

SECTION 2

MEDICAL AND EXPOSURE ASSESSMENT

The information contained in Section 2 has been gathered from medical questionnaires taken by active and retired FDNY members at the FDNY Bureau of Health Services during medical monitoring evaluations administered post-WTC. Active FDNY members were asked to respond to the questionnaire at their periodic company medical, which now includes the WTC medical.



On 9/11/01, BHS physicians immediately responded to the WTC. They were present during and after the collapse, seeing first-hand how FDNY rescue workers suffered from eye and skin irritation, nasal drip/congestion, coughing, breathing difficulties and other respiratory symptoms. The medical screening program developed by FDNY-BHS four weeks after 9/11 evaluated and monitored these symptoms in our first responders.

Members had blood tests administered, including complete blood cell counts, chemistries, lipid profiles, heavy metal screening and urine analysis. The blood and urine samples from the first 321 FDNY rescue workers were sent to the CDC's National Laboratory to test for more than 110 chemicals, including heavy metals, polycyclic aromatic hydrocarbons, PCBs and dioxins. These tests showed no clinically significant elevations and, therefore, bio-monitoring tests on the rest of our group (more than 13,600 additional members) concentrated on certain highly toxic heavy metals (lead, mercury and beryllium) and total PCBs. Testing found heavy metals to be within normal clinical limits for all of our members and total PCBs to be within normal limits for nearly all. In a group of approximately 50 Firefighters, PCB tests showed mild elevations.

The initial post-9/11 medical evaluation also included a chest x-ray, pulmonary function testing, EKG, hearing evaluations and a physical by our Medical Officers. At each medical, FDNY rescue workers also participated in an educational presentation with a question/answer ses-

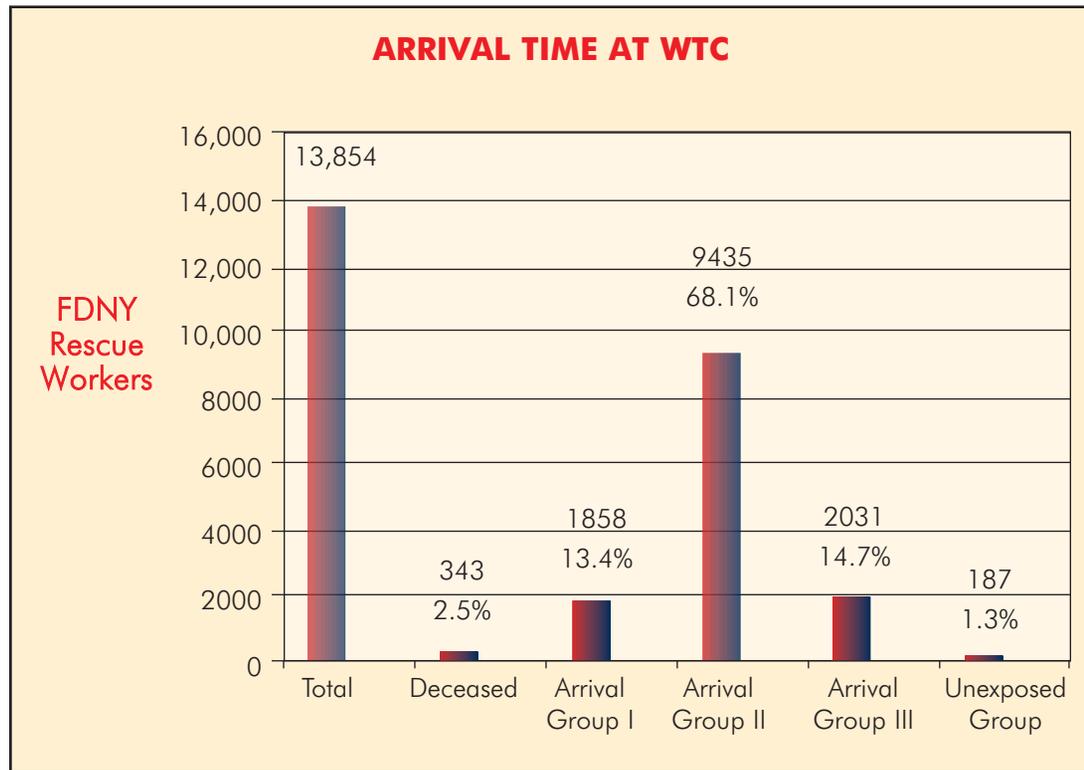
sion that reviewed WTC-related physical and mental health challenges, stress recognition and coping strategies.

