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Organizational Factors and Office Workers' Health After the World Trade Center Terrorist Attacks: Long-Term Physical Symptoms, Psychological Distress, and Work Productivity

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Learning Objectives

- Identify, in this survey of professional and service workers conducted 2 years after the World Trade Center (WTC) attacks, any relationship between direct exposure to the attacks and the frequency of physical symptoms or psychological disorders.
- Describe the relationship, if any, between the degree of exposure to the WTC attacks and work productivity as reflected by lost work time, presenteeism, and self-reported changes in overall job performance.
- Recall whether organizational culture was a significant predictor of worker's physical or psychological well-being.

Abstract

Objective: To assess if organizational factors are predictors of workers' health and productivity after the World Trade Center attacks. **Methods:** We conducted a survey of 750 workers and compared those who had direct exposures to the World Trade Center attacks (south of Canal Street workers; primary victims) with those less directly exposed (north of Canal Street workers; other victims and non-victims). **Results:** South of Canal Street workers reported headache more frequently than north of Canal Street workers did ($P = 0.0202$). Primary victims reported headache and cough more frequently than did other victims and non-victims ($P = 0.0086$ and 0.0043 , respectively). Defensive organizational culture was an independent predictor of cough and job stress, and job stress was an independent predictor of on-the-job productivity losses. **Conclusion:** Organizational variables may modify health and productivity outcomes after a large-scale traumatic event in the workplace. (J Occup Environ Med. 2008;50:112–125)

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Omowunmi Y. O. Osinubi and coauthors have no financial interest related to this research.

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DOI: 10.1097/JOM.0b013e31815e92bd

Large-scale disasters such as the World Trade Center (WTC) terrorist attacks have traumatizing effects on large and unselected populations. Disaster-related community surveys have demonstrated significant levels of posttraumatic stress and other psychiatric diagnoses among persons directly impacted by a traumatic event.^{1–3} Studies have also examined the impact of traumatic events on disaster relief workers who participate in disaster-related emergency or rescue or cleanup operations and have found measurable levels of post-disaster physical symptoms or psychological distress.^{4–7}

A few studies have examined the effects of the WTC terrorist attacks on workers who were indirectly exposed to the traumatic events and found higher levels of physical symptoms or psychological distress relative to unexposed workers.^{8–10} Nevertheless, the literature is sparse on the long-term impact of such indirect exposures on workers' health or work productivity.¹¹ In addition, data on the modifying effects of organizational factors such as work culture and job stress on perceived well-being and work productivity in the aftermath of a large-scale traumatic event in the work environment is limited.

The purpose of our study was to examine the relationship between organizational factors and physical symptoms, psychological distress and work productivity among office

workers in Manhattan 2 years after the WTC terrorist attacks on September 11, 2001 ("9/11"). We hypothesized that a negative (defensive) workplace culture or perceived job stress is associated with a higher prevalence of long-term health complaints or productivity losses among workers in the aftermath of the traumatic event. In this study, we assessed workers' exposures to WTC trauma, determined the prevalence of physical symptoms and psychological distress and their impact on work productivity. We also identified which organizational variables were important predictors of workers' physical health, psychological well being, and job productivity having controlled for workers' exposures to the traumatic event.

Materials and Methods

The University of Medicine and Dentistry of New Jersey Institutional Review Board approved the study protocol. We contacted the representatives of eight large unions to discuss the study and obtain their participation. Four of the eight unions agreed to participate in the study. From the four unions that agreed to participate, we randomly selected public sector and union office workers from 17 different worksite locations in Manhattan, NY (at one of the worksites selected for study, the union did not release the list of its members to the authors because of security concerns. The union representative distributed the surveys to the eligible employees. Subject selection at this worksite was based on dates of hire (seniority) to ensure that all subjects had been employed at the worksite before 9/11. Surveys were sent to approximately 75% of all of the employees at this worksite). Because the focus of the research was on the impact of WTC terrorist attacks on workers' health and productivity, we oversampled worksites that were closer in proximity to the WTC. Ten of the worksites were in close proximity to the WTC (distance ranged from 0.1 miles to 1.5 miles) and were located

south of Canal Street (SOC). Seven of the worksites were further away from the WTC (distance ranged from 3 miles to 9.5 miles) and were located north of Canal Street (NOC).

Members of the union were eligible to participate in the study if they were employed at the same worksite location before September 11, 2001, ie, for 2 or more years before the study. A total of 6618 members were eligible to participate from the four unions. For this pilot study, we mailed surveys to 750 federal and state government employees, municipal government office workers, and union office workers who met the eligibility criteria for study participation.

The survey instrument assessed the proximity of the worksite location to the WTC, subjects' levels of exposures to the terrorist attacks, work, personal losses because of 9/11, and frequency of physical symptoms within the 4 weeks before the survey. We used a 6-question short form (K6) Likert scale questionnaire to screen for psychological distress. This short form is an abbreviated scale from the World Health Organization (WHO) Composite International Diagnostic Interview and is widely used to monitor population prevalence and trends in nonspecific psychological distress.¹² The K6 is an abridged version of the 10-question survey (K10) that is used in the US National Health Interview Survey. The K6 assesses the frequency of a feeling of depressed mood, hopelessness, restlessness, worthlessness, nervousness, and being fidgety in the prior 4 weeks (28 days). The K10 and K6 have strong psychometric properties and have the ability to discriminate Diagnostic and Statistical Manual of Mental Disorders IV¹³ cases from non-cases.¹² We also assessed posttraumatic stress disorder (PTSD) using the Impact of Event Scale-Revised (IES-R),¹⁴ other personal life stressors within the prior 12 months using a modified PERI Life Event Scale,¹⁵ and perceived level of personal social support.

Work productivity measures were adapted from the WHO's Health and Work Performance Questionnaire (HPQ).¹⁶ The HPQ obtains information about the expected and actual hours worked in the prior 7 days, and absenteeism because of illness and other reasons in the prior 4 weeks. It has a series of Likert scale questions that ask respondents how often, during their working hours, they had decrements in quantity and quality of work to assess on-the-job productivity losses (presenteeism). We also asked respondents to rate their job performance on a scale of 0 to 10 (worst to best) in the months before 9/11 and in the 4 weeks before the survey ie, 2 years after 9/11.

Perceived job stress was assessed using the Job Content Questionnaire, a 49-item self-administered instrument designed to measure social and psychological characteristics of jobs.¹⁷ Scales from the Job Content Questionnaire that we used in the present study were psychological job demands, decision latitude, and social support at work.

Workplace culture was assessed using the Organizational Cultural Inventory[®]* (OCI), a 120-item Likert scale questionnaire that measures employees' beliefs about or understanding of the behaviors expected by the organization in carrying out their work and interacting with others on their jobs.¹⁸ It assesses 12 sets of behavioral norms that might be implicitly or explicitly required for people to "fit in" and "meet expectations" in an organization or its sub-unit(s). These cultural norms are organized into three culture clusters†: 1) Constructive cultures: members are encouraged to interact with others and approach tasks in ways that

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will help them to meet their higher-order satisfaction needs. These include achievement, self-actualizing, humanistic-encouraging, and affiliative styles. 2) Passive/Defensive cultures: members believe that they must interact with people in defensive ways that will not threaten their own security. These include approval, conventional, dependent, and avoidance styles. 3) Aggressive/Defensive cultures: members are expected to approach tasks in forceful ways to protect their status and security. These include oppositional, power, competitive, and perfectionistic styles. A more detailed description of the organizational cultural norms is provided in the Appendix.

