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Asthma in Medicaid Managed Care Enrollees Residing in New York City: Results from a Post–World Trade Center Disaster Survey

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ABSTRACT *The collapse of the World Trade Center on September 11, 2001, released a substantial amount of respiratory irritants into the air. To assess the asthma status of Medicaid managed care enrollees who may have been exposed, the New York State Department of Health, Office of Managed Care, conducted a mail survey among enrollees residing in New York City. All enrollees, aged 5–56 with persistent asthma before September 11, 2001, were surveyed during summer 2002. Administrative health service utilization data from the Medicaid Encounter Data System were used to validate and supplement survey responses. A total of 3,664 enrollees responded. Multivariate logistic regression models were developed to examine factors associated with self-reported worsened asthma post September 11, 2001, and with emergency department/inpatient hospitalizations related to asthma from September 11, 2001, through December 31, 2001. Forty-five percent of survey respondents reported worsened asthma post 9/11. Respondents who reported worsened asthma were significantly more likely to have utilized health services for asthma than those who reported stable or improved asthma. Residence in both lower Manhattan (adjusted OR=2.28) and Western Brooklyn (adjusted OR=2.40) were associated with self-reported worsened asthma. However, only residents of Western Brooklyn had an elevated odds ratio for emergency department/inpatient hospitalizations with diagnoses of asthma post 9/11 (adjusted OR= 1.52). Worsened asthma was reported by a significant proportion of this low-income, largely minority population and was associated with the location of residence. Results from this study provide guidance to health care organizations in the development of plans to ensure the health of people with asthma during disaster situations.*

KEYWORDS *Asthma, Medicaid managed care, Terrorism, World Trade Center.*

INTRODUCTION

The collapse of the World Trade Center (WTC) following the terrorist attacks of September 11, 2001, created a plume of smoke and dust that covered much of lower Manhattan before moving east to Brooklyn. The fires that ensued continued to burn through December 2001, making it the longest-burning commercial fire in the history of the United States.[1] Analysis of smoke and settled dust samples collected in and around lower Manhattan indicated the presence of several respiratory irritants including long and thin glass fibers.[2] Samples were found to have high pH

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levels, most likely due to the presence of pulverized cement and other construction debris.[2,3] Investigation into the emotional and psychological impact of the disaster indicated widespread effects.[4] A post 9/11 survey of adults living south of 110th Street in Manhattan reported prevalences of posttraumatic stress disorder (PTSD) and depression twice as high as national averages.[5] Given the synergistic relationship between asthma, air contamination, and emotional stress, it is hypothesized that the health of asthmatics exposed to these factors was adversely affected.

The New York State Department of Health (NYSDOH) is charged with administering the state's Medicaid program and has oversight responsibility for the 18 health plans that provide services to the over 1 million recipients enrolled in Medicaid managed care (MMC) in New York City (NYC). This article summarizes results from a cross-sectional study that examined survey and health utilization data to assess the asthma status of MMC enrollees following the collapse of the WTC.

METHODS

Study Population

A total of 16,629 enrollees were sent surveys by mail from July through September 2002. The study population consisted of enrollees residing in NYC, aged 5–56, who met a modified version of the Health Plan Employer Data and Information Set (HEDIS®) definition of persistent asthma before September 11, 2001.[6] Specifically, enrollees had to meet one or more of the following four criteria from September 1, 2000, through August 31, 2001: (1) at least four asthma medication dispensing events, (2) at least one emergency department visit, (3) or at least one acute inpatient hospitalization with International Classification of Diseases, Ninth Revision (ICD-9) code 493, as the principal diagnosis or (4) at least four outpatient visits with ICD-9 code 493 as one of the listed diagnoses and at least two asthma medication dispensing events.[7] Additionally, eligible enrollees had to be continuously enrolled in MMC from September 2001 through April 2002.

The NYSDOH Institutional Review Board approved the research design. The cover letter that accompanied surveys advised enrollees that answers would be confidential and that nonparticipation would not affect their Medicaid benefits.