To assess the long-term physiological and psychological impacts of 9/11 on rescue workers and their families, the WTC Program developed a series of self-administered, computerized questionnaires, in conjunction with periodic medical interviewing and testing of active members and retirees. The initial questionnaire was conducted from October 2001 to October 2002 and then was replaced with an updated questionnaire that ran from October 2002 until August 2005. The total number of members responding was 9953 in the first year and more than 14,200 cumulatively as of December 31, 2006. In the future, we will strive to give monitoring examinations to all 16,200 members with whom we have been in contact.

Responses have been analyzed for the October 2001 to August 2005 period. We are continuing to compile similar data from August 2005 to date, using newer versions of the computerized questionnaire. We have had an unprecedented response that clearly reflects our members' recognition of the importance of the FDNY-WTC Program and their active participation. We hope that our members will continue to participate, as the information we gain helps us to deliver the health services that best fit our members' needs. The results of these questionnaires, as shown on the following pages, indicate that many WTC-related symptoms and conditions (respiratory and mental health) are strongly tied to arrival time at the WTC site.

SECTION 2 • MEDICAL QUESTIONNAIRE DATA

In an effort to better understand the health effects of Ground Zero exposure on FDNY employees, we classified rescue workers into four groups, based on their estimated arrival times at the WTC site.¹



- **Arrival Group I** 1858 FDNY rescue workers present at WTC on the morning of 9/11/01 during the collapse
- **Arrival Group II** 9435 FDNY rescue workers who first came to the WTC site in the afternoon of Day 1 or anytime on Day 2
- **Arrival Group III** 2031 FDNY rescue workers who first came to the WTC site on Day 3 or later
- **Unexposed Group** 187 FDNY rescue workers with no presence, at anytime, at the WTC site

Ninety-nine percent of the group surveyed responded to the WTC. There was a job-wide recall that brought in active members. In addition, many retired members volunteered and that response continued for the weeks and months to come. In the initial trauma of that day, our injured members were taken to local hospital centers (including locations in New Jersey), most with significant orthopedic injuries and a few with severe respiratory injuries requiring mechanical ventilatory support. Members critically injured by falling debris required hospitalization and, for some, orthopedic surgeries to recover. In the first 24 hours, 240 FDNY members were treated in emergency departments and 28 members were admitted to hospitals. Some members had respiratory difficulties that began that day, but for many others, respiratory symptoms surfaced in the days, weeks and months after 9/11/01.

¹ Data analysis collected from questionnaires completed by FDNY rescue workers Oct. 2001-Aug. 2005.

Day 1

- 56% never wore a mask/respirator
- 23% rarely wore a mask/respirator
- 21% mostly wore a mask/respirator

