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Exposure to Community Violence is Associated with Asthma Hospitalizations and ED Visits

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Abstract

Background—Exposure to community violence (ECV) has been associated with asthma morbidity of children living in inner-city neighborhoods.

Objective—To examine with prospective longitudinal data whether ECV is independently associated with asthma-related health outcomes in adults.

Methods—Adults with moderate-severe asthma, recruited from clinics serving inner-city neighborhoods, completed questionnaires covering socio-demographics, asthma severity, and ECV and were followed for 26 weeks. Longitudinal models were employed to assess unadjusted and adjusted associations of subsequent asthma outcomes (emergency department (ED) visits, hospitalizations, FEV1, quality of life).

Results—397 adults, 47±14 years, 73% female, 70% African American, 7% Latino, mean FEV1 66%±19%, 133 with hospitalizations and 222 with ED visits for asthma in the year before entry were evaluated. 91 reported ECV. Controlling for age, gender, race/ethnicity, and household income, those exposed to violence had 2.27 (95% CI: 1.32-3.90) times more asthma-related ED visits per month and 2.49 (95% CI: 1.11-5.60) times more asthma-related hospitalizations per month over the 26-

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Clinical implications: Adults with moderate or severe asthma who are exposed to community violence are at increased risk for ED visits and hospitalizations for asthma and urgent care for any cause.

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week study period compared to those unexposed. Violence-exposed participants also had 1.71 (95% CI: 1.14-2.56) times more overall ED visits per month and 1.72 (95% CI: 0.95-3.11) times more overall hospitalizations per month from any cause. Asthma-related quality of life was lower in the violence-exposed participants (-0.40 (95% CI: -0.77-0.025), $p=0.04$). Effect modification by depressive symptoms was only statistically significant for the ECV association with overall ED visits and quality of life outcomes ($p<.01$).

Conclusion—In adults, ECV is associated with increased hospitalizations and emergency care for asthma or any condition and with asthma-related quality of life.

Keywords

asthma; quality of life; emergency department visits; community violence; inner-city asthma

Introduction

Asthma morbidity is high in low-income inner-city neighborhoods.¹ Among exposures that could link environment to poorer health, chronic psychosocial stress has received attention, particularly in youth.²⁻⁸

One marker of psychosocial stress is exposure to community violence (ECV), described by Wright and Steinbach as proximity to violence, either through direct victimization or observing arguments, fights, or crime in one's neighborhood.⁹ ECV is disproportionately experienced by the poor, people of color, and those living within the inner-city, the same population disproportionately affected by asthma.^{3, 10, 11} Much of the research on ECV has focused on youth and their caretakers and the effect of ECV on mental health.^{3, 5, 12, 13} We focus on the impact of ECV on a chronic health problem in adults: moderate or severe asthma.

ECV also has been considered a marker for neighborhoods with concentrated disadvantage: segregated communities where there is poorer access to health care, e.g., fewer pharmacies less likely to have adequate medication supplies,^{5, 14} fewer grocery stores with healthy foods,¹⁵ and increased exposure to environmental pollutants.^{2, 16, 17} Evidence is accumulating that living in concentrated disadvantage contributes to health disparities,⁵ although the reasons are unclear. One possibility for persons with asthma living in concentrated disadvantage is that they could be exposed to physical or social conditions that contribute to the development of their disease, exacerbate their symptoms, and interfere with successful treatment and management of their condition. Another possibility, and not mutually exclusive, is that, the psychological stress of living in concentrated disadvantage directly affects the health of persons with asthma.

In asthma ECV has been associated, mostly in children, with poorer outcomes.^{2, 3, 18-20} For example, Wright et al., in a landmark paper, found that caretakers of asthmatic children who reported more ECV also reported more symptom-days among their children and more caretaker lost sleep.³ However, Cohen and colleagues reported no association between witnessing community violence and increased risk of asthma in Puerto Rican children, although a history of physical or sexual abuse was associated with an increased risk of asthma.²¹ One limitation of these studies in children is that most of the asthma outcomes were self-reported or caretaker reported.

The impact of ECV on health outcomes in adults, particularly those with increased asthma morbidity, has received little attention. Therefore, our goal was to examine the effect of ECV on several health outcomes in adults with moderate or severe asthma: ED visits, hospitalizations, asthma-related quality of life, and lung function. We hypothesized that exposure to violence is associated with poorer asthma outcomes and that the effect might be

moderated by other contributors to psychosocial stress such as depressive symptoms and lack of social support.