Data Collection

Survey Data The survey instrument was derived from the Foundation for Accountability (FACCT) Adult Asthma Survey version 2.0 and was modified to include questions pertaining to the events of September 11, 2001.[8] Survey domains included indicators of asthma and general health status, change in asthma status post September 11, 2001, and quality of care and access to care post September 11, 2001. Two versions of the survey instrument were developed, one to be completed by adults aged 18–56 years, and another to be completed by the parents or guardians of enrolled children aged 5–17. The survey contained 22 multiple-choice questions and was designed not to exceed a fifth-grade reading level.

Medicaid Managed Care Administrative Data Respondents' demographic characteristics, medical service utilization, and pharmacy data were extracted from the Medicaid Encounter Data System (MEDS) to obtain a more complete picture of post 9/11 asthma in the survey population. Health services data extracted for the study

population included those on professional services, specialist visits, emergency department visits, and inpatient hospitalizations with diagnoses of asthma (ICD-9 code 493). Filled prescriptions for respiratory medications (antihistamines, systemic and topical nasal products, cough/cold/allergy, antiasthmatics, and miscellaneous respiratory medications) and psychoactive medications (antianxiety agents, antidepressants, antipsychotics, hypnotics, stimulants/anti-obesity/anorexiants, and miscellaneous psychotherapeutic and neurological agents), as well as services with mental health diagnoses (ICD-9 codes 290–316.99) were also extracted. Service encounters and claims with dates from September 11, 2001, through December 31, 2001, were extracted.

Variable Definition

Demographic variables used in this analysis included age, race/ethnicity (non-Hispanic black, Hispanic, "Other," and non-Hispanic white), gender, and months continuously enrolled in MMC. Medicaid aid type was included using the following three classifications: Temporary Assistance to Needy Families (TANF, which generally describes low-income families that include a minor child deprived of parental support or care); Safety Net (SN, which generally describes individuals and childless couples); and Supplemental Security Income (SSI, which describes Medicaid made available to the aged, blind, or disabled).

Location, and indirect "exposure," was measured by three ways: by neighborhood, by distance from the WTC, and by self-reported time spent in lower Manhattan. Respondents' home addresses, as of September 2001, were used to construct neighborhood and distance variables. Zip Code was grouped into the following neighborhoods: lower Manhattan (Manhattan Zip Codes below Canal Street), Western Brooklyn (Brooklyn Zip Codes adjacent to lower Manhattan), and the rest of NYC. Additionally, enrollees' home addresses were geocoded so that the distance from the WTC to respondents' homes could be calculated in radian miles. Moreover, self-reported time spent in lower Manhattan during the average week since the disaster was assessed from a survey question.

Enrollee utilization of psychoactive medications and services with mental health diagnoses were combined and dichotomized as a yes/no variable. Additionally, the HEDIS® criteria used to identify the survey population was re-categorized and dichotomized into a prior utilization of emergency department/inpatient hospitalizations for asthma from September 1, 2000, through August 31, 2001.

Outcome Variables

Change in asthma status post 9/11 was assessed using survey and MEDS data. The survey instrument asked respondents to report how their asthma changed from 9/11 to the present, that is, summer 2002 when the survey was administered. Respondents selected one of four responses: "got worse, but is better now"; "got worse and is still bad"; "stayed the same"; or "got better." Responses were categorized dichotomously as either worsened asthma or stable/improved asthma post 9/11. Emergency department visits and inpatient hospitalizations (ED/IP) for asthma from September 11, 2001 through December 31, 2001 were combined because of the small number of respondents with either of these services. This variable was then dichotomized as those who had at least one ED/IP and those who did not have.

