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Physical Health Status of World Trade Center Rescue and Recovery Workers and Volunteers -- New York City, July 2002--August 2004

In the months after the September 11, 2001, attacks on the World Trade Center (WTC), concerns grew the health consequences of exposures sustained by persons involved in the rescue and recovery respons addition to the estimated 10,000 Fire Department of New York (FDNY) personnel, an estimated 30,00 other workers and volunteers potentially were exposed to numerous psychological stressors, environme toxins, and other physical hazards. These concerns prompted CDC's National Institute for Occupational Safety and Health (NIOSH) to support the WTC Worker and Volunteer Medical Screening Program, w provided free, standardized medical assessments, clinical referrals, and occupational health education f workers and volunteers exposed to hazards during the WTC rescue and recovery effort. During July 16, 2002--August 6, 2004, the program evaluated 11,768 non-FDNY workers and volunteers. This report summarizes data analyzed from a subset of 1,138 of the 11,768 participants evaluated at Mount Sinai S of Medicine during July 16--December 31, 2002. These data indicated that a substantial proportion of participants experienced new-onset or worsened preexisting lower and upper respiratory symptoms, wit frequent persistence of symptoms for months after their WTC response work stopped. These findings underscore the need for comprehensive health assessment and treatment for workers and volunteers participating in rescue and recovery efforts.

The clinical program included a single screening evaluation consisting of medical- and exposure-assess questionnaires, physical examination, pre- and post-bronchodilator (BD) spirometry, complete blood c blood chemistries, urinalysis, chest radiograph, and mental health screening questionnaires. Participant were recruited through outreach that included community and union meetings, mailings, and articles in media. Eligibility for the screening program was based on arrival date and duration of exposure to the s rather than on symptomatology. Institutional review board approval and informed consent were obtaine data aggregation and analyses.

The subset of 1,138 program participants was predominantly male (91%) and non-Hispanic white (58% with a median age of 41 years (range: 21--74 years). Non-Hispanic blacks and Hispanics accounted for and 15% of the population, respectively. The largest occupational sectors represented in this sample we technical and utilities (25%), law enforcement (21%), and construction (18%). Numerous other occupat groups accounted for the remaining 36%; 89% were union members.

Of the 1,138 participants, 525 (46%) worked on WTC rescue and recovery efforts on September 11, 20 and 963 (84%) worked or volunteered during September 11--14, when exposures were greatest. During period, a total of 239 (21%) participants reported using appropriate respiratory protection (i.e., full- or h

face respirators) (*1*). The median length of time worked on the WTC effort was 966 hours (range 24--4, hours). Of the 610 examinees present in lower Manhattan on September 11, a total of 313 (51%) reporte being directly in the cloud of dust created by the collapse of the WTC buildings, and an additional 191 (31%) reported exposure to substantial amounts of dust.

A participant was considered to have a WTC-related symptom if the symptom either first developed (incident) or worsened (exacerbated) while working or volunteering on the WTC effort. WTC-related lo respiratory symptoms were reported by 682 (60%) of the sample, and 836 (74%) reported WTC-related upper respiratory symptoms. A total of 450 (40%) examinees had WTC-incident lower respiratory symptoms that persisted to the month before screening, and 565 (50%) reported WTC-incident and persistent upper respiratory symptoms (Table 1). Among the 851 participants who reported persistent W related symptoms, an average of 32 weeks (range: 7--63 weeks) had elapsed since either they stopped working at the site or since the end of May 2002, when site cleanup was officially completed[†]. On examination, 527 (46%) had nasal mucosal inflammation. Other respiratory abnormalities (e.g., abnorm nasal turbinates or sinuses, rhonchi, and wheezing) were less common.

All participants underwent spirometry before and after an inhaled BD using standard techniques (*2*). A of 360 (33%) participants had abnormal spirometry findings (Table 2), primarily because of results suggesting restriction; 84 (23%) had a significant[§] post-BD response. A total of 22 (27%) of those with airway obstruction had a significant BD response consistent with asthma.