Day 2

- 47% never worn
- 23% rarely worn
- 30% mostly worn

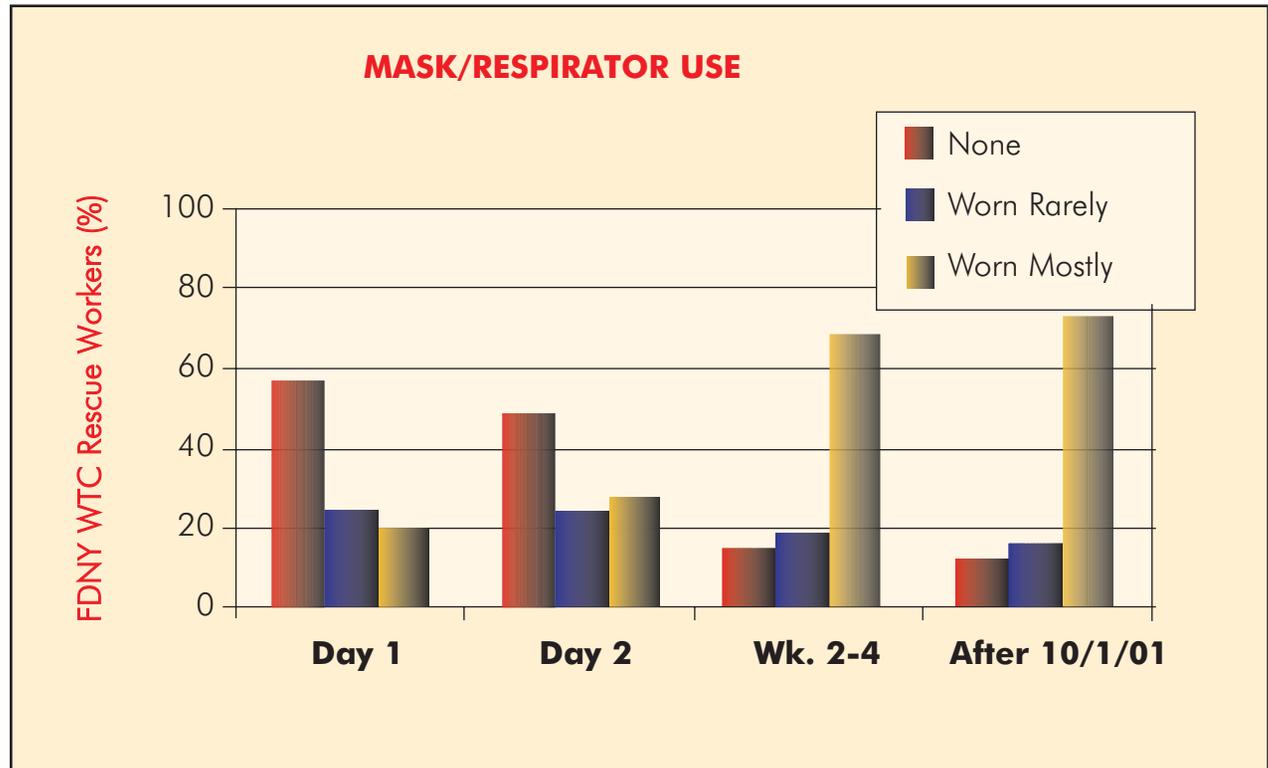
Weeks 2-4

- 12% never worn
- 19% rarely worn
- 69% mostly worn

After Oct. 1, 2001

- 9% never worn
- 16% rarely worn
- 75% mostly worn

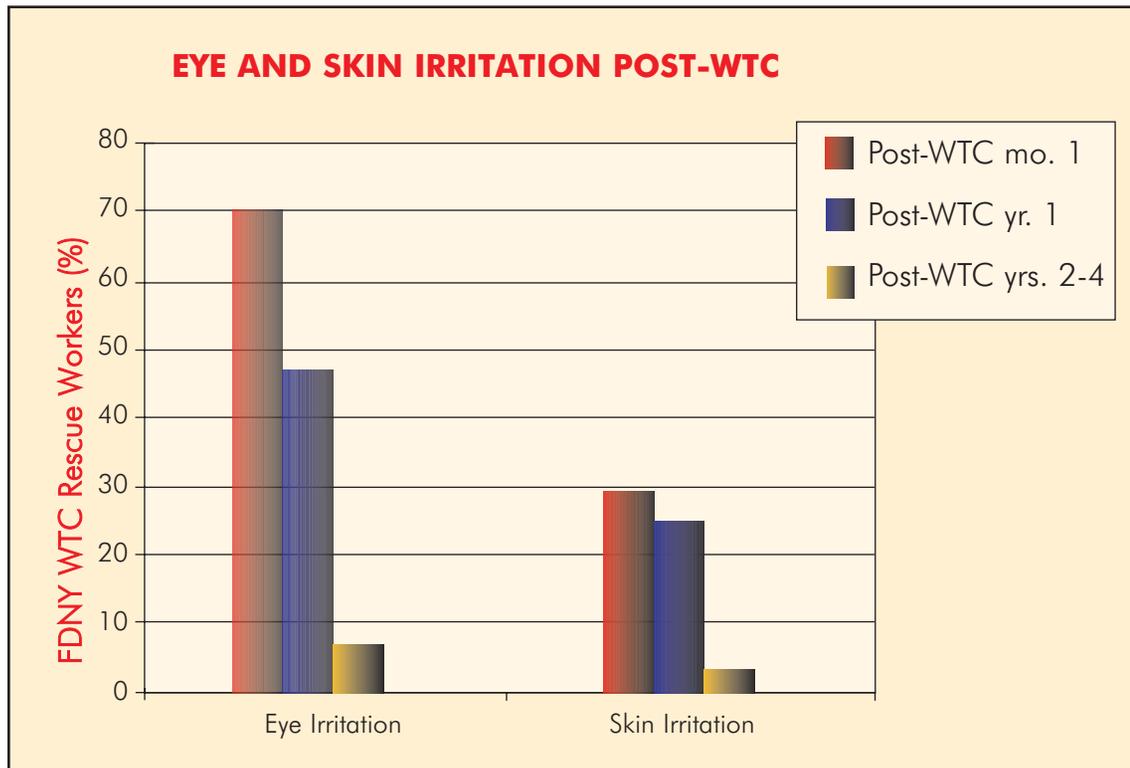
Frequency of mask and/or respirator* use is a prominent factor considered when determining the severity of the exposure experienced by WTC rescue workers.²