Statistical Analysis

Chi-square tests were performed to test for demographic differences between survey respondents and non-respondents, to examine associations between demographics,

survey responses, and measures of change in asthma status post 9/11, and to validate self-reported worsened asthma post 9/11. Two multiple logistic regression models were developed. The first model identified factors associated with self-reported worsened asthma post 9/11. The second model identified factors associated with ED/IP from September 11, 2001, through December 31, 2001. This model was restricted to respondents who were continuously enrolled in MMC from September 2000 through April 2002. Implementation of this criterion enabled us to enter the prior utilization of ED/IP variable into the model to determine whether previous utilization was a significant predictor of ED/IP utilization post 9/11. Independent variables entered into the models included respondent demographics, survey responses, and service utilization/pharmacy data. Results from full logistic regression models are presented with adjusted odds ratios and Wald 95% confidence intervals. All analyses were performed using the Statistical Analysis System statistical software version 8.2.[9]

Response Rate

Of the 16,629 enrollees surveyed, 1,326 (8%) were excluded from the eligible sample population because of undeliverable addresses. The survey yielded a 24.9% response rate (n = 3,808). Surveys were subsequently excluded from analysis for the following reasons: 142 (4%) reported that they did not have asthma, 53 (1%) were missing more than 50% of survey question responses (45 with no response to the asthma screening question and 8 with asthma), 55 surveys (1%) had illegible identification numbers and could not be linked to MEDS data, and aid type was unavailable for 1 respondent. This yielded 3,557 completed surveys for analysis.

Response rates differed significantly by age group, race/ethnicity, gender, aid type, and neighborhood (Table 1). Given these significant differences, and to yield results more generalizable to the NYC MMC asthmatic population, data were weighted by age group, race/ethnicity, gender, and aid type. Because of small sample sizes in both lower Manhattan and Western Brooklyn, we were unable to weight the data by this demographic variable. Responses from enrollees in subgroups with low response rates (e.g., asthmatics aged 5–17) were weighted more heavily to better reflect their membership in the overall population. Weighted data were used in all subsequent analyses (n = 16,431).

RESULTS

Respondent Demographics

Respondent demographics are summarized in Table 2. Most respondents were parents or guardians of asthmatics aged 5–17 (59%), of minority racial/ethnic groups (40% Hispanic and 38% black), female (60%), had a Medicaid aid type of TANF (72%), and were continuously enrolled in MMC for at least 17 months (92%). Regarding neighborhood, most respondents resided in other areas of NYC (93%), followed by lower Manhattan (4%), and in Western Brooklyn (3%). One third of respondents reported spending at least 1 day in lower Manhattan during an average week since 9/11.

Regarding general health status and asthma severity, 45% of respondents reported being in fair-to-poor health, and 73% reported moderate-to-severe asthma. Thirty-seven percent reported using inhaled steroids daily or being advised by their doctor to use inhaled steroids daily, 35% used them less frequently, and 28% reported that they did not use inhaled steroids. Sixty-eight percent of respondents reported receiving and understanding an asthma self-management plan.

TABLE 1. Comparison of survey response rates (n = 16,442)

Demographics	Response rate (%)	*P* value
Overall*	21.7	
Age group		
5–17	19.3	<.0001
18–56	25.1	
Race/ethnicity		
Black	22.2	.0007
Hispanic	20.2	
Other	23.3	
White	23.8	
Gender		
Male	19.9	<.0001
Female	22.9	
Aid type		
TANF	19.5	<.0001
Safety Net	29.2	
SSI	26.4	
Neighborhood—as of September 2001		
Rest of New York City	21.4	.0002
Lower Manhattan	28.7	
Western Brooklyn	24.7	

Comparisons excluded 45 respondents who failed to answer the asthma screening question and at least 50% of survey questions and 142 respondents who reported that they did not have asthma. TANF, Temporary Assistance to Needy Families; SSI, Supplemental Security Income.

*Demographic data extracted from Medicaid Encounter Data System (MEDS).

MEDS service utilization data indicated that 22% of respondents either had received a service with a mental health diagnosis or had filled a prescription for a psychoactive medication from September 11, 2001, through December 31, 2001.

Change in Asthma Status Post 9/11

Forty-five percent of survey respondents reported that their asthma became worse post 9/11. Approximately half of these (46%) indicated that their asthma was still bad at the time of survey. Respondents most commonly cited dust (63%), emotional stress (42%), and cold weather (37%) as the reasons for their worsened asthma (Figure). Common measures taken to remedy increased symptoms included seeing a doctor (58%), staying inside more (57%), and treating cold or infection (32%).

