EXTENDED ABSTRACT

Neighborhood Stressors and Health:

Crime Spikes and Short-Term Variability in BMI

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Abstract Submitted to the 2010 Population Association Meetings

September 21, 2009

Disparities in the prevalence of overweight and obesity across sociodemographic characteristics remain a source of enduring concern for social scientists, clinicians, and policy makers. Substantial increases in obesity rates in the U.S. over the last two decades have highlighted the need for more extensive research on the origins of resilient social disparities in health-consequential weight status. Recently, researchers have sought to understand the origins of obesity and body mass index (BMI) differentials in broader contextual factors, including the social and economic features of residential spatial and neighborhood environments. Indeed, a long history of research has documented the dramatically different conditions in which distinct racial, ethnic, and socioeconomic groups reside (Massey and Denton 1993). 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 short-term changes in BMI across neighborhood context, focusing on the role that rapid increases in the crime rate ("crime spikes") may play in influencing weight-related stress and behavioral patterns. We employ data from the Dallas Heart Study (DHS), an innovative, longitudinal data collection effort that offers an unprecedented opportunity to explore the "upstream" contextual origins of health disparities. The DHS combines extensive survey-based measures of socio-demographic characteristics with a wealth of carefully measured biomeasure data related to cardiovascular health.

Theoretical Background

We draw on theoretical approaches to the stress-health link, neighborhood social capital/collective efficacy theory, and insights from the social network perspective on information diffusion to develop hypotheses regarding the link between crime spikes and BMI. We suggest that neighborhoods with limited structural resources experience weaker social cohesion and associated norms encouraging the social control of public space. The level of social cohesion (including trust and perceptions of mutual support) characterizing a neighborhood is strongly associated with norms supporting beneficial action on behalf of communities (Sampson, Raudenbush, and Earls 1997). Levels of cohesion are likely to be associated with action on behalf of health-relevant goals such as safe public streets and parks, and correspondingly reduced crime levels. Thus, higher levels of collective trust, mutual support, and normative expectations supporting a safe public environment may lead to decreases in BMI through their impact on use of outdoor space for recreation and reduced fear. Anxiety associated with exposure to potentially threatening environments may be accompanied by a physiological stress response with implications for regulation of the hypothalamic-pituitary-adrenal axis. Indeed, research examining links between stress, glucocorticoid hormone production, and eating behavior offers evidence consistent with the hypothesis that exposure to stressors may increase caloric intake (disproportionately saturated fat and carbohydrates) (Dallman et al. 2004; Tataranni, et al. 1996; Yacano-Freeman and Gill 2004).

In addition to overall levels of social cohesion, the prevalence of crime also provides a direct source of information about potential risks rooted in the local environment and may contribute to physiological stress. Crime rates, as a component of "psychosocial hazard," have been linked with self-reported history of physician-diagnosed cardiovascular disease (CVD), and may be related to CVD risk factors, such as obesity (Augustin et al. 2008). Extant theory and research on the health impact of crime rates have emphasized the detrimental health impact of exposure to chronically high crime neighborhoods. Stress responses may be as, or more severe, however, when residents face relatively rapid increases in the crime rate, or crime "spikes."

Finally, we consider the role of social cohesion in moderating any observed influence of crime rates or spikes on short-term changes in BMI. Two hypotheses are considered. First, cohesive environments may serve to mitigate the stress impacts of crime by encouraging residents to interpret crime as manageable and/or aberrant (in the case of recent crime spikes). A competing hypothesis, however, would suggest that social cohesion is linked with more extensive social network interaction and exchange. Information on crime in general, and crime spikes in particular, would be more efficiently transmitted in such contexts, simultaneously diffusing the associated stress response. The latter hypothesis would expect that any beneficial average effects of cohesion would be offset by the increased exposure to knowledge of local crime. The DHS offers an opportunity to examine the joint impact of neighborhood social cohesion and crime in an 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 30 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, and health behavior. 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 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 1476 respondents (across 260 census tracts) for whom height and weight were assessed at visits 1 and 3. 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 crime and neighborhood social cohesion on changes in BMI. Respondents who began the study after 2001 were also excluded from the analysis, since geocoded data on crime by type and date were not available for 2002. The study design oversampled African American respondents (the unweighted racial composition of the sample was 30% white, 15% Latino, 53.5% African American, and 1.5% other race/ethnicity. All analyses control for stratification variables used in the study sampling design.

