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Impact of perceived neighborhood problems on change in asthma-related health outcomes between baseline and followup

Abstract

We investigated whether perceived neighborhood problems (NP) predicted changes over a two-year period in asthma-specific quality of life (QOL), physical functioning (PF), and depressive symptomology (DEP) in a longitudinal cohort of 340 adults with asthma. There is a threshold and plateau effect between NP and PF, such that NP do not affect changes in PF until the problems reach the level of Quartile 3. People who had NP scores in Quartile 3 had lower PF compared to people who reported NP in Quartiles 1 or 2 (mean difference -3.09). High NP also predicted over twofold odds of high DEP (Center for Epidemiological Studies Depression [CESD] score ≥ 16) at follow-up (Odds Ratio=2.34; 95% confidence interval: 1.09–5.00). NP did not predict decline in QOL. Analyses adjusted for demographics, asthma severity, and baseline value of the health outcome.

Keywords

neighborhood; asthma; depressive symptomatology; quality of life; physical functioning

Background

A growing body of literature highlights associations between neighborhood environment and asthma-related morbidity, broadly defined (Juhn et al., 2005, Koinis Mitchell and Murdock, 2005, Saha et al., 2005, Corburn et al., 2006). Nearly all of this research, however, pertains to childhood asthma. Stress has been linked to asthma-related morbidity (Wright et al., 1998, Rietveld et al., 2000) and negative life events have been linked to poorer asthma-specific quality of life (Archea et al., 2007). Wright and co-authors propose a biopsychosocial model in which environmental demands (stressors or life events) lead to negative emotional responses, then physiological responses, and, finally, an increased risk of more severe physical disease. Clinical reports have suggested connections between an individual's experiences of stress, upset, anxiety and asthma attacks (Rietveld et al., 1999, Rumbak et al., 1993). Depression is associated with increased steroid use and greater health care utilization in asthma (Eisner et al., 2005, Stein et al., 2006, Kullowatz et al., 2006). Steroid use in these cases is likely to be linked to an increased frequency of asthma attacks. Depressed adults with asthma also tend to be less likely to use preventive therapies such as asthma controller medications (Smith et al., 2006, Balkrishnan et al., 2002). The role of stress is relevant because urban environments can produce stress in the form of nuisances such as excessive noise or in a more extreme form, violence. Indeed, exposure to violence has been linked to asthma hospitalizations and a higher number of days with symptoms among children with established asthma (Wright and Steinbach, 2001, Wright et al., 2004).

For adults with asthma, prior analyses suggested that perceived neighborhood environment are cross-sectionally associated with poorer disease-specific quality of life, physical functioning, and depressive symptomatology (Yen et al., 2006). Cross-sectional analyses are limited, however, such that the direction of the observed effect may not be clear. For example, worsened asthma severity may result in loss of employment, necessitating moving to a dangerous neighborhood, rather than such a neighborhood being the cause of worsening disease. Prospective data can support stronger conclusions regarding causality because the order of events in time can be studied. This is the report of analysis of prospective data for adults with asthma, investigating the effect of perceived neighborhood problems on asthma-associated outcomes determined in follow-up.

Methods

STUDY OVERVIEW

This analysis is based on interview data from an ongoing cohort study of adults with asthma, rhinitis, or both conditions. The University of California, San Francisco (UCSF) Committee on Human Research approved the data collection protocol. Beginning in 1992, the UCSF Asthma and Rhinitis Panel sampled persons with asthma recorded on visit logs maintained by a random sample of northern California adult pulmonologists, allergy-immunologists, and family practice physicians. The participation rate of physicians was 57 of 92 (62%) pulmonologists, 17 of 19 (89%) allergists, and 34 of 74 (46%) family practice physicians. Each participating physician was asked to maintain a registry of persons aged 18 through 50 years old with outpatient visits for asthma over a prospectively defined four-week period (increased to eight weeks in cases of low visit frequency). 751 of 869 (86%) eligible patients were recruited successfully. In 1999, an additional group of subjects, some with asthma and others with rhinitis alone, was recruited by random digit dialing from the same geographic area as the original physician-based recruitment. Study eligibility was also limited to people aged 18 to 50 years old and based on report of physician's diagnosis of the condition. For the random digit dialing sample, 300 of 455 eligible (66%) participated. Details of recruitment and initial follow-up have been previously reported (Blanc et al., 1996, Blanc et al., 1999, Blanc et al., 1997, Eisner et al., 1998, Eisner et al., 2001, Blanc et al., 2001).