We categorized respondents' levels of exposures to WTC terrorist attacks based on 1) location of worksite on 9/11 and 2) personal level of exposure to WTC trauma. Worksites that were located SOC were closer in proximity to the WTC. As such, these workers were more likely to have been directly exposed to the trauma relative to employees of worksites located NOC, which were further away from the WTC. Although the location of the worksite can be used as a surrogate for workers' exposures to WTC trauma, the personal level of exposure of workers within a worksite location may differ based on their actual experience of the traumatic event.

To assess personal level of exposure to WTC trauma, we adapted the definition of victims of traumatic events by Taylor and Frazer^{19,20} to categorize subjects. Primary victims were office workers who had direct exposures to the WTC terrorist attacks. These included individuals who were in one of the twin towers or in one of the WTC complex buildings, or they were in the immediate neighborhood and saw the plane(s) hit the building(s), or they had to run from the debris cloud after the twin towers collapsed, or they suffered physical injury from the WTC disaster. Secondary victims were workers who had close relatives, friends, or

business associates who died, or were seriously injured, or were declared missing because of WTC attack. Tertiary victims were office workers who were involved in WTC-related rescue, recovery, or cleanup operations. Sestenary victims were workers who but for chance would have been primary victims, ie, their regular place of employment was either in the WTC, WTC complex, or was located at SOC, but were not at work, did not witness the event in person, and were not in the immediate neighborhood at the time of the disaster. Nonvictims were subjects that did not meet any of the above criteria.

Statistical Analyses

Descriptive statistics included frequencies when summarizing responses for categorical responses as well as means and standard deviations for continuous variables. The effects of level of exposure to WTC trauma (primary victim, other victim, or non-victim) and work location (SOC or NOC) on worker responses related to physical symptoms, psychological distress, perceived job stress, work productivity, and other worker-level responses, were estimated using generalized estimating equations.^{21,22} Separate models were used to examine these primary predictors of interest (level of exposure and work location) because they were so highly correlated that it was impossible to differentiate their effects. Additional covariates in each of these sets of models included organizational culture (Constructive or Defensive), job stress, sex, salary, age, ethnicity, size of organization, and number of life-event stressors. Through the use of these generalized estimating equations, simultaneous evaluation of both workplace and worker level characteristics was possible, while accounting for correlation between subjects within a single workplace. Type III Wald χ^2 tests were used to examine the significance of each covariate. Proc Genmod in the SAS programming language Ver-

sion 8.1 was used for this estimating procedure.²³

In many cases, it was necessary to use a log transformation of semi-continuous response variables because of the right skew of the distributions. The effect size for a significant result was reported as the change in the mean because of a change in the covariate under investigation. If a response was binary, a logit link was used. For binary responses that were significant under the multivariate logistic model, marginal risk ratios were reported because of the simpler interpretation when compared with odds ratios. In all cases, these marginal risk ratios accurately reflected the magnitude of the effect measured by the odds ratio in the multivariate model.

Results

We mailed surveys to 750 subjects approximately 2 years after 9/11. The post office returned 17 surveys because the addresses were invalid. Of 733 surveys with valid addresses, 380 participants responded to the survey. Of 380, 11 subjects were excluded from the study for the following reasons: 3 were excluded because they worked outside New York City (NYC) as of 9/11, and 8 were excluded because they had been hired at their respective worksites for less than 2 years hence, did not meet the eligibility criteria for the study. The overall survey response rate for those with valid addresses was 51.8%. The response rate for valid surveys was 50.3%.

Demographic Characteristics

All of the respondents were professional or service workers who were hired by a federal government agency, state government agency, municipal government agency, or labor organization. As shown in Table 1, a variety of industries and professions or occupations were represented in the study population. Most (62%) of the respondents were women and the majority (87%) were 30 years or older. Approximately half (51%) were white and the vast

TABLE 1

Demographic Distribution Based on Location of Worksite on 9/11

	SOC, <i>n</i> = 243 (65.85%)	NOC, <i>n</i> = 126 (34.15%)	Total, <i>n</i> = 369 (100%)	<i>P</i> *
Sex				
Male	85 (34.98)	41 (32.54)	126 (34.15)	0.5170
Female	146 (60.08)	82 (65.08)	228 (61.79)	
Missing	12 (4.94)	3 (2.38)	15 (4.07)	
Age (yr)				
20–29	35 (14.40)	14 (11.11)	49 (13.28)	0.4011
30–39	52 (21.40)	22 (17.46)	74 (20.05)	
40–49	64 (26.34)	31 (24.60)	95 (25.75)	
50–59	64 (26.34)	44 (34.92)	108 (29.27)	
≥60	19 (7.82)	13 (10.32)	32 (8.67)	
Missing	9 (3.70)	2 (1.59)	11 (2.98)	
Ethnicity				
Asian	20 (8.23)	6 (4.76)	26 (7.05)	0.4669
Black	54 (22.22)	25 (19.84)	79 (21.41)	
Hispanic	25 (10.29)	18 (14.29)	43 (11.65)	
White	121 (49.79)	68 (53.97)	189 (51.22)	
Other and missing	23 (9.47)	9 (7.14)	32 (8.67)	
Education				
High school	31 (12.76)	4 (3.17)	35 (9.49)	0.0002
Some college	55 (22.63)	28 (22.22)	83 (22.49)	
Bachelor's degree	66 (27.16)	27 (21.43)	93 (25.20)	
Postdoctoral degree	78 (32.10)	66 (52.38)	144 (39.02)	
Other and missing	13 (5.35)	1 (0.79)	14 (3.79)	
Organizational level				
Nonmanagement	204 (83.95)	98 (77.78)	302 (81.84)	0.0753
Line management	18 (7.41)	19 (15.08)	37 (10.03)	
Middle management	4 (1.65)	3 (2.38)	7 (1.90)	
Senior management	3 (1.23)	4 (3.17)	7 (1.90)	
Missing	14 (5.76)	2 (1.59)	16 (4.34)	
Salary				
≤\$35,000	67 (27.57)	26 (20.80)	93 (25.20)	<0.0001
\$35,001–\$90,000	102 (41.96)	95 (76)	197 (53.38)	
≥\$90,001	61 (25.10)	4 (3.20)	65 (17.62)	
Missing	13 (5.35)	1 (0.79)	14 (3.79)	
Years with organization (yr)				
2–4	31 (12.76)	18 (14.29)	49 (13.28)	0.6268
5–10	87 (35.8)	40 (31.75)	127 (34.42)	
≥11	111 (45.68)	64 (50.79)	175 (47.43)	
Missing	14 (5.76)	4 (3.17)	18 (4.88)	
Organization type				
Accounting	12 (4.94)	4 (3.17)	16 (4.34)	<0.0001
Computers	3 (1.23)	1 (0.79)	4 (1.08)	
Educational	49 (20.16)	65 (51.59)	114 (30.89)	
Financial	20 (8.23)	3 (2.38)	23 (6.23)	
Health care	0 (0)	19 (15.08)	19 (5.15)	
Insurance	46 (18.93)	1 (0.79)	47 (12.74)	
Not-for-profit	7 (2.88)	6 (4.76)	13 (3.52)	
Public sector	63 (25.93)	9 (7.14)	72 (19.51)	
Other	43 (17.69)	18 (14.29)	61 (16.53)	

* χ^2 test unless otherwise indicated.