Compared with a general population sample of employed, adult, white males (National Health and Nutr Examination Surveys [NHANES III]) (*3*), the 599 participants who had never smoked had a higher prevalence of abnormalities on spirometry (31% versus 13%), which was attributable to a higher preval of restriction (21% versus 4%).

Participants experienced numerous other symptoms (Table 3), including a substantial proportion with incident and persistent musculoskeletal symptoms, such as low back pain (16%) and upper or lower extremity pain (16% and 13%, respectively). Other incident and persistent symptoms included heartbur (15%), eye irritation (14%), and frequent headache (13%). Overall, 364 (23%) of the sample reported previously receiving medical care for WTC-related respiratory conditions. A total of 214 (19%) of examinees reported missing work because of WTC-related health problems (median: 10 days; range: 1- days).

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Editorial Note:

The findings in this report indicate that a substantial proportion of program participants had new-onset a persistent upper and lower airway symptoms, musculoskeletal symptoms, and gastrointestinal symptom addition, a substantial proportion of participants had respiratory abnormalities on spirometry. This preliminary analysis is consistent with earlier reports from WTC screening programs conducted by FDN (*4,5*), which documented a substantial proportion of respiratory symptoms in emergency response work These findings suggest a need for continued monitoring and appropriate treatment of WTC responders.

NIOSH recently funded a program that will provide continued medical screening of responders for an additional 5 years. Through philanthropic sources, a WTC Health Effects Treatment Program was

established to provide further clinical evaluation and treatment to responders at no cost. Thus far, this program has provided approximately 3,587 services to 844 responders, 40% of whom lacked health insurance.

A substantial proportion of workers evaluated in this program had low forced vital capacity (FVC). Restrictive lung diseases (low FVC) typically develop during a long period and are not the consequence airway irritant exposures such as those experienced by WTC workers. Reduction in FVC might be attributable to air trapping rather than true restriction (i.e., pseudo-restriction), a hypothesis supported b increase of FVC into the normal range after inhaled BD in 29% of the workers with low FVC. Further analyses that include lung volume measurement might clarify the implications of these findings.

The destruction of the WTC towers resulted in the release of high levels of airborne contaminants (*6*). T Environmental Protection Agency estimated that potential dust exposures ranged from 1,000 $\mu g/m^3$ to >100,000 $\mu g/m^3$ in the hours after the towers' collapse. Exposures were attributed primarily to smolderi fires (until December 2001), dust resuspension, and diesel exhaust from heavy equipment. WTC dust contained pulverized (alkaline) cement, glass fibers, asbestos, polycyclic aromatic hydrocarbons (PAHs polychlorinated biphenyls (PCBs), and polychlorinated furans and dioxins. WTC dust was highly alkali (pH: 9.0--11.0) (*7*). The deposit of larger particles in the upper respiratory tract might have resulted in persistent upper airway inflammation. Highly irritant, respirable particles are likely to have accounted f lower airway symptoms and clinical findings. Administration of respirable particulate (particles <2.5 μ diameter) WTC dust to rodents resulted in lower airway hyper-responsiveness (*8*). Thus, the findings in WTC examinees are consistent with current understanding of WTC exposures; however, the persistence symptoms for >1 year after the 9/11 event is a new finding and requires further study.

The findings in this report are subject to at least three limitations. First, no reliable statistics exist on the or composition of the exposed worker/volunteer population, so determining participation rates for the screening program is not possible, and generalizations to all WTC-exposed workers should be made wi caution. Second, the screened population might overrepresent those most affected; those screened earlie might not be representative of all persons screened with regard to WTC exposures or health outcomes, a persons examined earlier might have had more severe health problems and sought out the program for t reason. However, preliminary analyses of exposure data among all persons examined through January 2 2004, demonstrate similar patterns of acute and longer-term WTC exposures. Additional analyses of da the remainder of the cohort will address concerns regarding health outcomes of persons screened later i program. Finally, because of the absence of pre-9/11 symptom prevalence and pulmonary function tests (PFTs) for these participants, the ability to measure accurately the impact of WTC exposures on respon health is limited. Because of the absence of an unexposed control group, spirometry data from this sam were compared with those of NHANES III (*3*).

