## Original Contribution

# Collective Efficacy and Major Depression in Urban Neighborhoods

## Jennifer Ahern* and Sandro Galea

* Correspondence to Dr. Jennifer Ahern, Division of Epidemiology, School of Public Health, University of California, Berkeley, 101 Haviland Hall, Berkeley, CA 94720-7358 (e-mail: jahern@berkeley.edu).

Depression contributes substantially to the global burden of disease and disability. Population-level factors that shape depression may be efficient targets for intervention to decrease the depression burden. The authors aimed to identify the relation between neighborhood collective efficacy and major depression. Analyses were conducted on data from the New York Social Environment Study ($n = 4,000$), a representative study of residents of New York, New York, conducted in 2005. Neighborhood collective efficacy was measured as the average neighborhood response on a well-established scale. Major depression was assessed with the Patient Health Questionnaire. A marginal modeling approach was applied to present results on the additive scale relevant to public health and intervention. Analyses were adjusted for demographic and socioeconomic characteristics, recent life events that could contribute to both depression and change in residence, and individual perception of collective efficacy. Collective efficacy was related to major depression among older adults; marginal models estimated a 6.2% (95% confidence interval: 0.1, 17.5) lower prevalence of depression if all older adults (65 years and older) had lived in high versus low collective efficacy neighborhoods. Similar results were suggested among younger adults; however, the confidence interval crossed the null. These and other study findings suggest that community-randomized trials targeting collective efficacy merit consideration.

depression; residence characteristics; social environment

Abbreviation: CI, confidence interval.

---

Depression contributes substantially to the global burden of disease and disability (1, 2). Recent estimates suggest that in the United States, lifetime, past-year, and current prevalences of a major depressive episode are 16%, 7%, and 3%, respectively (1, 3). Although the past decade has seen a dramatic increase in research on the molecular basis of depression, identifying population-level factors that shape depression could be an efficient means of intervention to decrease the burden of this disorder (4).

Recent conceptualizations of the processes that shape health generally and depression specifically suggest that characteristics of the residential context are important (5, 6). In particular, a large body of recent work has shown that characteristics of neighborhoods are associated with individual health (7–9). Among the studies that examined neighborhood characteristics and individual depression, the most consistent results are found in those examining social processes in neighborhoods as captured by collective

efficacy, a construct that incorporates social cohesion and informal social control, or by related measures of social capital and social disorder (10–14); these neighborhood social processes thus hold promise as potential targets of population-level intervention to reduce the burden of depression. Neighborhoods that exert more social control may reduce the actual or perceived potential for stressful events to occur while residents are in their neighborhoods, and neighborhoods that are more cohesive may provide more social support to residents and buffer the effects of stressful events when they occur (5, 6). Thus, collective efficacy has a variety of specific plausible mechanisms through which it could affect depression. Although the number of studies is small, all of the studies examining neighborhood collective efficacy or related constructs and depression in the United States have found that higher levels of collective efficacy are associated with lower levels of depression or depression symptoms (15–18). The results

of studies on collective efficacy and depression in other countries are less consistent (19–22), and it has been suggested that the neighborhood social environment may be more important for mental health in the United States than in other high-income countries because of the less egalitarian society, in which there are few safety nets (5).

Despite the promising results of research to date examining collective efficacy and depression, particularly in the United States, limitations of the measures used in most studies suggest that further research is important to clarify our understanding of the collective efficacy-depression relation. Some studies only measure individual perception of the neighborhood (17, 18, 21, 22), whereas others include both individual- and neighborhood-level measures but only find significant results for the individual perception measure (16, 19). Perception of the neighborhood is certainly a legitimate construct that can affect health, but when the outcome is depression, it raises a particular concern about same-source bias because negative affect may influence perception of the neighborhood. In addition, some studies use indices of the neighborhood environment that incorporate a variety of constructs (e.g., safety, facilities, and the physical environment) in addition to the social environment (20, 21). Characteristics such as neighborhood collective efficacy could influence depression rates for reasons that are distinct from those of other characteristics in these indices, so it is impossible to know what exactly these indices capture about a neighborhood that might relate to depression. Therefore, there is a need for research that examines the neighborhood collective efficacy-depression relation adjusted for individual perception of collective efficacy and that considers collective efficacy on its own and not as part of a general neighborhood environment index.

In the present study, we examined whether neighborhood collective efficacy was related to depression in the population of New York, New York. We examined neighborhood-level measures of collective efficacy while adjusting for individual perception of collective efficacy. We considered age, race, and sex as potential effect modifiers based on previous research that suggested that these characteristics might modify the relations between neighborhood characteristics and depression (5, 23).

## MATERIALS AND METHODS

The New York Social Environment Study is a multilevel study designed to examine neighborhood-level exposures, including economic, social, and structural characteristics, as well as mental health and substance abuse in New York, New York. The New York Social Environment Study was conducted between June and December of 2005. We used random digit dialing to contact and interview 4,000 New York residents. One adult ≥18 years of age was interviewed by telephone in each household; the respondent was the person who either most recently had or would next celebrate their birthday (randomly selected). Interviews were conducted in English or Spanish. The participation percentage was 49%. Respondents were offered $10 in compensation for their participation. The study protocol was approved by

the institutional review boards of the New York Academy of Medicine, the University of Michigan, and the University of California, Berkeley.

