

Relationship of Self-Reported Asthma Severity and Urgent Health Care Utilization to Psychological Sequelae of the September 11, 2001 Terrorist Attacks on the World Trade Center Among New York City Area Residents

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Objective: Posttraumatic psychological stress may be associated with increases in somatic illness, including asthma, but the impact of the psychological sequelae of the September 11, 2001 terrorist attacks on physical illness has not been well documented. The authors assessed the relationship between the psychological sequelae of the attacks and asthma symptom severity and the utilization of urgent health care services for asthma since September 11. **Materials and Methods:** The authors performed a random digit dial telephone survey of adults in the New York City (NYC) metropolitan area 6 to 9 months after September 11, 2001. Two thousand seven hundred fifty-five demographically representative adults including 364 asthmatics were recruited. The authors assessed self-reported asthma symptom severity, emergency room (ER) visits, and unscheduled physician office visits for asthma since September 11. **Results:** After adjustment for asthma measures before September 11, demographics, and event exposure in multivariate models posttraumatic stress disorder (PTSD) were a significant predictor of self-reported moderate-to-severe asthma symptoms (OR = 3.4; CI = 1.2–9.4), seeking care for asthma at an ER since September 11 (OR = 6.6; CI = 1.6–28.0), and unscheduled physician visits for asthma since September 11 (OR = 3.6; CI = 1.1–11.5). The number of PTSD symptoms was also significantly related to moderate-to-severe asthma symptoms and unscheduled physician visits since September 11. Neither a panic attack on September 11 nor depression since September 11 was an independent predictor of asthma severity or utilization in multivariate models after September 11. **Conclusions:** PTSD related to the September 11 terrorist attacks contributed to symptom severity and the utilization of urgent health care services among asthmatics in the NYC metropolitan area. **Key words:** asthma, disaster, mental health, posttraumatic stress.

NYC = New York City; PTSD = posttraumatic stress disorder; WTC = World Trade Center; RDD = random digit dial; ER = emergency room.

INTRODUCTION

Several studies have shown a substantial prevalence of psychological symptoms including major depression and posttraumatic stress disorder (PTSD) in the general population of New York City (NYC) after the events of September 11 (1,2). In addition, exposure to dust, smoke, and odors from the fires that burned at the site for several weeks exacerbated respiratory symptoms in many residents and workers (3–7), including persons with asthma. While the effects of the terrorist attacks on the World Trade Center (WTC) on mental (1,2) and physical (3–7) health are the topic of a number of ongoing studies, the impact of psychological stress associated with these attacks on somatic illnesses and symptoms has received relatively little attention.

We have previously reported that both the environmental and psychological sequelae of the September 11 attacks were associated with increasing symptoms experienced by some persons with asthma 1 month after the attacks (5). Here we report findings from a survey assessing the relations between the psychological sequelae of the attacks and self-reported

asthma symptom severity and health care utilization for asthma since September 11, 2001 to see if these relationships were present 6 months after the event.

MATERIALS AND METHODS

We conducted a random digit dial (RDD) household survey between March 25 and June 25, 2002. The sampling frame included all adults in the NYC metropolitan area; for sampling purposes, we sampled equal numbers of people from four sampling zones radiating concentrically out from the WTC site (eg, the first zone included only Manhattan south of 14th Street). The overall cooperation rate, for residents where a respondent was reached, was 56.0% (based on the sum of the number of completed interviews, quota outs [ie, persons called who were in a sampling zone after we had completed quota for that zone] and screen outs [ie, persons who were not eligible for surveying, eg, persons who were visitors and not living in the area]) divided by the sum of completed interviews, quota outs, screen outs, refusals, and premature terminations (8). A total of 2755 persons were interviewed. These analyses are based on the 364 (12.7%) participants who responded “yes” to “has a doctor ever told you that you have asthma?”