Measures

The dependent variable, short-term change in BMI, is the difference in BMI between DHS visits 1 and 3. We assessed change in BMI over a twenty week period, limiting the analysis to respondents for whom the time between visits 1 and 3 was at least two and no more than twenty-two weeks (the median time between visits 1 and 3 was 69 days). We truncated the distribution of BMI change to fall within -12 and 12 BMI points (at the high end of the distribution, a 12 BMI point change roughly corresponded to the 99th percentile on change in BMI between visits 1 and 3). Values outside this range were considered implausible given the length of the study period considered (more restrictive and expansive ranges, however, yielded comparable results). The sample was becoming heavier over the course of the study period considered—the average change in BMI was .80 points. Crime measures are constructed for the year prior to each respondent's first DHS visit date. Crime rates include burglary, robbery, and aggravated assault for Dallas County tracts. Evidence suggests that fear is most pronounced for burglary and robbery—crimes that typically involve strangers (Skogan 1986; Sprott and Doob 1997). We include assault under the assumption that the prevalence of violent crimes would also contribute to fear. In order to construct a measure of residence in a crime spike neighborhood, we subtracted the crime rate for the most recent six months before the first DHS interview from that of the six months just prior (thus capturing changes in the crime rate over the previous year). Respondent are coded as residing in a crime spike neighborhood if the absolute value of the change in crime rate over the previous year is in the top 20%. The median proportionate increase in the combined burglary, robbery, and aggravated assault rates for respondents who experienced a crime spike in the last year was 240%. For respondents residing in non-crime-spike neighborhoods, the median proportionate change in the crime rate was 0.[1] Social cohesion was measured using three items drawn from the social cohesion scale developed by Sampson, Raudenbush, and Earls (1997). Respondents were asked to report their level of agreement with the following statements: (1) This is a close knit neighborhood; (2) People here are willing to help their neighbors; and (3) People in this neighborhood can be trusted.[2] The reliability of the level 1 combined scale was .78. The responses to the three cohesion items were aggregated to the neighborhood level using a three-level rating scale analysis (ordinal logit model) controlling the stratification variables used in the sampling design of the study.

We also included a host of controls at the individual and neighborhood level. At the individual level, we included a number of covariates drawn from the DHS survey and biomeasure data including age, gender, race/ethnicity, marital status, education, income, immigrant status, number of years resident in the neighborhood, whether the respondent had a usual source of medical care, physical activity level, the visit 1

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[1] We have no a priori justification for choosing any one cut off point to define a "crime spike." Accordingly, we examined multiple cut points (including the top 15% and 10% on change in the crime rate). Results were comparable to those reported.

[2] The original social cohesion scale developed by Sampson and colleagues also included items tapping level of agreement with the statements "People in this neighborhood don't get along" and "People in this neighborhood don't share the same values." These items were included in the DHS survey, but exhibited considerably smaller factor loadings on the latent cohesion scale, suggesting a different pattern of intercorrelation than observed in the 1995 Project on Human Development in Chicago Neighborhoods Community Survey data. Nevertheless, including these items in an alternative cohesion scale resulted in a similar pattern of association with BMI change.

average of systolic and diastolic blood pressure, visit 1 BMI, and logged measures of the number of close friends and relatives.[3] We also include a mean-centered measure of the number of days between visit 1 and 3 and its square. At the census tract level, we included measures of concentrated poverty (combining the percent in poverty, on public assistance, in female-headed households, and unemployed), residential stability (combining the percent living in the same house since 1995 and the percent of dwelling units that are owner-occupied), and immigrant concentration (percent Latino and percent foreign-born).