### Neighborhoods

Respondents provided information about their residential address or nearest cross-streets so that their locations could be geocoded and linked to their neighborhoods of residence (24). The neighborhood units for this analysis were the 59 community districts in New York. They were well-defined units, each headed by an administrative community board that, as such, has political and social relevance for the residents. Many characteristics of these neighborhood areas have been associated with resident health and health behaviors (24–27).

### Measures

Respondents were interviewed with a structured questionnaire that included questions on demographic and socioeconomic characteristics that were potential confounders of the relation of interest, including age, race, sex, marital status, place of birth, educational level, income, years lived in the current neighborhood, and interview language.

Neighborhood collective efficacy was measured using the scale developed by Sampson et al. (28), which comprises the subscales of social cohesion and informal social control. The social cohesion subscale includes 5 items with Likert scale responses and assesses residents' perceptions of the extent to which their neighbors are close-knit, are helpful, get along, share values, and are trustworthy. The informal social control subscale also includes 5 items with Likert scale responses and measures perceptions of the likelihood that neighbors would intervene if children skipped school, sprayed graffiti, or disrespected an adult, if there were a fight, or if the city was closing a firehouse. The responses of all residents in each neighborhood were averaged to calculate the neighborhood-level measure of collective efficacy; this measure captured the neighborhood average perception of the potential for collective efficacy. Cronbach's alpha for the full collective efficacy scale was 0.77 (alpha for social cohesion was 0.64; alpha for informal social control was 0.72), consistent with previous reports (28, 29). Individual perception of collective efficacy reported by each resident was adjusted in all analyses to distinguish the effect of the neighborhood-level measure from that of individual perception of that characteristic.

Major depression was assessed by using the Patient Health Questionnaire-9, a valid and reliable measure of current depression symptoms (30, 31). To meet the criteria for major depression, 5 or more of the 9 symptoms have to have been present more than half of the days over the past 2 weeks (suicidal ideation counts regardless of duration), and 1 symptom must be depressed mood or anhedonia. The Patient Health Questionnaire-9 major depression measure has 73% sensitivity and 98% specificity compared with physician diagnosis of major depression (31). Consistent with the original validation study, our recent clinical reappraisal of the Patient Health Questionnaire-9 found excellent internal consistency and similar diagnostic accuracy (32).

### Analysis

All analyses were weighted by the ratio of the number of persons in the household to the number of phone lines in the household to account for the probability of selection for interview. Individual demographic and socioeconomic characteristics that were conceptually considered as confounders (listed in measures), as well as individual perception of collective efficacy, were included in all multivariable analyses. In cross-sectional neighborhood studies, there is always a concern that associations represent both social selection (e.g., people with depression move to certain neighborhoods) and social causation (e.g., neighborhood characteristics affect depression) processes and that the 2 cannot be differentiated (33). Therefore, in this analysis, we adjusted for reports within the past year of an illness or injury starting or worsening, financial problems, or unemployment as confounders to account for one contributor to social selection; by controlling for these life events that may both instigate a move and increase depression symptoms, we assured that the associations observed were not due to individuals who had experienced these life events recently moving to places with lower collective efficacy. Missingness indicator variables were included for all covariates when respondents declined to answer.

Several descriptive analyses were conducted initially. Propensities for living in low rather than high collective efficacy neighborhoods, estimated as a function of confounders (listed above), were used to examine the potential that analyses would rely on extrapolation. Neighborhood collective efficacy and all covariates were examined in association with major depression in bivariable analysis. For multivariable analyses, logistic generalized estimating equation regression models were used to account for potential clustering by neighborhood and to estimate population averaged parameter estimates with robust standard errors (34). Interaction terms were included between collective efficacy and each of age, race, and sex to assess possible effect modification.

On the basis of the models described above, we applied a marginal modeling approach to present the results of the models as marginal relations on the additive scale (35). This approach was attractive because 1) the logistic modeling approach provides results on the multiplicative scale, and this additional step allowed us to present relations on the additive scale, which is relevant to public health and intervention (36), and 2) traditional regression model parameters estimate relations that are conditional on covariates and effect modifiers, and we were interested in presenting marginal relations relevant to the whole study population. This marginal modeling approach starts by using the logistic models above to estimate the outcome for each individual in the population had he or she experienced different levels of collective efficacy. Next, the individual outcome estimates are averaged across the population to estimate the prevalence of depression if all residents had lived in neighborhoods with high collective efficacy compared with all living in neighborhoods with low collective efficacy. Using statistical notation, the pa-

rameters described above can be defined as $\theta(\text{low}) = E_W\{E[Y|A = \text{low},W]\}$, $\theta(\text{high}) = E_W\{E[Y|A = \text{high},W]\}$, and $\theta(\text{low-high}) = E_W\{E[Y|A = \text{low},W] - E[Y|A = \text{high},W]\}$, where $A$ is collective efficacy (with the values for low and high defined by the 5th and 95th percentile values of collective efficacy), $W$ is the vector of confounders, and $Y$ is the outcome of major depression. Confidence intervals for these parameters were bootstrapped because no analytical standard error estimate was available (37).