MEDS data post 9/11 were used to validate self-reported change in asthma status. Respondents who reported worsened asthma post 9/11 were significantly more likely ($P < .05$) to have had at least one (1) professional service visit, (2) specialist visit, (3) emergency department visit, and (4) inpatient hospitalization with a diagnosis of asthma. Also, they were significantly more likely ($P < .05$) to have filled a prescription for an asthma medication, had a service with a behavioral health diagnosis, and filled a prescription for a psychoactive medication (data not shown). Although fifty-seven percent of respondents reported increasing at least one of their asthma medications post 9/11, and 43% reported starting at least one new asthma medication post 9/11, a comparison of MEDS data pre and post 9/11 did

TABLE 2. Bivariate analysis of respondent demographics, survey responses, and asthma outcomes

	Total		Worse asthma post 9/11			Had ED/IP*		
Demographics	n	%	n	%	*P*-value	n	%	*P*-value
Overall†	16,431		6,891	44.7		1,466	10.2	
Age group								
5–17	9,610	58.5	3,290	36.6	<.0001	870	10.4	<.0001
18–29	1,106	6.7	556	51.5		117	12.6	
30–39	1,638	10.0	919	58.2		175	12.1	
40–49	2,408	14.7	1,261	56.8		196	9.2	
50+	1,670	10.2	865	55.7		108	7.3	
Race/ethnicity								
White	1,635	10.0	645	41.5	<.0001	84	6.2	<.0001
Black	6,240	38.0	2,414	41.7		654	11.8	
Hispanic	6,557	39.9	2,971	47.9		579	9.9	
Other	1,999	12.2	861	45.7		149	9.0	
Gender								
Male	6,617	40.3	2,424	39.3	<.0001	632	11.0	.0093
Female	9,814	59.7	4,467	48.3		834	9.7	
Aid type								
TANF	11,866	72.2	4,589	41.3	<.0001	1,003	9.7	<.0001
Safety Net	1,468	8.9	775	57.3		60	5.1	
SSI	3,097	18.9	1,528	52.0		404	13.9	
Months continuously enrolled								
17+ months	15,031	91.5	6,191	44.0	<.0001	Not entered		
8–16 months	1,396	8.5	696	52.2				
Neighborhood—as of September 2001								
Rest of New York City	15,317	93.2	6,197	43.1	<.0001	1,381	10.3	.0591
Lower Manhattan	630	3.8	406	70.2		39	7.2	
Western Brooklyn	484	3.0	289	61.3		46	10.5	

Table 2. ***Continued***

Demographics	Total		Worse asthma post 9/11			Had ED/IP*		
	n	%	n	%	*P*-value	n	%	*P*-value
Time spent in Lower Manhattan								
None	10,631	67.3	3,748	37.5	<.0001	948	10.1	.6632
1–3 days	4,043	25.6	2,170	56.6		348	10.0	
4+ days	1,125	7.1	668	63.2		104	11.0	
General health status								
Excellent	1,126	6.9	259	24.6	<.0001	65	6.8	<.0001
Very good	2,721	16.8	681	26.5		180	7.7	
Good	5,151	31.7	1,908	39.5		402	8.9	
Fair	5,024	30.9	2,439	51.4		500	11.2	
Poor	2,226	13.7	1,535	74.6		287	14.6	
Asthma severity								
Mild	4,378	27.3	1,095	26.9	<.0001	266	6.9	<.0001
Moderate	7,035	43.9	2,691	40.3		459	7.5	
Severe	4,601	28.7	2,932	68.2		695	17.3	
Inhaled steroid usage								
No inhaled steroids	4,073	28.3	1,092	28.5	<.0001	248	6.8	<.0001
Use inhaled steroids	4,990	34.7	2,077	44.1		388	8.8	
Inhaled steroids used/ prescribed daily	5,311	37.0	2,886	57.3		622	13.6	
Self-management plan								
No	5,061	31.8	2,025	42.2	<.0001	354	8.2	<.0001
Yes	10,861	68.2	4,715	46.4		1,076	11.2	
Post 9/11 diagnoses/ treatment of mental health								
No	12,845	78.2	5,011	41.7	<.0001	1,131	10.1	.4840
Yes	3,586	21.8	1,881	55.3		335	10.5	

*Outcome limited to respondents continuously enrolled from September 2000 through April 2002.