Methods

We conducted a prospective cohort study within a large randomized controlled trial. The ongoing parent study, Individualized Interventions to Improve Adherence in Asthma (NCT00115323, R01 HL073932), compares an individualized problem-solving strategy to standard asthma education in adults with moderate or severe asthma. The problem-solving intervention addresses and integrates solutions to a problem of the participant's choosing, tailoring problem-solving to the participant's needs with ways to maintain or improve adherence to inhaled steroid regimens. The primary outcome is electronically-monitored adherence to inhaled steroids. Other outcomes are changes in asthma-related health status, including FEV1, quality of life, hospitalizations, and ED visits.

Subjects

Participants were English- or Spanish-speaking adults with moderate or severe persistent asthma according to National Heart Lung and Blood Institute Expert Panel Report 3 guidelines.²² Inclusion criteria were 1) age at least 18 years, 2) physician's diagnosis of asthma, 3) prescription for an inhaled corticosteroid-containing medication for asthma, 4) evidence of reversible airflow obstruction; and 5) at least a 12% improvement with bronchodilator.

Subjects were recruited from practice sites that serve inner-city neighborhoods with high rates of asthma morbidity. Clinical sites included outpatient primary care and asthma specialty practices of the University of Pennsylvania Health System, Woodland Avenue Health Center, the Comprehensive Health Center at Episcopal Hospital, and Philadelphia Veterans Affairs Medical Center. Charts or electronic medical records of participating practices were pre-screened for patients with asthma who were prescribed an inhaled corticosteroid. Potential subjects were then approached by telephone or at the time of a clinic visit and asked to sign consent for further screening. Those satisfying all enrollment criteria were then asked to sign a second informed consent to participate in the study. The protocol was approved by the Institutional Review Boards of the University of Pennsylvania and the Philadelphia Veterans Affairs Medical Center.

Procedures

Participants were interviewed to determine socio-demographics, asthma status, exposure to community violence, asthma-specific quality of life, depressive symptoms, and social support. Spirometry was obtained according to American Thoracic Society procedures.²³ Participants were then seen monthly for the parent trial; spirometry, asthma-related quality of life, report of hospitalizations and ED visits were obtained as part of data collected at these visits.

Data Collection and Measures

All questions were read to the participant while the participant looked at the written questionnaire. For patients whose primary language was Spanish, bilingual research coordinators administered the questionnaires. All validated questionnaires were available in English and Spanish. Participants chose whether to have the questionnaires read in English or Spanish.

Dependent Variables—The dependent variables were asthma-related outcomes: self-reported asthma-related ED visits, self-reported asthma-related hospitalizations, asthma-related quality of life (AQOL), and FEV1. Except for AQOL which was assessed at baseline and weeks 14 and 26, they were assessed monthly over the 26-week period. We similarly

recorded any hospitalizations and ED visits that did not result in a hospitalization, for any cause over the 26-week period. Some patients had more than one hospitalization or ED visit.

Asthma-related quality of life was measured using the Mini-Asthma Quality of Life Questionnaire (mini-AQLQ) at baseline and weeks 14 and 26.²⁴⁻²⁶ This questionnaire has been validated in low-income adults.²⁷ It contains 15 items each scored on a scale ranging from 1 (maximum impairment) to 7 (no impairment). The score of the overall questionnaire is given by the mean of the 15 responses. FEV1 was obtained by spirometry, using ATS criteria.²³

Independent Variables—The primary independent variable of interest was ECV. Participants' socio-demographic variables were controlled for as potential confounders, and depressive symptoms and the availability of social support were analyzed as moderators of the effect of ECV on outcomes.

Exposure to Community Violence (Ecv): ECV was measured at baseline using a question modified from Wright et al.³: “In the past 6 months, did you witness any violence in your neighborhood (yes/no)?” This was used in the primary analysis. For positive responses to this question, participants were asked to check all that applied using the options of Wright et al.³ That is, they were asked to indicate all they had witnessed: “a fight in which a weapon was used, a violent argument between neighbors, a gang fight, a sexual assault or rape, a robbery or mugging.”³ We also added an “other” category. While we did not use these options in the primary analysis, they allowed both participants and researchers to better understand what was meant by witnessing violence. Although there are several other measures of ECV,^{28, 29} we used this question because of the importance of this study in the asthma literature, it was brief, and it could be used for adults.