Analytic Strategy

We employ two-level hierarchical linear models (HLM) to investigate the impact of social cohesion and crime on individual level BMI change. HLM accounts for the nonindependence of observations within census tracts (the level two unit of aggregation). We assume that the impact of a crime spike will peak and begin to fade across time. Hence we incorporate measures of length of time between visits 1 and 3 (as noted above) and interact these measures with the crime spike indicator to capture the potential for changing impact of the crime spike on BMI differentials across participation periods of different lengths. To capture the potential for social cohesion to modify the effects of crime, we include an interaction term between cohesion and the crime spike indicator. Incorporating short-term changes in BMI as an outcome of short-term changes in neighborhood environments partially allays concerns about selection bias that typically afflict neighborhood analyses.

Results

Table 1 presents the results of two-level linear models of BMI change.[4] Model 1 includes only sociodemographic and socioeconomic background variables. Model 1 indicates that African American race is associated with increased positive change in BMI over the study period by comparison with whites. Study length is also positively associated with BMI change, highlighting the overall trend toward increased BMI in this sample. Being male, in contrast, reduced BMI change, suggesting that women gained body weight faster than men over the study period. Model 2 adds a host of additional sociodemographic variables (omitted) and measures of neighborhood structure (the latter do not significantly influence change in BMI). A measure of neighborhood social cohesion, included in Model 3, achieves significance at the conventional level and suggests that increases in social cohesion are associated with reduced BMI over the study period. Model 4 incorporates measures of the person-specific crime rate and crime spike in the year prior to the first DHS visit. The coefficients indicate that, while the overall crime rate is not a significant predictor of BMI change, residence in a crime spike neighborhood is significantly associated with this outcome. Interaction terms are included between the crime spike dummy variable and measures of study length and study length squared. The crime spike coefficient can be interpreted as the effect of residence in a crime spike neighborhood on BMI change 10 weeks from the initiation of the study period. At this time point, the coefficient indicates that a neighborhood crime spike increases BMI by roughly half of one point. Figure 1 graphs the increase in BMI across the study period for respondents in crime spike and non-crime spike neighborhoods.[5] As is evident from the figure, respondents participating in the DHS study were becoming heavier over the course of the study at a non-trivial rate. However, residents of crime spike neighborhoods exhibit an accelerated rate of BMI increase initially (although the effect fades over time).

Model 5 adds the interaction between social cohesion and the crime spike indicator. The significant positive coefficient for the interaction term indicates that, as social cohesion increases, the positive effect of residence in a crime spike neighborhood on BMI change also increases. The interaction term offers evidence consistent with the hypothesis that social cohesion provides more efficient information diffusion, enhancing awareness of, and stress associated with, crime spikes. Figure 2 shows the impact of crime spikes on BMI change (at 10 weeks after the first DHS interview date) across low medium and high levels of social cohesion (from -1 to 1 standard deviations). Crime spikes have the largest impact in high social cohesion neighborhoods (.84 BMI points vs. .16 BMI points in low social cohesion neighborhoods)

Summary

Neighborhood social cohesion and crime constitute important potential sources of both stress reduction and amplification. Extant neighborhood theory has suggested that cohesion can serve as a psychosocial resource,

[3] A measure of current pregnancy for women did not alter the pattern of results observed.
[4] All models control DHS stratification variables.
[5] The predictions are based on Model 6 and incorporate the significant and positive linear effect of study length and the negative and marginally significant coefficient for the interaction of crime spike and the quadratic effect of study period length.

diminishing the stress-potential of neighborhood environments. Crime has also been hypothesized to be a significant contextual predictor of health-consequential stress. Findings from the DHS investigating the effects of cohesion and crime on short-term BMI change offer evidence, first, of the protective effect of cohesion on weight gain. Residents of higher cohesion neighborhoods, on average, experience less of an increase in BMI over the DHS study period considered. These findings also offer evidence of a neighborhood crime spike effect on changes in BMI. Crime spikes, but not overall higher crime rates, were associated with significant increases in BMI for DHS adults. The findings suggest that volatile environments may be more stressful even than chronically higher crime neighborhoods. Residents of the latter may find methods of adapting to the context in order to reduce exposure to stress. Wallace and colleagues (2003) found that community stress exhibits a curvilinear association with a measure of resident demoralization. They suggest that the more volatile and potentially transitional middle range of the neighborhood stress continuum may be more difficult to tolerate as residents attempt to manage less predictable environments. A similar phenomenon may be at work in the relative contributions of overall crime rates and crime spikes. Rapid changes in crime capture instability in neighborhood conditions that may be highly consequential for the experience of stress. Finally, although cohesion, on average, serves as a protective mechanism, cohesion also amplifies the effect of crime spikes on weight gain. Information about the prevalence of crime is likely to be more rapidly diffused in cohesive neighborhoods, providing residents with relevant local knowledge, but also exposing them to the stress-inducing awareness of crime increases. Thus the beneficial average effects of social cohesion on stress and accompanying weight gain may be offset in the context of a crime spike by the effective operation of neighbor-network based information exchange.