†Numbers and percentages may not add to overall totals because of missing data.

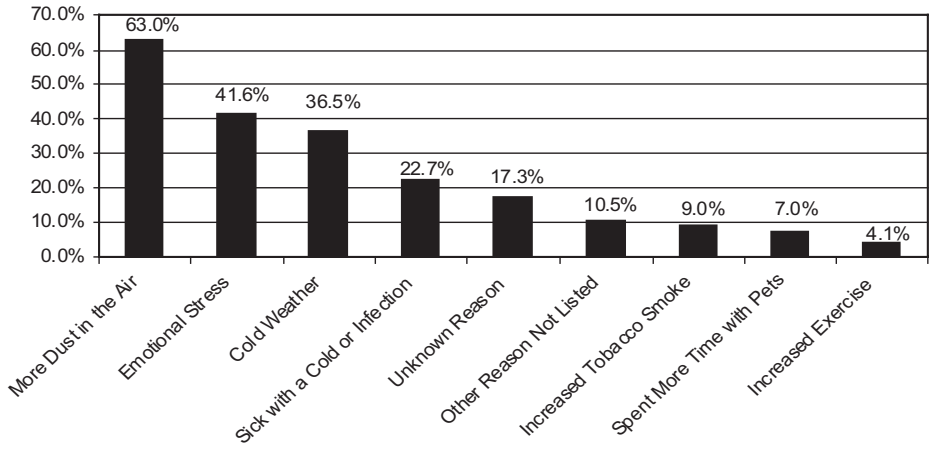

FIGURE. Self-reported reasons why asthma worsened post 9/11 (n = 6,891).

not confirm this. This may in large part be due to the survey question wording that included over-the-counter medications that may not be reflected in MEDS pharmacy data.

In bivariate analyses, all independent variables examined were significantly associated with self-reported worsened asthma post 9/11 (Table 2). Specifically, higher proportions of self-reported worsened asthma were observed among respondents over the age of 17 years, Hispanics, and those with race/ethnicity of Other, females, those with Medicaid aid type of SN and SSI, and respondents continuously enrolled in MMC for 16 or fewer months. Regarding location, respondents who resided in the neighborhoods of lower Manhattan and Western Brooklyn, and those who reported spending one or more days in lower Manhattan during an average week since 9/11, had significantly higher proportions of worsened asthma. A stepwise relationship was observed between general health status, self-reported asthma severity, frequency of inhaled steroid usage, and the proportion of respondents who reported worsened asthma post 9/11. Specifically, the proportion of respondents who reported worsened asthma post 9/11 increased with declining health status and increased with greater self-reported asthma severity and inhaled steroid usage. Utilization of mental health services from September 11, 2001, through December 31, 2001 was also associated with self-reported worsened asthma.

Several independent variables were associated with ED/IP from September 11, 2001, through December 31, 2001. Higher proportions were observed among respondents under the age of 40 years, those with a race/ethnicity of black, males, and respondents with Medicaid aid types of TANF and SSI. A similar stepwise relationship, as observed with the outcome of self-reported asthma post 9/11, was observed between general health status, measures of asthma severity, inhaled steroid usage, and the outcome of ED/IP from September 11, 2001, through December 31, 2001.

