnicity as defined by the 1990 US Census (based on self-report) and as described on the death certificate routinely reported by physician, medical examiner, or coroner in Rhode Island and Massachusetts. We categorized race of victims into three groups: (1) black, non-Hispanic; (2) Hispanic; and (3) white, non-Hispanic. (We use the terms black, Hispanic, and white to refer to these groups throughout the article.) We looked at only black, Hispanic, and white men because only these racial and gender categories had sufficient information for analysis during our study period.

We used seven measures of block-group socioeconomic conditions constructed from data from the 1990 census. Census block-groups are areas of varying size that contain an average of 1,000 persons and have boundaries drawn to create groups that are relatively stable and homogeneous regarding social and economic characteristics compared to other geographic areas such as ZIP codes and counties. Block-groups are the smallest geographic area for which the census will release socioeconomic information, and they are able to identify areas of deprivation or wealth that might otherwise be hidden if using larger geographic areas, such as census tracts.[40]

These block-group measures were (1) poverty (percentage of individuals residing in households that had an annual income below the 1990 federal poverty line); (2) home ownership (proportion of owner-occupied homes); (3) higher educational attainment (proportion of persons at least 25 years old who had completed 4 or more years of college); (4) low educational attainment (proportion of persons at least 25 years old who had not completed high school); (5) unemployment (proportion of persons at least 16 years old who were actively seeking but unable to find work)[41]; (6) household structure (proportion of female-headed households); and (7) racial composition (ratio of black residents compared to white residents in each block-group). These block-group measures were selected to capture measures of deprivation (poverty, low educational attainment, unemployment, female-headed households, and segregation) and wealth (home ownership and higher educational attainment). For more description on motivations for selection of US Census measures, see Refs. 42–45.

We initially examined many different census measures that might be used to categorize block-group socioeconomic position. To illustrate, we initially sought to examine wealth by measuring the value of owned homes within block-groups. However, there were 70 homicides in block-groups in which home ownership was so rare that the 1990 census did not calculate the value of owner-occupied homes.

Age of the homicide victim was obtained from the death certificates and was categorized as 15–24, 25–34, or 35–44 years. For some analyses, the two older age categories were collapsed into one category of 25–44 years.

Analysis

We sought to estimate the relative and absolute differences in risk of homicide victimization among 15- to 44 -year-old black, Hispanic, and white men by block-group-level socioeconomic characteristics and the effects of race on homicide risk after block-group-level conditions were taken into account. Numerators in rates were the aggregate number of race- and age-specific homicide victims in block-groups with similar socioeconomic characteristics 1989 through 1991. Denominators were the aggregate number of male residents in block-groups with similar socioeconomic characteristics and in the same race and age groups from the 1990 census multiplied by three to represent 3 years of person-time. Cumulative incidence estimates were per million men 1989 through 1991.

Block-group population counts by gender were directly available for Hispanics from Summary Tape File 3A. For black and white persons, gender counts combined persons of Hispanic and non-Hispanic origin. To obtain specific population counts for Hispanic and non-Hispanic black and white men separately, we estimated counts by first calculating, for each block-group, the proportion of white and black persons of Hispanic and non-Hispanic origin and then multiplying these proportions by each group's age distribution within the block-group. We then summed across all block-groups within the same socioeconomic stratum to obtain denominator data stratified by race and ethnicity, age, and block-group socioeconomic position.[42,46]

First, we examined the trend of homicide risk across strata of block-group socioeconomic conditions for each block-group socioeconomic variable separately. We then analyzed race-specific trends of homicide risk for each block-group socioeconomic variable and compared race-specific homicide risk across categories of block-group socioeconomic conditions. We used attributable risk to estimate the public health impact of socioeconomic conditions in block-groups for all men and for black, Hispanic, and white men separately.

Regression Modeling

We used negative binomial regression to estimate effects of block-group variables on homicide rates.[47,48] Our outcome, the number of homicides within block-groups sharing certain socioeconomic conditions, exhibited more variability than allowed under a Poisson model. To account for this overdispersion, we used a negative binomial model, which has the same mean structure, but allows for overdispersion in the variance. Standard model-checking tools (such as residual analysis) were employed, but are not detailed here. Because the incidence rate was similar across all 3 years of this study and homicide death was a rare outcome, we used the 3-year incidence rate to approximate the cumulative incidence as an estimate of risk during the 3-year study period.