When the towers collapsed, an enormous dust cloud with a high concentration of particulate matter consumed lower Manhattan. FDNY first responders constantly inhaled this thick air, a process made worse by strenuous work and open-mouth breathing. On Day 1, even those with self-contained breathing apparatus (SCBA) only had clean air for about 15 minutes. After the SCBAs ran out of air and for the many who did not have an SCBA, there were few respirators available to rescue workers and those who used protection wore dust masks. N95 “TB” respirators are correct for biological emergencies; however, dust, surgical masks and N95 “TB” respirators do not provide adequate respiratory protection at a collapse/fire disaster site. The correct mask for this exposure (P-100 respirator) was not widely available until after the first week. The intense environmental exposure is directly related to the respiratory symptoms/illnesses described throughout this publication.

* A respirator is a specially fitted device worn over the mouth and/or nose that protects the respiratory system of the user.
²Data analysis collected from questionnaires completed by FDNY rescue workers Oct. 2001-Oct. 2002.

The number of rescue workers suffering from eye and skin irritation has decreased dramatically as time has progressed.³



Eye and skin irritations were likely to occur when exposed to the thick dust cloud, as evidenced by the high rates of these symptoms in the first months after 9/11/01. There has been a dramatic decline in the incidence of both types of irritation in years 2-4. Currently, few continue to report eye and skin symptoms.

One Month Post-WTC

- 70% of rescue workers had eye irritation
- 30% had skin irritation

One Year Post-WTC

- 47% had eye irritation
- 25% had skin irritation

Years 2-4 Post-WTC

- 7% had eye irritation
- 4% had skin irritation

³Data analysis collected from questionnaires completed by FDNY rescue workers Oct. 2001-Aug. 2005.