Two multivariate logistic regression models were developed to identify factors associated with change in asthma status post 9/11 (Table 3). The first model identified factors associated with self-reported worsened asthma post 9/11. Demographic factors significantly associated with worsened asthma included age 5–17 (OR = 0.55), 18–29 (OR = 0.69), 40–49 (OR = 0.73), and 50+ (OR = 0.64); race/ethnicity of Hispanic (OR = 1.26) and Other (OR = 1.31); aid type of SSI (OR = 0.78); and continuous

TABLE 3. Multiple logistic regression models of self-reported worse asthma post 9/11 and emergency department/inpatient hospitalizations from September 11, 2001, through December 31, 2001

	Worse asthma post 9/11 (n = 12,367†)		ED/IP* (n = 11,389†)	
Independent variables	Odds ratio	95% CI	Odds ratio	95% CI
Age group				
5–17	0.55	0.47–0.64	0.90	0.70–1.15
18–29	0.69	0.57–0.84	0.85	0.62–1.16
30–39	1.00		1.00	
40–49	0.73	0.62–0.86	0.61	0.46–0.81
50+	0.64	0.53–0.77	0.55	0.40–0.76
Race/ethnicity				
White	1.00		1.00	
Black	1.11	0.96–1.29	1.73	1.27–2.35
Hispanic	1.26	1.09–1.45	1.74	1.28–2.36
Other	1.31	1.10–1.56	1.67	1.17–2.38
Gender				
Male	1.00		1.00	
Female	1.03	0.94–1.13	0.95	0.81–1.11
Aid type				
TANF	1.00		1.00	
SSI	0.78	0.68–0.88	1.39	1.16–1.67
Safety Net	1.16	0.99–1.37	0.77	0.55–1.06
Months continuously enrolled				
17+ months	1.00		Not entered	
8–16 months	1.41	1.22–1.62		
Neighborhood—as of September 2001				
Rest of New York City	1.00		1.00	
Lower Manhattan	2.28	1.76–2.95	0.55	0.34–0.90
Western Brooklyn	2.40	1.87–3.07	1.52	1.04–2.21
Distance from World Trade Center	1.00	0.99–1.02	1.02	1.00–1.04
Time spent in Lower Manhattan				
None	1.00		1.00	
1–3 days	1.95	1.78–2.14	1.08	0.92–1.26
4+ days	2.43	2.04–2.89	1.43	1.09–1.89
General health status				
Excellent	1.00		1.00	
Very good	1.01	0.83–1.23	1.33	0.94–1.89
Good	1.36	1.13–1.63	1.21	0.87–1.68
Fair	1.62	1.34–1.95	1.17	0.84–1.63
Poor	3.37	2.69–4.22	1.10	0.76–1.59
Asthma severity				
Mild	1.00		1.00	
Moderate	1.46	1.31–1.62	1.30	1.06–1.60

TABLE 3. ***Continued***

	Worse asthma post 9/11 (n = 12,367†)		ED/IP* (n = 11,389†)	
Independent variables	Odds ratio	95% CI	Odds ratio	95% CI
Severe	2.91	2.56–3.31	2.72	2.17–3.41
Total medications/treatments used regularly	1.30	1.25–1.35	1.17	1.10–1.24
Inhaled steroid usage				
No inhaled steroids	1.00		1.00	
Use inhaled steroids	1.30	1.17–1.44	0.97	0.80–1.17
Inhaled steroids used/ prescribed daily	1.67	1.49–1.86	1.48	1.22–1.79
Self-management plan				
No	1.00		1.00	
Yes	1.10	1.01–1.20	1.21	1.04–1.42
History of ED/IP September 2000 to August 2001				
Yes	Not entered		5.01	4.38–5.74
No			1.00	
Post 9/11 diagnoses/ treatment of mental health				
No	1.00		1.00	
Yes	1.12	1.01–1.25	1.16	0.97–1.37

*Model restricted to respondents continuously enrolled for ≥ 20 months as of April 2002.
†Excludes responses with missing data.

enrollment in an MMC plan of 8–16 months (OR = 1.41). Regarding location, significant differences were observed by neighborhood (lower Manhattan, OR = 2.28; Western Brooklyn, OR = 2.40) and by time spent in lower Manhattan (1–3 days, OR = 1.95; 4+ days, OR = 2.43). Measures of general health status and asthma severity also proved to be strongly associated with worsened asthma post 9/11. Specifically, a stepwise relationship was observed with both general health status (good, OR = 1.36; fair, OR = 1.62; poor, OR = 3.37) and asthma severity (moderate, OR = 1.46; severe, OR = 2.91). The odds of worsened asthma increased with each medication/treatment reported (OR = 1.30), inhaled steroid usage (used less than daily, OR = 1.30; used daily, OR = 1.67), possession/comprehension of an asthma self-management plan (OR = 1.10), and utilization of mental health services (OR = 1.12).