SOC indicates worksite was located south of Canal Street on September 11, 2001; NOC, worksite was located north of Canal Street on September 11, 2001.

majority (90%) had attained more than a high school education. Only 8% of the respondents were hired at small worksites (<50 workers); 37% were hired at medium worksites (50

to 249 workers); 30% were hired at large worksites (250 to 499 workers); 20% were hired at very large worksites (≥500 workers). The majority (80%) worked in non-manage-

ment positions and approximately half (53%) had worked at the same organization for more than 10 years. Over a quarter (29%) of the respondents had an annual salary in excess of \$75,000. Subjects who worked SOC tended to have higher levels of salary relative to those who worked NOC, and there were significant differences between NOC and SOC workers in educational attainment, types of occupations, and types of organizations in which the subjects were hired (Table 1).

Location of Worksite and Level of Exposure to WTC Terrorist Attacks

As of 9/11, 66% of the subjects were hired SOC whereas 34% worked NOC. Approximately half (52%) of the respondents were primary victims, 2% were secondary victims, 5% were tertiary victims, 16% were sestenary victims, and 25% were non-victims. For the purposes of data analysis, we collapsed the levels of personal exposure to WTC attacks into three main categories: Primary victims (52%); other victims ie, secondary, tertiary, and sestenary victims (23%); and non-victims (25%). Most (73%) of the subjects who worked SOC were primary victims whereas most (67%) of those who worked NOC were non-victims ($P < 0.0001$) (Table 2). The vast majority of subjects did not live in close proximity to the WTC. Only 1.4% lived SOC on 9/11.

Work and Personal Losses From WTC Terrorist Attacks

Eighty-one subjects (22%) reported that they lost work time because of the WTC attacks and related consequences. Among those who lost work time, 75% were out of work for 1 month or less; 19.7% were out of work for 2 to 6 months; and 3.7% were out of work for more than 6 months. Respondents who worked SOC were more likely to have lost work time than those who worked NOC were (30.6% vs 5.6%;

TABLE 2

The Relationship Between Location of Worksite and Level of Exposure to WTC Terrorist Attacks

Location of Worksite on 9/11	Degree of Exposure to 9/11 Trauma			Total	P*
	Primary Victims	Other Victims	Non-Victims		
SOC	177 (72.84%)	59 (24.28%)	7 (2.88%)	243 (65.85%)	0.0001
NOC	15 (11.90%)	27 (21.43%)	84 (66.67%)	126 (34.15%)	
TOTAL	192 (52.03%)	86 (23.31%)	91 (24.66%)	369 (100%)	

* χ^2 test.

SOC indicates worksite was located south of Canal Street on September 11, 2001; NOC, worksite was located north of Canal Street on September 11, 2001; Primary Victims, persons with maximum exposure to traumatic event. Other Victims, grieving relatives and friends of primary victims; or persons involved in rescue, recovery or clean up operations; or persons who but for chance would have been primary victims; or those who led others to take a course of action which resulted in their becoming primary victims. Non-Victims, persons with minimal exposure to the traumatic event.

$P < 0.0001$). Similarly, primary victims were more likely to be out of work than other victims or non-victims were (29.3% vs 24.4% vs 4.4%; $P < 0.0001$). Overall, 22.6% of the respondents lost personal possessions or suffered personal financial losses as a result of 9/11. Persons who worked SOC were significantly more likely to incur such losses relative to those who worked NOC (31.09% vs 6.40%; $P < 0.0001$). Likewise primary victims were more likely to suffer such losses relative to other victims or non-victims were (33.33% vs 22.35% vs 0%; $P < 0.0001$).

Personal Life-Event Stressors and Perceived Level of Personal Social Support in the 2 Years After 9/11

Overall, 20% of the respondents endorsed four or more significant life events (eg, relocation, separated from partner, lost job, divorced from spouse, etc) between 9/11 and the time of the survey. Approximately 38% endorsed two to three life events; 23% endorsed one life event; and 19% had no significant life events during the same period. There were no statistically significant differences in the number of life-event stressors based on work location and degree of exposure to 9/11 trauma. The perceived level of personal social support was high in the study

population. Most (65.5%) of the respondents had at least three or more people with whom they felt at ease with and could talk to about what was on their minds, and 29.6% of respondents had one or two people they could talk to. Only 4.9% reported that they had no one in whom they were able to confide. There were no statistically significant differences in the perceived level of personal social support based on work location and degree of exposure to 9/11 trauma.

Physical Symptoms, Psychological Distress, PTSD, and Psychiatric Illnesses 2 Years After 9/11

Physical Symptoms. The majority (86%) of subjects reported that they were in good or excellent overall health. Only 14% rated their health as "fair" or "poor." Overall, the most frequently reported physical symptoms that occurred "most or all of the time" within the 4 weeks before the survey were feeling tired or low energy (21.8%); eye, nose, and throat irritation (17.4%); head and sinus congestion (16.8%); shortness of breath (10.1%); cough (7.9%); and severe headache or migraine (7.6%). SOC workers tended to report severe headache or migraine more frequently than NOC workers did ($P = 0.0202$) (Table 3). Similarly, primary victims

were more likely to report severe headache or migraine and cough more frequently relative to other victims and non-victims ($P = 0.0086$ and 0.0043 , respectively). The distribution of physical symptoms based on the personal level of exposure to WTC terrorist attacks is shown in Table 4.

Using multivariate analytical methods we examined the demographic and WTC trauma-related variables that independently predicted reporting of physical symptoms. There was a dose-response relationship between physical symptoms and the personal level of exposure to WTC trauma. Primary victims were 48% more likely to report severe headaches or migraine relative to non-victims, and other victims were similar to non-victims in this regard ($\chi^2 = 6.45$, $P = 0.0398$). Also, women were 64% more likely to report severe headaches or migraine compared with men ($\chi^2 = 8.06$, $P = 0.0045$). Relative to non-victims, primary victims were 61% more likely to report cough whereas other victims were 40% more likely to report the same ($\chi^2 = 6.70$, $P = 0.0351$). Also, persons who experienced four or more significant life events were 44% more likely to report cough compared with those who had not experienced any significant life events after 9/11 ($\chi^2 = 8.14$, $P = 0.0433$).