All interviews were conducted by trained interviewers using a computer-assisted telephone interview system. Interviews were available in English, Spanish, and Chinese. Measures of post-September 11 asthma severity collected during the interview included severity of their symptoms during the past 4 weeks (moderate or severe symptoms vs. none or mild), ER visits for asthma (1 or more vs. none), and unscheduled physician office visits for asthma (1 or more vs. none) during the period since the September 11 attacks. Participants’ asthma status before September 11 was assessed by asking questions addressing the severity of symptoms during the 4 weeks before September 11 (moderate or severe symptoms vs. none or mild), nighttime symptoms (1 or more nights/mo woken with symptoms vs. never woken with symptoms) and use of ER care during the 12 months before September 11 (1 or more vs. none).

We also asked about socio-demographic characteristics (age, gender, race/ethnicity, yearly household income, education, social support [6 mo before September 11], and sentinel life-stressors [12 mo before September 11]). Social support was assessed using three questions from the MOS social support scale, asking about emotional, instrumental, and appraisal support (9); sentinel life stressors were assessed by asking if a respondent had experienced one of eight possible significant stressors (eg, personal experience of violence, natural disaster). To assess respondent exposure to the September 11 terrorist attacks, respondents were asked whether they witnessed the attacks in person, had a friend or relative killed, lost a job because of the attacks,

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changed their smoking status, smelled unusual odors related to the attacks during the week after, and the location where they lived on September 11. Psychological syndromes assessed included peri-event panic attack using a modified version of the Diagnostic Interview Schedule (DIS) for panic attack (phrased to detect symptoms experienced during or soon after the September 11 terrorist attacks) (10). We used the National Women's Study (NWS) PTSD module to measure PTSD symptoms. The NWS PTSD module was validated in a field trial against the PTSD module of the Structured Clinical Interview for DSM-III-R (SCID) (11) administered by mental health professionals; in the field trial, interrater kappa coefficients were 0.85 for the diagnosis of lifetime PTSD and 0.86 the diagnosis of current PTSD (12). We used a modified, validated, version of the Structured Clinical Interview for DSM-IV major depressive episode questions to determine presence of depression within the past 30 days (13).

We used chi-square tests to identify bivariate associations between socio-demographic characteristics, September 11 event exposures, psychological factors, and asthma status before September 11 with each of the three post-September 11 asthma outcomes. We developed separate logistic models for each outcome that included covariates associated with the outcome at $p < 0.2$. Each of the three psychological syndromes (peri-event panic attack, PTSD, and depression) of interest was added separately to the multivariate models to estimate the relative odds of each asthma outcome in the presence of the psychological impact, with the absence of the impact serving as the referent category. In addition, models were fit to estimate the relation of the number of PTSD symptoms to each outcome. Sampling weights were devel-

oped and applied to our data when estimating proportions and odds ratios to adjust for differences in selection probabilities related to the number of household telephones, persons in the household, and over-sampling.

RESULTS

The estimated mean age of adults with asthma was 40 (SD = 21.3) with 81.0% being younger than age 55 years, 61.0% were women, 53.5% were non-Hispanic whites, 28.5% had an annual household income of \$40,000 or more, 42.7% had a college or graduate degree, and 20.1% had two or more life stressors during the 12 months before September 11.

On average, more asthmatics reported moderate-to-severe symptoms in the past 4 weeks (24.2%), compared with the 4 weeks before September 11 (14%) (Table 1). A similar proportion reported ER visits for asthma (13.3%) in the 6 to 9 months since September 11 compared with 17.7% during the 12 months before September 11. Among adults with asthma, 1 in 5 reported symptoms compatible with a panic attack during or soon after the September 11 attacks, 6.5% reported symptoms compatible with PTSD since September 11, and 13.0% demonstrated symptoms of depression since September 11.