We grouped ages into 15 to 24 and 25 to 44 years, and race was grouped as black, Hispanic, and white. Our reference group comprised 25- to 44-year-old white men. We parameterized block-group socioeconomic characteristics as continuous variables ranging from 0% to 100% of residents sharing a particular characteristic. Every block-group socioeconomic characteristic was first evaluated in a smaller model that included only age, race, block-group socioeconomic characteristic, and

all interaction terms to specify separate intercept values for each race and to allow for dependence between the variables.

Spline Modeling

Areas with greater than 20% of individuals living below the poverty threshold are designated as federal poverty areas and are eligible for special programs and funds.[49] To determine whether the relationship between homicide risk and percentage poverty varied depending on status of the neighborhood as a federally defined poverty area, we added a spline term to the poverty model (parameterized as percentage poverty minus 20% if the neighborhood had 20% or more poverty and as zero otherwise).[47] We restricted these analyses to block-groups with less than 60% poverty to avoid extrapolation and improve model fit.

RESULTS

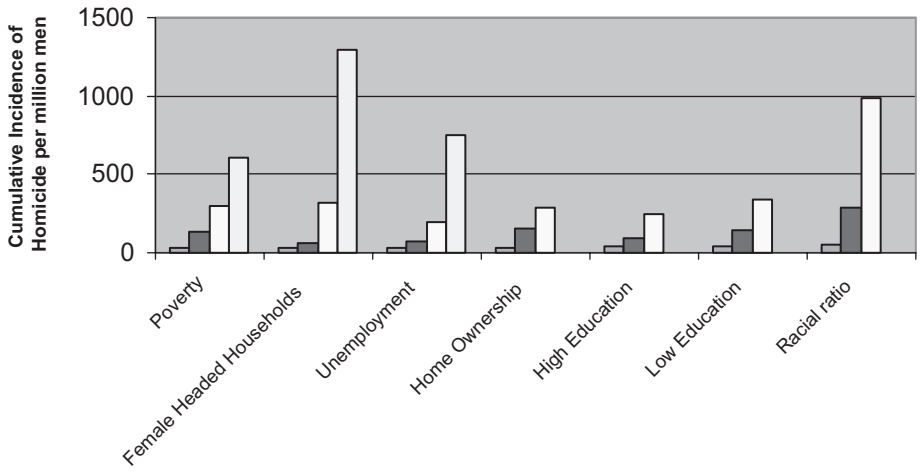
According to health department records and the 1990 census, the overall 1989–1991 cumulative incidence of homicide for men aged 15 to 44 years living in Rhode Island and Massachusetts was approximately 90 homicides per million men (95% confidence interval [CI] 82 to 99 per million men) or 0.009%. Disaggregated by race, this risk was highest for black men (781 homicides per million men; 95 % CI 670 to 911 per million men), followed by Hispanic men (582 homicides per million men; 95% CI 462 to 735 per million men). White men had the lowest risk of homicide (35 homicides per million men; 95% CI 30 to 42 per million men). Thus, black men had 22 times (95% CI 18 to 28 per million men) and Hispanic men had 17 times (95% CI 12 to 22 per million men) the homicide risk of white men.

Block-Group Socioeconomic Position Pattern

For all men combined, there was a trend of increasing homicide risk as block-group socioeconomic conditions moved down the gradient (Fig. 1). Race-specific patterns also showed this trend. However, except for proportion of female-headed households, white men had not only a substantially lower risk of homicide compared to black and Hispanic men within the same block-group socioeconomic level, but also the highest risk for white men (over all socioeconomic levels) was still substantially lower than the lowest risk of homicide for black and Hispanic men (over all socioeconomic levels) (Table 1).

To assess the association between block-group socioeconomic conditions and risk of homicide, each block-group socioeconomic variable was entered into a model that accounted for race and age. The data indicated that, for every 10% increase in block-group socioeconomic deprivation, the log of the coefficient for the associated increase in homicide risk ranged from 1.21 to 1.67, with the strongest relationship seen with block-group unemployment. For example, after adjusting for race and age, the coefficient for poverty was 3.02 with a standard error of 0.34 meaning, that a 20% increase in the proportion of residents living below the federal poverty line in a block-group was associated with an 83% (95% CI 60% to 109%) increase in homicide risk.