Psychological Distress. The K6 instrument¹² had a possible range of scores of 6 to 30. Workers who had a score that was ≥ 19 met the criteria for clinically significant psychological distress. Only 7% of all respondents endorsed symptoms that met the criteria for clinically significant psychological distress within the 4 weeks before the survey. The distribution of psychological distress was similar between those who worked SOC and those who worked NOC (7.08% vs 6.45%; $P = 0.8213$). Similarly, there were no significant differences in psychological distress based on degree of exposure to 9/11 trauma (primary victims, 7.98%; other victims, 4.71%; non-victims,

TABLE 3

Physical Symptoms 2 yr After 9/11 Based on Location of Worksite

Symptoms	Worksite Location	None of the Time	A Little of the Time	Some of the Time	Most or All of the Time	Total	P*
Feeling tired or low energy	SOC	9 (3.73%)	59 (24.48%)	120 (49.79%)	53 (21.99%)	241	0.2588
	NOC	10 (7.94%)	35 (27.78%)	54 (42.86%)	27 (21.43%)	126	
	Total	19 (5.18%)	94 (25.61%)	174 (47.41%)	80 (21.80%)	367	
Eye, nose, or throat irritation	SOC	60 (24.79%)	69 (28.51%)	71 (29.34%)	42 (17.36%)	242	0.4781
	NOC	40 (31.75%)	29 (23.02%)	35 (27.78%)	22 (17.46%)	126	
	Total	100 (27.17%)	98 (26.63%)	106 (28.80%)	64 (17.39%)	368	
Head or sinus congestion	SOC	75 (30.99%)	65 (26.86%)	58 (23.97%)	44 (18.18%)	242	0.7602
	NOC	44 (34.92%)	33 (26.19%)	31 (24.60%)	18 (14.29%)	126	
	Total	119 (32.34%)	98 (26.63%)	89 (24.18%)	62 (16.85%)	368	
Severe headache or migraine	SOC	122 (50.41%)	64 (26.45%)	39 (16.12%)	17 (7.02%)	242	0.0202
	NOC	79 (62.70%)	16 (12.70%)	20 (15.87%)	11 (8.73%)	126	
	Total	201 (54.62%)	80 (21.74%)	59 (16.03%)	28 (7.61%)	368	
Difficulty concentrating	SOC	68 (28.10%)	87 (35.95%)	68 (28.10%)	19 (7.85%)	242	0.5131
	NOC	43 (34.13%)	44 (34.92%)	33 (26.19%)	6 (4.76%)	126	
	Total	111 (30.16%)	131 (35.60%)	101 (27.45%)	25 (6.79%)	368	
Cough	SOC	102 (42.15%)	69 (28.51%)	51 (21.07%)	20 (8.26%)	242	0.3005
	NOC	66 (52.38%)	31 (24.60%)	20 (15.87%)	9 (7.14%)	126	
	Total	168 (45.65%)	100 (27.17%)	71 (19.29%)	29 (7.88%)	368	
Shortness of breath	SOC	126 (52.28%)	55 (22.82%)	39 (16.18%)	21 (8.71%)	242	0.0799
	NOC	71 (56.35%)	30 (23.81%)	9 (7.14%)	16 (12.70%)	126	
	Total	197 (53.68%)	85 (23.16%)	48 (13.08%)	37 (10.08%)	368	
Wheezing	SOC	177 (73.14%)	40 (16.53%)	17 (7.02%)	8 (3.31%)	242	0.1099
	NOC	90 (71.43%)	15 (11.90%)	10 (7.94%)	11 (8.73%)	126	
	Total	267 (72.55%)	55 (14.95%)	27 (7.34%)	19 (5.16%)	368	
Chest tightness	SOC	159 (65.43%)	46 (18.93%)	33 (13.58%)	5 (2.06%)	243	0.6634
	NOC	85 (67.46%)	21 (16.67%)	15 (11.90%)	5 (3.97%)	126	
	Total	244 (66.12%)	67 (18.16%)	48 (13.01%)	10 (2.71%)	369	
Bad taste in mouth	SOC	149 (61.57%)	50 (20.66%)	33 (13.64%)	10 (4.13%)	242	0.7263
	NOC	70 (55.56%)	29 (23.02%)	21 (16.67%)	6 (4.76%)	126	
	Total	219 (59.51%)	79 (21.47%)	54 (14.67%)	16 (4.35%)	368	
Nausea or vomiting	SOC	178 (73.55%)	47 (19.42%)	13 (5.37%)	4 (1.65%)	242	0.1929†
	NOC	101 (80.80%)	16 (12.80%)	8 (6.40%)	0 (0%)	125	
	Total	279 (76.02%)	63 (17.17%)	21 (5.72%)	4 (1.09%)	367	
Indigestion, constipation, or diarrhea	SOC	103 (42.56%)	65 (26.86%)	57 (23.55%)	17 (7.02%)	242	0.9774
	NOC	51 (40.80%)	35 (28%)	31 (24.80%)	8 (6.40%)	125	
	Total	154 (41.96%)	100 (27.25%)	88 (23.98%)	25 (6.81%)	367	
Rash or skin irritation	SOC	148 (60.91%)	55 (22.63%)	28 (11.52%)	12 (4.94%)	243	0.5108
	NOC	81 (64.80%)	21 (16.80%)	14 (11.20%)	9 (7.20%)	125	
	Total	229 (62.23%)	76 (20.65%)	42 (11.41%)	21 (5.71%)	368	
Muscle soreness, aches, pains	SOC	58 (23.97%)	80 (33.06%)	64 (26.45%)	40 (16.53%)	242	0.8850
	NOC	28 (22.22%)	45 (35.71%)	30 (23.81%)	23 (18.25%)	126	
	Total	86 (23.37%)	125 (33.97%)	94 (25.54%)	63 (17.12%)	368	

* χ^2 test unless otherwise indicated.

†Fisher exact test.

SOC indicates worksite was located south of Canal Street on September 11, 2001; NOC, worksite was located north of Canal Street on September 11, 2001.

6.59%; $P = 0.6082$). Multivariate analysis demonstrated that the number of life-event stressors between 9/11 and the time of survey was an independent predictor of nonspecific psychological distress. The scores for nonspecific psychological distress was 48.5% higher for persons who reported four or more life events relative to those who had no signifi-

cant life events ($\chi^2 = 9.06$, $P = 0.0286$).

Posttraumatic Stress. The range of scores for the IES-R instrument was 0 to 88. Subjects with scores ≥ 24 met the criteria for clinically significant PTSD.^{14,24} The mean IES-R score for all respondents was 2.85. Although none of the subjects met the criteria for clinically significant

PTSD, the level of exposure to WTC trauma was a significant predictor of total IES-R scores. Subjects who worked SOC tended to have higher mean scores on the hyperarousal sub-scale compared with those who worked NOC (0.89 vs 0.69; $P = 0.0474$). Multivariate analysis showed that IES-R scores were 26.4% higher for primary victims