The respondents were interviewed at the time of enrollment (wave 1), with up to 6 follow-up interviews (depending on recruitment) at 18–24 month intervals thereafter to date. The follow-up interviews (waves 5 and 6) upon which this paper is based occurred in 2000–2001 and 2002–2003, respectively. In this paper, we will refer to wave 5 as “baseline” and wave 6 as “follow-up.” During the baseline interview, 439 subjects had asthma with or without concomitant rhinitis. An additional 109 subjects who reported a physician's diagnosis of rhinitis alone, but not asthma, were excluded from this analysis in order to more specifically investigate the associations between neighborhood environment and asthma. Of the 439 subjects with asthma interviewed at baseline, 340 (77%) were re-interviewed at follow-up.

The subjects responded to a 45-minute computer-assisted telephone interview at both waves of data collection. The interview schedule included items addressing general health and asthma-specific status (including measures of psychological health and quality of life), demographic variables, and perceived neighborhood problems. The cohort study in which this analysis was imbedded was powered to observe an effect size to standard deviation ratio for risk factors of interest ranging from 0.3 to 0.5 with projected subject numbers similar to those available for our specific analysis

KEY INTERVIEW VARIABLES ANALYZED

Neighborhood problems—Neighborhood problems were ascertained at baseline through the responses to the stem question, “Thinking about your neighborhood as a whole, how much of a problem do you feel each of the following is in your neighborhood?” Following this stem question, respondents were then asked about five specific problems: too much traffic, excessive noise, trash and litter, smells or odors from factories or farms, and smoke from fires or burning. They were asked to indicate the seriousness of each on a scale of 0 to 5, where 0 is not a problem and 5 is a serious problem. This five-item battery was adapted from the neighborhood problem question used in the Alameda County Study (Balfour and Kaplan, 2002).

In this prospective analysis, we used the same approach to quantify perceived neighborhood problems that we used in previously published cross-sectional analysis (Yen et al., 2006). We analyzed reported neighborhood problems both individually and as a group. We did not have an *a priori* assumption as to the relative weighting of each type of problem among the five types, but anticipated that some problems would be less frequent or might be perceived as less serious than others, for example smoke from fires compared to trash or litter. Moreover, in initial examination of the response frequencies to the individual questions, we noted a skewed distribution. To address this, we reduced each 5-point scaled response to three categories for the purposes of regression modeling: 0 (no problem at all; reference category), levels 1 through 4, and level 5 (maximal seriousness).

We also created an integrated measure of perceived neighborhood problems by summing the responses to all of the individual neighborhood problems, with a potential range of 0 to 25. In this summary score, a value of “0” corresponds to a person reporting no serious problem with any of the five types of issues. The summary score was divided into four categories approximating quartiles of the summary score: quartile 1 (total score = 0), quartile 2 (total score = 1 to 3), quartile 3 (total score = 4 to 7), and quartile 4 (score ≥ 8) (Yen et al., 2006).

Health variables

Marks Asthma Quality of Life: To assess disease-specific quality of life, we used the 20-item asthma-specific quality of life (QOL) measure developed and validated by Marks and colleagues and later adapted by our study for modified scoring (Marks et al., 1992, Katz et al., 1999). The maximum summary score is 60; higher scores reflect greater negative effect of asthma on QOL.

Physical functioning: We used the SF-12 Physical Component Scale score (SF-12 PCS) to measure physical function. The SF-12 is a short version of the SF-36 (Ware et al., 1993). Test-retest reliability for the SF-12 PCS scale was 0.89 in the US (Ware et al., 1995). Scores range from 0 to 100, with a population mean of 50; higher scores reflect better function.