The results of our analysis to estimate associations for particular socioeconomic features when all socioeconomic variables were in the model are presented in column B of Tables 2 and 3. In the full model (column B), proportion of female-headed households, home ownership, and block-group ratio of black to



Poverty categories: <10%, 10%-19.9%, 20%-29.9%, and 40%-100%

Female-headed household categories: <10%, 10%-9.9%, 20%-39.9%, and 40-100%

Unemployment categories: <5%, 5%-9.9%, 10%-19.9%, and 20%-100%

Home ownership categories: 50%-100%, 20-49.9%, and <20%

Higher Education categories: 25%-100%, 10%-24.9%, and <10%

Low Education categories: <25%, 25-39.9%, and 40%-100%

Racial ratio categories: <0.25, 0.25-0.49, and ≥0.5

FIGURE 1. Homicide risk by neighborhood socioeconomic characteristic: Rhode Island and Massachusetts, 1989–1991.

white residents showed a strong association with homicide. To build a more parsimonious model to describe homicide risk, we removed variables from the model one at a time. This backward selection resulted in model results seen in columns C and D of Tables 2 and 3. In model C, an increase of 10% in female-headed households was associated with an increase of 35% (95% CI 23% to 49%) in homicide risk, an increase of 10% of home ownership was associated with a 12% decrease (95% CI 8% to 16%) in homicide risk, a 10% increase in higher education was associated with a 12% reduction (95% CI 5% to 19%) in homicide risk, and a two-fold increase in the ratio of black residents to white residents was associated with a 1% increase (95% CI 0% to 2%) in homicide risk.

The proportion of female-headed households has been correlated with male unemployment, particularly among black populations,[50–52] and in our data there was a strong correlation between proportion of female-headed households and proportion of adults unemployed (correlation coefficient was 0.41) and proportion of persons living in poverty (correlation coefficient was 0.56) (Table 4). We therefore looked at a model without female-headed households. Because poverty and female-headed households were highly collinear, poverty showed a strong association with homicide risk when proportion of female-headed households was no

TABLE 1. Estimates of attributable risk for homicide in relation to socioeconomic characteristics stratified by race, men 15–44 years old in Massachusetts and Rhode Island, 1989 to 1991

Characteristic of block-groups	Estimate risk per million men	Estimated risk per million white men	Estimated risk per million Hispanic men	Estimated risk per million black men
Individuals below poverty, %				
<10%	34	25	180	335
10%–19.9%	134	74	441	738
20%–39.9%	298	50	819	1,095
40%–100%	607	88	1,344	1,284
Attributable risk* (95% CI)	573	63	1,164	949
	(420 to 727)	(–13 to 141)	(589 to 1,739)	(493 to 1,406)
Female-headed households, %				
<10%	29	23	80	220
10%–19.9%	66	44	534	339
20%–39.9%	319	72	770	1,124
40%–100%	1,298	242	1900	1,644
Attributable risk* (95% CI)	1,269	218	1,820	1,425
	(1,012 to 1,526)	(6 to 431)	(1,002–2,637)	(1,027–1,823)
Unemployment, %				
<5%	29	17	240	344
5%–9.9%	70	38	579	599
10%–19.9%	192	68	594	935
20%–100%	745	162	1,240	1,567
Attributable risk* (95% CI)	716	146	999	1223
	(548 to 885)	(39 to 252)	(340 to 1,599)	(750 to 1,695)
Homes owned by occupant, %				
50%–100%	31	22	212	338
20%–49.9%	156	65	521	919
<20%	288	55	985	1004
Attributable risk* (95% CI)	257	33	772	665
	(207 to 308)	(7 to 59)	(422 to 1,123)	(391 to 940)

TABLE 1. ***Continued***

Characteristic of block-groups	Estimate risk per million men	Estimated risk per million white men	Estimated risk per million Hispanic men	Estimated risk per million black men
College education, %				
25%–100%	36	22	257	355
10%–24.9%	89	39	332	897
<10%	248	71	1085	1030
Attributable risk* (95% CI)	211	49	828	675
	(173 to 249)	(26 to 72)	(488 to 1,169)	(406 to 944)
Less than high school education, %				
<25%	38	25	162	392
25%–39.9%	139	54	510	888
40%–100%	340	77	1,099	1,309
Attributable risk* (95% CI)	301	52	937	917
	(247 to 355)	(22 to 82)	(609 to 1,265)	(602 to 1,232)
Ratio of black to white Residents				
<0.25	50	32	393	398
≥0.25–0.49	286	109	1,164	452
0.5	991	166	1,301	1,340
Attributable risk* (95% CI)	941	134	907	942
	(788 to 1,093)	(19 to 250)	(362 to 1,453)	(686 to 1,198)

CI, confidence interval.

