EXTENDED ABSTRACT

The Sociospatial Context of Cardiovascular Risk:

The Relationship Between Neighborhood Crime Rates and Blood Pressure

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Health disparities across race, ethnicity, and socioeconomic status remain sources of enduring concern for social scientists, clinicians, and policy makers. Evidence of the magnitude and breadth of the health gap continues to mount, generating increased interest in identifying its roots. Increasingly, researchers are seeking to understand the origins of health status in broader contextual factors, including the social and economic features of residential spatial and neighborhood environments. A long history of research has documented the dramatically different conditions in which distinct racial, ethnic, and socioeconomic groups reside (Massey and Denton 1993). These conditions have been linked with a host of negative health outcomes in an emerging focus on the neighborhood context of health and well-being. This research, however, remains incipient; plagued by ongoing concerns regarding selection, endogeneity, and causality; and limited with respect to the measurement of relevant health outcomes and disease processes (Diez Roux 2007).

We apply neighborhood theory to understanding variation in blood pressure across neighborhood context using recently collected data from the Dallas Heart Study (DHS). The DHS is an innovative, longitudinal data collection effort that offers an unprecedented opportunity to explore the "upstream" contextual origins of health disparities by race, ethnicity, and socioeconomic status. The DHS combines extensive survey-based measures of socio-demographic characteristics with a wealth of carefully measured biomarkers related to cardiovascular health.

Theoretical Background

We draw on a *social capital/collective efficacy* perspective on neighborhood functioning to develop a theory of the link between neighborhood context and cardiovascular health. This approach suggests that neighborhoods with limited structural resources experience weaker norms encouraging the social control of public space. The capacity of neighborhood residents to act on behalf of health-relevant goals such as safe public streets and parks, and correspondingly reduced crime levels, may contribute to the health status of local adults through a number of mechanisms. Normative orientations encouraging safe public space and reduced crime levels at the neighborhood level may directly limit fear and the associated development of "allostatic load" (with corresponding exposure to a variety of potentially health-compromising stress mediators such as catecholamines and cortisol; McEwen 1998). Adults who reside in neighborhoods with strong pro-social norms and limited crime levels may also be more likely to use outdoor space for recreational activity and exercise, reducing the likelihood of a range of poor health outcomes. On average, African Americans reside in substantially more disadvantaged neighborhood environments than whites (and, in most urban contexts, Latinos) and are at significantly increased risk of violent victimization (Sampson and Wilson 1995). Neighborhood crime may account for a proportion of the race disparity in cardiovascular health.

Neighborhood collective efficacy and associated crime rates may be particularly important for the experience of urban women. Evidence suggests that fear of crime among women is more pronounced (Warr 1994; 2000); comparable levels of crime in residential environments may have disproportionate effects on women's sense of security and corresponding stress responses. Theoretical approaches emphasizing the health-benefits of strong and effective normative orientations limiting neighborhood crime have been fruitfully applied to understanding contextual variation in adult self-rated health (Browning and Cagney 2002, 2003) and all-cause mortality (Browning, Wallace, Feinberg, and Cagney 2006) in the context of Chicago. The DHS offers an opportunity to examine the impact of neighborhood crime levels in an alternative urban context and, critically, to examine their effects on carefully measured biomarkers longitudinally.

Data

The 2000-2002 Dallas Heart Study is a probability-based sample of Dallas County residents aged 18 to 65 years (Victor et al. 2004). A household health interview was completed for 6,101 subjects (visit 1—survey, 54% black) that incorporated a number of modules including demographic background, socioeconomic status, health history, neighborhood, social support, acculturation, and discrimination. The DHS used a variety of methods for assessing cardiovascular health, including genetics, advanced imaging modalities, survey research, and clinical research center approaches. A subsample of participants 30 to 65 years of age provided in-home fasting blood and urine samples (visit 2—phlebotomy) and underwent multiple imaging studies, including cardiac magnetic resonance imaging and electron beam computed tomography (visit 3—clinic). Participation rates were 80.4% for interviews, 75.1% for phlebotomy visits, and 87.4% for clinic visits. We employ a subsample of 993 women and 778 men residing in Dallas County to analyze the effect of both overall violence rates (1999) and lagged changes in violence rate (1999-2000) on blood pressure measures.

Data from the 2000 Census and the 1999-2001 National Neighborhood Crime Study on census tract-level violent crime rates in Dallas were merged with the DHS in order to investigate the effects of both crime and neighborhood structural characteristics on blood pressure.