A second model was developed to examine factors associated with ED/IP encounters from September 11, 2001, through December 31, 2001. Demographics significantly associated with ED/IP included age 40–49 (OR = 0.61) and 50+ (OR = 0.55); race/ethnicity of black (OR = 1.73), Hispanic (OR = 1.74), and Other (OR = 1.67); and aid type of SSI (1.39). Regarding location, both residence in the neighborhoods of Lower Manhattan (OR = 0.55) and Western Brooklyn (OR = 1.52) and spending 4 or more days per week in Lower Manhattan (OR = 1.43) were significantly associated with ED/IP. In the general health status and asthma severity domain, asthma severity (moderate, OR = 1.30; severe, OR = 2.72), total medications/treatments (OR = 1.17), inhaled steroid usage (used daily, OR = 1.48), possession/comprehension of an asthma self-management plan (OR = 1.21), and a history of ED/IP utilization

in the 12 months preceding 9/11 (OR = 5.01) were significantly associated with ED/IP utilization from September 11, 2001, through December 31, 2001.

DISCUSSION

In our study of MMC enrollees residing in NYC, we found location the of residence and time spent in Lower Manhattan to be significantly associated with both self-reported worsened asthma and ED/IP from September 11, 2001, through December 31, 2001. Residents of Lower Manhattan were significantly more likely to report worsened asthma post 9/11 and were significantly less likely to have had an ED/IP from September 11, 2001, through December 31, 2001. This association may be reflective of difficulty accessing emergency/inpatient care in post 9/11 lower Manhattan. As indicated in our survey, 23% of lower Manhattan residents reported difficulty accessing emergency asthma care. This proportion was significantly higher than that reported by residents of both Western Brooklyn (8%) and the rest of NYC (11%). However, in an analysis of MEDS ED/IP encounters pre and post 9/11, ED or IP utilization rates did not differ by neighborhood of residence. These results may be due to small sample sizes in the lower Manhattan and Western Brooklyn neighborhoods.

A stepwise relationship was observed between time spent in lower Manhattan and both self-reported worsened asthma post 9/11 and ED/IP from September 11, 2001, through December 31, 2001. Specifically, the more time respondents reported spending in lower Manhattan, the greater the likelihood that they experienced worsened asthma and had an ED/IP encounter. Interestingly, the distance respondents lived from the WTC was not significantly associated with either self-reported worsened asthma or ED/IP. This suggests that the relationship between location and these asthma outcomes was influenced more by the combination of distance and plume direction than distance alone.

Our research identified adverse health outcomes as far east as Western Brooklyn. Given that the air contaminants created by the collapse were known to move east, we analyzed data from Western Brooklyn respondents as a separate, intermediate exposure group. We found the residents of Western Brooklyn to be significantly more likely to report worsened asthma post 9/11 and to have had an ED/IP from September 11, 2001, through December 31, 2001. In future studies of the health affects of 9/11, researchers should consider inclusion of this exposed but potentially understudied group.

In addition to location, measures of general health status and asthma severity were also associated with both asthma outcomes. This suggests that the sickest respondents with the most severe asthma were the group most vulnerable to the effects of 9/11. Also vulnerable were enrollees with mental health comorbidities, who were significantly more likely to report worsened asthma post 9/11. A comparison of the survey populations' mental health service utilization rates from fall 2000 and fall 2001 indicated that utilization rates did not increase substantially post 9/11. Yet, the rates were considerably higher than those found among the general MMC population of NYC during fall 2001. This may suggest that the high mental health service utilization rate observed post 9/11 was driven more by asthma/mental health comorbidity than the trauma of the event. However, enrollees may have sought mental health services from the wide array of free programs created in response to 9/11, and therefore, our post 9/11 data may be an underestimation of enrollees' mental health service utilization.