*Differences are estimates of cumulative incidence at level of greatest economic deprivation (last category) relative to cumulative incidence at level of greatest economic well-being.

TABLE 2. Estimated coefficients (βs) and standard errors (SEs) from regression modeling of homicide risk for black, Hispanic and white men, Rhode Island and Massachusetts, 1989–1991

	A	B		C		D	
	β (SE)	β (SE)	VIF	β (SE)	VIF	β (SE)	VIF
Constant	–10.28 (0.100)	–9.97 (0.346)		–9.57 (2.17)		–9.23 (0.230)	
Black	2.68 (0.155)	1.69 (0.186)		1.68 (0.185)		1.86 (0.180)	
Hispanic	2.67 (0.186)	1.85 (0.204)		1.88 (0.202)		1.97 (0.201)	
Age	0.10 (0.173)	0.07 (0.173)		0.08 (0.173)		0.07 (0.174)	
Black × age	0.84 (0.234)	0.81 (0.251)		0.81 (0.252)		0.86 (0.250)	
Hispanic × age	0.33 (0.295)	0.24 (0.307)		0.24 (0.306)		0.25 (0.307)	
Poverty		–.011 (0.616)	2.44			1.48 (0.485)	1.77
Female-headed households		2.96 (0.558)	1.69	3.03 (0.488)	1.39		
Unemployment		–0.02 (0.939)	1.44				
Home ownership		–1.17 (0.293)	1.85	–1.32 (0.243)	1.19	–1.20 (0.279)	1.71
Higher education		–0.73 (0.550)	2.09	–1.31 (0.415)	1.19	–2.09 (0.383)	1.09
Low education		0.89 (0.566)	2.73				
Black/white ratio		0.01 (0.003)	1.06	0.01 (0.002)	1.06	0.01 (0.002)	1.02
Pseudo R^2	0.16	0.20		0.20		0.19	

VIF, variance inflation factor. VIFs are provided for continuous variables only.

TABLE 3. Relative change in homicide risk associated with 10% increase in the neighborhood characteristic from regression modeling of homicide risk for black, Hispanic, and white men, Rhode Island and Massachusetts, 1989–1991

	A	B	C	D
	RR* (95% CI)	RR* (95% CI)	RR* (95% CI)	RR* (95% CI)
Black	14.66 (10.82–19.85)	5.40 (3.75–7.76)	5.37 (3.73–7.72)	6.42 (4.51–9.14)
Hispanic	14.43 (10.02–20.77)	6.38 (4.27–9.52)	6.58 (4.43–9.79)	7.16 (4.83–10.63)
Age	1.10 (0.78–1.55)	1.08 (0.77–1.51)	1.08 (0.77–1.51)	1.07 (0.76–1.51)
Black × Age	2.31 (1.46–3.65)	2.26 (1.38–3.69)	2.24 (1.37–3.68)	2.37 (1.46–3.88)
Hispanic × Age	2.31 (1.46–3.65)	1.27 (0.70–2.32)	1.27 (0.70–2.32)	1.29 (0.71–2.35)
Poverty		0.99 (0.88–1.12)		1.16 (1.05–1.28)
Female-headed households		1.35 (1.21–1.50)	1.35 (1.23–1.49)	
Unemployment		1.00 (0.83–1.20)		
Home ownership		0.89 (0.84–0.94)	0.88 (0.84–0.92)	0.89 (0.84–0.94)
Higher education		0.93 (0.83–1.04)	0.88 (0.81–0.95)	0.81 (0.75–0.87)
Low education		1.09 (0.98–1.22)		
Black/white ratio*		1.01 (1.00–1.02)	1.01 (1.00–1.02)	1.02 (1.01–1.03)

CI, confidence interval.

*Relative risk is change in homicide risk associated with a doubling of proportion of black residents compared to white residents.

longer in the model. While controlling for proportion of individuals with home ownership, college education, and ratio of black residents to white residents, a 10% increase in block-group poverty was associated with a 16% increase (95% CI 5% to 28%) in homicide risk (Table 3).