Daily Cough

- 54% of Arrival Group I
- 47% of Arrival Group II
- 31% of Arrival Group III

Shortness of Breath

- 38% of Arrival Group I
- 25% of Arrival Group II
- 14% of Arrival Group III

Wheezing

- 27% of Arrival Group I
- 20% of Arrival Group II
- 12% of Arrival Group III

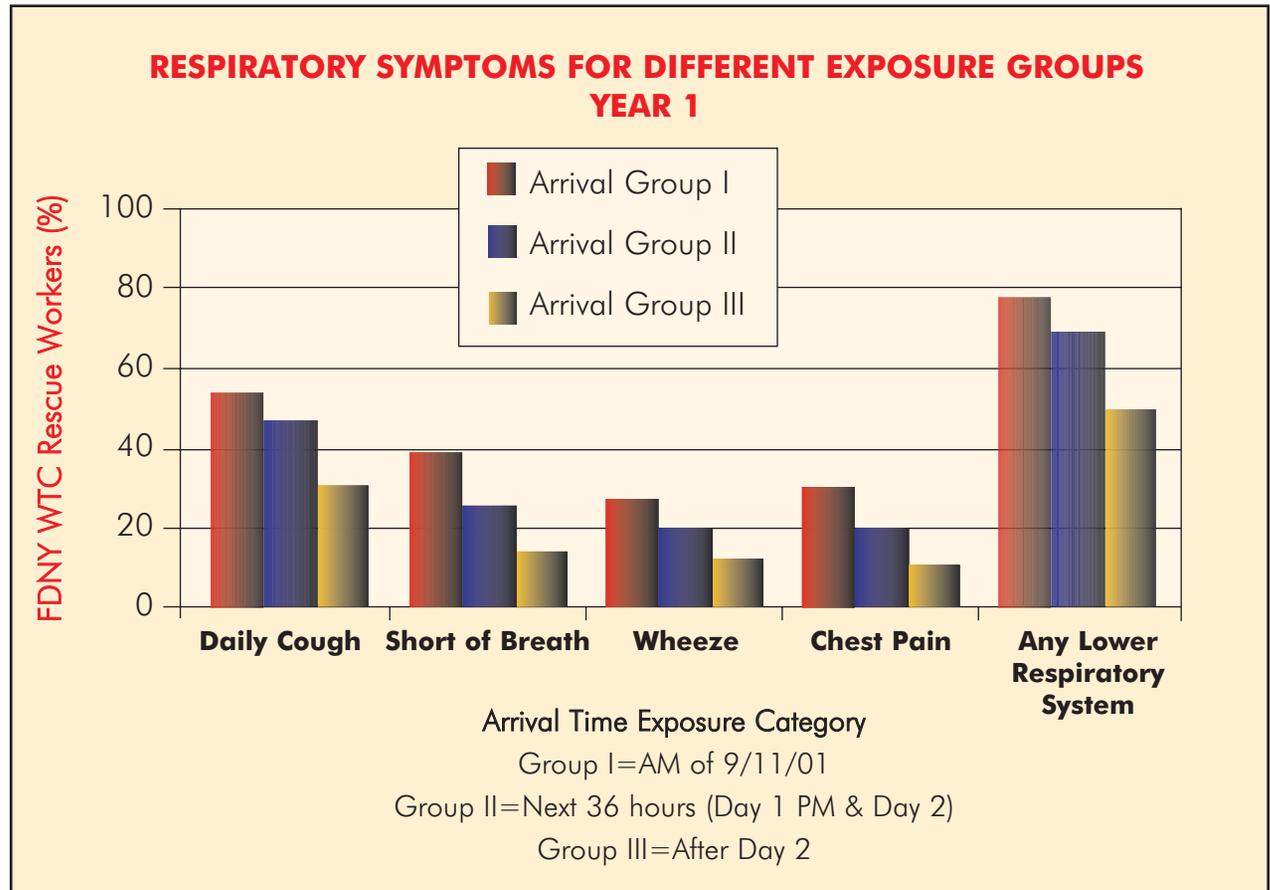
Chest Pain

- 30% of Arrival Group I
- 20% of Arrival Group II
- 10% of Arrival Group III

Any of these Symptoms

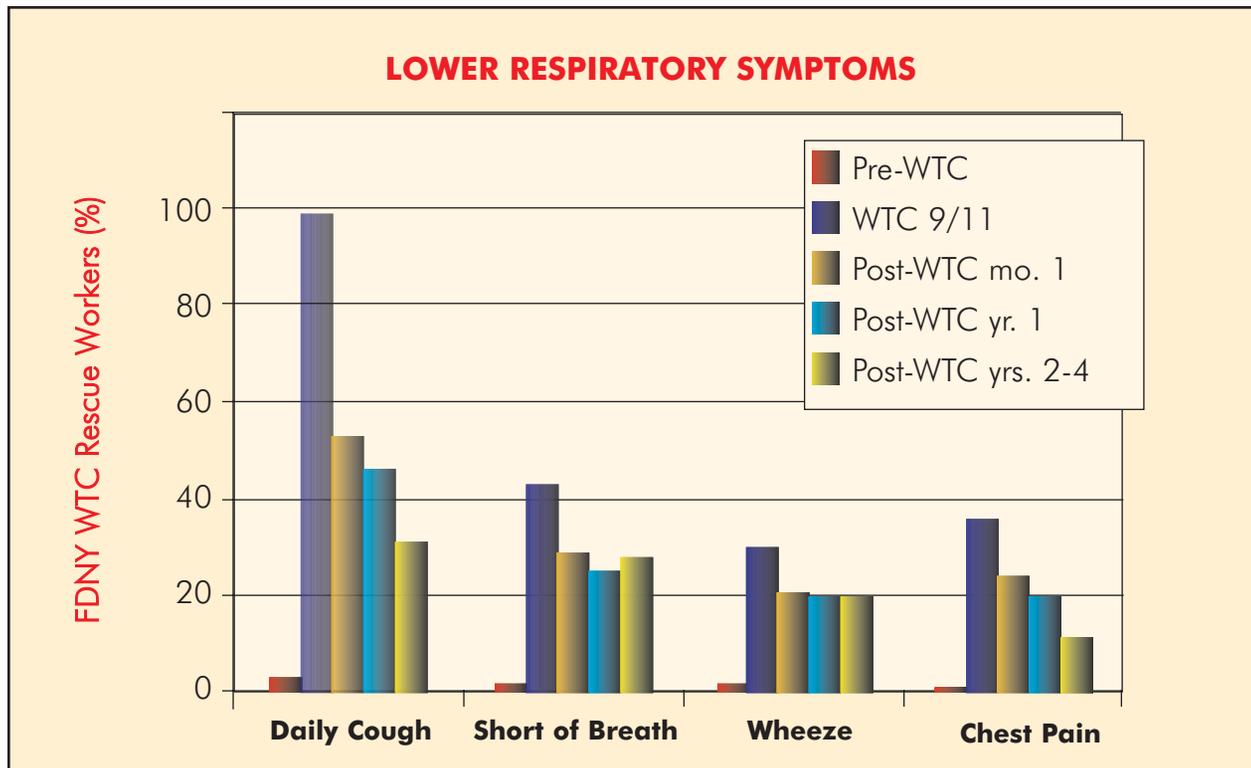
- 79% of Arrival Group I
- 69% of Arrival Group II
- 50% of Arrival Group III

The incidence of respiratory symptoms in the first year after 9/11/01 is directly related to WTC arrival time.⁴



In total, more than 79 percent of those present during the morning of 9/11/01 had at least one lower respiratory symptom, with a large number demonstrating multiple symptoms. Our data show a strong connection between WTC exposure and respiratory ailments. These data clearly indicate that earlier arrival times (especially within the first 48 hours) at WTC by FDNY members are associated with the highest incidence rate for respiratory symptoms. Other scientific groups have mirrored our results, showing a clear association between arrival time and loss of pulmonary function.

With early diagnosis and treatment, the incidence rate of lower respiratory symptoms has declined significantly since 9/11/01, but these symptoms persist in many of our members.⁵