To assess the sensitivity of our results, we replicated all analyses with 2 alternate formulations of the measure of neighborhood collective efficacy: the average of all residents except each individual's own response, and the average of all residents except those with major depression.

### RESULTS

The survey respondents were demographically similar to the overall population of New York, New York, based on the most recent census, with 38.1% being white, 27.0% African American, 5.0% Asian, 27.2% Hispanic, and 2.5% belonging to other racial groups. The mean age was 45 years (range, 18–94). A total of 51.1% of respondents were female, and 39.2% were born outside of the United States. Symptoms consistent with major depression were found in 3.7% of respondents. A full description of the sample is provided in Table 1.

Examination of neighborhood collective efficacy suggested there were no outliers; the mean collective efficacy value was 3.5, with a range of 2.7–4.0 and 5th and 95th percentile values of 3.0 and 4.0, respectively. Fewer than 4% of respondents had propensity values that were more extreme (higher or lower) than the maximum or minimum propensity values among respondents living in neighborhoods with the other exposure value (Table 2), suggesting that analyses did not rely on extrapolation.

In bivariable analysis, lower neighborhood collective efficacy was associated with a higher prevalence of depression. From the lowest to highest quartiles of collective efficacy, the rates of major depression were 5.3%, 4.0%, 3.5%, and 2.5% ($P = 0.05$). Other characteristics associated with higher rates of depression in bivariable analysis included separated marital status, low educational level, low income, and all of the life events (unemployment, serious illness or injury, and financial problems) (all $P$'s < 0.01) (Table 1).

Multivariable logistic regression analysis of the relation between neighborhood collective efficacy and major depression adjusted for confounders, including demographic and socioeconomic characteristics, individual perception of collective efficacy, and factors that potentially influence social selection, such as unemployment, serious illness or injury, and financial problems, is presented in Table 3. Among the interactions considered (age, race, and sex), the age interaction was significant ($P < 0.05$) and is presented in Table 3; age was modeled with a squared term to accommodate the shape of the interaction observed in descriptive analysis.

**Table 1.** Respondent Characteristics and Bivariable Associations With Major Depression, New York Social Environment Study, New York, New York, 2005

| | No. | % | 2000 New York Census Data, % | Major Depression | | |
| --- | --- | --- | --- | --- | --- | --- |
| | | | | No. | % | P Value |
| Total | 4,000 | 100.0 | 100.0 | 155 | 3.7 | |
| Age, years | | | | | | 0.62 |
| 18–24 | 350 | 11.8 | 13.2 | 14 | 4.1 | |
| 25–34 | 685 | 18.1 | 22.5 | 26 | 3.4 | |
| 35–44 | 815 | 19.5 | 20.8 | 28 | 2.8 | |
| 45–54 | 808 | 21.4 | 16.7 | 37 | 4.5 | |
| 55–64 | 612 | 14.9 | 11.3 | 27 | 4.3 | |
| ≥65 | 690 | 14.4 | 15.5 | 23 | 3.4 | |
| Missing | 40 | | | | | |
| Race | | | | | | 0.48 |
| White | 1,616 | 38.2 | 38.7 | 52 | 3.3 | |
| African-American | 1,055 | 27.0 | 23.0 | 41 | 3.6 | |
| Asian | 164 | 5.1 | 10.1 | 3 | 2.3 | |
| Hispanic | 958 | 27.2 | 24.7 | 50 | 4.4 | |
| Other | 95 | 2.5 | 3.6 | 6 | 6.8 | |
| Missing | 112 | | | | | |
| Sex | | | | | | 0.24 |
| Male | 1,880 | 48.9 | 46.2 | 61 | 3.3 | |
| Female | 2,120 | 51.1 | 53.8 | 94 | 4.1 | |
| Marital status | | | _[a] | | | <0.01 |
| Married | 1,632 | 47.3 | | 36 | 2.3 | |
| Divorced | 479 | 9.6 | | 24 | 5.4 | |
| Separated | 208 | 4.7 | | 23 | 10.2 | |
| Widowed | 354 | 6.7 | | 17 | 4.6 | |
| Never married | 1,270 | 31.7 | | 54 | 4.2 | |
| Missing | 57 | | | | | |
| Birthplace | | | _ | | | 0.86 |
| New York, New York | 1,810 | 44.7 | | 73 | 3.9 | |
| Other US location | 731 | 16.1 | | 25 | 3.4 | |
| Different country | 1,406 | 39.2 | | 55 | 3.6 | |
| Missing | 53 | | | | | |
| Interview conducted in Spanish | | | _ | | | 0.69 |
| Yes | 455 | 13.4 | | 20 | 4.1 | |
| No | 3,545 | 86.6 | | 135 | 3.6 | |