TABLE 4

Physical Symptoms 2 yr After 9/11 and Level of Exposure to 9/11 Trauma

Symptoms	Worksite Location	None of the Time	A Little of the Time	Some of the Time	Most or All of the Time	Total	P*
Feeling tired or low energy	Primary victims	4 (2.09%)	45 (23.56%)	95 (49.74%)	47 (24.61%)	191	0.0925
	Other victims	8 (9.41%)	22 (25.88%)	37 (43.53%)	18 (21.18%)	85	
	Non-victims	7 (7.69%)	27 (29.67%)	42 (46.15%)	15 (16.48%)	91	
	Total	19 (5.18%)	94 (25.61%)	174 (47.41%)	80 (21.80%)	367	
Eye, nose, or throat irritation	Primary victims	49 (25.52%)	49 (25.52%)	57 (29.69%)	37 (19.27%)	192	0.6263
	Other victims	21 (24.71%)	28 (32.94%)	24 (28.24%)	12 (14.12%)	85	
	Non-victims	30 (32.97%)	21 (23.08%)	25 (27.47%)	15 (16.48%)	91	
	Total	100 (27.17%)	98 (26.63%)	106 (28.80%)	64 (17.39%)	368	
Head or sinus congestion	Primary victims	54 (28.27%)	54 (28.27%)	47 (24.61%)	36 (18.85%)	191	0.6170
	Other victims	31 (36.05%)	23 (26.74%)	18 (20.93%)	14 (16.28%)	86	
	Non-victims	34 (37.36%)	21 (23.08%)	24 (26.37%)	12 (13.19%)	91	
	Total	119 (32.34%)	98 (26.63%)	89 (24.18%)	62 (16.85%)	368	
Severe headache or migraine	Primary victims	88 (46.07%)	56 (29.32%)	32 (16.75%)	15 (7.85%)	191	0.0086
	Other victims	55 (63.95%)	14 (16.28%)	11 (12.79%)	6 (6.98%)	86	
	Non-victims	58 (63.74%)	10 (10.99%)	16 (17.58%)	7 (7.69%)	91	
	Total	201 (54.62%)	80 (21.74%)	59 (16.03%)	28 (7.61%)	368	
Difficulty concentrating	Primary victims	49 (25.52%)	68 (35.42%)	58 (30.21%)	17 (8.85%)	192	0.0735
	Other victims	24 (28.24%)	36 (42.35%)	22 (25.88%)	3 (3.53%)	85	
	Non-victims	38 (41.76%)	27 (29.67%)	21 (23.08%)	5 (5.49%)	91	
	Total	111 (30.16%)	131 (35.60%)	101 (27.45%)	25 (6.79%)	368	
Cough	Primary victims	73 (38.02%)	56 (29.17%)	48 (25%)	15 (7.81%)	192	0.0043
	Other victims	39 (45.88%)	28 (32.94%)	12 (14.12%)	6 (7.06%)	85	
	Non-victims	56 (61.54%)	16 (17.58%)	11 (12.09%)	8 (8.79%)	91	
	Total	168 (45.65%)	100 (27.17%)	71 (19.29%)	29 (7.88%)	368	
Shortness of breath	Primary victims	97 (50.79%)	41 (21.47%)	33 (17.28%)	20 (10.47%)	191	0.1652
	Other victims	43 (50.59%)	24 (28.24%)	9 (10.59%)	9 (10.59%)	85	
	Non-victims	57 (62.64%)	20 (21.98%)	6 (6.59%)	8 (8.79%)	91	
	Total	197 (53.68%)	85 (23.16%)	48 (13.08%)	37 (10.08%)	367	
Wheezing	Primary victims	133 (69.27%)	36 (18.75%)	13 (6.77%)	10 (5.21%)	192	0.5022
	Other victims	63 (74.12%)	11 (12.94%)	7 (8.24%)	4 (4.71%)	85	
	Non-victims	71 (78.02%)	8 (8.79%)	7 (7.69%)	5 (5.49%)	91	
	Total	267 (72.55%)	55 (14.95%)	27 (7.34%)	19 (5.16%)	368	
Chest tightness	Primary victims	120 (62.50%)	41 (21.35%)	26 (13.54%)	5 (2.60%)	192	0.6752
	Other victims	58 (67.44%)	14 (16.28%)	12 (13.95%)	2 (2.33%)	86	
	Non-victims	66 (72.53%)	12 (13.19%)	10 (10.99%)	3 (3.30%)	91	
	Total	244 (66.12%)	67 (18.16%)	48 (13.01%)	10 (2.71%)	369	
Bad taste in mouth	Primary victims	114 (59.69%)	45 (23.56%)	23 (12.04%)	9 (4.71%)	191	0.6999
	Other victims	53 (61.63%)	16 (18.60%)	13 (15.12%)	4 (4.65%)	86	
	Non-victims	52 (57.14%)	18 (19.78%)	18 (19.78%)	3 (3.30%)	91	
	Total	219 (59.51%)	79 (21.47%)	54 (14.67%)	16 (4.35%)	368	
Nausea and/or vomiting	Primary victims	140 (73.68%)	38 (20%)	8 (4.21%)	4 (2.11%)	190	0.1831†
	Other victims	68 (79.07%)	14 (16.28%)	4 (4.65%)	0 (0%)	86	
	Non-victims	71 (78.02%)	11 (12.09%)	9 (9.89%)	0 (0%)	91	
	Total	279 (76.02%)	63 (17.17%)	21 (5.72%)	4 (1.09%)	367	
Indigestion, constipation, or diarrhea	Primary victims	79 (41.36%)	52 (27.23%)	44 (23.04%)	16 (8.38%)	191	0.8355
	Other victims	33 (38.82%)	25 (29.41%)	23 (27.06%)	4 (4.71%)	85	
	Non-victims	42 (46.15%)	23 (25.27%)	21 (23.08%)	5 (5.49%)	91	
	Total	154 (41.96%)	100 (27.25%)	88 (23.98%)	25 (6.81%)	367	
Rash or skin irritation	Primary victims	121 (63.35%)	41 (21.47%)	19 (9.95%)	10 (5.24%)	191	0.7572
	Other victims	50 (58.14%)	21 (24.42%)	10 (11.63%)	5 (5.81%)	86	
	Non-victims	58 (63.74%)	14 (15.38%)	13 (14.29%)	6 (6.59%)	91	
	Total	229 (62.23%)	76 (20.65%)	42 (11.41%)	21 (5.71%)	368	
Muscle soreness, aches, and pains	Primary victims	40 (20.94%)	68 (35.60%)	52 (27.23%)	31 (16.23%)	191	0.8258
	Other victims	25 (29.07%)	27 (31.40%)	19 (22.09%)	15 (17.44%)	86	
	Non-victims	21 (23.08%)	30 (32.97%)	23 (25.27%)	17 (18.68%)	91	
	Total	86 (23.37%)	125 (33.97%)	94 (25.54%)	63 (17.12%)	368	

* χ^2 test unless otherwise indicated.

†Fisher exact test.

Primary victims indicates persons with maximum exposure to traumatic event. Other victims, grieving relatives and friends of primary victims; or persons involved in rescue, recovery or clean up operations; or persons who but for chance would have been primary victims or those who led others to take a course of action, which resulted in their becoming primary victims. Non-victims, persons with minimal exposure to the traumatic event.

relative to non-victims. The scores for other victims were similar to that of non-victims ($\chi^2 = 6.35$, $P = 0.0418$). Similarly, primary victims were more likely to have higher mean scores on the intrusion and hyperarousal sub-scales relative to other and non-victims. ($P = 0.0458$ and $P = 0.0033$, respectively). Also, the total IES-R scores tended to increase with age. Relative to persons who were 39 years old or younger, IES-R scores were 63.1% higher in respondents who were ≥ 60 years old and 52.0% higher for those who were 40 to 59 years old ($\chi^2 = 8.04$, $P = 0.0179$).