Finally, we note that these findings contribute to the neighborhood literature more generally by offering a research design that examines the effect of changes in neighborhood environments on changes in a significant health outcome. Although we cannot completely rule out a selection mechanism that may bias our results, advancing a plausible selection-based process that could explain the patterns of association we observe (and their timing) is a more challenging task by comparison with typical, cross-sectional designs. Our findings thus offer more convincing evidence of the potentially causal role of neighborhood context effects on the health and well-being of urban residents.

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Table 1. Hierarchical Linear Models: Change in BMI Regressed on Individual Level Characteristics, Social Cohesion, and Crime (Selected Covariates)

Independent Variables	D in BMI between DHS Visit 1 and 3: 1	2	3	4	5	6
Individual level						
Age	.00	.00	.01	.01	.01	.00
	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)
Race/ethnicity						
African American	.33 *	.32 *	.31 +	.31 +	.32 +	.30 +
	(.16)	(.16)	(.18)	(.18)	(.18)	(.18)
Latino	.20	.15	.11	.11	.11	.12
	(.16)	(.21)	(.23)	(.23)	(.23)	(.23)
Other	.24	.03	-.11	-.11	-.12	-.17
	(.40)	(.42)	(.45)	(.45)	(.45)	(.45)
Male	-.33 **	-.31 **	-.37 **	-.37 **	-.38 ***	-.42 ***
	(.10)	(.10)	(.11)	(.11)	(.11)	(.11)
Study period length (days)	.01 ***	.01 ***	.01 ***	.01 ***	.01 ***	.01 ***
	(.00)	(.00)	(.00)	(.00)	(.00)	(.00)
Study period length squared	.00	.00	.00	.00	.00	.00
	(.00)	(.00)	(.00)	(.00)	(.00)	(.00)
Crime rate (prior year)	-	-	-	.00	.00	.00
				(.00)	(.00)	(.00)
Crime spike (prior year)	-	-	-	.54 *	.50 *	.50 *
				(.21)	(.21)	(.21)
Crime spike*study per length	-	-	-	.00	.00	.00
				(.00)	(.00)	(.00)
Crime spike*study per length sq	-	-	-	-.0002	-.0002 +	-.0002 +
				(.00)	(.00)	(.00)
Neighborhood level						
Concentrated poverty	-	.06	.00	.06	.00	.00
		(.07)	(.09)	(.08)	(.08)	(.09)
Residential stability	-	.02	.05	.01	.08	.07
		(.07)	(.07)	(.07)	(.07)	(.07)
Immigrant concentration	-	.01	-.07	-.08	-.07	-.08
		(.08)	(.09)	(.09)	(.08)	(.08)
Social cohesion	-	-	-.14 *	-.14 *	-.23 **	-.23 **
			(.07)	(.07)	(.07)	(.07)
Crime spike*Social cohesion	-	-	-	-	.35 **	.34 **
					(.13)	(.13)
Intercept	.98 ***	.96 ***	.96 ***	.83 ***	.81 ***	.61 ***

+p < .10 *p < .05 ** p < .01 *** p < .001 (two-tailed)

Note: Models 2-6 control education level, marital status, income, usual source of care, immigrant status, and years resident in the neighborhood. Model 5 controls visit 1 bmi, visit 1 blood pressure, physical activity, and the number of friends and relatives. All models control DHS stratification variables.