This report underscores the need for comprehensive occupational health assessment and treatment for r workers and volunteers as part of all emergency preparedness programs. Guidelines for professional emergency response workers have been developed (*1*). The results described in this report suggest that disaster preparedness also should include 1) planning for rapid provision of suitable respiratory and oth protective gear and 2) provision of medical care for first responders and nontraditional responders (e.g., persons from construction trades, utility workers, and other occupational groups).

Acknowledgments

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* Minimum of 24 hours working/volunteering during September 11--30, 2001, or >80 hours during September 11--Novemb 2001, either south of Canal Street, the Staten Island landfill, or the barge loading piers. Employees of the Office of the Chief Medical Examiner also were eligible, regardless of hours worked. FDNY and State of New York employees had access to o screening programs and were not eligible for this program.

† After official site closure, exposure levels were reduced markedly.

§ Defined by using the American Thoracic Society criteria or an increase in either forced expiratory volume in 1 second (FE or forced vital capacity (FVC) of >12% and >0.2 L, respectively.

Table 1

TABLE 1. Number and percentage of World Trade Center (WTC) rescue and recovery workers and volunteers reporting upper lower respiratory symptoms, by symptom — New York City, July 16–December 31, 2002

Symptom	Previous history (prevalence in year before September 11, 2001)*†		Worsened while working or volunteering on WTC effort§		Incidence (new onset) while working or volunteering on WTC effort¶		Incidence (n onset) an persistent month befo screening	
	No.	(%)	No.	(%)	No.	(%)	No.	(%
Lower respiratory	217	(19.1)	87	(40.1)	654	(57.5)†	450	(39.5
Dry cough (excluding colds)	58	(5.1)	23	(39.7)	403	(37.3)	213	(19.7
Cough with phlegm (excluding colds)	57	(5.0)	25	(43.9)	214	(19.8)	110	(10.2
Shortness of breath	79	(6.9)	28	(35.4)	261	(24.6)	206	(19.5
Wheezing apart from having a cold	75	(6.6)	24	(32.0)	195	(18.3)	105	(9.9
Chest tightness upon waking or at any other time of day	51	(4.5)	16	(31.4)	216	(19.9)	148	(13.6
Upper respiratory**	487	(42.8)	250	(51.3)	794	(69.8)†	565	(49.6
Facial pain or pressure	41	(3.6)	18	(43.9)	84	(7.7)	67	(6.1
Head or sinus congestion	292	(25.7)	151	(51.7)	249	(29.4)	177	(20.9
Post-nasal discharge	143	(12.6)	55	(38.5)	174	(17.5)	121	(12.2
Blowing nose more than usual	52	(4.6)	23	(44.2)	388	(35.7)	196	(18.0
Nosebleeds	30	(2.6)	8	(26.7)	84	(7.6)	24	(2.2
Stuffy nose	208	(18.3)	91	(43.8)	326	(35.1)	216	(23.2
Sneezing	131	(11.4)	53	(40.8)	245	(24.3)	148	(14.7
Runny nose	105	(9.2)	37	(35.2)	195	(18.9)	114	(11.0
Irritation in nose	46	(4.0)	28	(60.9)	187	(17.1)	92	(8.4
Ear fullness ("blocked")	66	(5.8)	18	(27.3)	144	(13.4)	115	(10.7
Ear pain	16	(1.4)	5	(31.3)	64	(5.8)	44	(3.9
Throat irritation	50	(4.4)	23	(46.0)	481	(44.2)	246	(22.6
Sore throat	52	(4.6)	22	(42.3)	360	(33.1)	180	(16.6
Hoarseness	49	(4.3)	18	(36.7)	298	(27.4)	171	(15.7
Losing voice	4	(0.4)	1	(25.0)	86	(7.6)	35	(3.1

* A number of participants (n = two to 19) are missing data on this question; except for chest tightness, 164 are missing.
† Denominator = 1,138.
§ Denominator = participants with previous history.
¶ Denominator = 1,138 minus participants with previous history.
** All are excluding colds, except for those with facial pain or pressure.