Other Independent Variables: Depressive symptoms were measured at baseline using the Center for Epidemiologic Studies Depression Scale (CES-D), a validated 20-item scale, developed to measure self-reported depression in community populations.^{30, 31} Each item uses a 0-3 response scale with responses summed to provide a score ranging from 0 - 60. Scores of 16 or more are considered indicative of possible major depression; but the instrument is not diagnostic of depression and is most accurately construed as a measure of depressive symptoms, demoralization, or general distress.³² It has been used in cross-cultural research in minority patients.^{30, 33}

Social support was assessed at baseline using the Medical Outcomes Study Social Support Survey.³⁴ The Survey has 19 items on a 5-point Likert scale. The overall score of the survey is given by the mean of all 19 items, rescaled to a range of 0-100. A higher score indicates more support.

Demographic characteristics-- age, race, ethnicity, educational attainment, and household income-- were ascertained by self-report. Household income was asked in categories to make responses by participants more acceptable and feasible: < \$10,000/year, \$10,000-\$19,999/year, \$20,000-\$29,999/year, \$30,000-\$49,999/year, \$50,000-\$99,999/year, and > \$100,000/year.

Statistical Analysis

Descriptive statistics and data analyses were performed using STAT 11.0 (STATA Corporation, College Station, TX) and SAS V9.2 (SAS Corp, Cary, NC). Logistic regression was employed for assessing pairwise associations of ECV with demographic factors, depressive symptoms, and social support. Log-linear regression with offsets for logged months of follow-up was employed to assess the pairwise and multivariate rate ratios (RR) between ECV as the primary exposure and ED or hospital admissions over the entire follow-up period.

as the dependent variable. Demographic factors were analyzed as confounders. Depressive symptoms and social support were analyzed as effect modifiers of the ECV-visits associations by including interactions between ECV and the effect modifiers in the above models. For the longitudinal FEV1 and AQOL outcomes, we employed longitudinal random effects linear models with random intercepts and slopes specified for each participant to account for longitudinal correlations. Fixed effects were specified for baseline covariates, ECV, each visit except baseline (time treated as categorical), and separate interactions between ECV and each of the follow-up visits. Because we were interested in testing exposure group differences in mean outcomes, the sum of the 12 month main effect and corresponding interaction term was used to test for the ECV effect at that time point. We used the “lsmeans” statement in Proc Mixed of SAS to obtain these tests.³⁵ All effects for ECV on the outcome were tested at the .05 level and estimated with 95% confidence intervals. For the final models assessing the significance of interactions of ECV with the effect modifiers (baseline depressive symptoms and social support) on the above outcome variables, we included a main effect or the effect modifier and the interaction. For the longitudinal models for FEV1 and AQOL, two-way interaction terms between the effect modifier and visit, as well as the three-way interactions between the effect modifier, ECV, and visit were included. These interaction terms were tested at the .05 level. For the random effects linear models, we assessed the distribution of the dependent variables to confirm that they were not skewed.

Given that the exposed group exhibited twice as high a rate of drop-out between the baseline and first follow-up visit, the random effects models still satisfied the Missing at Random (MAR) assumption (missing data related to observed outcomes and covariates) at least with respect to ECV because ECV is in the model. Nonetheless, it is impossible to confirm that MAR is the correct assumption as there may be unmeasured factors influencing outcome and missingness. Consequently, there may be bias in the tests. However, every analysis approach of longitudinal data regardless of assumptions it makes is vulnerable to such bias, as there always is the potential for a missing data process that is not accounted for by the model.³⁶

Results

Recruitment

We prescreened more than 49,000 charts of patients admitted to the ED for asthma or scheduled to have a physician's appointment in participating general or specialty clinics within the following 2 weeks. Charts were reviewed more than once if the patient had more than one appointment. This prescreening process identified approximately 7000 patients 18 years or older with a doctor's diagnosis of asthma who were taking an inhaled corticosteroid. After screening for the other enrollment criteria; 585 were eligible and 397 completed the surveys for this study. Of the 188 who declined, 70 stated they were too busy, 57 did not come for appointments scheduled with researchers, 39 thought the travel time for appointments too burdensome, and 18 did not consider the research likely to be beneficial to themselves or others. In addition, another 4 eligible patients declined, 1 for each of the following reasons: “concerns about research,” “concerns about data privacy/protection of personal medical information,” patient's doctors believed the study was not likely to be beneficial, and patient unable to switch to an inhaled steroid for which we had a monitor.