Results presented here are consistent with other published reports regarding the respiratory effects of the WTC collapse. Research conducted among firefighters found that exposure to dust and smoke was associated with bronchial hyperreactivity, bronchial responsiveness, and the onset of cough.[10,11] A post 9/11 survey of adults living south of 110th found that 27% of respondents reported an increase in asthma severity.[12] This study reinforces the finding that respiratory symptoms associated with the collapse of the WTC buildings were not limited to individuals directly involved with the rescue and cleanup activities.

STRENGTHS AND LIMITATIONS

Several strengths and limitations regarding this study are noteworthy. The availability of Medicaid encounter data allowed us to survey all enrollees residing in NYC with persistent asthma. Additionally, the availability of these data enabled us to link individual survey responses with health service utilization and pharmacy claims data to validate and supplement survey responses. However, use of these data is limited because service utilization data may be incomplete and pharmacy data reflects only that a prescription was filled, not necessarily taken.

Perhaps the most notable limitation is the survey response rate of 25%. Although the response rate was similar to the response rates of other mail-only surveys conducted among the Medicaid population, including the Consumer Assessment of Health Plans Survey that averages a return rate of 27% for adults nationwide, the potential for response bias remains a concern (Russell E. Mardon, PhD, personal communication, August, 27, 2003). In an attempt to minimize the potential effects, we weighted data by four demographics found to be significantly different in a comparison of respondents and non-respondents, thereby making results more generalizable to the MMC population of NYC. A significant difference in response rate was observed by location of residence. However, we were unable to weight by this demographic because of the small sample sizes of respondents residing in lower Manhattan and Western Brooklyn. To ensure that the weighting strategy used in our analysis did not bias our results, we weighted the data by location of residence alone and observed no difference in the association between location of residence and the outcomes of self-reported worsened asthma post 9/11 and ED/IP. Additionally, a telephone follow-up survey was conducted among a random sample of 431 non-respondents. No difference was observed between telephone respondents and mail respondents regarding the proportion who reported that their asthma became worse post 9/11 (44% vs. 45%). However, telephone respondents were significantly less likely to categorize their asthma as moderate to severe (24% vs. 29%) and to categorize their general health status as fair to poor (20% vs. 45%). These findings suggest that the association between disease severity, general health status, and self-reported worsened asthma post 9/11 may be overestimated, but that the proportion whose asthma worsened was not.

Another limitation is the extended time frame used in two of the survey questions; time spent in lower Manhattan during an average week and self-reported worsened asthma post 9/11. Both questions asked respondents about the period from 9/11 through the summer of 2002 when surveys were completed. Therefore, we were unable to assess exposure and asthma status in the critical time period from September 11, 2001, through December 2001 when the fires continued to burn.

Owing to the cross-sectional design of the study, we are unable to assess causality. Additionally, our findings may be confounded by the seasonal nature of asthma.

However, respondents most commonly identified factors associated with 9/11, that is, dust and emotional stress, as the reasons for their worsened asthma. Yet, this perception may be biased by the truly extraordinary nature of what occurred on September 11, 2001, and the extensive media coverage surrounding possible adverse health effects. Moreover, the socioeconomic homogeneity of the sample potentially limits the generalizability of our findings to the larger NYC population.

The findings from this study can be used by health care organizations to help prepare for disaster situations. Several activities should be considered to safeguard the health of people with asthma, including (1) development of asthma registries, with particular emphasis on the identification of those most vulnerable, that is, clients in poor health, those with severe asthma, and those mental health comorbidities, to assist in the outreach, case management, and triage of clients especially during times of crisis; (2) providing training to physicians regarding the mental health issues associated with disasters and concomitant physical conditions; and (3) providing individuals with asthma self-management plans that detail what to do when asthma symptoms are exacerbated and how to avoid known triggers and irritants.

The potential long-term effects of this type of disaster are not well documented in the literature and need to be further studied to better quantify risks and recommend adequate protections. The recent development of a WTC Registry, designed to track health outcomes of people residing in NYC, will assist state and local officials in understanding the long-term health effects of the WTC collapse and possibly better prepare for future events.

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