**Table continues**

Using the models in Table 3 (as described in the Materials and Methods section), we generated marginal estimates of the relations between collective efficacy and the depression outcomes for the whole population and for age subgroups (due to the age interaction). These marginal model results are presented in Table 4. If the whole study population had lived in neighborhoods with high collective efficacy (95th percentile = 4.0; on average, respondents "somewhat agree" that the neighborhood is cohesive), the estimated major depression prevalence would have been 4.3% (estimated by the parameter θ(4)), whereas had the whole population lived in neighbor- hoods with low collective efficacy (5th percentile = 3.0; on average, respondents "neither agree nor disagree" that the neighborhood is cohesive), the major depression preva- lence would have been 4.2% (estimated by the parameter θ(3)). This difference of −0.1% (estimated by the param- eter θ(3–4); 95% confidence interval (CI): −3.1, 3.1) in depression prevalence across the entire population is es- sentially null, but there was a depression prevalence dif- ference in the older population. For residents 65 years of age or older, under high collective efficacy conditions ma- jor depression is estimated to have been 2.0%, but under low collective efficacy conditions major depression is

**Table 1.** Continued

| | No. | % | 2000 New York Census Data, % | Major Depression | | |
| --- | --- | --- | --- | --- | --- | --- |
| | | | | No. | % | P Value |
| Annual income | | | – | | | <0.01 |
| ≤$40,000 | 1,605 | 46.5 | | 96 | 5.3 | |
| $40,001–$80,000 | 1,093 | 32.0 | | 29 | 2.8 | |
| >$80,000 | 722 | 21.6 | | 8 | 1.3 | |
| Missing | 580 | | | | | |
| Educational level | | | – | | | <0.01 |
| Less than high school | 508 | 13.9 | | 39 | 7.7 | |
| High school or equivalent | 923 | 24.7 | | 43 | 3.8 | |
| Some college | 879 | 23.2 | | 36 | 4.1 | |
| College graduate | 883 | 21.6 | | 20 | 2.1 | |
| Graduate work | 730 | 16.6 | | 14 | 1.6 | |
| Missing | 77 | | | | | |
| Years lived in the current neighborhood | | | – | | | 0.45 |
| <8 | 1,330 | 34.4 | | 49 | 3.1 | |
| 8–21 | 1,318 | 34.0 | | 54 | 3.9 | |
| >21 | 1,335 | 31.6 | | 51 | 4.1 | |
| Missing | 17 | | | | | |
| Unemployed | | | – | | | <0.01 |
| Yes | 321 | 8.5 | | 27 | 7.4 | |
| No | 3,658 | 91.5 | | 128 | 3.4 | |
| Illness or injury starting or worsening in the past 12 months | | | – | | | <0.01 |
| Yes | 624 | 14.4 | | 64 | 9.1 | |
| No | 3,376 | 85.6 | | 91 | 2.8 | |
| Financial problems in the past 12 months | | | – | | | <0.01 |
| Yes | 867 | 21.7 | | 93 | 9.6 | |
| No | 3,133 | 78.3 | | 62 | 2.1 | |
| Neighborhood collective efficacy | | | – | | | 0.05 |
| Quartile 1 | 803 | 19.6 | | 45 | 5.3 | |
| Quartile 2 | 1,023 | 26.1 | | 42 | 4.0 | |
| Quartile 3 | 1,067 | 26.8 | | 39 | 3.5 | |
| Quartile 4 | 1,107 | 27.5 | | 29 | 2.5 | |

[a] Dashes indicate that no data are available.

estimated to have been 8.2%, a difference of 6.2% (95% CI: 0.1, 17.5). There was a suggestion of a similar relation for young adults; however, the confidence interval crossed the null.

Results of the sensitivity analyses were similar to those of the final model. Using the collective efficacy measure with each individual's response removed, we found that among those 65 years of age or older, there was a depression

**Table 2.** Distribution of Propensities for Living In a Low Collective Efficacy Neighborhood by Actual Neighborhood Collective Efficacy, New York Social Environment Study, New York City 2005

| Collective Efficacy | Minimum | 2.5% | 50% | 97.5% | Maximum | % of Observations With More Extreme Propensity Values[a] |
| --- | --- | --- | --- | --- | --- | --- |
| High | 0.0814 | 0.12385 | 0.32824 | 0.76914 | 0.91588 | 3.8 |
| Low | 0.1005 | 0.16791 | 0.57428 | 0.86759 | 0.94035 | |

[a] More extreme propensity values were those that were higher or lower than the maximum or minimum propensity values among respondents living in neighborhoods with the other exposure value.

