Urban Neighborhood Poverty and the Incidence of Depression in a Population-Based Cohort Study

SANDRO GALEA, MD, DrPH, JENNIFER AHERN, MPH, ARIJIT NANDI, MPH,
MELISSA TRACY, MPH, JOHN BEARD, PhD, AND DAVID VLAHOV, PhD

PURPOSE: It has long been suggested that certain characteristics of the urban environment may influence population mental health. However, evidence from multilevel research addressing the relation between intraurban environments and depression has been conflicting, and prospective evidence in this regard has been limited. We assessed the relation between urban neighborhood poverty and incident depression in a population-based prospective cohort study.

METHODS: Using random-digit-dial telephone surveys, we recruited 1570 adult residents of New York City (NYC) in 2002. All persons interviewed at baseline were contacted again for follow-up 6 and 18 months after the initial interview. Eighty-one percent of the sample completed at least one follow-up visit. Analysis was restricted to 1120 persons who could be geocoded to NYC neighborhoods, which were represented by NYC community districts (N = 59).

RESULTS: Among persons with no history of major depression at baseline (N = 820) there were 113 incident cases of major depression during the 18 months of follow-up; cumulative incidence of depression during the study period was 14.6 per hundred persons (95% confidence interval, 10.9–18.3). In low–socioeconomic status (SES) neighborhoods, the cumulative incidence of depression was 19.4 per hundred persons (95% confidence interval, 13.5–25.3), which was greater than that in high-SES neighborhoods (10.5; 95% confidence interval, 5.9–15.2). In multivariable models adjusting for individual covariates (sociodemographics, individual SES, social support, stressors, traumas, and history of post-traumatic stress disorder), the relative odds of incident depression was 2.19 (95% confidence interval, 1.04–4.59) for participants living in low-SES compared with high-SES neighborhoods.

CONCLUSIONS: SES of neighborhood of residence is associated with incidence of depression independent of individual SES and other individual covariates. Additional work needs to characterize the pathways that may explain the observed association between living in low-SES neighborhoods and risk for depression. *Ann Epidemiol* 2007;17:171–179. © 2007 Elsevier Inc. All rights reserved.

KEY WORDS: Mental Health, Neighborhood, Context, Socioeconomic Position, Urban.

INTRODUCTION

The majority of the world's population will soon reside in urban areas (1, 2). Empiric evidence has long suggested that certain characteristics of the urban environment may influence population mental health (3, 4). Faris and xDunham (3) argued that community disorganization in Chicago neighborhoods contributed to poor mental health of urban residents. Subsequently, results from the Midtown Manhattan Study also suggested that features of the urban environment, such as social disorganization, might influence mental health (5). In recent years, several cross-sectional population-based studies assessed urban–rural or interurban differences in prevalence of mental health problems (6–10). Results from these prevalence studies were conflicting. For example, greater prevalences of mental illness were documented in urban compared with rural areas in the United Kingdom (9), but urban–rural differences in prevalence of mental illness were not found in a Canadian study using similar methods (8).

Intraurban analyses, typically neighborhood level, present an opportunity to assess whether specific characteristics of a local urban environment are associated with psychopathologic states. A few recent studies used multilevel analytic techniques to consider whether characteristics of urban neighborhoods were associated with individual mental health. The empirical work on neighborhoods and mental health to date produced inconsistent results. Some studies, primarily from the United Kingdom, reported that living

172 Galea et al.
URBAN NEIGHBORHOOD POVERTY AND DEPRESSION

AEP Vol. 17, No. 3
March 2007: 171–179

Selected Abbreviations and Acronyms

NYC = New York City
SES = socioeconomic status
BSI = Brief Symptom Index
GEE = generalized estimating equation
NWS = National Women's Study
PTSD = post-traumatic stress disorder

---

in socially and economically deprived neighborhoods did not contribute to mental illness independent of individual covariates (11–15). Conversely, a number of US reports indicated increased risk for mental illness in poorer neighborhoods, even after accounting for individual covariates (16–18). For example, Walters et al. (13) found that living in the most deprived areas of Britain was not associated with depression among older persons after adjusting for individual characteristics, whereas studies in multiple cities across the United States reported that neighborhood disadvantage was associated with greater rates of depressive symptoms independent of individual characteristics (16, 18).

Multilevel analyses published to date are predominately cross-sectional and hence susceptible to prevalence bias, limiting causal inference about the relation between neighborhood context and onset of mental health illnesses. We are aware of only two other studies that assessed the relation between characteristics of neighborhoods and *incident* mental health problems. One study failed to document an association between poverty-area residence and incident depression in adjusted models (15). Another more recent study using a prospective design suggested that neighborhood disorder was associated with depressive symptoms over time when controlling for baseline depressive symptoms (19). Building on this work, we were interested in assessing whether living in a poorer neighborhood was associated with greater risk for incident major depression independent of individual covariates by using data from a prospective general population survey of New York City (NYC) adults.