TABLE 4. Correlation coefficients for block-group variables in Rhode Island and Massachusetts from the 1990 US Census

	Poverty	Female-headed households	Unemployment	Home ownership	High education	Low education	Black/white ratio
Poverty	1.00						
Female-headed households	0.56	1.00					
Unemployment	0.49	0.41	1.00				
Home ownership	–0.65	–0.39	–0.35	1.00			
High education	–0.28	–0.39	–0.35	0.23	1.00		
Low education	0.54	0.46	0.43	–0.50	–0.69	1.00	
Black/white ration	0.14	0.24	0.11	–0.11	–0.07	0.08	1.00

Relative Risk of Homicide for Black and Hispanic Men Compared to White Men

Overall, we estimated, controlling for age, that black men had 21.3 times (95% CI 17.1 to 26.6) and Hispanic men had 16.3 times (95% CI 12.3 to 21.6) the homicide risk of white men. Younger black men had approximately 33.8 times (95% CI 23.9 to 47.7) and older black men had approximately 14.7 times (95% CI 10.8 to 19.8) the homicide risk of white men the same age. Among Hispanic men, the difference in risk by age was also large. Younger Hispanic men had approximately 20.0 times (95% CI 12.8 to 31.4) and older Hispanic men had approximately 14.4 times (95% CI 10.0 to 20.8) the homicide risk as white men the same age (column A of Table 2). When block-group characteristics were taken into account singly, the relative difference in homicide risk for black and Hispanic men compared to white men was attenuated somewhat, but did not disappear (results not shown). When multiple block-group conditions were controlled, the relative risk of homicide for black men and Hispanic men compared to white men was further attenuated, but still did not disappear (columns B through D in Table 2).

Assessing Multiplicative Interaction

To assess whether the relationship between block-group socioeconomic conditions and homicide risk varied by race, we entered interaction terms into each of the models with one block-group characteristic. Only the relationship between block-group unemployment and homicide risk varied by race. A 10% increase in block-group unemployment corresponded with a 100% increase (95% CI 70% to 140%) in risk of homicide for white men, a 51% increase (95% CI 27% to 80%) in homicide risk for black men, and a 55% increase (95% CI 25% to 93%) in homicide risk for Hispanic men. Indeed, as unemployment increased to 100%, the predicted homicide risk for white, Black, and Hispanic men became increasingly similar (Fig. 2).

In the models with multiple block-group characteristics, only the slope of the relationship between higher education and homicide risk varied by race and only in the model with female-headed households. Thus, when block-group female-headed households, home ownership, and racial composition were accounted for, a 10% increase in adults who had at least 4 years of college corresponded to an 18% reduction (95% CI 8% to 26%) in homicide risk for white men, a 14% reduction (95% CI 4% increase to 28% decrease) in homicide risk for Hispanic men, and only a 1% reduction (95% CI 12% increase to 13% reduction) in homicide risk for black men.

Homicide Risk and Percentage Poverty in Federal Poverty Areas

There was considerable variation in the slope of the relationship between homicide risk and neighborhood poverty by federal poverty area status for men aged 25 to 44 years. For men aged 15 to 24 years, a 10% increase in neighborhood poverty, when neighborhood poverty was below 20%, was associated with a 40% increase (95% CI 6% to 85%) in homicide risk. When neighborhood poverty was above 20%, a 10% increase in neighborhood poverty for 15- to 24-year-old men was associated with a 20% increase in homicide risk (95% CI 0% to 44%). For men aged 25 to 44 years, a 10% increase in neighborhood poverty, when neighborhood poverty was less than 20%, was associated with a 163% increase (95% CI 103% to 240%) in homicide risk. When neighborhood poverty was greater than 20%, a 10%