Depressive symptoms: We used the Center for Epidemiologic Studies Depression Scale (CES-D), a 20-item, self-report scale developed to identify depressive symptoms in the general population, to measure depressive symptoms (Radloff, 1977). Overall scores range from 0 to 60, with higher scores indicating greater depressive symptomatology. We analyzed the scale both as a continuous variable and as a categorical variable using the cutoff of ≥ 16 . Scores of 16 or more are commonly taken as indicative of high depressive symptomatology (Weissman et al., 1977).

Severity of Asthma Score: The severity-of-asthma score was previously developed and validated by Blanc and colleagues and includes items on symptoms, systemic corticosteroids, other medication use in prior two weeks, and hospitalizations and intubations (Blanc et al., 1993)(Eisner et al., 1998). The score incorporates a widely accepted stepwise approach to

asthma pharmacotherapy in which higher levels of treatment are indicative of an inability to control asthma with medications used at prior steps (Program., 1997). The Severity of Asthma Score is calculated based on the subjects' responses at the time of each interview. In addition to current symptoms and recent medication use, however, three variables in the score represent cumulative lifetime experience: ever hospitalized for asthma (weighted 3 points), ever received mechanical ventilatory support for asthma (weighted 5 points), and ever received oral or parenteral (intravenous or intramuscular) corticosteroids for asthma (weighted 1 point). For these variables, responses from previous interview waves can contribute to the Severity of Asthma Score calculated at the time of a subsequent interview. In addition to baseline interview, lifetime experience was re-ascertained in Wave 5. Higher scores reflect greater asthma severity; the maximum score is 28.

Demographic variables—Demographic variables have been shown to be associated with quality of life (Campbell et al., 1999), psychological status (Hollingshead and Redlich, 1958, Miech et al., 1999), and physical functioning (Stansfeld et al., 2003, Mishra et al., 2004) in general population samples. Quality of life may affect perception and reporting of neighborhood problems as well (Feldman and Steptoe, 2004). Therefore, analyses controlled for the following demographic variables: age, sex, income, and education. In preliminary analyses, we also controlled for race/ethnicity. Because results were essentially the same with or without race/ethnicity (data not shown) in the models, this was not included in the final results.

The demographic characteristics of the sample are shown in Table 1, providing a comparison between the 340 people in our analytic sample interviewed at baseline and follow-up and the 99 people who were not included because they completed the baseline interview only. For regression models, age was entered as a continuous variable. Household income was classified into four categories: less than \$40,000 (20%), \$40–80,000 (37%), greater than \$80,000 (38% - reference group), and refused or unknown (5%). Education was classified into four categories: high school graduate or less (14%), some college or an associate degree (38%), college graduate (28%), and graduate degree (19% - reference group).

A higher proportion of cohort members with lower incomes or lower educational attainment did not participate in the follow-up interview (chi-square test $p < 0.001$). Also, those who did not participate had a higher mean CES-D score (consistent with more depressive symptoms) than those who completed both baseline and follow-up interviews.

ANALYSIS

Univariate and bivariate analysis of the baseline data were conducted for a previously published report (Yen et al., 2006).

We used linear regression models to analyze the association between neighborhood problems (individual and summed) at baseline and three distinct health outcome variables (QOL, SF-12 PCS, and CES-D) at follow-up. We also analyzed the association between neighborhood problems and CES-D, dichotomized to assess high levels of depressive symptomatology (score of 16 or higher) using logistic regression. We tested simple (unadjusted) models; then added demographic covariates (i.e. age, sex, income, and education) and the baseline score for the health outcome measure which was the dependent variable of interest in that particular model (e.g. the baseline score of QOL for the model that predicts QOL at follow-up). By including the baseline score for the health outcome measure in the model, we are effectively conducting a change in score analysis. That is, our modeling approach is equivalent to modeling the change in health outcome from baseline to following [e.g. QOL at followup – QOL at baseline] as the dependent variable.

In a final model, we also included Severity of Asthma Score as a covariate. Because the intermediate and final models did not substantively differ, we present the unadjusted and the final models only. We wished to retain asthma severity in the models, even though it had little impact and in preliminary modeling severity was not statistically associated with the neighborhood environment. We did so because asthma severity is a key covariate in studies of asthma-related health outcomes and thus its omission would have complicated interpretation of the results.