METHODS

Participants

We conducted a random-digit-dial telephone survey of residents of the NYC metropolitan area between March 25 and June 25, 2002. The study is designed to document population mental health in the aftermath of the September 11, 2001, terrorist attacks. The sampling frame consisted of all noninstitutionalized adults (age ≥18 years) and oversampled residents living in the area closest to the World Trade Center site. Interviews were conducted in English, Spanish, Mandarin, and Cantonese by trained interviewers using translated and backtranslated questionnaires and

a computer-assisted telephone interview system. Households were screened for eligibility by location. If eligible, an adult in each household was selected randomly by choosing the adult with the birthday closest to the interview date. Up to 10 attempts were made to conduct the interview. The response rate among those eligible was 56%. Contact information was obtained for respondents, their key family members, and other important contacts. At 6 and 18 months after baseline, we conducted follow-up interviews, again using telephone surveying (September 25, 2002, to January 31, 2003, and September 25, 2003, to February 29, 2004, respectively). We were successful in contacting and completing at least one follow-up interview in 81% of baseline respondents.

This analysis was restricted to residents of NYC itself (N = 1570). We included in this analysis residents of NYC who completed at least one follow-up interview and could be linked to their neighborhood of residence, for a total of 1120 participants. Additional details on sample selection are provided elsewhere (20). This work was reviewed and approved by the Institutional Review Board of the New York Academy of Medicine.

Measures

The outcome of interest in this analysis is major depression. We assessed major depression by using a modified version of the Structured Clinical Interview for *Diagnostic and Statistical Manual of Mental Disorders, Third Edition Revised* major depressive disorder subscale (21), a validated measure that captures symptoms of major depression consistent with *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* criteria (22, 23). To meet criteria for depression, respondents had to report five or more symptoms for at least 2 weeks, one of which was depressed mood or loss of pleasure or interest. Past-6-month depression was based on reporting five or more symptoms within the same month during the past 6 months, and lifetime depression was based on reporting the required symptoms at any time in the past. Incident cases were those satisfying criteria for depression at any time during follow-up among persons who did not report depression at any time in the past at baseline. Cronbach α for the depression scale was 0.79 in our sample (24). Furthermore, in a validation study comparing our instrument with the Brief Symptom Inventory (BSI) (25), a widely used depression scale, the BSI depression scale had sensitivity of 73% and specificity of 87%, with our instrument as the "gold standard" (22). In a receiver operating characteristic analysis (26), the BSI depression cutoff score of 65 or higher best predicted depression defined by our instrument (area under the curve = 0.89) (22).

We considered variables that are known determinants of depression that could be potential confounders of the

central relationship of interest to this analysis (27). Information for individual covariates, including age, sex, race/ethnicity, income, education, and marital status, was obtained from respondents by using a structured questionnaire. We assessed social support by asking about emotional (e.g., "having someone to love you and make you feel wanted"), instrumental (e.g., "someone to help you if you were confined to bed"), and appraisal (e.g., "someone to give you good advice in a crisis") support in the 6 months before the September 11 attacks and summed responses (28). The combined social support score was divided into thirds for analysis.

September 11, 2001, event experiences also were assessed, and respondents were classified by whether they were affected directly by the attacks of September 11, 2001 (in the World Trade Center complex during the attacks, injured during the attacks, lost possessions or property, had a friend or relative killed, lost job as a result of the attacks, or involved in rescue efforts), and/or living within 2 miles of the World Trade Center site on September 11, 2001. Respondents also were asked about the occurrence of any of 12 traumatic events (natural disaster; serious accident at work, in a car, or somewhere else; assault with a weapon; assault without a weapon; unwanted sexual contact; serious injury or illness; other situation involving serious injury or physical damage; situation causing fear of death or serious injury; seeing someone seriously injured or violently killed; death of a spouse or mate; death of a close family member other than a spouse; or any other extraordinarily stressful situation or event) in their lifetime, as well as about stressors in the past year (divorce or separation, marriage, family problems, problems at work, and unemployment). For the analysis, prior lifetime traumatic experiences were categorized according to whether respondents experienced zero, one, two, three, or four or more traumatic events. Stressors in the past year were categorized as zero or one or more for the analysis.

Finally, we used the National Women's Study posttraumatic stress disorder (PTSD) module (29) to assess probable PTSD symptoms in the respondent's lifetime. The National Women's Study PTSD module is a 17-item measure of probable PTSD that evaluates the presence (yes/no) of criterion B (reexperiencing, e.g., intrusive memories or distressing dreams), C (avoidance, e.g., efforts to avoid thoughts associated with the trauma or loss of interest in significant activities), and D (arousal, e.g., difficulty falling asleep or concentrating) symptoms and determines content for content-specific symptoms (e.g., content of dreams or nightmares) if symptom presence is endorsed. We assessed lifetime history of probable PTSD based on the presence of at least one reexperiencing symptom, at least three avoidance symptoms, and two arousal symptoms reported to have been experienced any time in the past.

Neighborhood units for this analysis were the 59 community districts in NYC. These neighborhoods initially were defined by a resident consultative process organized by the Office of City Planning to reflect residents' own descriptions of neighborhoods in the 1970s. Therefore, community districts delineate meaningful neighborhoods within NYC, each with an administrative community board, that as such have political and social a priori significance for their residents. Although community districts are not demographically homogenous, they represent neighborhoods associated with resident behavior and health (30–33). Using 2000 US Census data (34), we dichotomized neighborhood socioeconomic status (SES) as high or low based on a median split of neighborhood median ($36,470) household income.