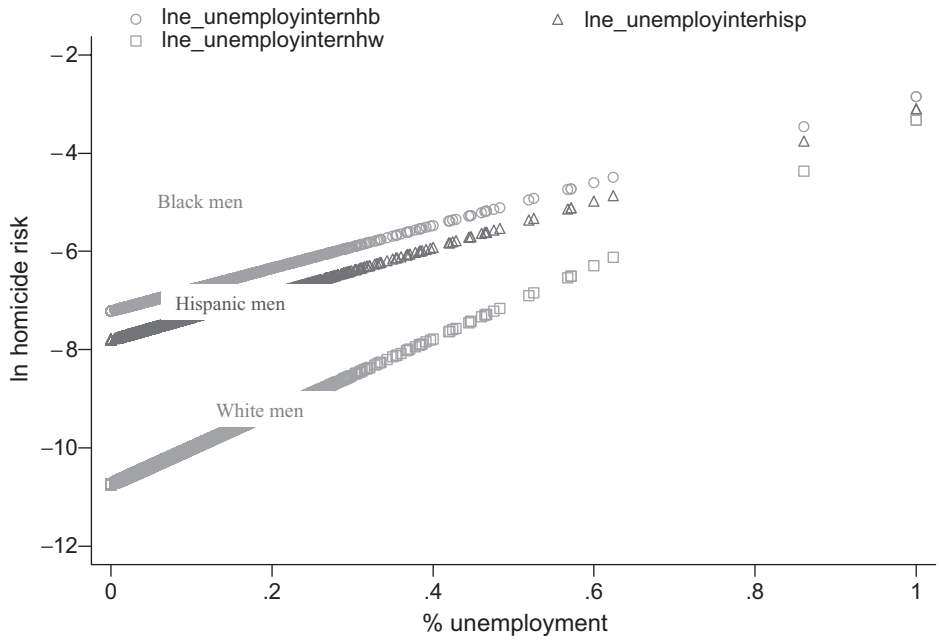


FIGURE 2. Predicted homicide risk for white, Hispanic, and black men aged 15 to 24 years by neighborhood unemployment (ln scale) (model contained race, age, race-and-age interaction, unemployment, and unemployment-and-race interaction).

increase in neighborhood poverty was associated with a 20% increase (95% CI 1% to 44%) in homicide risk (Fig. 3).

DISCUSSION

In this retrospective population-based cohort study, we found steep gradients of homicide risk in relation to residential neighborhood socioeconomic position. Like any retrospective study, this outcome was also subject to potential biases. One potential source of error was the misclassification of race. On death certificates, the doctor, coroner or, medical examiner assigns the race of the decedent. This may be a different race than how the victim would self-identify or even different from the race identified on the decedent's birth certificate, and this difference is more likely for non-white and mixed-race individuals than white individuals.[53–55] If homicide victims were more likely to have self-identified as Asian or Native American on the 1990 US Census, and thus not be a part of our denominator, but were identified as black or Hispanic on their death certificates, then their person-time at risk would not be counted, but the event would have been assigned to the black or Hispanic stratum, making the obtained effect estimate greater than the true effect of race on homicide victimization.

In addition, there is a chance that there was differential misclassification of cause of death on death certificates because the *ICD-9* definition of homicide requires that the coroner or medical examiner know the intent of the suspect to kill or injure.[56] If a coroner or medical examiner is more likely to assign homicide as a cause of death to black and Hispanic men and men living in poor neighborhoods