For the models investigating how the summed neighborhood problems predicted changes in the different asthma-specific outcomes, we utilized a threshold coding approach (Walter et al., 1987). The threshold coding approach codes each quartile variable to take into consideration the incremental impact of additional exposure. In this way, an observation falling in Quartile 4 receives “credit” in the coding for having an exposure level as great as that in Quartile 3 and Quartile 2 as well as in Quartile 4. Thus, the resulting coefficient for the Quartile 4 variable reflects the incremental difference of exposure between Quartile 4 and Quartile 3. A conventional indicator variable approach would enter a variable representing each quartile (except the reference) into the multivariate model. In that approach, the model coefficients show differences between Quartiles 2, 3, and 4 and the referent category (Quartile 1), an analysis that would not have addressed the potential step-up in risk we wished to explore.

We did not know how long people lived at their addresses. We did have information on whether subjects had moved between baseline and follow-up ($n=21$). We did conduct a sensitivity analysis excluding people who had moved.

Results

Frequency of serious neighborhood problems

For the individual perceived neighborhood issues, respondents perceived the most serious problems with traffic (17% rated it ≥ 4); and the least problems with smells (5% rated ≥ 4) and trash (3% ≥ 4). In terms of the summed neighborhood problem score, 85 (25%) of respondents scored 0, reporting no problems with any of the five types of problems; 38 (11%) reported only one problem and only at a minimal level of seriousness (total score of 1), and another 39 (11%) reported either one problem at the level of 2 seriousness or two problems at the level of 1 (total summary score = 2). The maximum score observed was 25. The quartiles of the score are included in Table 1.

Association of neighborhood problems with health outcomes

The results from linear regression models of the associations between individual neighborhood problems and QOL, SF-12, and depressive symptoms, suggest limited prospective effects linked to individual neighborhood issues among a range of health outcomes (See Table 2), especially after taking into consideration baseline score, age, sex, income, education, and asthma severity. People who reported problems (1–4 on a scale of 0 to 5) with noise (mean change = -2.05), and trash (mean change = -2.00), had lower physical functioning scores between baseline and follow-up, after taking into consideration demographic characteristics and asthma severity. People who had serious problems (5 on the scale of 0 to 5) with smells (mean change = -6.76) had lower physical functioning between baseline and follow-up.

Table 3 provides the linear regression results for the associations between the total perceived neighborhood problem score and asthma specific QOL, physical functioning, and depressive symptomatology, using a threshold coding approach (see Methods). Results are shown for unadjusted models and a model that adjusted for demographic covariates (age, sex, low-

income, and education), baseline score for the outcome variable analyzed, and Severity of Asthma Score.

There appears to be a threshold effect of perceived neighborhood problems on asthma-specific QOL at quartile 3 (i.e. total score between 4 and 7). That is, perceived neighborhood problems do not affect changes in QOL until the problems reach the level of Quartile 3. The pattern seems to show a plateau effect, in that reporting more perceived problems (Quartile 4) does not further affect QOL over the follow-up period. However, after adjusting for demographic covariates, baseline score, and asthma severity, there is no statistically significant effect of perceived neighborhood problems on changes in asthma-specific QOL.

Similarly for physical functioning, there appears to be threshold and plateau effects at Quartile 3. People who had scores in Quartile 3 had lower physical functioning compared to people who reported serious neighborhood problems in Quartiles 1 or 2 (mean difference -5.73). After taking covariates into consideration, people who had scores in quartile 3 still showed a mean decline in physical functioning of 3.09 points. Reporting more serious problems (Quartile 4) did not further decrease physical functioning over the follow-up period.

For the CES-D depressive symptomatology score, there were consistent associations with high levels of perceived neighborhood problems, whether assessed as a continuous (Table 3) or dichotomous measure (Table 4). Analyzing the CES-D as a continuous score, negative effects appeared at Quartile 4, with scores over 3 points higher than people who had scores in Quartiles 1, 2, and 3 (mean change $=3.25$), after taking into consideration demographic characteristics, baseline score, and asthma severity.