Statistical Analyses

Sampling weights were developed and applied to the data to correct for potential selection bias relating to number of household telephones, persons in the household, and oversampling. We compared distributions of key demographic characteristics, neighborhood poverty, and history of depression for respondents included in our analysis with those of respondents excluded because they could not be linked to their neighborhood of residence or were lost to follow-up. We also compared included respondents with 2000 US Census data for NYC (34). We calculated the prevalence of lifetime and past-6-month depression at baseline and cumulative incidence of depression during follow-up and used two-tailed chi-square tests to test for associations between covariates of interest and incidence of depression. Incident depression is defined as depression at either of the follow-up visits among those with no history of depression at baseline. We used generalized estimating equations (GEEs) to fit a multilevel multivariable model that assessed the relation between neighborhood SES and risk for depression at any time during follow-up for persons who did not report depression at baseline (35). The GEE model was specified with nesting by neighborhood, an exchangeable correlation structure, and weighting, as described. The model was adjusted for sociodemographic characteristics (i.e., income, education, marital status, social support, stressors, and traumatic events), as well as September 11, 2001, event experiences and lifetime history of PTSD. All analyses were carried out using SUDAAN (Research Triangle Institute, Research Triangle Park, NC) and SAS (SAS Institute, Cary, NC) (36). We replicated regression analyses by using Cox proportional hazards analysis, which allows consideration of the person-time contributed by each individual, and results were essentially equivalent. Only GEE models are presented here for the sake of brevity.

174 Galea et al.
URBAN NEIGHBORHOOD POVERTY AND DEPRESSION

AEP Vol. 17, No. 3
March 2007: 171–179

RESULTS

Overall, of 1570 NYC residents interviewed, 1120 successfully completed at least one follow-up interview and provided information allowing us to link them to their neighborhood. The remaining 450 respondents were excluded from further analyses. As listed in Table 1, there were no significant differences in distributions of key demographic characteristics or baseline prevalence of past-6-month depression between the included and excluded groups. There also was no significant difference in neighborhood poverty status between the included group and those excluded because of loss to follow-up. Additionally, distributions of age, sex, and race/ethnicity of the included sample are consistent with those of the general NYC adult population from the 2000 US Census (34). Mean age was 41.7 years, 55.6% of respondents were women, 38.1% were white, 6.4% were Asian, 25.1% were African American, 26.0% were Hispanic, and 4.4% were of other race or ethnicity. In the 59 neighborhoods, there was a mean of 19 respondents (median, 11 respondents; range, 2 to 246 respondents).

At baseline, the prevalence of past-6-month depression was 12.2%, and 20.8% had a lifetime history of depression (Table 2). For subjects who had no history of depression at baseline (n = 820), the cumulative incidence of depression during the 18-month period of follow-up was 14.6 per 100 persons. The cumulative incidence of depression was greater in low-SES compared with high-SES neighborhoods (19.4 per 100 versus 10.5 per 100 persons, respectively).

In bivariate analysis (Table 3), characteristics significantly associated with the incidence of depression during the 18-month follow-up were residence in a neighborhood of lower SES ($p = 0.024$), female sex ($p = 0.037$), living more than 2 miles from the World Trade Center site on September 11 ($p = 0.022$), and a lifetime history of PTSD ($p < 0.001$). Age, race/ethnicity, individual income, education, marital status, social support, being directly affected by the September 11 attacks, lifetime traumatic events, and stressors in the past year were not associated significantly with the incidence of depression during follow-up.

A multilevel model assessing the relation between neighborhood SES and incidence of depression during follow-up also is presented in Table 3. After adjusting for sociodemographic characteristics (i.e., income, education, marital status, social support, stressors, and traumatic events), September 11 experiences, and lifetime history of PTSD, respondents residing in lower SES neighborhoods had more than two times the odds of developing depression during follow-up relative to those residing in higher SES neighborhoods (odds ratio, 2.19; 95% confidence interval, 1.04–4.59). Female sex, lower social support, four or more

TABLE 1. Sample demographics

	Included in sample, weighted %	Excluded from sample, weighted %	Census 2000, %	Chi-square *p* (included vs. census)	Chi-square *p* (included vs. excluded)
Total (n)	1120	450			
Age, years					
18–24	15.2	13.7	13.2	0.77	0.26
25–34	24.6	31.8	22.5		
35–44	18.8	21.2	20.8		
45–54	18.8	17.4	16.7		
55–64	12.0	9.6	11.3		
65+	10.6	6.3	15.5		
Sex					
Male	44.4	43.3	46.2	0.72	0.81
Female	55.6	56.7	53.8		
Race/ethnicity					
White	38.1	31.3	38.7	0.78	0.13
Asian	6.4	6.1	10.1		
African American	25.1	20.9	23.0		
Hispanic	26.0	34.2	24.7		
Other	4.4	7.6	3.6		
Neighborhood socioeconomic status[a]					
High	53.3	46.9			0.28
Low	46.7	53.1			
Past-6-mo depression					
No	87.8	88.0			0.95
Yes	12.2	12.0			

[a]Among those with neighborhood information (all included subjects, 235 of excluded subjects).