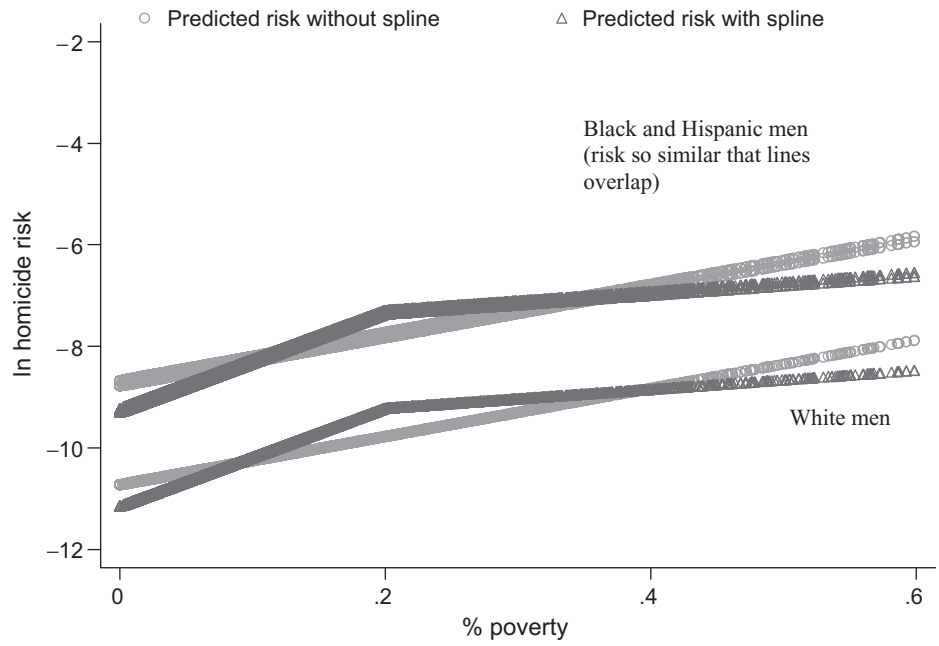


FIGURE 3. Predicted homicide risk for white, Hispanic, and black men aged 25–44 years by block-group poverty for which block-group poverty was less than 60% with and without a knot at 20% poverty (ln scale).

and more likely to assign "unintentional" or "undetermined" as a cause of death to white men and men living in neighborhoods more well off, then we would have overestimated the true relationship between race and risk of homicide and between residential neighborhood socioeconomic conditions and risk of homicide. However, given the large effect estimates that we obtained, it is unlikely that misclassification of race or cause of death can explain our findings.

We were also concerned that, by using regression analysis, a functional form of the relationship between homicides and residential neighborhood characteristics, not inherent in the data, would be imposed. Categorical analyses were used first to observe what form the relationship took, higher order relationships between dependant variables and homicide rates were tested, and in the spline analyses, different locations of "knots" in the slope were tested to account for this potential limitation. Also of concern were the sparse data for very high poverty areas because less than 1% of block-groups had greater than 60% poverty. When block-groups with greater than 60% poverty were excluded from the analyses, the association between block-group poverty and homicide risk increased, making our results of the effect of block-group poverty on homicide risk using the full spectrum of poverty within neighborhoods a conservative underestimate.

Nevertheless, we estimated strong associations between residential neighborhood socioeconomic conditions and risk of homicide victimization overall and for black, Hispanic, and white men separately. For all strata of residential neighborhood socioeconomic position, white men had lower homicide risk than black or Hispanic men. Proportion of block-group unemployment and higher education were important

determinants of slope gradients of the relationship between block-group socioeconomic position and homicide risk and varied by race.

Risk estimates attributable to lower block-group socioeconomic position also varied by race. Thus, for example, according to our data, an increase in block-group home ownership that moved from 20% or less to 50% or more might reduce white male homicide victims by 33 (95% CI 7–59) per million, Hispanic male homicide victims by 772 (95% CI 422–1123) per million, and the black male homicide victims by 665 (95% CI 391–940) per million (Table 1).

Effect of status of residential neighborhood as a federal poverty area differed for young men and for older men (Fig. 3). When interpreting this finding, it is important to recall the federal poverty threshold (which in 1990 ranged from $6,310 for a single person under age 65 years to $25,480 for a family of nine or more)[57] and realize that neighborhoods with even a little poverty are not "well off." Our finding that increases in homicide risk associated with increases in poverty did not differ for young men by federal poverty status and that there was a much larger increase in homicide risk associated with increasing poverty for older men in neighborhoods not designated federal poverty areas indicated that any increase in neighborhood poverty has a deleterious effect on homicide risk, even among neighborhoods with a small proportion of persons living below the federal poverty threshold.

We measured neighborhood-level covariates and estimated how these affected homicide rates for black, Hispanic, and white men in these neighborhoods. It is important to note that we did not estimate the affect of an individual's socioeconomic condition on individual risk of homicide victimization. It is possible that it is the men most well off living in the neighborhood least well off who are most at risk for homicide victimization. Nevertheless, the structural effects of socioeconomic deprivation on homicide victimization are important in their own right. In addition, we examined the effect of the homicide victim's residential neighborhood and did not examine the context of the location of death. Although the majority of personal crimes are committed close to the residence of the victim or offender,[58] it is important to interpret these results as reflecting the risk of men who reside in the neighborhoods described and not the risk of men who may be visiting these neighborhoods.

CONCLUSION

Our structural analysis of race, neighborhood socioeconomic conditions, and homicide suggested that area-based interventions that would improve neighborhood social and economic conditions such as increased home ownership and access to college education may be effective in decreasing homicide risk for men. In addition, although homicide risk is highest in federally defined poverty areas and increasing poverty within federally defined poverty areas is strongly associated with increasing homicide risk, any increase in poverty within a neighborhood has a strong influence on increasing homicide risk for the men living in that neighborhood.

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