When CES-D was analyzed as a dichotomous measure, those who had reported neighborhood problems scored in the highest quartile at baseline were over two times as likely to be also classified as having high depressive symptomatology (OR $=2.34$, 95% CI: 1.09, 5.00; Table 4). We reanalyzed the data, limiting the sample only to those had CES-D scores less than 16 at baseline ($n=249$); reported neighborhood problems at baseline in the highest quartile of scores manifest over three times the risk of high depressive symptomatology at follow-up (OR $=3.24$, 95% CI: 0.98, 10.65).

We do not know how long people lived at their addresses. When we excluded people who moved between baseline and follow-up ($n=21$), the results did not change substantively (results not shown).

Discussion

In this prospective study of adults with asthma, we found that perceived neighborhood problems were associated with a three-point decline in physical functioning measured by the SF-12 PCS. This is approximately one-third the standard deviation in SF-12 PCS in our study sample and similar in magnitude to the decrement in SF-12 PCS associated with asthma (-2.7 points) compared to persons without co-morbidity (Ware et. al., 1995). We also observed that a high level of perceived neighborhood problems was prospectively linked to a doubling of depression risk using the standard cutoff of 16 points for increased depressive symptoms in the CES-D. Moreover, there appeared to be a threshold effect for cumulative neighborhood problems, both for decline in physical functioning and increased risk of depression. Associations between perceived neighborhood problems and asthma behaviors have been reported in children (Chen et al., 2007). Our findings are the first results from a prospective study of adults with asthma.

Asthma affects over 10 million adults and is the third leading cause of preventable hospitalizations in the United States (Kowalski, 2000). Given asthma's prevalence and its

associated morbidity (Pearce et al., 1998, Wright and Weiss, 2000), it is important to identify the factors that affect health status and quality of life in this condition. Environmental factors are believed to play an important role in asthma causation but whether these factors also act on health status and quality of life in adult asthma remains open to question.

A substantial portion of the neighborhood-health literature suggests an influential role of neighborhoods on chronic conditions, in particular cardiovascular diseases (Diez-Roux et al., 1997, Diez Roux et al., 2001, Sundquist et al., 2004) and behaviors associated with these conditions (Sundquist et al., 1999, Cubbin et al., 2006). Here we show prospective evidence of neighborhood environment's influence on depressive symptomatology and physical function among adults with asthma. Reports have identified important links between depression and asthma (Zielinski et al., 2000, Feldman et al., 2005) and physical functioning and asthma (Ford et al., 2003).

The inter-relationship between neighborhood environment, depressive symptomatology, and asthma has implications for asthma management. Since we only have data from two points in time, we are not able to sort out the temporal association between the depressive symptomatology and the asthma-associated outcomes. Prior research has demonstrated that people with asthma who are also depressed do not take asthma controller medications and tend to have more attacks. Our findings suggest that adults with asthma who perceive more neighborhood problems are at an increased risk to have depressive symptomatology. These people may then be at increased risk for poorer control of asthma symptoms and more asthma attacks.

We did not have objective measures of the characteristics of neighborhoods, only respondents' perceptions of their environments. For example, one neighborhood problem area that could be further investigated objectively is traffic based on flow and density measures. Although the subjective nature of our data is a study limitation, such measures have been commonly used to assess the neighborhood environment and may be even more appropriate than objective measures within the stress framework underlying this investigation (Elliott, 2000, Steptoe and Feldman, 2001, Balfour and Kaplan, 2002). That framework proposes that *perceived* neighborhood problems act as a stressor for people with asthma and contribute to poor physical health, mental health, and quality of life.

We did not know how long people resided at their current addresses prior to baseline. If we exclude from the analysis people who had moved between the baseline and follow-up waves, the pattern of the results does not change substantively. Our measures of socioeconomic status (SES) were limited to income and educational attainment. Employment status, access to health care, and other unmeasured SES confounders could be in part responsible for the observed associations.

Another important potential limitation is that people who have depressive symptomatology may also perceive more problems in their neighborhoods. We did adjust for people's baseline CES-D scores to mitigate this methodological issue. People who have poor asthma-specific QOL might be similarly predisposed to perceive more neighborhood problems. Taking into account baseline QOL, we did not find the same pattern of association between perceived environment and QOL, even though depressive symptoms and QOL have been linked in adult asthmatics (Mancuso et al., 2000). Other neighborhood-health research has reported effects on depression and physical functioning (Matheson et al., 2006, Gary et al., 2006, Feldman and Steptoe, 2004).