TABLE 2. Prevalence and cumulative incidence of major depression

	n	%	95% Confidence interval
Baseline lifetime depression (n = 1120)	300	20.8	17.1–24.4
Baseline past-6-mo (n = 1120)	162	12.2	9.2–15.3
Cumulative incidence of depression over 18 mo (n = 820)[a]	113	14.6	10.9–18.3
High neighborhood socioeconomic status (n = 432)	45	10.5	5.9–15.2
Low neighborhood socioeconomic status (n = 388)	68	19.4	13.5–25.3

[a]Among those with no lifetime depression at baseline.

lifetime traumatic events, and lifetime history of PTSD also were associated significantly with incidence of depression in this multivariable model.

DISCUSSION

Using data from a population-based prospective cohort study, we found that the odds of incident major depression were greater among persons living in poor neighborhoods, independent of individual characteristics. Specifically, multilevel analyses showed that among persons who had never had depression previously, residents of poorer urban neighborhoods had more than two times the odds of incident depression during an 18-month period of follow-up relative to residents of neighborhoods of higher SES, independent of individual-level risk factors for depression, including individual income.

Persons living in poor urban neighborhoods may be exposed to a greater number of stressors and have less access to salutary resources than persons living in wealthier neighborhoods. For example, residents of socially and economically deprived neighborhoods may be exposed more frequently to such traumatic event experiences as rape and interpersonal violence and such stressors as unemployment (37), both consistently linked to poorer mental health, including anxiety and mood disorders (38, 39). Concomitantly, living in poorer neighborhoods may be associated with limited access to sources of material protections and social supports salutary for mental health (37). This mechanism was called the "differential vulnerability" hypothesis, suggesting that individuals living in deprived neighborhoods may be more likely to experience intermittent traumatic events and stressors and more vulnerable to their adverse effects (40).

In our study, we documented an association between experiencing traumatic events and having low social support and greater risk for incident depression during follow-up. However, in contrast to other work (13–15), we found that the relation of neighborhood SES and incident depression persisted in multivariable models independent of these potentially explanatory individual-level covariates. However, we did not document an association between stressors (including unemployment and family problems) and incident depression. This suggests that mechanisms that explain the observed relation between neighborhood SES and incident depression may be complex, and it is not sufficient or particularly informative to discuss stressors as a broad undifferentiated group as mechanisms that explain the relation between neighborhood conditions and psychopathologic states. It is plausible that in different contexts, particular stressors may have different roles in mediating relations between neighborhood conditions and mental health.

It also is possible that stressors not measured in this study contribute to the relation between urban neighborhood SES and incident depression. For example, additional noise exposure in poorer urban neighborhoods may adversely affect mental health (41). In the study by Yen and Kaplan (15) of poverty-area residence and incident depression in Alameda County, CA, adjustment for individual health behaviors (including smoking and alcohol consumption), in addition to other characteristics, such as individual income, attenuated the relation between neighborhood poverty and depression. Several other studies showed a greater likelihood of smoking and heavy drinking in more deprived areas (15, 42–44), suggesting that these health behaviors themselves may be influenced by neighborhood residence and may mediate the relation between neighborhood poverty and depression. Additional research should consider the role of these and other potential mediators of the relations documented here.

The quality of the social and built environments of poorer urban neighborhoods may contribute directly to the elevated risk for depression. For example, in relatively poorer neighborhoods, limited social cohesion may diminish community capacity to control group-level processes (45), potentially resulting in manifestations of neighborhood disorder (46–48). Exposure to visible signs of neighborhood disorder then may result in psychologic stress and poorer mental health (18, 37, 49). Consistent with this hypothesis, one recent study showed that perceptions of neighborhood characteristics (i.e., vandalism, litter or trash, vacant housing, teenagers hanging out, burglary, drug selling, and robbery) predicted depressive symptoms at a 9-month follow-up interview (19), and another study showed that persons living in neighborhoods characterized by poorer features of the built environment were more likely to report depressive symptoms than persons living in neighborhoods characterized by a better built environment (50).

We show an association between neighborhood SES and depression independent of several other variables that are known determinants of depression. Depression is comorbid

176 Galea et al.
URBAN NEIGHBORHOOD POVERTY AND DEPRESSION

AEP Vol. 17, No. 3
March 2007: 171–179

TABLE 3. Bivariate and multivariate associations between key covariates and incident depression