Analytic Strategy

We employ hierarchical linear models to investigate the impact of neighborhood context on individual level blood pressure. HLM provides a flexible framework for multilevel modeling that can decompose variance across individuals and neighborhoods and take into account the possible non-independence of observations within neighborhood (census tracts). We assume that the impact of a changing crime rate will not be immediate. Rather, changes in offending are likely to be apprehended with some lag, either through the dissemination of information on crime incidents through networks or the accumulation of direct witnessing experiences over time. Only the most severe (and relatively rare) instances of violent crime are likely to receive media attention, resulting in more accelerated impact. Accordingly, we regress continuous measures of systolic and diastolic blood pressure taken from visit 2 of the DHS (visits 1 and 2 occurred largely between 2000 and 2001) on measures of the neighborhood aggravated assault rate for 1999 and the *change* in the aggravated assault rate between 1999 and 2000. Additional predictors include individual level characteristics (demographic background, socioeconomic status, and cardiovascular risk factors at visit 1) and the visit 1 measure of systolic/diastolic blood pressure--a highly conservative assessment as it essentially captures the effects of short-term changes in neighborhood violence rates on short-term changes in blood pressure between DHS visits. We estimate initial models examining only race/ethnic effects on blood pressure, controlling for age. We then consider the extent to which socioeconomic status (education, marital status), cardiovascular disease risk factors (smoking, waist circumference), neighborhood assault rates, and blood pressure levels at visit 1 explain variation across individuals and neighborhoods in both systolic and diastolic blood pressure at visit 2. All models are presented separately for men and women.

Results

We first examine the results of unconditional two level linear models of systolic and diastolic blood pressure (SBP/DBP) for women and men. Results of these analyses offer little evidence that blood pressure levels vary across neighborhoods for men (the intra-class correlations for both BP outcomes were close to zero). In contrast, unconditional models of BP offered evidence of substantial variation across neighborhoods for women. Intra-class correlations were .25 and .23 for systolic and diastolic blood pressure, respectively, suggesting that neighborhood may play a more important role in understanding variation in BP for women than men.

Table 2 presents the results of conditional two-level linear models of SBP and DBP for women. Model 1 includes only age and race/ethnicity. Beginning with SBP, both age and African American race are positively and significantly associated with SBP, while Latino ethnicity is negatively associated with this outcome. African American race exerts a substantial effect on SBP—on average, African American women have a SBP 8.5 points higher than white women. Models 2 and 3 include socioeconomic and cardiovascular disease risk factors, accounting for 20% of the African American-white disparity in systolic blood pressure. Including the 1999 aggravated assault rate and the change in the assault rate between 1999 and 2000 results in significant positive effects and reduces the African American-white disparity by another 22% (by comparison with its magnitude in Model 1). Including systolic blood pressure at visit 1—a highly conservative model—indicates that the effects of assault rates on blood pressure remain significant. Note that Model 5 essentially estimates the effect of the temporally lagged change in the neighborhood assault rate on the change in systolic blood pressure between visits. Models of diastolic blood pressure for women reveal comparable results. African American women, on average, have a 6.3 point higher DBP than white women. Controlling for socioeconomic and cardiovascular disease risk factors accounts for about 18% of the baseline African American-white disparity. Including measures of the neighborhood assault rate in Model 4 accounts for another 21% of the baseline disparity. Both assault rate measures are significant and positive. Finally, Model 5 includes visit 1 DBP and indicates that both the absolute assault rate and the change in the assault rate are significant predictors of change in DBP between visits. In models not presented, the effects of assault rates hold after including neighborhood structural controls such as poverty rates, residential instability, and race/ethnic composition. These findings offer evidence of the role of neighborhood crime (including short-term changes in violent crime) in predicting short-term changes in BP for women.

Table 3 presents the results of comparable models for men. Although a similar pattern of African American-white disparity in BP emerges for men, the models explain a smaller proportion of the total disparity when compared with women. Consistent with the low magnitude of variation in BP across neighborhoods, crime rates are not significant predictors of BP, suggesting that neighborhoods play a smaller role in the cardiovascular health of men.

Summary

These findings offer evidence of neighborhood crime effects on blood pressure in a rigorous, multilevel analytic context. For women, absolute levels of, and changes in, the neighborhood aggravated assault rate exerts significant influence on changes in blood pressure (both systolic and diastolic) in an urban US sample. Moreover, neighborhood crime rates account for a nontrivial proportion of the African American-white disparity in blood pressure among women. These findings offer more convincing evidence of the potentially causal role of neighborhood context effects on cardiovascular health.

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Table 2. Hierarchical Linear Models: Visit 2 BP Regressed on Individual Level Characteristics, Assault Rates, and Visit 1 BP (DHS Women); N=993.