**Table 3.** Logistic Generalized Estimating Equation Models of the Relation Between Neighborhood Collective Efficacy and Major Depression, New York Social Environment Study, New York, New York, 2005[a]

| | Model A | | | Model B | | |
|---|---|---|---|---|---|---|
| | β | SE | P Value | β | SE | P Value |
| Intercept | −3.32 | 1.47 | 0.02 | 17.28 | 8.64 | 0.05 |
| Neighborhood CE | 0.02 | 0.32 | 0.96 | −5.84 | 2.36 | 0.01 |
| Individual perception of collective efficacy | −0.43 | 0.11 | <0.01 | −0.43 | 0.11 | <0.0001 |
| Age | −0.01 | 0.01 | 0.55 | −1.05 | 0.39 | 0.01 |
| Age × age | | | | 0.01 | 0.00 | <0.01 |
| Neighborhood CE × age | | | | 0.30 | 0.11 | 0.01 |
| Neighborhood CE × age × age | | | | 0.00 | 0.00 | <0.01 |
| Race | | | | | | |
| White | 0.00 | | | 0.00 | | |
| African-American | −0.66 | 0.29 | 0.02 | −0.68 | 0.30 | 0.02 |
| Asian | −0.24 | 0.68 | 0.72 | −0.29 | 0.71 | 0.68 |
| Hispanic | −0.61 | 0.32 | 0.05 | −0.65 | 0.32 | 0.05 |
| Other | 0.16 | 0.50 | 0.75 | 0.17 | 0.49 | 0.73 |
| Missing | −0.93 | 0.60 | 0.12 | −0.86 | 0.61 | 0.15 |
| Sex | | | | | | |
| Female | 0.00 | | | 0.00 | | |
| Male | −0.10 | 0.20 | 0.61 | −0.09 | 0.20 | 0.67 |
| Marital status | | | | | | |
| Married | 0.00 | | | 0.00 | | |
| Divorced | 0.52 | 0.33 | 0.11 | 0.53 | 0.33 | 0.11 |
| Separated | 0.85 | 0.35 | 0.01 | 0.91 | 0.35 | 0.01 |
| Widowed | 0.04 | 0.48 | 0.93 | 0.06 | 0.51 | 0.91 |
| Never married | 0.38 | 0.25 | 0.13 | 0.39 | 0.24 | 0.11 |
| Missing | 0.03 | 1.09 | 0.98 | −0.06 | 0.90 | 0.94 |
| Birthplace | | | | | | |
| New York, New York | 0.00 | | | 0.00 | | |
| Other US location | 0.18 | 0.25 | 0.48 | 0.12 | 0.27 | 0.66 |
| Different country | 0.11 | 0.24 | 0.64 | 0.14 | 0.25 | 0.58 |
| Missing | 0.59 | 0.94 | 0.53 | 0.62 | 0.92 | 0.50 |

**Table continues**

prevalence difference associated with collective efficacy of 6.2% (95% CI: 0.5, 16.2). Using the collective efficacy measure with all depressed individuals removed, we computed similar point estimates and confidence intervals (depression prevalence difference = 6.1%; 95% CI: 0.3, 19.3).

## DISCUSSION

In the present analysis of a representative study of residents of New York, New York, we found that higher levels of neighborhood collective efficacy were associated with lower prevalences of major depression among older adults. The results are consistent with previous research that suggested that there were relations between neighborhood collective efficacy and depression in the United States generally, and they supported previous indications that these

relations are strongest in older adults and children (23). The observed relation in older adults is consistent with work that suggested that the elderly may be more affected by their local communities because of decreased mobility and reduced social networks (38). The suggestion of a relation among younger adults merits examination in future work. Most young adults begin living separately from their families for the first time between the ages of 18 and 24 years, and the community environment may be particularly salient during this transition (39).

Several pathways through which collective efficacy could affect depression have been hypothesized (5, 6). Neighborhoods that are more cohesive and that exert more social control may provide more social support to residents, reduce the actual number of or perceived potential for stressful events, and potentially buffer the

**Table 3.** Continued

|  | Model A | | | Model B | | |
|---|---|---|---|---|---|---|
|  | β | SE | P Value | β | SE | P Value |
| Interview conducted in Spanish | −0.14 | 0.42 | 0.74 | −0.10 | 0.44 | 0.83 |
| Annual income |  |  |  |  |  |  |
| >$80,000 | 0.00 |  |  | 0.00 |  |  |
| $40,001–$80,000 | 0.36 | 0.52 | 0.49 | 0.39 | 0.52 | 0.45 |
| ≤$40,000 | 0.38 | 0.58 | 0.52 | 0.42 | 0.60 | 0.48 |
| Missing | 0.51 | 0.55 | 0.35 | 0.53 | 0.59 | 0.37 |
| Educational level |  |  |  |  |  |  |
| Graduate work | 0.00 |  |  | 0.00 |  |  |
| College graduate | 0.10 | 0.37 | 0.78 | 0.12 | 0.36 | 0.75 |
| Some college | 0.53 | 0.37 | 0.15 | 0.54 | 0.36 | 0.14 |
| High school or equivalent | 0.41 | 0.34 | 0.22 | 0.42 | 0.33 | 0.20 |
| Less than high school | 1.26 | 0.43 | <0.01 | 1.27 | 0.43 | <0.01 |
| Missing | 1.67 | 1.05 | 0.11 | 1.72 | 1.04 | 0.10 |
| Years lived in the current neighborhood | 0.01 | 0.01 | 0.08 | 0.01 | 0.01 | 0.08 |
| Unemployed | 0.38 | 0.26 | 0.14 | 0.34 | 0.26 | 0.19 |
| Illness or injury starting or worsening in the past 12 months | 0.92 | 0.20 | <0.01 | 0.93 | 0.20 | <0.01 |
| Financial problems in the past 12 months | 1.21 | 0.23 | <0.01 | 1.24 | 0.23 | <0.01 |

Abbreviations: CE, collective efficacy; SE, standard error.