	Population with follow-up		Population with follow-up and no lifetime depression		Incident depression			Multivariable model	
	n	%	n	%	N	Cumulative incidence	p^a	Odds ratio	95% Confidence interval
Total (n)	1120	100.0	820					782	
Neighborhood socioeconomic status									
High	598	53.3	432	54.1	45	10.5	0.024	1.00	
Low	522	46.7	388	45.9	68	19.4		2.19	1.04–4.59
Age, years									
18–24	107	15.2	85	14.4	7	6.3	0.260	1.00	
25–34	274	24.6	198	25.0	27	15.6		2.62	0.69–9.94
35–44	231	18.8	156	17.8	26	17.3		5.47	1.23–24.36
45–54	211	18.8	144	18.7	23	18.0		5.39	1.16–25.03
55–64	133	12.0	102	12.9	15	18.6		6.73	1.50–30.09
65+	155	10.6	126	11.3	14	8.9		1.58	0.23–10.98
Sex									
Male	505	44.4	379	45.4	38	10.3	0.037	1.00	
Female	615	55.6	441	54.6	75	18.2		2.31	1.22–4.39
Race/ethnicity									
White	582	38.1	395	35.3	38	13.0	0.216	1.00	
Asian	77	6.4	69	7.5	3	4.0		0.30	0.04–2.10
African American	182	25.1	146	26.7	26	15.9		0.70	0.34–1.41
Hispanic	231	26.0	176	25.9	43	19.6		1.55	0.59–4.09
Other	33	4.4	23	4.6	3	14.0		0.93	0.15–5.74
Income, $									
30,000+	617	50.5	428	48.2	44	12.7	0.597	1.00	
<30,000	334	33.2	254	34.6	48	15.7		1.26	0.46–3.49
Missing	169	16.3	138	17.2	21	17.7		2.17	1.00–4.70
Education									
<High school graduate	133	14.0	107	15.9	21	18.0	0.603	1.00	
High school graduate/general equivalency diploma	194	22.9	163	24.2	25	11.6		0.67	0.27–1.64
Some college	197	22.5	134	21.4	24	19.1		1.75	0.60–5.07
College degree	373	29.1	265	28.2	32	13.3		1.45	0.46–4.57
Graduate degree	220	11.4	148	10.3	11	11.2		1.20	0.30–4.76
Marital status									
Married	374	40.4	292	43.0	25	11.9	0.795	1.00	
Divorced	121	9.6	77	8.4	15	16.6		0.64	0.24–1.68
Separated	43	3.5	29	3.7	7	16.5		0.86	0.17–4.35
Widowed	81	5.5	67	5.7	12	23.1		2.92	0.80–10.67
Never married	447	37.7	320	36.8	49	15.4		1.88	0.81–4.35
Unmarried couple	48	3.3	32	2.5	5	22.1		1.85	0.38–8.93
Social support									
High	405	33.8	288	33.5	27	8.9	0.060	1.00	
Medium	317	29.5	232	28.2	25	14.3		1.44	0.65–3.18
Low	380	36.8	286	38.3	59	20.0		3.09	1.64–5.81
Directly affected by September 11[b]									
No	755	70.3	577	72.7	67	13.7	0.411	1.00	
Yes	365	29.7	243	27.3	46	17.0		1.15	0.46–2.85
Lived within 2 miles of World Trade Center									
No	692	95.2	535	96.1	86	14.9	0.022	1.00	
Yes	428	4.9	285	3.9	27	7.3		0.48	0.20–1.15
Traumatic events[c]									
0	249	24.5	223	27.8	21	9.4	0.306	1.00	
1	237	17.6	186	18.7	22	17.8		2.79	1.00–7.76
2	201	19.5	148	20.0	19	14.1		1.94	0.68–5.53
3	152	15.0	105	15.7	17	13.3		2.49	0.70–8.78
4+	281	23.4	158	17.9	34	21.0		3.27	1.34–7.94

(*Continued*)

TABLE 3. Continued

	Population with follow-up		Population with follow-up and no lifetime depression		Incident depression			Multivariable model	
	n	%	n	%	N	Cumulative incidence	p^a	Odds ratio	95% Confidence interval
Stressors[d]									
0	810	72.4	635	76.4	80	13.9	0.507	1.00	
1+	310	27.6	185	23.6	33	17.0		1.16	0.54–2.51
Lifetime post-traumatic stress disorderD									
No	861	80.5	734	89.5	79	12.3	<0.001	1.00	
Yes	259	19.5	86	10.5	34	34.4		3.07	1.43–6.57

[a]Two-tailed chi-square tests.
[b]Directly affected by September 11 includes persons in the World Trade Center complex during attacks, injured during attacks, lost possessions or property, had a friend or relative killed, lost a job as a result of the attacks, or involved in rescue efforts.
[c]Traumatic events include natural disaster; serious accident at work, in a car, or somewhere else; assault with or without a weapon; unwanted sexual contact; serious injury or illness; other situation involving serious injury or physical damage; any other situation causing fear of death or serious injury; seeing someone seriously injured or violently killed; death of a spouse or mate; death of close family member other than spouse; any other extraordinarily stressful situation or event.
[d]Stressors include divorce or separation from mate, marriage, family problems with spouse or child, problems at work, and unemployment.

with many other affective and anxiety disorders (51, 52), and we found that prior history of PTSD was associated with incident depression, even in this group of persons who had not previously experienced depression. Consistent with previous literature, we also found that women had a greater risk for incident depression than men (53, 54). We note that there are very few published results from prospective studies assessing incident psychopathologic states. Additional work likely is needed to enable definitive comment about the role of race/ethnicity or age as determinants of risk for incident depression (27).