Independent	Visit 2 Systolic					Visit 2 Diastolic				
Variables	1	2	3	4	5	1	2	3	4	5
Individual level										
Age	.63 ***	.64 ***	.56 ***	.57 ***	.12 **	.14 ***	.15 ***	.11 ***	.12 ***	.01
Race/ethnicity										
African american	8.47 ***	7.56 ***	6.86 ***	5.01 **	1.77	6.31 ***	5.58 ***	5.15 ***	3.81 ***	1.13
Latino	-4.23 **	-2.75	-1.28	-1.32	-.95	-.21	.04	.71	.64	-.45
Other	2.53	2.96	4.72	4.19	4.27	2.50	2.40	3.20	2.73	2.10
Education (vs. HS)										
Less than HS	-	-.34	.35	-.52	-.05	-	-.23	.04	-.58	-.90
Some HS	-	3.95 *	3.88 *	2.94	-.60	-	1.93 *	1.77 *	1.15	-.29
Some college	-	1.87	2.09	2.32	-.38	-	1.37	1.49 *	1.62 *	.14
College degree	-	-3.11	-2.05	-1.56	-3.27 **	-	-.58	-.04	.35	-1.32
Graduate education	-	-4.18 *	-2.78	-2.31	-1.46	-	-1.45	-.70	-.40	-.58
Married	-	-2.73 **	-1.53	-1.16	-.24	-	-1.77 ***	-1.10 *	-.84	-.02
Don’t smoke	-	-	-.59	-.12	.14	-	-	-.70	-.36	-.48
Waist circumference	-	-	.28 ***	.28 ***	.12 ***	-	-	.14 ***	.14 ***	.07 ***
Visit 1 systolic	-	-	-	-	.64 ***	-	-	-	-	-
Visit 1 diastolic	-	-	-	-	-	-	-	-	-	.67 ***
Neighborhood level										
1999 Assault rate	-	-	-	.24 ***	.16 *	-	-	-	.17 ***	.06 ***
1999-2000 Change in Assault rate	-	-	-	.23 *	.08 **	-	-	-	.18 ***	.12 **
Intercept	91.88 ***	92.27 ***	67.93 ***	65.52 ***	23.40 ***	67.87 ***	68.12 ***	55.89 ***	54.25 ***	16.16 ***

*p < .10 **p < .05 *** p < .01 (two-tailed)

Table 3. Hierarchical Linear Models: Visit 2 BP Regressed on Individual Level Characteristics, Assault Rates, and Visit 1 BP (DHS Men); N=778.

Independent	Visit 2 Systolic					Visit 2 Diastolic				
Variables	1	2	3	4	5	1	2	3	4	5
Individual level										
Age	.59 ***	.59 ***	.52 ***	.52 ***	.16 ***	.20 ***	.21 ***	.17 ***	.16 ***	.04
Race/ethnicity										
African american	5.95 ***	6.22 ***	6.01 ***	5.52 ***	3.18 **	4.25 ***	3.64 ***	3.56 ***	3.22 ***	1.83 **
Latino	-2.79	-1.36	-2.21	-2.26	-1.58	.73	.57	.03	-.05	-.01
Other	-1.25	.84	1.59	1.35	5.62	3.37	3.52	4.04 *	3.88 *	4.32 *
Education (vs. HS)										
Less than HS	-	.01	.53	.37	.63	-	-1.64	-1.21	-1.33	-1.41
Some HS	-	.65	.67	.65	1.09	-	-.64	-.65	-.63	-.28
Some college	-	-2.80 *	-3.36 **	-3.20 *	-1.86	-	-.95	-1.36	-1.21	-1.03
College degree	-	-1.48	-1.88	-1.62	-1.26 **	-	-.16	-.55	-.35	-.91
Graduate education	-	-4.29	-4.12 *	-3.94 *	-2.41	-	-2.30	-2.30	-2.18	-2.03 *
Married	-	-.47	-1.80	-1.60	-.63	-	-.34	-1.32 *	-1.20	-.76
Don't smoke	-	-	-1.54	-1.41	-1.00	-	-	-.59	-.51	-.36
Waist circumference	-	-	.27 ***	.27 ***	.15 ***	-	-	.19 ***	.19 ***	.11 ***
Visit 1 systolic	-	-	-	-	.64 ***	-	-	-	-	-
Visit 1 diastolic	-	-	-	-	-	-	-	-	-	.61 ***
Neighborhood level										
1999 Assault rate	-	-	-	.05	.00 *	-	-	-	.04	.01
1999-2000 Change in Assault rate	-	-	-	.13	-.02 **	-	-	-	.14 **	.05
Intercept	100.17 ***	101.18 ***	78.54 ***	77.98 ***	23.47 ***	68.20 ***	69.11 ***	52.72 ***	52.42 ***	17.94 ***

*$p < .10$ ** $p < .05$ *** $p < .01$ (two-tailed)