Figure 1. Change in BMI Between DHS Visit 1 and 3 by Crime Spike Neighborhood

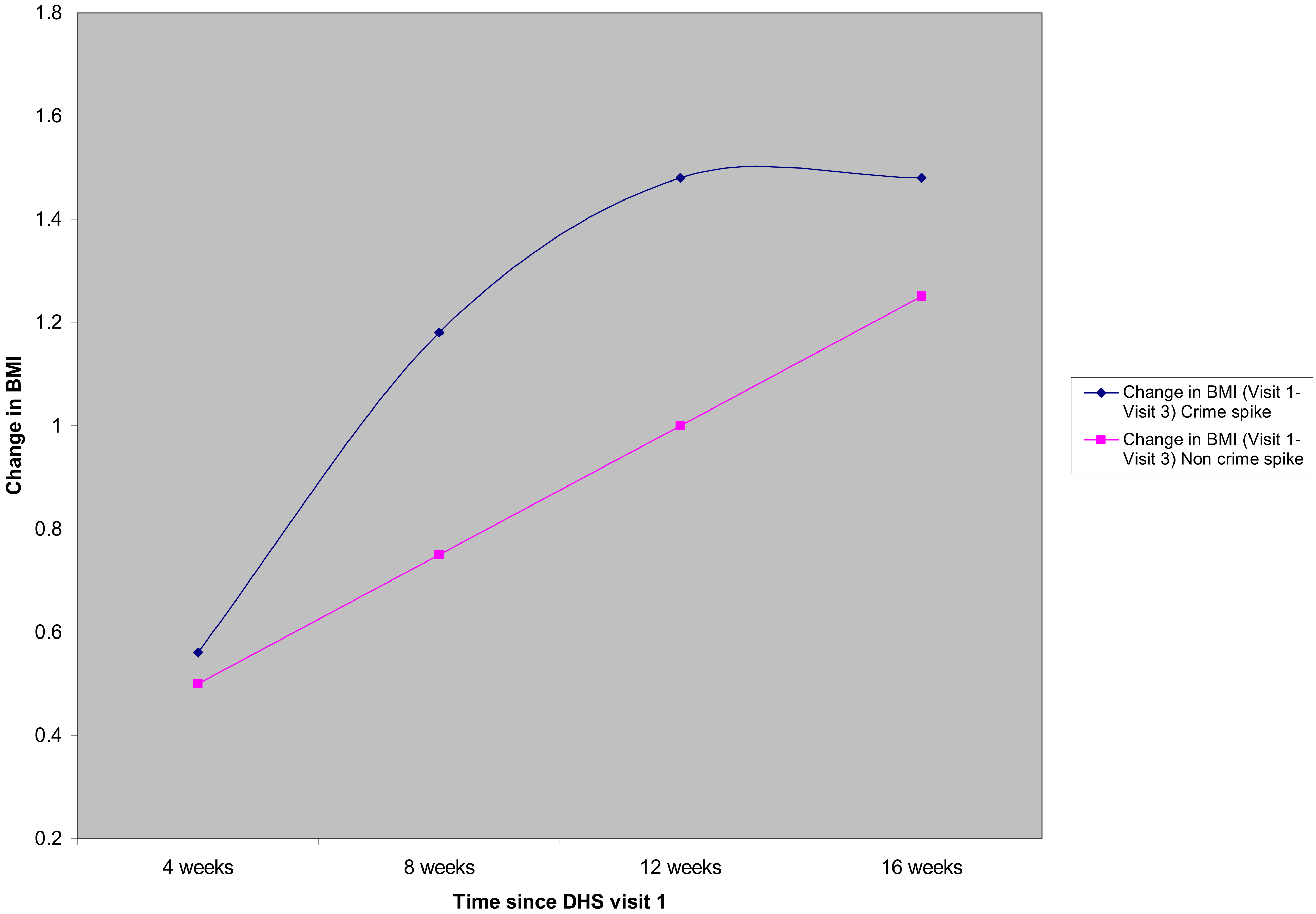

Figure 2. Change in BMI by Crime Spike and Neighborhood Social Cohesion (10 Weeks After first DHS Visit)