The cohort study we report here was started approximately 6 months after the September 11, 2001, terrorist attacks and continued in the 2 years thereafter. Therefore, it is plausible that the recent mass trauma may have influenced the findings documented here. However, in this longitudinal analysis, we show that exposure to the events of September 11, 2001, by either proximity or experience, was not associated with increased risk for major depression. Although depression and other psychopathologic states are elevated soon after a mass traumatic event (55), we previously showed (56) that the prevalence of depression returns to baseline in the first 6 months after such traumas, which is when this particular study was started. The absence of a strong effect of exposure to the attacks on prospective risk for incident depression in these data suggest that it is unlikely that exposure to the recent September 11 attacks explains the relation between neighborhood poverty and incident depression that we document here.

There are several limitations to this study. First, we chose as our units of analysis neighborhoods that are meaningful to local residents and, as such, may plausibly represent areas that can influence population behavior and health. However, these neighborhoods are not homogenous, and it is possible that smaller urban neighborhoods are more relevant for mental health.

Second, we used lay-administered telephone interviews for establishing a probable diagnosis of depression by assessing major depression episodes. Although telephone and in-person assessment of *Diagnostic and Statistical Manual of Mental Disorders, Third Edition,* Axis I disorders, including anxiety disorders and affective disorders, were shown to result in similar estimates of symptoms (57), depression assessed in this manner cannot be equated to a full diagnosis of major depressive disorder.

Third, although we used a prospective cohort, we were unable to estimate length of residence of respondents in their particular neighborhoods and hence duration of exposure to a particular neighborhood context. However, we suggest it is unlikely that persons with incident depression would systematically be more or less likely to move from poor to rich neighborhoods (or vice versa) during the brief (18-month) period included in this assessment. Therefore, any misclassification caused by this limitation likely would be nondifferential and unlikely to influence our conclusions. Future work should assess whether there is a dose–response relation between time or degree of exposure to neighborhood poverty and incidence of depression.

Fourth, it is possible that persons who chose not to participate in the study could have been different systematically from those who did not participate, biasing our results. Two observations are reassuring in this regard. Using the available literature as a guide, recent analyses showed that response rates are at most weakly associated with bias for a range of response rates for telephone surveys between 30% and 70% (58). In one analysis, although a larger difference in response rate was associated with a larger difference in estimates of cigarette-smoking prevalence between the telephone-administered Behavioral Risk Factor Surveillance System and the in-person Current Population Survey, effects were small: a 45 percentage point difference in response rates predicted a difference in smoking prevalence

178 Galea et al.
URBAN NEIGHBORHOOD POVERTY AND DEPRESSION

AEP Vol. 17, No. 3
March 2007: 171–179

estimates of 1.5 percentage points (58). In an analysis designed to test potential differences associated with different response rates obtained from identical surveys, there were very few significant differences across 91 comparisons comparing data from two surveys with response rates of 61% and 36% (59). Also, in this study, we show (Table 1) no systematic differences between persons enrolled in the study and census distributions. Importantly, there also was no systematic difference between persons successfully followed up throughout the study and those lost to follow-up with respect to either independent (neighborhood poverty) or dependent (depression) variable of interest.

Caveats considered, this study is one of the first to show by using a prospective design that living in poor neighborhoods may be associated with greater risk for incident depression compared with living in wealthier neighborhoods while accounting for individual characteristics, including individual household income. Additional work is needed to characterize the pathways that may explain the observed association between living in low-SES neighborhoods and risk for depression. Elucidation of the particular pathways between neighborhood poverty and depression can help guide interventions that most effectively promote mental health. For example, if the relation between urban neighborhood poverty and depression is mediated by signs of physical disorder in a neighborhood, interventions that address vandalism and trash in urban neighborhoods may be indicated. Given the preponderance of urban living worldwide, understanding the characteristics of the urban environment that may influence mental health and how these characteristics exert their influence can provide opportunities for substantially improving population mental health.

REFERENCES

1. Brockerhoff MP. An urbanizing world. Popul Bull. 2000;55(3):3–4.

2. Vlahov D, Galea S, Gibble E, Freudenberg N. Perspectives on urban conditions and population health. Cad Saude Publica. 2005;21:949–957.

3. Faris RE, Dunham HW. Mental disorders in urban areas: An ecological study of schizophrenia and other psychoses. Chicago, IL: University of Chicago; 1939.

4. White W. The geographical distribution of insanity in the United States. J Nerv Ment Dis. 1902;30:257–279.

5. Srole L, Langner TS, Michael ST, Kirkpatrick P, Opler MK, Rennie TA. Mental health in the metropolis. New York: McGraw-Hill; 1962.

6. Blazer DG, George LK, Landerman R, Pennybacker M, Melville ML, Woodbury M, et al. Psychiatric disorders: A rural/urban comparison. Arch Gen Psychiatry. 1985;42:651–656.

7. Blazer DG, Kessler RC, McGonagle KA, Swartz MS. The prevalence and distribution of major depression in a national community sample: The National Comorbidity Survey. Am J Psychiatry. 1994;151:979–986.