[a] Models included a total of 3,946 participants; exclusions were for missing age or years lived in the current neighborhood.

effects of stressful events when they occur (5, 6). There may be more diffusion of knowledge in high collective efficacy neighborhoods, leading residents to have better health behaviors and health, which in turn could affect depression symptoms (5, 6). Facilitation of collective action in high collective efficacy communities could improve local services and amenities, and such improve-ments may affect behaviors as well as mental and physical health (5, 6). Future research that explicitly ex-amines potential mechanisms behind the collective effi-cacy-depression relation is important and could be informative for intervention planning.

There are several limitations to the present study. The response percentage was 49%, which is consistent with

**Table 4.** Prevalence of Major Depression (%) That Would Have Existed If All Residents Had Lived in Low Collective Efficacy Neighborhoods[a] Compared With High Collective Efficacy Neighborhoods[a], Estimated Using a Marginal Modeling Approach, New York Social Environment Study, New York, New York, 2005

|  | θ(3)[b] | θ(4)[b] | θ(3–4)[b] | 95% Confidence Interval[c] |
|---|---|---|---|---|
| Total | 4.2 | 4.3 | −0.1 | −3.1, 3.1 |
| Age, years |  |  |  |  |
| 18–24 | 7.0 | 2.7 | 4.3 | −1.7, 14.3 |
| 25–64 | 2.9 | 5.0 | −2.1 | −5.0, 1.0 |
| ≥65 | 8.2 | 2.0 | 6.2 | 0.1, 17.5 |

[a] Low and high collective efficacy were defined by the 5th and 95th percentile values, which were 3 and 4, respectively. A collective efficacy value of 4 indicated that, on average, respondents "somewhat agree" that the neighborhood is cohesive, whereas a value of 3 indicated that, on average, respondents "neither agree nor disagree" that the neighborhood is cohesive. Models included a total of 3,946 participants; exclusions were for missing age or years lived in the neighborhood.

[b] $\theta(3) = E_W\{E[Y|A = 3, W]\}$, $\theta(4) = E_W\{E[Y|A = 4, W]\}$ $\theta(3–4) = E_W\{E[Y|A = 3, W] - E[Y|A = 4, W]\}$, where $A$ is collective efficacy, $W$ is the vector of confounders (all covariates in Table 2), and $Y$ is the outcome, major depression.

[c] Bias-corrected bootstrapped confidence interval.

many other recent telephone-based studies (40). However, this cooperation percentage does raise concern about how well the study sample represents the residents of the city of New York. Participants were informed that they would be participating in a "survey about the neighborhoods where New Yorkers live and what people think about their neighborhoods," and thus they were not likely to refuse based on depression symptoms. The distribution of demographic characteristics, such as age, race, gender, and birth place, is very similar to that from the 2000 census data for New York. However, the participants may still have differed from those in the city overall in ways that we were unable to capture. The neighborhood collective efficacy measure captures aggregate perception of the potential for collective efficacy (28). Perceptions are affected by individual characteristics, including negative affect that could be caused by depression. It is reassuring that our findings were similar when we used a measure of collective efficacy calculated with depressed individuals removed. The depression symptoms were assessed with a validated instrument but do not constitute diagnosis of major depression. Given the moderate sensitivity and high specificity found in validation of this instrument, our measure of major depression is likely conservative.

One of several strengths of this study is the large population-based sample. Analyses were adjusted for individual perception of collective efficacy, which allowed documentation of an association of neighborhood collective efficacy with depression that was independent of individual perceptions; this approach provided a conservative estimate. We accounted for some potential contributors to social selection by adjusting for unemployment, serious illness or injury, and financial problems. Social selection has been considered one of the major barriers to determining whether the environment has an influence on people or whether people who have worse health "drift" or select into worse types of environments (33, 41). Associations observed are not due to an effect of people with recent adverse life events moving to lower collective efficacy neighborhoods and also developing depression symptoms because of the life events. However, this adjustment cannot account for any event that precipitated a move and onset of depression symptoms if it occurred more than a year previously and the depression symptoms have persisted since then. Research suggests that episodes of major depression last 16 weeks, on average (range, 14–23 weeks depending on depression severity) (1); therefore, it is unlikely that individuals in our study with a current major depression episode had an event precipitating that episode more than a year previously.