Patient Characteristics

The 397 subjects were mostly female, African-American, and from households earning less than \$30,000/year (Table 1). More than 80% were high school graduates. Asthma was of significant severity, with the cohort having a low mean FEV1 (Table 1). More than half had had an asthma-related ED visit in the year prior to enrollment and about a third had been hospitalized for asthma in that time interval. The mean baseline CES-D score was greater than

16, consistent with the higher depressive symptoms frequently seen in poor urban populations (Table 1).³⁷

ECV was reported by 91 participants, almost one quarter of the population, with 43% of this subset reporting exposures to at least 2 types (Table 1). Among those exposed there were 29 ED visits and 18 hospitalizations that were asthma-related; while among the 305 participants who were not exposed, there were 96 ED visits and 57 hospitalizations for asthma. One participant did not answer the question about ENV. There were fewer days of follow-up in which to count urgent visits in the violence exposed group: 119 ± 91 days versus 151 ± 77 days. Younger age, African American race/ethnicity, and lower household income were associated with increased risk of ECV (Table 2). ECV was related to greater depressive symptoms and less social support (Table 2).

Clinical Outcomes

Overall, ED and hospitalization visits and AQOL were associated with ECV with and without adjusting for demographics. Adjusting for the fewer days of observation in the exposed group, ED visits and hospitalizations for asthma and for any cause were more frequent among those exposed to violence (Table 3). That is, those in the exposed group had a rate of .090 ED visit per month of observation compared with those unexposed to violence who had a rate of .039 ED visits per month of observation. Similarly, the exposed- to-violence group exhibited .051 asthma-related hospitalizations per month compared to the unexposed group with .019 visits per month (Table 3).

The analysis of unadjusted and adjusted ratios of overall ED and asthma-related hospital visits per month showed similar significant results (Table 4). Adjusting for months of follow-up, the crude ratio of ED visits of the exposed patients compared to unexposed patients was 2.34 (95% CI=1.26, 4.36); $p=0.0073$). Adjusting for baseline demographics, the ratio of visits per month was 2.27 ((1.32, 3.90); $p=0.0031$). The crude ratio of asthma-related hospitalizations in the exposed group compared to the unexposed group was 2.68 (95% CI= 1.12, 6.41); $p=.027$). However, adjusting for baseline demographics led to a non-significant ratio of overall hospital visits per month ($p=.071$).

Asthma-related quality of life was significantly lower on average in the exposed group, regardless of whether there was adjustment for demographics (Tables 3, 4). Specifically, at the 26th week visit, the exposed-to-violence group showed a significant decrease in AQOL of -0.50 ((-0.88, -0.12); $p=.010$). Adjusting for baseline demographic factors produced similar results, but FEV1 did not significantly differ between groups over the observation period (Table 4).

Effect Modification

We assessed whether social support and depressive symptoms acted as effect modifiers on the relationships of ECV with hospitalizations, ED visits, and quality of life. A statistically significant interaction between violence and depressive symptoms (i.e., effect modification by depressive symptoms) was shown for only the overall ED visits and quality of life outcomes. Social support did not show significant effect modification for any outcomes. For overall ED visits, a unit change in the CES-D was associated with a reduction of about 5% in the rate ratio between exposure to violence and overall ED visits (interaction=-0.051; SE=0.0187; 95% CI= (-0.0876,-0.0144) chi-square=7.45 (df=1); $p=0.0063$). This change in the violence-ED visit association due to depressive symptoms is about 3% of the above estimate of the association itself. For quality of life, a unit change in the CES-D leads to a reduction of the 0.062 reduction in the difference in quality of life between the violence-exposed and unexposed groups. (SE=0.005453, $t=11.33$; $p<0.0001$; 95% CI= (-0.072, -0.051)). This change in the violence-QOL association due to depression is about 6% of the above estimate of the association itself.

Discussion

We found ECV to be relatively common among our adults with moderate or severe asthma who lived in mostly low income inner-city neighborhoods. ECV was associated with an increased risk of both ED visits and hospitalization for asthma and for ED visits in general regardless of cause. We also found asthma-related quality of life was lower in the violence-exposed group. There was no effect modification by social support; but there was a small degree of effect modification by depressive symptoms on the relation between ECV and overall ED visits and AQOL.