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Table 2

TABLE 2. Number and percentage of World Trade Center (WTC) rescue and recovery workers and volunteers who received spirom testing, by cigarette smoking status, bronchodilator (BD) response, and spirometry results — New York City, July 16–December 31, 2

Spirometry results	Cigarette smoking status: Never		Former		Current		Total*		BD response†	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)
Normal	412	(69)	179	(70)	134	(59)	725	(67)	39	(5)
Obstruction§	48	(8.0)	18	(7)	15	(7)	81	(7)	22	(27)
Obstruction and low FVC¶	11	(2)	5	(2)	10	(4)	26	(2)	10	(38)
Restriction** ††	128	(21)	55	(21)	70	(31)	253	(23)	52	(21)
Total	599	(55)	257	(24)	229	(21)	1,085		123	(11)

* Includes 1,085 participants with three good spirometry maneuvers and valid smoking-status responses.
† Defined as an increase of >12% and >0.2 L in forced vital capacity (FVC) or forced expiratory volume in 1 second (FEV1) after inhaling albu respectively.
§ FEV1 / FVC < lower limit of normal range (LLN) and FVC > LLN (pre-BD).
¶ FEV1 / FVC < LLN and FVC < LLN.
** FVC < LLN and FEV1 / FVC ≥ LLN.
†† Includes 75 participants with a normal FVC after BD (pseudo-restriction).

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Table 3

TABLE 3. Number and percentage of World Trade Center (WTC) rescue and recovery workers and volunteers reporting sympt other than upper and lower respiratory symptoms, by type of symptom — New York City, July 16–December 31, 2002

Symptom	Previous history (prevalence in year before September 11, 2001)†§ No.	(%)	Worsened while working or volunteering on WTC effort¶ No.	(%)	Incidence (new onset) while working or volunteering on WTC effort** No.	(%)	Incidence (new onset) persistent month befo screening No.	(%
Musculoskeletal symptoms								
Low back pain	304	(26.7)	80	(26.3)	155	(18.6)	130	(15
Neck/Upper back pain	138	(12.1)	39	(28.3)	136	(13.6)	116	(1
Any upper extremity pain	215	(18.9)	52	(24.2)	203	(17.8)§	182	(16
Shoulder pain	119	(10.5)	27	(22.7)	98	(9.6)	88	(8
Elbow/Forearm pain	51	(4.5)	8	(15.7)	50	(4.8)	44	(4
Hand/Wrist pain	75	(6.6)	16	(21.3)	61	(5.7)	55	(5
Pain, numbeness, or tingling in fingers	85	(7.5)	20	(23.5)	97	(9.2)	84	(8
Any lower extremity pain	256	(22.5)	75	(29.3)	170	(14.9)§	146	(12
Hip/Thigh pain	58	(5.1)	18	(31.0)	48	(4.4)	40	(3
Knee pain	174	(15.3)	48	(27.4)	64	(6.6)	60	(6
Lower leg pain	45	(4.0)	9	(20.0)	41	(3.8)	38	(3
Pain, numbness, or tingling in feet	69	(6.1)	15	(21.7)	79	(7.4)	62	(5
Other symptoms								
Frequent headache	110	(9.7)	35	(31.8)	179	(17.4)	130	(12
Eye irritation	66	(5.8)	33	(50.0)	422	(39.4)	146	(13
Dizziness	40	(3.5)	9	(22.5)	151	(13.8)	99	(9
Chest pain with exertion	27	(2.4)	3	(11.1)	58	(5.2)	42	(3
Chest pain at rest	27	(2.4)	5	(18.5)	66	(5.9)	48	(4
Coughing up blood	2	(0.2)	0	(0.0)	44	(3.9)	5	(0
Nausea/Vomiting	19	(1.7)	4	(21.1)	117	(10.5)	55	(4
Indigestion/Heartburn	248	(21.8)	76	(30.7)	168	(18.9)	135	(15
Diarrhea	57	(5.0)	15	(26.3)	93	(8.6)	57	(5
Rash	64	(5.6)	16	(25.0)	164	(15.3)	79	(7

* Lasting more than a week or severe enough to result in missed work.
† A number of participants (n = four to 20) are missing data on specific questions.
§ Denominator = 1,138.
¶ Denominator = participants with previous history.
** Denominator = 1,138 minus participants with previous history.

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