New Onset Psychiatric Illnesses in the 2 Years After 9/11. Overall, 9.0% of subjects reported that they had been diagnosed with a psychiatric illness such as depression, anxiety, or panic attacks between 9/11 and the time of the survey. Those who worked NOC were more likely to have been diagnosed with a psychiatric illness compared with those who worked SOC (16% vs 5%; $P = 0.0008$). Similarly, non-victims and other victims tended to report new onset psychiatric diagnoses relative to primary victims (13.1% vs 9.4% vs 6.9%) although these differences did not achieve statistical significance ($P = 0.2241$).

Work Productivity 2 Years After 9/11

Absenteeism. The respondents were expected to work an average of 38 hours each week. Overall, respondents reported that they had worked on average 38 hours in the week before the survey. The mean number of total days absent including sick and non-sick days in the 28 days (4 weeks) before the survey was 4.15 (SD = 5.0) days. There were no statistically significant differences in the number of total days absent based on location of work or level of personal exposure to WTC trauma (Table 5).

As shown in Table 5, the mean number of sick days absent because of problems with physical or mental health in the 4 weeks before the survey was 1.83 (SD = 5.1) days for all the subjects. NOC workers had a slightly higher average number of sick days absent compared with SOC workers (2.2 days vs 1.6 days; $P = 0.3036$). Similarly, non-victims had a slightly higher average number of sick days absent compared with other victims and primary victims (2.2 days vs 1.8 days vs 3.2 days; $P = 0.1317$).

On-the-Job Productivity Losses. The possible range of scores for presenteeism questions adapted from the WHO HPQ was 5 to 25.¹⁶ The presenteeism questions were modified from the original because of concerns expressed by labor representatives about some of the questions in the WHO questionnaire. There are no established benchmarks for the adapted questionnaire. The mean presenteeism score for all the subjects was 9.44 (SD = 3.7). A median score of 9 was used as the criteria for presenteeism in the adapted questionnaire. Overall, 42.2% of subjects had presenteeism scores greater than 9, indicating lower quality of work within the 4 weeks (28 days) before the survey. There were no statistically significant differences in presenteeism scores based on location of work or level of exposure to 9/11 trauma (Table 6).

Self-Reported Changes in Overall Job Performance. On average, all the respondents reported a slight decrease (−9%) in their overall job performance in the 4 weeks before the survey relative to their usual performance in the months before 9/11. Persons who had the highest levels of direct exposures tended to report slightly more decrements in job performance relative to those who had lower exposures to WTC trauma, although the differences did not achieve statistical significance. SOC workers reported a 10% decrease whereas NOC workers reported a 7% decrease in job performance.

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TABLE 5

Self-Reported Absenteeism 2 yr After 9/11

	No. Sick Days Absent Because of Physical or Mental Health Problems in Prior 4 wk (mean \pm SD)	<i>P</i> *	No. Total Days Absent in Prior 4 wk (Sick Days and Non-sick Days) (mean \pm SD)	<i>P</i> *
Worksite location on 9/11				
SOC	1.63 \pm 4.45	0.3036	4.40 \pm 5.05	0.1909
NOC	2.21 \pm 6.15		3.66 \pm 5.02	
Total	1.83 \pm 5.09		4.15 \pm 5.05	
Level of exposure to WTC trauma				
Primary victims	1.67 \pm 4.67	0.7405	4.34 \pm 5.10	0.1317
Other victims	1.83 \pm 3.90		4.68 \pm 5.08	
Non-victims	2.17 \pm 6.73		3.25 \pm 4.85	
Total	1.83 \pm 5.09		4.15 \pm 5.05	

*t test.

SOC indicates worksite was located south of Canal Street on September 11, 2001; NOC, worksite was located north of Canal Street on September 11, 2001. Primary victims, persons with maximum exposure to traumatic event. Other victims, grieving relatives and friends of primary victims; or persons involved in rescue, recovery or clean up operations; or persons who but for chance would have been primary victims or those who led others to take a course of action, which resulted in their becoming primary victims. Non-victims, persons with minimal exposure to the traumatic event.

TABLE 6

Self-Reported On-the-Job Productivity Losses 2 yr After 9/11

	Presenteeism Score ≤9 (%)	Presenteeism Score >9 (%)	Total*	P†
Worksite location on 9/11				
SOC	134 (55.60)	107 (44.0)	241	0.2668‡
NOC	78 (61.90)	48 (38.10)	126	
Total	212 (57.77)	155 (42.23)	367	
Level of exposure to WTC trauma				
Primary victims	108 (56.84)	82 (43.16)	190	0.6936
Other victims	48 (55.81)	38 (44.19)	86	
Non-victims	56 (61.54)	35 (38.46)	91	
Total	212 (57.77)	155 (42.23)	367	

*Data are missing on two subjects.

† χ^2 test unless otherwise indicated.

‡Fisher exact test.

SOC indicates worksite was located south of Canal Street on September 11, 2001; NOC, worksite was located north of Canal Street on September 11, 2001. Primary victims, persons with maximum exposure to traumatic event. Other victims, grieving relatives and friends of primary victims; or persons involved in rescue, recovery or clean up operations; or persons who but for chance would have been primary victims or those who led others to take a course of action, which resulted in their becoming primary victims. Non-victims, persons with minimal exposure to the traumatic event.

TABLE 7

Perceived Job Stress yr After 9/11

	Isostrain Jobs (%)	Other Jobs (%)	Total*	P†
Worksite location on 9/11				
SOC	36 (14.8)	207 (85.1)	243	0.1094
NOC	27 (21.4)	99 (78.5)	126	
Total	63 (17.1)	306 (82.9)	369	
Level of exposure to WTC trauma				
Primary victims	31 (16.1)	161 (83.8)	192	0.3240
Other victims	12 (13.9)	74 (86.0)	86	
Non-victims	20 (21.9)	71 (78.0)	91	
Total	63 (17.1)	306 (82.9)	369	

*Data is missing on six subjects.

† χ^2 test.

SOC indicates worksite was located south of Canal Street on September 11, 2001; NOC, worksite was located north of Canal Street on September 11, 2001. Primary victims, persons with maximum exposure to traumatic event. Other victims, grieving relatives and friends of primary victims; or persons involved in rescue, recovery or clean up operations; or persons who but for chance would have been primary victims or those who led others to take a course of action which resulted in their becoming primary victims. Non-victims, persons with minimal exposure to the traumatic event. Isostrain job, high job strain in a setting of low social support. Defensive organizational cultures, aggressive or defensive and passive or defensive.

mance 2 years after 9/11 ($P = 0.27$). Similarly, primary victims reported a 10% decrease, other victims reported a 9% decrease, whereas non-victims reported a 6% decrease in job performance ($P = 0.17$).