TABLE 1. Distribution of Asthma Severity and Urgent Health Care Utilization Before and After September 11 and Psychological Outcomes after the September 11 Terrorist Attacks

	Number ^a	Percent ^b
Total	364	12.7
Asthma status after September 11		
Asthma symptoms past 4 weeks		
None to mild	273	75.8
Moderate to severe	88	24.2
Emergency room care for asthma since September 11		
No	317	86.7
Yes	45	13.3
Unscheduled physician visit for asthma since September 11		
No	272	74.8
Yes	91	25.2
Asthma status before September 11		
Before September 11 symptoms		
None to mild	318	86.0
Moderate to severe	41	14.0
Nighttime symptoms 12 months before September 11		
No nights woken	197	55.0
1 or more nights woken/mo	143	45.0
Emergency room care 12 months before September 11		
None	315	82.3
1 or more	49	17.7
Psychological factors		
Peri-event panic attack		
No	287	80.0
Yes	77	20.0
Post traumatic stress disorder related to the September 11 attacks		
No	334	93.5
Yes	30	6.5
Depression since September 11		
No	307	87.0
Yes	49	13.0

^a Number of respondents who had ever been told by a physician that they had asthma. Numbers that do not add up to 364 for variables reflect participants with unknown or missing values.

^b Percents are all weighted to account for varying probabilities of selection among respondents based on number of phone numbers, number of adults in household, and oversampling.

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In models unadjusted for pre-September 11 asthma measures and other covariates, all three psychological outcomes (panic attack, depression, and PTSD) after September 11 were associated with more severe asthma symptoms and with urgent health care visits for asthma since September 11; some, but not all, of these associations were greatly attenuated with adjustment for covariates (Table 2). For peri-event panic attack, significant crude associations were seen with seeking care for asthma at an ER since September 11 (OR = 2.9; CI = 1.2–7.5) and seeking unscheduled physician care for asthma since September 11 (OR = 3.7; CI = 1.8–7.7), but these associations were no longer significant when controlling for covariates (OR = 1.1, CI = 0.4–3.4; OR = 2.0, CI = 0.8–4.6, respectively). Depression was not a significant predictor for any of the post-September 11 asthma outcomes in either crude or adjusted models. PTSD was a significant predictor of self-reported moderate-to-severe asthma symptoms in the unadjusted, bivariate analysis (OR = 3.4; CI = 1.0–10.9) and in the multivariate model (OR = 3.4; CI = 1.2–9.4). PTSD was also significantly associated with seeking care for asthma at an ER and with unscheduled physician visits in crude and adjusted models (adjusted OR = 6.6; CI = 1.6–28.0 and OR = 3.6; CI = 1.1–11.5, respectively). When assessing the effect of the number of PTSD symptoms on self-reported moderate-to-severe asthma symptoms and seeking unscheduled care from a physician for asthma since September 11, the relationships were significant in the bivariate analyses (OR = 1.2 per each additional symptom; CI = 1.1–1.4 and OR = 1.2; CI = 1.01–1.4, respectively); however, only the relationship with self-reported moderate-to-severe asthma symptoms remained significant in the multivariate model (OR = 1.2; CI = 1.1–1.4).

DISCUSSION

Psychological stress has been shown to worsen asthma (14), and PTSD has been associated with an increase in respiratory symptoms (15) and asthma (16). In this study, we documented a relationship between the psychological sequelae of the attacks and increased asthma severity and the utilization of urgent health care services 6 to 9 months after September 11. The increased reporting of physical symptoms including respiratory symptoms reported by individuals with PTSD may be related to a comorbid diagnosis of depression (15). In our study, however, the associations of depression with post-September 11 asthma severity were largely explained by adjustment for past asthma history and other covariates. Our findings suggest that while depression may be associated with more asthma symptoms in general, PTSD and posttraumatic stress symptoms may be better indicators of risk for worsening asthma after a traumatic event.

Although there is corroborating evidence from other studies that stress and PTSD are associated with reporting of increased respiratory symptoms, other physical symptoms, and health care utilization, the explanation for these relationships is unclear. It has been shown that hypocorticalism is common in individuals with PTSD and chronic stress, as well as individuals with asthma (17,18). Wright and colleagues (14) reported on data demonstrating that stress reduces an individual's resistance to respiratory infectious agents explaining another potential causal link. Cohen (19) demonstrated that severe chronic stress was associated with an increase in developing a cold. β -adrenergic hyporesponsiveness and parasympathetic hyperresponsiveness have been demonstrated in individuals with both asthma (20) and PTSD (21). Stress and PTSD may also affect an individual's ability to