Our cohort of adults with asthma was heterogeneous in relation to key factors such as age of disease onset and disease severity. This is a study strength insofar as it reflects real-world patient diversity. Nonetheless, we did not have large enough study numbers to carry out

stratified sub-analyses based on such attributes, a study analytic limitation that should be acknowledged.

In order to take advantage of having measures of outcomes at two points in time, we adjusted for the baseline measure in our multivariate models. This is a conservative approach and the results for depressive symptoms, for example, indicate that perceived neighborhood problems predict an increase in depressive symptomatology over a two-year followup period, over and above any effects the same neighborhood may have had prior to the baseline measure of depressive symptoms.

Previous studies have linked urban deprivation to asthma (Rimington et al., 2001, Wright and Steinbach, 2001). Despite some limitations, the results of this study suggest that attention to the neighborhood environment is an important potential approach to of life of people with asthma. Attention to municipal services such as trash removal, traffic calming measures in residential areas, and regulation of emissions could have beneficial effects for people with asthma in terms of their quality of life, physical functioning, and level of depressive symptoms. Neighborhood design, city planning policies, and attention to environmental quality may be important additional tools for addressing asthma in the community.

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Table 1

Adults with asthma interviewed at baseline and follow-up (n=340) compared to those interviewed at baseline alone (n=99)

	Analytic sample (n=340)	Not re-interviewed (n=99)	Chi-square (p-value)
Characteristics at wave 5	Frequency n (%)		
Sex			
Male	98 (29%)	32 (32%)	0.45 (0.50)
Female	242 (71%)	67 (68%)	
Age in years			
20–35	56 (17%)	18 (18%)	6.83 (0.23)
36–40	47 (14%)	13 (13%)	
41–45	55 (16%)	22 (22%)	
46–50	71 (21%)	23 (23%)	
51–55	82 (24%)	21 (21%)	
≥56	29 (9%)	2 (2%)	
Race/Ethnicity ^I			
White/other	257 (76%)	69 (70%)	3.38 (0.34)
Latino	38 (11%)	16 (16%)	
African American	18 (5%)	8 (8%)	
Asian	24 (7%)	5 (5%)	
Annual Family Income			
< \$40,000	68 (20%)	36 (36%)	12.15 (0.007)
\$40–80,000	124 (37%)	26 (26%)	
> \$80,000	130 (38%)	31 (31%)	
Refused / Unknown	18 (5%)	7 (7%)	
Education			
≤ high school graduate	48 (14%)	31 (31%)	18.99 (0.0004)
some college	130 (38%)	35 (35%)	
college graduate	96 (28%)	24 (24%)	
graduate degree	66 (19%)	9 (9%)	
Perceived Neighborhood Problems			
Summary Score			
Quartile 1 (Score=0)	85 (25%)	28 (28%)	7.51 (0.06)
Quartile 2 (Score=1–3)	104 (31%)	20 (20%)	
Quartile 3 (Score = 4–7)	78 (23%)	19 (19%)	
Quartile 4 (Score ≥8)	73 (21%)	32 (32%)	
	Overall mean ± S.D. (range)		F value (p-value)
Severity of Asthma Score	8.4 ± 5.8(0–26)	8.3 ± 6.1 (0–25)	0.03 (0.87)
Quality of life	16.1 ± 13.8 (0–59)	18.5 ± 17.2 (0–59)	2.26 (0.13)
Physical functioning	44.6 ± 10.8 (13.9–63.8)	43.6 ± 11.0 (12.7–61.25)	0.74 (0.39)
Depressive symptoms	11.5 ± 10.5 (0–58)	15.7 ± 13.9 (0–50)	11.12 (0.0009)

^I Information on race/ethnicity for 337 people only.

Table 2
Neighborhood problems at baseline as a predictor of quality of life, physical functioning and depressive symptoms at follow-up among 340 adults with asthma.