The Relationship Between Work Organizational Factors and Outcome Variables of Interest

Job Stress. We categorized perceived job stress into passive jobs,

active jobs, low-strain jobs, and high-strain jobs using the psychological job demand and decision latitude model.²⁵ Overall, 33.1% of the respondents had passive jobs, 25.2% had active jobs, 20.6% had low-strain jobs, and 21.1% had high-strain jobs. We also considered the effect of workplace social support on job stress and added a subcategory of isostrain, which consists of high strain in a setting of low social sup-

port.²⁶ Overall, 17.1% of all respondents had isostrain jobs. Although there were no statistically significant differences based on work location or personal level of exposure to WTC trauma, the proportion of isostrain jobs was higher in NOC workers relative to SOC workers (21.4% vs 14.8%; $P = 0.1094$); and in non-victims relative to other victims and primary victims (21.9% vs 13.9% vs 16.1%; $P = 0.3240$) (Table 7). Given that isostrain is the highest level of perceived job stress, we used this as the indicator variable for job stress in multivariate analyses.

Organizational Culture. We categorized organizational culture into three main profiles (see OCI definitions in the Appendix) using the Organizational Culture Inventory.¹⁸ Overall, 34.4% of the respondents indicated that their workplace culture was Constructive, 42.5% reported a Passive/Defensive culture, whereas 23.1% reported an Aggressive/Defensive culture. For the purposes of multivariate analyses, we categorized organizational culture into two main variables: Constructive cultures and Defensive (Aggressive/Defensive and Passive/Defensive) cultures. Although there were no statistically significant differences based on work location or personal level of exposure to WTC trauma, the distribution of Defensive organizational cultures was slightly higher in NOC workers relative to SOC workers (82.2% vs 76.1%; $P = 0.18$). Also, 80.0% of non-victims, 85.7% of other victims, and 74.1% of primary victims reported Defensive organizational cultures at their respective worksites ($P = 0.0886$) (Table 8).

We also examined if organizational factors (perceived job stress and organizational culture) were independent predictors of any of the health or work productivity outcomes in a population of office workers who worked in Manhattan on 9/11, having controlled for covariates of interest. Workers who reported Defensive organizational cultures were 2.57 times more likely to report that they had isostrain jobs (high

TABLE 8

Perceived Workplace Culture 2 yr After 9/11

	Defensive Organizational Culture (%)	Constructive Organizational Culture (%)	Total*	P†
Worksite location on 9/11				
SOC	182 (76.1)	57 (23.8)	239	0.1811
NOC	102 (82.2)	22 (17.7)	124	
Total	284 (78.2)	79 (21.7)	363	
Level of exposure to WTC trauma				
Primary victims	140 (74.1)	49 (25.9)	189	0.0886
Other victims	72 (85.7)	12 (14.2)	84	
Non-victims	72 (80)	18 (20)	90	
Total	284 (78.2)	79 (21.7)	363	

*Data is missing on six subjects.

† χ^2 test.

SOC indicates worksite was located south of Canal Street on September 11, 2001; NOC, worksite was located north of Canal Street on September 11, 2001. Primary victims, persons with maximum exposure to traumatic event. Other victims, grieving relatives and friends of primary victims; or persons involved in rescue, recovery or clean up operations; or persons who but for chance would have been primary victims or those who led others to take a course of action which resulted in their becoming primary victims. Non-victims, persons with minimal exposure to the traumatic event. Isostrain job, high job strain in a setting of low social support. Defensive organizational cultures, aggressive or defensive and passive or defensive.

demand, low control, and low social support) compared with those who reported Constructive organizational cultures ($\chi^2 = 6.05$, $P = 0.0139$). Although organizational culture was not a significant predictor of psychological distress, it was a significant predictor of cough. Workers who reported Defensive organizational cultures were 34% more likely to report cough relative to those who reported a Constructive organizational culture ($\chi^2 = 5.29$, $P = 0.0214$). On-the-job productivity losses (presenteeism scores) were 15.3% higher for persons who worked in isostrain jobs relative to those with less stressful jobs ($\chi^2 = 4.17$, $P = 0.0411$).

Discussion

The magnitude of human and economic loss from the terrorist attacks on the WTC on 9/11 has been unparalleled in the United States since the Civil War.²⁷ The majority of studies that have examined the psychological sequelae of the WTC disaster have tended to focus on NYC community adult residents^{27–33} and children^{34,35} or nation-wide surveys that assessed the stress reactions of Americans after 9/11.^{36–38} Although research has

been done on post-disaster sequelae among workers who were directly involved in WTC rescue and recovery operations,^{4–7,39} and short-term health effects in office workers in close proximity to the WTC,^{8,9} fewer studies have examined the long-term health impact of the WTC disaster on office workers who were in proximity to the WTC disaster³ and long-term worker productivity.¹¹ Specifically data are lacking on the organizational factors that predict post-disaster symptomatology or changes in worker productivity in response to different levels of worker exposures to WTC trauma.

In this study, we categorized office workers' WTC-related exposures based on geographical location of the worksite and on personal levels of exposures to the traumatic event. By adopting the classification of victims of disasters by Taylor and Frazer,¹⁹ we were able to determine if there was a dose-response relationship between levels of exposures and reported symptoms after the WTC terrorist attacks. Our study demonstrated that relative to their counterparts with lower or indirect exposures, office workers who had the highest levels of exposure to WTC trauma (primary

victims) or those whose worksites were located closest to the WTC (SOC) were significantly more likely to report cough or severe headaches or migraine 2 years after 9/11, and there was a dose-response relationship in the reports of cough based on personal levels of exposures to the WTC terrorist attacks.

We posit that the reported physical symptoms are related to exposures to irritant vapors, fumes, and particulates from the WTC debris and air pollutants. This is biologically plausible given that fires continued to smolder in ground zero for more than 3 months after 9/11, causing plumes of acrid smoke to pollute the air. Also, resuspended dusts were generated from debris removal and site recovery activities. Hence, the contamination of indoor air in office buildings in surrounding areas.^{40–42} The higher prevalence of cough or headache among highly exposed office workers in the present study is consistent with other studies that have reported respiratory or irritant symptoms among responders that were present in the cloud of dust when the buildings collapsed or those who worked at ground zero soon thereafter. For example, the phenomenon of "WTC cough" or "aerodigestive syndrome" because of mucous membrane irritation have been reported in WTC rescue and recovery workers,^{41,43} and some of these symptoms have persisted for more than 2 years after 9/11.⁶

Almost 80% of subjects reported either an Aggressive/Defensive or Passive/Defensive organizational culture in the workplace, and office workers who reported such negative organizational cultures were 34% more likely to report cough relative to those who reported a Constructive or positive organizational culture. This suggests that organizational variables may be independent predictors of symptoms in an office population 2 years post-disaster. It is uncertain whether this finding relates to subjects' prior disaster exposure or is simply a product of the organi-

zational culture itself. Does the perception of a negative work culture predispose to more health complaints even more so in aftermath of disaster exposure? The modifying effect of work culture on the reporting of physical symptoms in response to traumatic events in the work environment is an important area for further research.