8. Parikh SV, Wasylenki D, Goering P, Wong J. Mood disorders: Rural/urban differences in prevalence, health care utilization, and disability in Ontario. J Affect Disord. 1996;38:57–65.

9. Paykel ES, Abbott R, Jenkins R, Burgha TS, Meltzer H. Urban-rural mental health differences in Great Britain: Findings from the national morbidity survey. Psychol Med. 2002;30:269–280.

10. Romans-Clarkson SE, Walton VA, Herbison GP, Mullen PE. Psychiatric morbidity among women in urban and rural New Zealand: Psycho-social correlates. Br J Psychiatry. 1990;156:84–91.

11. Propper C, Jones K, Bolster A, Burgess S, Johnston R, Sarker R. Local neighborhood and mental health: Evidence from the UK. Soc Sci Med. 2005;61:2065–2083.

12. Wainwright NWJ, Surtees PG. Places, people, and their physical and mental functional health. J Epidemiol Community Health. 2003;58:333–339.

13. Walters K, Breeze E, Wilkinson P, Price GM, Bulpitt CJ, Fletcher A. Local area deprivation and urban-rural differences in anxiety and depression among people older than 75 in Britain. Am J Public Health. 2004;94:1768–1774.

14. Weich S, Twigg L, Holt G, Lewis G, Jones K. Contextual risk factors for the common mental disorders in Britain: A multilevel investigation of the effects of place. J Epidemiol Community Health. 2003;57:616–621.

15. Yen IH, Kaplan GA. Poverty area residence and changes in depression and perceived health status: Evidence from the Alameda County study. Int J Epidemiol. 1999;28:90–94.

16. Kubzansky LD, Subramanian SV, Kawachi I, Fay ME, Soobader M, Berkman LF. Neighborhood contextual influences on depressive symptoms in the elderly. Am J Epidemiol. 2005;162:253–260.

17. Ross CE. Neighborhood disadvantage and adult depression. J Health Soc Behav. 2000;41:177–187.

18. Silver E, Mulvey EP, Swanson JW. Neighborhood structural characteristics and mental disorder: Faris and Dunham revisited. Soc Sci Med. 2002;55:1457–1470.

19. Latkin CA, Curry AD. Stressful neighborhoods and depression: A prospective study of the impact of neighborhood disorder. J Health Soc Behav. 2003;44:34–44.

20. Galea S, Vlahov D, Resnick H, Ahern J, Susser E, Gold J, et al. Trends of probable post-traumatic stress disorder in New York City after the September 11 terrorist attacks. Am J Epidemiol. 2003;158:514–524.

21. Spitzer RL, Williams JB, Gibbon M. Structured clinical Interview for DSM-III-R—Non-patient Version. New York: Biometrics Research Department, New York State Psychiatric Institute; 1987.

22. Boscarino JA, Galea S, Adams R, Ahern J, Resnick H, Vlahov D. Mental health service and psychiatric medication use following the terrorist attacks in New York City. Psychiatr Serv. 2004;55:274–283.

23. Kilpatrick DG, Ruggiero KJ, Acierno R, Saunders BE, Resnick HS, Best CL. Violence and risk of PTSD, major depression, substance abuse/dependence, and comorbidity: Results from the national survey of adolescents. J Consult Clin Psychol. 2003;71:692–700.

24. Boscarino JA, Galea S, Ahern J, Resnick H, Vlahov D. Utilization of mental health services following the September 11th terrorist attacks in Manhattan. Int J Emerg Ment Health. 2002;4:143–155.

25. Derogatis LR. Brief Symptom Inventory 18 (BSI–18) Manual. Minnetonka, MN: NCS Assessments; 2001.

26. Hosmer DW, Lemeshow S. Applied Logistic Regression, 2nd ed. New York: Wiley; 2000.

27. Horwath E, Cohen RS, Wiessman MM. Epidemiology of depressive and anxiety disorders. In: Tsuang MT, Tohen M, eds. Textbook in Psychiatric Epidemiology. New York: Wiley-Liss; 2002.

28. Sherbourne CD, Stewart AL. The MOS social support survey. Soc Sci Med. 1991;32:705–714.

29. Kilpatrick DG, Resnick HS, Freedy JR, Pelcovitz D, Resick PA, Roth S, et al. The posttraumatic stress disorder field trial: Evaluation of the PTSD construct—Criteria A through E. In: Widiger TA, Frances AJ, Pincus HA, First MB, Ross R, Davis W, eds. DSM-IV Sourcebook, Vol 4. Washington, DC: American Psychiatric Association; 1998.

30. Messner SF, Tardiff K. Economic inequality and levels of homicide: An analysis of urban neighborhoods. Criminology. 1986;24:297–317.

31. Marzuk P, Tardiff K, Leon AC, Hirsch CS, Stajic M, Portera L, et al. Poverty and fatal accidental drug overdoses in New York City. Am J Drug Alcohol Abuse. 1997;23:221–228.

32. Suecoff SA, Avner JR, Chou KJ, Crain EF. A comparison of New York City playground hazards in high- and low-income areas. Arch Pediatr Adolesc Med. 1999;153:363–366.