This study adds to the findings of earlier studies which showed that ECV was associated with poorer health of children.^{2, 3, 18, 20, 21} We have found a similar relationship between ECV and asthmatic adults. Previous studies were generally cross-sectional and thus unable to evaluate the critical temporal relation between ECV and asthma.^{2, 3, 18-21} However, our longitudinal prospective analysis significantly strengthens these earlier findings. Additionally, our outcome measures are not self-report of symptoms,^{2, 3, 18-21} but rather ED visits and, even more significantly, hospitalizations. These findings, together with the lack of significant effect modification by depressive symptoms and social support, suggest this effect is not simply one related to an individual's subjective perception of stress, but rather a significant association between ECV and health status. The relationship of ECV with asthma hospitalizations is particularly disturbing as hospitalizations represent not only patient distress, but physician judgment that health is at risk. Our study suggests that the ECV-exposed group was, in fact, sicker. Additionally, because overall ED visits were increased and there was a trend toward increase in overall hospitalizations, our findings suggest that ECV is associated with far reaching health effects, beyond the single condition of asthma.

What this investigation does not answer is whether ECV directly affects asthma through the generation of psychosocial distress or it is a marker for conditions that exacerbate asthma. One possibility is that psychosocial stress that arises from living in concentrated disadvantage with exposure to violence *directly* affects health through, for instance, immune or neuroendocrine mechanisms. Recently Marin et al showed that exposure to stress is associated with immune changes in children: higher levels of IL-4, IL-5 and IFN- γ , thus suggesting how stress could act on the immune system to affect health.³⁸ On the other hand psychological stress could also act indirectly, affecting, for instance, diet and lifestyle.

The other possibility is that ECV, rather than triggering health effects, acts as a marker for environmental conditions in communities with concentrated disadvantage. These environmental conditions, such as increased exposure to pollutants including tobacco and vehicular exhaust, substandard housing, limited access to healthy foods, health care, other social services, and outdoor exercise,^{16, 17} may then have a deleterious effect on health. It is important to point out, however, that ECV could be both a trigger and a marker; these two mechanisms are not mutually exclusive, and unraveling them will be difficult. Regardless of the mechanism that connects ECV and poor health, one would predict that reversing concentrated disadvantage would improve health; either by reducing psychosocial stress, or by reducing adverse conditions associated with concentrated disadvantage or both.

Like all research, ours has limitations. The analysis is a secondary analysis from a larger study. However, it is not an ad hoc analysis; and it is one of very few using longitudinal prospective data. Our measure of ECV is self-report like most such measures.^{28, 29} It did not differentiate between indirect violence (observing violence, when one is not a victim) and direct violence (when one is a victim). The paper by Wright et al³ used the word "occurred" and we used the word "witnessed" to describe exposure to violence, a change that may limit comparison of the results.

Finally, while our study population may not be generalizable to all patient groups, this specific group had significant morbidity with baseline FEV1 averaging only 66% of predicted. Depressive symptoms were increased in this group consistent with the CES-D scores frequently seen in poor urban populations.³⁷ The AQLQ mean scores were also lower than seen in other studies^{24, 39} but consistent with other similar socio-demographic groups.^{27, 40} MOS Social Support score was in the range of a multi-ethnic urban sample of post-partum women attending a community health center⁴¹ and lower than a group of ovarian cancer survivors.⁴²

In summary, our study, the first to examine an asthma outcome in adults exposed to ECV, finds:

1. ECV was relatively common among our mostly inner-city patients and similar to the prevalence of exposure reported in other studies.¹⁰
2. Those exposed to violence had approximately twice the rate of a hospitalization or ED visit for asthma in the past year. This is consistent with the ECV-ED association previously reported in children.^{43, 44}
3. Younger adults are more likely to be exposed to violence and more likely to have an ED visit.
4. Neither depressive symptoms nor lack of social support were effect modifiers of the ECV-asthma-related hospitalization or ED relationships.