	Quality of Life (QOL)			Physical Functioning (SF-12 PCS)			Depressive Symptomatology (CES-D)		
	Beta (standard error)			Beta (standard error)			Beta (standard error)		
	Unadjusted	Adjusted*	Unadjusted	Adjusted*	Unadjusted	Adjusted*	Unadjusted	Adjusted*	Unadjusted
Traffic									
1-4	3.86 (1.67)	2.41 (1.23)	-1.68 (1.29)	-1.32 (0.92)	1.62 (1.23)	1.06 (1.02)			
5	6.83 (2.69)	1.12 (1.99)	-3.41 (2.08)	-1.68 (1.48)	5.16 (1.98)	1.31 (1.66)			
Noise									
1-4	1.41 (1.64)	0.63 (1.21)	-2.00 (1.25)	-2.05 (0.89)	1.93 (1.20)	0.96 (1.00)			
5	11.04 (3.57)	2.52 (2.73)	-8.61 (2.74)	-3.74 (2.01)	7.46 (2.62)	1.60 (2.25)			
Trash									
1-4	1.68 (1.81)	-0.22 (1.35)	-3.47 (1.38)	-2.00 (1.00)	2.80 (1.33)	0.52 (1.13)			
5	13.87 (4.92)	1.71 (3.77)	-10.20 (3.76)	-5.04 (2.76)	9.04 (3.61)	0.85 (3.11)			
Smells									
1-4	5.54 (1.94)	1.58 (1.45)	-3.58 (1.49)	-1.09 (1.07)	2.28 (1.44)	1.52 (1.19)			
5	13.68 (4.63)	0.33 (3.57)	-11.92 (3.55)	-6.76 (2.58)	10.38 (3.42)	2.20 (2.91)			
Fires									
1-4	2.44 (1.73)	0.53 (1.27)	2.67 (1.33)	-1.02 (0.96)	2.35 (1.27)	1.22 (1.05)			
5	8.32 (3.66)	0.23 (2.74)	-2.19 (2.82)	-0.67 (2.02)	4.31 (2.69)	-0.90 (2.25)			

* Adjusted for age, sex, baseline score of outcome (i.e. QOL, SF-12 PCS, or CES-D), income, education, and Severity of Asthma Score

Bold-face indicates statistically significant at the p=0.05 level.

The incremental effect of increasing neighborhood problems as predictors of asthma-related health outcomes: among 340 adults with asthma.

Table 3

	Quality of Life (QOL)		Physical Functioning (SF-12 PCS)		Depressive Symptomatology (CES-D)	
	Unadj	Adjusted*	Unadj	Adjusted*	Unadj	Adjusted*
Beta (standard error)						
Cumulative Neighborhood Problems						
Quartile 1 (score 0)	--	--	--	--	--	--
Quartile 2(score 1-3)	0.76 (2.11)	1.50 (1.55)	0.96 (1.61)	-0.25 (1.16)	1.46 (1.54)	1.47 (1.29)
Quartile 3 (score 4-7)	4.32 (2.17)	1.39 (1.61)	-5.73 (1.65)	-3.09 (1.24)	0.98 (1.58)	-1.38 (1.32)
Quartile 4 (score ≥ 8)	1.14 (2.36)	-0.73 (1.72)	1.26 (1.79)	1.80 (1.27)	4.17 (1.72)	3.25 (1.42)
Adjusted R-squared	0.02	0.49	0.04	0.52	0.04	0.35

* Adjusted for age, sex, baseline score (i.e. QOL, SF-12 PCS, or CES-D), income, education, and Severity of Asthma Score Bold-face indicates a statistically significant incremental difference compared to the preceding (next lower) quartile at p <0.05.

Table 4

Perceived neighborhood problems at baseline as a predictor of as a predictor of high depressive symptomatology at follow-up among 340 adults with asthma.

Cumulative Neighborhood Problems	CES-D ≥ 16 (yes/no) Odds Ratios (95% Confidence Intervals)	
	Unadj	Adjusted*
Quartile 1 (score 0)	REF	REF
Quartile 2 (score 1–3)	1.01 (0.46,2.23)	1.30 (0.57,3.00)
Quartile 3 (score 4–7)	1.53 (0.72,3.27)	1.30 (0.58,2.88)
Quartile 4 (score ≥ 8)	2.50 (1.23,5.10)	2.34 (1.09,5.00)

* Adjusted for age, sex, income, education, and asthma severity