33. Galea S, Ahern J, Vlahov D, Coffin P, Fuller C, Leon A, et al. Income distribution and risk of fatal drug overdose in New York City neighborhoods. Drug Alcohol Depend. 2003;70:139–148.

34. Bureau of the Census. Census Summary Tape, File 3A (STF 3A). Washington, DC: US Department of Commerce; 2000.

35. Zeger SL, Liang KY. Longitudinal data analysis for discrete and continuous outcomes. Biometrics. 1986;42:121–130.

36. Shah B, Barnwell B, Bieler G. SUDAAN User's Manual, Release 7.5. Research Triangle Park, NC: Research Triangle Institute; 1997.

37. Pearlin L. Stress and mental health: A conceptual overview. In: Horowitz A, Scheid T, eds. A Handbook for the Study of Mental Health. Cambridge, UK: Cambridge University; 1999.

38. Seedat S, Nyamai C, Njenga F, Vythilingum B, Stein DJ. Trauma exposure and post-traumatic stress symptoms in urban African schools: Survey in Cape Town and Nairobi. Br J Psychiatry. 2004;184:169–175.

39. Sundaram V, Helweg-Larsen K, Laursen B, Bjerregaard P. Physical violence, self rated health, and morbidity: Is gender significant for victimization? J Epidemiol Community Health. 2004;58:65–70.

40. McLeod J, Kessler R. Socioeconomic status differences in vulnerability to undesirable life events. J Health Soc Behav. 1990;31:162–172.

41. Evans GM. The built environment and mental health. J Urban Health. 2003;80:536–555.

42. Kleinschmidt I, Hills M, Elliott P. Smoking behavior can be predicted by neighborhood deprivation measures. J Epidemiol Community Health. 1995;49(Suppl 2):S72–77.

43. Reijneveld SA. The impact of individual and area characteristics on urban socioeconomic differences in health and smoking. Int J Epidemiol. 1998;27:33–40.

44. Hill TD, Ross CE, Angel RJ. Neighborhood disorder, psychophysiological distress, and health. J Health Soc Behav. 2005;46:170–186.

45. Sampson RJ, Raudenbush SW, Earls F. Neighborhoods and violent crime: A multilevel study of collective efficacy. Science. 1997;5328:918–924.

46. Ross CE, Jang SJ. Neighborhood disorder, fear, and mistrust: The buffering role of social ties with neighbors. Am J Community Psychol. 2000;28:401–420.

47. Shaw CR, McKay HD. Juvenile delinquency and urban areas: A study of the rates of delinquents in relation to differential characteristics of local communities in American cities. Chicago, IL: University of Chicago; 1942.

48. Skogan WG. Disorder and Decline. Berkeley, CA: University of California; 1990.

49. Turner RJ, Lloyd DA. The stress process and the social distribution of depression. J Health Soc Behav. 1999;40:374–404.

50. Galea S, Ahern J, Karpati A. A model of underlying socioeconomic vulnerability in human populations: Evidence from variability in population health and implications for public health. Soc Sci Med. 2005;60:2417–2430.

51. Kessler RC, Stang PE, Wittchen HU, Ustun TB, Roy-Burne PP, Walters EE. Lifetime panic-depression comorbidity in the National Comorbidity Survey. Arch Gen Psychiatry. 1998;55:801–808.

52. Horwath E, Lish J, Johnson J, Hornig CD, Weissman MM. Depressive symptoms as relative and attributable risk factors for first-onset major depression. Arch Gen Psychiatry. 1992;49:817–823.

53. Kessler RC, McGonagle KA, Zhao S, Nelson CB, Hughes M, Eshleman S, et al. Lifetime and 12-month prevalence of *DSM-III-R* psychiatric disorders in the United States: Results from the National Comorbidity Study. Arch Gen Psychiatry. 1994;51:8–19.

54. Bijl RV, De Graaf R, Ravelli A, Smit F, Vollebergh WA. Netherlands Mental Health Survey and Incidence Study. Gender and age-specific first incidence of *DSM-III-R* psychiatric disorders in the general population: Results from the Netherlands Mental Health Survey and Incidence Study (NEMESIS). Soc Psychiatry Psychiatr Epidemiol. 2002;37:372–379.

55. Galea S, Ahern J, Resnick H, Kilpatrick D, Bucuvalas M, Gold J, et al. Psychological sequelae of the September 11 attacks in Manhattan, New York City. N Engl J Med. 2002;346:982–987.

56. Person C, Tracy M, Galea S. Risk factors for depression six months after disaster. J Nerv Ment Dis. 2006;194(9):659–666.

57. Paulsen AS, Crowe RR, Noyes R, Pfohl B. Reliability of the telephone interview in diagnosing anxiety disorders. Arch Gen Psychiatry. 1988;45:62–63.

58. Mariolis P. Data Accuracy: How Good Are Our Indicators? Presented at: Proceedings of the 2001 Methodology Symposium, 2001; Canada. Avilable at: http://www.statcan.ca/english/freepub/11-522-XIE/2001001/session2/s2b.pdf.

59. Keeter S, Miller C, Kohut A, Groves R, Presser S. Consequences of reducing nonresponse in a national telephone survey. Public Opin Res Q. 2000;64:125–148.