Overall, we found a relation between collective efficacy and major depression among older adults that was independent of individual perceptions of collective efficacy, life events that could contribute to social selection, and other confounders. Naturally, an association observed between neighborhood characteristics and depression does not necessarily represent how a resident might respond to an intervention on collective efficacy. This is one of the greatest challenges in the interpretation of neighborhood research (33, 41). The assumptions necessary for causal interpretation of associations in observational research generally and observational neighborhood research specifically have been well elaborated elsewhere (42, 43). In brief, exposure must precede the outcome (temporal ordering), all confounders must be controlled (ignorability), exposures in one neighborhood cannot affect the potential outcomes of individuals in other neighborhoods (neighborhood-level stable unit treatment value assumption), and the outcomes observed for a given exposure value must reflect those that would have been observed if the exposure had been counterfactually assigned to that value (consistency assumption). Given the cross-sectional design of our study, we cannot establish temporal ordering between the exposure and outcome. For a causal interpretation, we must assume that collective efficacy comes before depression; this is a reasonable assumption, but the reverse may also be true to some extent. Were this assumption untrue, we would infer the wrong causal direction for the parameter estimated. Longitudinal consideration of these relations will be necessary to establish that temporal relation and improve the potential for causal interpretation. Although we controlled for many confounders, notably recent health and financial problems, ignorability cannot be assessed empirically and can only ever be approximated with observational data. The stability assumption is not unreasonable for the collective efficacy exposure because the potential for collective action in one area does not seem likely to affect potential outcomes in another area.

Despite the challenges in interpreting results of this and other observational studies causally, the associations observed in this and prior studies suggest collective efficacy is a neighborhood-level factor that merits consideration in intervention planning in the United States. A recent community-based intervention to improve collective efficacy around depression care succeeded in increasing perception of depression as a medical illness and increasing community engagement generally (44), which suggests that collective efficacy can successfully be targeted by intervention. Community-randomized interventions informed by existing observational studies that target collective efficacy and measure depression outcomes could improve our understanding of how such interventions could be expected to affect depression in terms of magnitudes of effect; duration of effects; effects on depression onset, persistence and recovery; and interrelation of the effects with individual depression treatments.

## REFERENCES

1. Kessler RC, Berglund P, Demler O, et al. The epidemiology of major depressive disorder: results from the National Comorbidity Survey Replication (NCS-R). *JAMA.* 2003; 289(23):3095–3105.
2. Moussavi S, Chatterji S, Verdes E, et al. Depression, chronic diseases, and decrements in health: results from the World Health Surveys. *Lancet.* 2007;370(9590):851–858.
3. Williams DR, González HM, Neighbors H, et al. Prevalence and distribution of major depressive disorder in African Americans, Caribbean blacks, and non-Hispanic whites: results from the National Survey of American Life. *Arch Gen Psychiatry.* 2007;64(3):305–315.
4. Rose G. Sick individuals and sick populations. *Int J Epidemiol.* 2001;30(3):427–432.
5. Kim D. Blues from the neighborhood? Neighborhood characteristics and depression. *Epidemiol Rev.* 2008; 30(1):101–117.
6. Cutrona CE, Wallace G, Wesner KA. Neighborhood characteristics and depression: an examination of stress processes. *Curr Dir Psychol Sci.* 2006;15(4):188–192.
7. Pickett KE, Pearl M. Multilevel analyses of neighbourhood socioeconomic context and health outcomes: a critical review. *J Epidemiol Community Health.* 2001;55(2):111–122.
8. Sellström E, Bremberg S. The significance of neighbourhood context to child and adolescent health and well-being: a systematic review of multilevel studies. *Scand J Public Health.* 2006;34(5):544–554.
9. Riva M, Gauvin L, Barnett TA. Toward the next generation of research into small area effects on health: a synthesis of multilevel investigations published since July 1998. *J Epidemiol Community Health.* 2007;61(10):853–861.
10. Faris RE, Dunham W. *Mental Disorders in Urban Areas: An Ecological Study of Schizophrenia and Other Psychoses.* Chicago, IL: University of Chicago Press; 1939.
11. Shaw CR, McKay HD. *Juvenile Delinquency and Urban Areas.* Chicago, IL: University of Chicago Press; 1942.
12. Durkheim E. *Suicide: A Study in Sociology.* New York, NY: Free Press; 1897.
13. Bandura A. Social cognitive theory: an agentic perspective. *Annu Rev Psychol.* 2001;52(1):1–26.
14. Hollingshead AB, Redlich FC. *Social Class and Mental Illness: A Community Study.* New York, NY: John Wiley & Sons, Inc; 1958.
15. Mair C, Diez Roux AV, Shen M, et al. Cross-sectional and longitudinal associations of neighborhood cohesion and stressors with depressive symptoms in the Multi-Ethnic Study of Atherosclerosis. *Ann Epidemiol.* 2009;19(1):49–57.
16. Echeverría S, Diez-Roux AV, Shea S, et al. Associations of neighborhood problems and neighborhood social cohesion with mental health and health behaviors: the Multi-Ethnic Study of Atherosclerosis. *Health Place.* 2008;14(4):853–865.
17. Gary TL, Stark SA, LaVeist TA. Neighborhood characteristics and mental health among African Americans and whites living in a racially integrated urban community. *Health Place.* 2007;13(2):569–575.
18. Ross CE, Reynolds JR, Geis KJ. The contingent meaning of neighborhood stability for residents' psychological well-being. *Am Sociol Rev.* 2000;65(4):581–597.
19. Veenstra G. Location, location, location: contextual and compositional health effects of social capital in British Columbia, Canada. *Soc Sci Med.* 2005;60(9):2059–2071.
20. Yen YC, Rebok GW, Yang MJ, et al. A multilevel analysis of the influence of apolipoprotein E genotypes on depressive symptoms