TABLE 2. Crude and Adjusted Relationships Between Psychological Outcomes and Asthma Severity and Utilization of Health Care Services

	Moderate to Severe Asthma Symptoms after September 11			Emergency Room Visit after September 11			Unscheduled Physician Visit after September 11		
	%	Crude	Adjusted ^a	%	Crude	Adjusted ^b	%	Crude	Adjusted ^c
Peri-event panic attack									
No	21.9	1.8	1.3 (0.6–2.9)	10.3	2.9*	1.1 (0.4–3.4)	19.7	3.7**	2.0 (0.8–4.6)
Yes	33.6			25.3			47.4		
Depression									
No	22.8	1.8	1.6 (0.6–4.3)	12.4	2.2	1.0 (0.3–3.7)	25.1	1.2	0.9 (0.3–2.5)
Yes	34.6			23.9			28.7		
PTSD									
No	22.5	3.4*	3.4 (1.2–9.4)*	11.4	5.3*	6.6 (1.6–28.0)*	23.2	4.0*	3.6 (1.1–11.5)**
Yes	49.4			40.4			54.6		
Number of PTSD symptoms		1.2**	1.2 (1.1–1.4)**		1.2	1.1 (0.9–1.4)		1.2**	1.1 (1.0–1.3)

^a Adjusted for age, gender, race, education, friend or relative killed during the September 11 terrorist attacks, on-site involvement, and severity of symptoms 4 weeks before September 11.

^b Adjusted for gender, race, income, education, life-time stressors, smells related to the September 11 terrorist attacks, on-site involvement, and ER visits before September 11.

^c Adjusted for age, gender, race, income, education, witnessing the September 11 attacks in person, on-site involvement, and ER visits before September 11.

* $p < .05$.

** $p < .01$.

self-manage asthma and adhere to treatment, although research to support this is sparse (14). In addition, individuals experiencing psychological stress may be more likely than others to seek health care for physical symptoms. Thus, there appear to be both biological and behavioral pathways that might link PTSD and asthma severity, although their elucidation is beyond the scope of this study.

The findings in this report are subject to limitations, including a lack of objective measures to validate the self-reported measures of asthma severity and the cross-sectional design precluding demonstration of temporal or causal relations of asthma severity to psychological symptoms. The prevalence of asthma reported in our survey is similar to the prevalence estimated for New York State adults for 2001 (11.1%) (22). Our sample of individuals living in close proximity to the WTC may not be representative of the population living there on September 11, because those individuals with severe asthma may have been more likely to move away and out of our sampling frame. Similarly, differential response rates by persons with and without psychological symptoms may affect the observed relations. However, our sample was comparable with expected census demographics, suggesting that we are reporting results on a representative sample of the population. In addition, this study was not designed to assess the environmental impacts of the September 11 terrorist attacks, which contributed to respiratory symptoms in the weeks after September 11 (6,7) and to persistent respiratory illness in some of the most heavily exposed (4). Despite the lack of objective environmental measures, the fact that most of the study population lived outside the immediate impact zone and the fact that reported experience of smells related to the attacks in the week after September 11 did not account for the association between PTSD and asthma severity argues against this association being explained solely by environmental exposures or concerns. We only assessed the respiratory symptoms among those respondents who stated they had asthma. Therefore, we were not able to compare our findings in the population with asthma to a population, which had increased respiratory symptoms but no history of asthma. Finally, the lack of comparable surveys before September 11, 2001 and the seasonal variation in asthma severity preclude any estimate of the absolute impact of the terrorist attacks on overall asthma severity in the NYC region.

Notwithstanding these limitations, our findings add to previous evidence of increased rates of somatic symptoms and illness among persons with PTSD. This connection of psychological stress symptoms to physical illness after mass trauma may represent a significant, although poorly documented, public health impact of the September 11 terrorist attacks. Researchers and health care providers working with populations impacted by the September 11 attacks should be attentive to the potential impact of posttraumatic stress on physical illness experienced by those populations.

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