Persons exposed to traumatic events can experience multiple symptoms with varying intensities including difficulty concentrating, memory loss, psychological distress, which may cause tardiness, absenteeism, and diminished work quality. For example, Dirkzwager et al.⁴⁴ demonstrated a doubling of the average length of sickness absence among rescue workers who attended to a firework depot explosion in the Netherlands that resulted in 22 deaths and injured about 1000 people. There is little empirical data on work absence and productivity losses among office workers in the aftermath of a large-scale workplace disaster.

Data from the present study showed that the WTC terrorist attacks had minimal impact on absenteeism, on-the-job productivity losses, and changes in self-reported job performance in office workers 2 years after the event. Although there appeared to be a dose-response relationship in decreases in overall self-reported job performance based on levels of exposures to WTC trauma, the differences did not achieve statistical significance. Nevertheless, this study demonstrated that a Defensive organizational culture was an important predictor of perceived job stress. Specifically, persons who reported Defensive organizational cultures were more than twice as likely to report high job strain with low social support (ie, isostrain) relative to their counterparts who reported Constructive organizational cultures. Furthermore, persons who worked in isostrain jobs tended to have higher on-the-job productivity losses relative to their counterparts with less stressful jobs.

Although the magnitude of the WTC terrorist attacks was much larger than the 1995 bombing of the Alfred P.

Murrah Federal Building in Oklahoma City, data from this study and other researchers^{27,31} indicate that the long-term psychological sequelae from the WTC disaster is relatively low when compared with the psychological impact of the bombing disaster on Oklahoma City survivors and residents. For example, approximately 45% of the survivors (primary victims) of the Oklahoma City bombing had a post-disaster psychiatric disorder approximately 6 months after the event.² There was also a doubling in the reported rates of perceived stress and psychological distress among adult residents of the Oklahoma City metropolitan areas and these psychological effects persisted for more than 1 year after the bombing.⁴⁵

The prevalence of clinically significant psychological distress 2 years after the WTC terrorist attacks was relatively low among office workers in this study. Only 7% of the respondents endorsed symptoms of nonspecific psychological distress, and multivariate analysis showed that this was likely related to personal life-event stressors and not because of WTC trauma. Even among those subjects that had the highest level of exposure to the 9/11 trauma (primary victims), the prevalence of psychological distress was approximately 8%. This relatively low level of post-disaster psychological sequelae has been observed in another study of NYC residents where the investigators found that PTSD prevalence declined from 7.5% 1 month after 9/11 to 0.6% 6 months after 9/11.³¹

The reasons for the differential psychological impact of the terrorist attacks in Oklahoma City versus NYC are unknown. A possible explanation for the lower prevalence of long-term psychological sequelae post-9/11 is that NYC is a more fast-paced, high-stress environment overall relative to Oklahoma City. Also, NYC has had prior terrorism exposure with the bombing of the WTC in the early 1990s. In addition, there was tremendous national and international outpouring of psychosocial or financial

support for NYC victims after 9/11. As such NYC residents and workers may have been better able to cope and were less likely to have long-term psychological distress compared with their counterparts in Oklahoma City. The reason(s) for the differential impacts of disasters or traumatic events on psychological symptoms in diverse communities is an important area for future research.

An unexpected finding in this study is the significantly higher rates of reporting of new onset psychiatric illnesses such as depression, anxiety disorder, and panic attacks in the 2 years after 9/11 among persons that were not directly exposed to WTC trauma (NOC workers) relative to persons with more direct exposures (SOC workers). We hypothesize that relative to NOC workers who comprised largely of non-victims, those that were directly exposed (SOC workers, primary victims) were more likely to have had access to or utilized WTC-related psychological or counseling programs made available by employer or community organizations. As such, the higher rates of reported psychiatric illnesses in persons considered less exposed may in fact be a delayed reaction from indirect exposures to the large-scale disaster that traumatized the entire nation and was not recognized in workers that were located further away from the WTC attacks.

An important study limitation is that the study was conducted 2 years after 9/11. As such, persons who were the most adversely impacted by WTC trauma and were no longer hired at the worksites at the time of the survey are not represented in the study population. Hence, this study is only representative of the "survivor" population, and likely underestimates the true prevalence of symptoms and productivity losses in the exposed population. On the other hand, those workers who volunteered to participate may have had higher exposures, or experienced health effects post-9/11 and as such may be overrepresented in the study population. Also,

as with any survey research, all data reported are based on subjects' self-report, as such objective measures of work productivity variables that can only be obtained from employer records were not available to these investigators.

Although our study population was racially and socioeconomically diverse, and a wide variety of industries or professions were well represented in the study population, another limitation of this study is that the population is comprised of public sector and union workers. As such the results cannot be generalized to private sector workers as there are likely organizational culture differences between public versus private sector workers. For example, more than half of our study population had worked for the same employer for at least 10 years. This is not likely representative of the private sector workers who may have shorter average work tenures with the same employer, hence a more mobile workforce. In addition, the sample size of this pilot study is relatively small. A much larger study that includes private sector workers would be required to be able to generalize the research findings to all office workers.

In conclusion, the majority of office workers in this study reported that they were in good or excellent health 2 years after 9/11. Those workers that had the highest exposures to the WTC attacks were more likely to report headaches or cough relative to their less exposed counterparts. A perception of Defensive organizational cultures was highly prevalent in the study population. Office workers who reported Defensive organizational cultures were more likely to report cough and perceived job stress compared with those who reported Constructive organizational cultures. Job stress was an independent predictor of on-the-job productivity losses. The modifying effect of organizational culture on workers' health and productivity in response to traumatic events in the

work environment is an important area for further research.

Acknowledgment

This research was supported in part by the Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health (NIOSH) Grant 5 R21 OH007713-02, and the NIEHS sponsored UMDNJ Center for Environmental Exposures and Disease, Grant NIEHS P30ES005022.

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Appendix

TABLE A1

Descriptions of the 12 Styles Measured by the Organizational Culture Inventory

Cluster and Style	Description
Constructive norms—styles promoting satisfaction behaviors	
Achievement	Characterizes organizations that do things well and values members who set and accomplish their own goals
Self-actualizing	Characterizes organizations that value creativity, quality over quantity, and both task accomplishment and individual growth
Humanistic-encouraging	Characterizes organizations that are managed in a participative and people-centered way
Affiliative	Characterizes organizations that place high priority on constructive interpersonal relationships
Passive/Defensive norms—styles promoting people-security behaviors	
Approval	Characterizes organizations in which conflicts are avoided and interpersonal relationships are pleasant—at least superficially
Conventional	Characterizes organizations that are conservative, traditional, and bureaucratically controlled
Dependent	Characterizes organizations that are hierarchically controlled and non-participative
Avoidance	Characterizes organizations that fail to reward success but nevertheless punish mistakes
Aggressive/Defensive norms—styles promoting task-security behaviors	
Oppositional	Characterizes organizations in which confrontation prevails and negativity is rewarded
Power	Characterizes non-participative organizations structured on the basis of the authority inherent in members' positions
Competitive	Characterizes organizations in which winning is valued and members are rewarded for "out-performing" one another
Perfectionistic	Characterizes organizations in which perfection, persistence, and intolerance for mistakes are valued

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