21. in late-life moderated by the environment. *Prog Neuropsychopharmacol Biol Psychiatry.* 2008;32(2):479–486.
21. Mulvaney C, Kendrick D. Depressive symptoms in mothers of pre-school children—effects of deprivation, social support, stress and neighbourhood social capital. *Soc Psychiatry Psychiatr Epidemiol.* 2005;40(3):202–208.
22. Steptoe A, Feldman PJ. Neighborhood problems as sources of chronic stress: development of a measure of neighborhood problems, and associations with socioeconomic status and health. *Ann Behav Med.* 2001;23(3):177–185.
23. Mair C, Diez Roux AV, Galea S. Are neighbourhood characteristics associated with depressive symptoms? A review of evidence. *J Epidemiol Community Health.* 2008; 62(11):940–946.
24. Ahern J, Galea S, Hubbard A, et al. Neighborhood smoking norms modify the relation between collective efficacy and smoking behavior. *Drug Alcohol Depend.* 2009;100(1-2):138–145.
25. Galea S, Ahern J, Nandi A, et al. Urban neighborhood poverty and the incidence of depression in a population-based cohort study. *Ann Epidemiol.* 2007;17(3):171–179.
26. Ahern J, Galea S, Hubbard A, et al. "Culture of drinking" and individual problems with alcohol use. *Am J Epidemiol.* 2008;167(9):1041–1049.
27. Galea S, Ahern J, Rudenstine S, et al. Urban built environment and depression: a multilevel analysis. *J Epidemiol Community Health.* 2005;59(10):822–827.
28. Sampson RJ, Raudenbush SW, Earls F. Neighborhoods and violent crime: a multilevel study of collective efficacy. *Science.* 1997;277(5328):918–924.
29. Echeverría SE, Diez-Roux AV, Link BG. Reliability of self-reported neighborhood characteristics. *J Urban Health.* 2004;81(4):682–701.
30. Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. *J Gen Intern Med.* 2001;16(9):606–613.
31. Spitzer RL, Kroenke K, Williams JB. Validation and utility of a self-report version of PRIME-MD: the PHQ primary care study. Primary Care Evaluation of Mental Disorders. Patient Health Questionnaire. *JAMA.* 1999;282(18):1737–1744.
32. Uddin M, Aiello AE, WIldman DE, et al. Epigenetic and immune function profiles associated with posttraumatic stress disorder. *Proc Natl Acad Sci U S A.* 2010;107(20): 9470–9475.
33. Oakes JM. The (mis)estimation of neighborhood effects: causal inference for a practicable social epidemiology. *Soc Sci Med.* 2004;58(10):1929–1952.
34. Zeger SL, Liang KY, Albert PS. Models for longitudinal data: a generalized estimating equation approach. *Biometrics.* 1988;44(4):1049–1060.
35. Ahern J, Hubbard A, Galea S. Estimating the effects of potential public health interventions on population disease burden: a step-by-step illustration of causal inference methods. *Am J Epidemiol.* 2009;169(9):1140–1147.
36. Greenland S. Additive risk versus additive relative risk models. *Epidemiology.* 1993;4(1):32–36.
37. Efron B, Tibshirani R. Bootstrap methods for standard errors, confidence intervals, and other measures of statistical accuracy. *Stat Sci.* 1986;1(1):54–77.
38. Yen IH, Michael YL, Perdue L. Neighborhood environment in studies of health of older adults: a systematic review. *Am J Prev Med.* 2009;37(5):455–463.
39. Furstenberg FF Jr. On a new schedule: transitions to adulthood and family change. *Future Child.* 2010;20(1):67–87.
40. Galea S, Tracy M. Participation rates in epidemiologic studies. *Ann Epidemiol.* 2007;17(9):643–653.

41. Sampson RJ. Neighborhood-level context and health: lessons from sociology. In: Kawachi I, Berkman LF, eds. *Neighborhoods and Health*. Oxford, United Kingdom: Oxford University Press; 2003:132–146.

42. Van der Laan MJ, Robins JM. *Unified Methods for Censored Longitudinal Data and Causality*. New York, NY: Springer Verlag; 2003.

43. Vanderweele TJ. Ignorability and stability assumptions in neighborhood effects research. *Stat Med*. 2008;27(11): 1934–1943.

44. Chung B, Jones L, Jones A, et al. Using community arts events to enhance collective efficacy and community engagement to address depression in an African American community. *Am J Public Health*. 2009;99(2):237–244.