These findings contribute to the growing body of information about the link between community characteristics and health, and in particular, the growing understanding of ECV as a psychological stressor which can affect health.⁵

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Abbreviations

AQOL	asthma-related quality of life
CES-D	Center for Epidemiologic Studies Depression Scale
ECV	exposure to community violence
ED	emergency department
FEV1	forced expiratory volume in 1 second, percent predicted
FVC	forced vital capacity

Table 1
Baseline characteristics of 397 participants including sociodemographics, asthma severity, and exposure to violence

Demographics	
Age (years) *	47 ± 14
Female	291 (73%)
Race **	
Black/African American	277 (70%)
White	75 (19%)
Other ***	9 (2%)
No response or declined to answer	36 (9%)
Ethnicity: Hispanic/Latino	28 (7%)
Household income	
< \$30,000/year	262 (66%)
\$30,000 - \$49,999/year	49 (12%)
\$50,000 to \$99,999	52 (13%)
\$100,000 or more	19 (5%)
No response or declined to answer	15 (4%)
High school graduate	325 (82%)
Asthma severity at baseline	
FEV1 (percent predicted) *	66 ± 19
# with at least one ED visit for asthma in past year	222 (56%)
# with at least one hospitalization for asthma in past year	133 (34%)
Asthma-related quality of life ³ *	4.0 ± 1.4
Total witnessing violence in the last 6 months [†]	91 (23%)
A fight in which a weapon was used	50
A violent argument between neighbors	43
A gang fight	11
A sexual assault or rape	2
A robbery or mugging	21
Other ^{††}	33
CES-D ^{¶¶}	17.5 ± 11.5
MOS Social Support ^{¶¶}	72.6 ± 22.2

* mean ± sd

** Some participants checked off more than one race category

*** Other = American Indian/Alaskan Native, Asian, Native Hawaiian/Pacific Islander

[†] 39 subjects witnessed at least 2 types of violence

^{††} Subjects witnessed murders (7 subjects), shootings (15 subjects), vandalism of cars (2 subjects), domestic violence (2 subjects), and drug-related violence (1 subject).

[¶]Center for Epidemiologic Studies Depression Scale, range 0 – 60, with scores ≥ 16 suggestive of depressive symptoms or general distress.

^{¶¶}Medical Outcomes Study Social Support Survey, scale 0-100, with higher score more support.

Table 2
Pairwise associations between ECV and demographic factors, depressive symptoms and social support, using logistic regression

	OR (95%CI) *	P
Demographic factors		
Age	.96 (.94, .98)	<.001
Female	1.09 (.64, 1.86)	.76
African American	3.49 (1.61, 7.56)	.002
Latino	1.14 (.47, 2.77)	.78
Household income	.82 (.70, .96)	.015
Depressive symptoms	1.04 (1.02, 1.06)	<.001
Social support	.99 (.98, .999)	.032

* OR= odds ratio, 95%CI=95% confidence interval

Table 3
Asthma-related and general health outcomes over 26 weeks of observation

	Exposed	Unexposed
Emergency Department Visits for Asthma *	.090 (0.055, .15)	.039 (.027, .056)
Emergency Department Visits for Any Cause *	.16 (.11, .22)	.091 (.07, .11)
Hospitalization for Asthma *	.051 (.026, .10)	.019 (.011, .033)
Hospitalization for Any Cause *	.090 (.057, .14)	.043 (.031, .059)
FEV1 (percent predicted) **, ***	69.4 ± 20.5	68.7 ± 18.5
Asthma-related quality of life **, ***, †	4.3 ± 1.4	4.9 ± 1.4

* Average Rate (obtained from log-linear model): point estimate and 95%CI, adjusting for months of observation

** Mean ± standard deviation

*** Data from the final visit displayed

† Mini-Asthma Quality of Life Questionnaire

Table 4
Pairwise associations between asthma and general health outcomes with exposure to community violence (ECV), crude and adjusted,* expressed as rate ratio (RR)

	Asthma-related			General		
	RR*	95%CI*	P	RR*	95%CI*	P
Emergency Department						
Crude	2.34	1.26, 4.36	.0073	1.70	1.13, 2.55	.011
Adjusted	2.27	1.32, 3.90	.0031	1.71	1.14, 2.56	.0096
Hospitalizations						
Crude	2.68	1.12, 6.41	.027	2.09	1.20, 3.65	.0091
Adjusted	2.49	1.11, 5.60	.028	1.72	0.95, 3.11	.071
FEV1						
Crude**	0.042 (.026)	-0.010, 0.093	.11			
Adjusted**	.010 (.027)	-0.043, 0.064	.070			
Quality of life						
Crude**	-.50 (0.19)	-.88, -.12	.010			
Adjusted**	-.40 (.19)	-.77, -.025	.037			

* Adjusted for age, gender, African American, Latino, household income

** Mean differences between exposed and unexposed at the final visit, standard error is in the parentheses