Day 1 exposure to clouds of dust and debris resulted in cough symptoms for 99% of those present at the WTC site. One month later, more than half of our rescue workers were still reporting a daily cough and 2-4 years later, 31% were still struggling with this symptom. With early diagnosis and treatment, the incidence rate of this symptom improved compared to Day 1, but is still significantly higher than before 9/11/01 when only 3% of FDNY rescue workers reported a daily cough. Other lower respiratory symptoms have followed a similar evolution over time. These persistent symptoms, coupled with objective proof of pulmonary function declines (see page 29), are why FDNY WTC rescue workers should continue to participate in the long-term monitoring and treatment programs offered by the WTC Program.

Day 1 9/11/01

- 99% of FDNY rescue workers present were coughing
- 43% had shortness of breath
- 30% were wheezing
- 36% had chest pain

Month 1 Post-WTC

- 53% had a daily cough
- 29% had shortness of breath
- 21% were wheezing
- 24% had chest pain

Year 1 Post-WTC

- 46% had a daily cough
- 25% had shortness of breath
- 20% were wheezing
- 20% had chest pain

Years 2-4 Post-WTC

- 31% had a daily cough
- 28% had shortness of breath
- 20% were wheezing
- 11% had chest pain

⁵Data analysis collected from questionnaires completed by FDNY rescue workers Oct. 2001-Aug. 2005.

Day 1 9/11/01

- 99% of FDNY rescue workers present were coughing
- 80% had nasal congestion
- 63% had sore/hoarse throat

Month 1 Post-WTC

- 53% had a daily cough
- 40% had frequent nasal congestion
- 54% had frequent sore throat

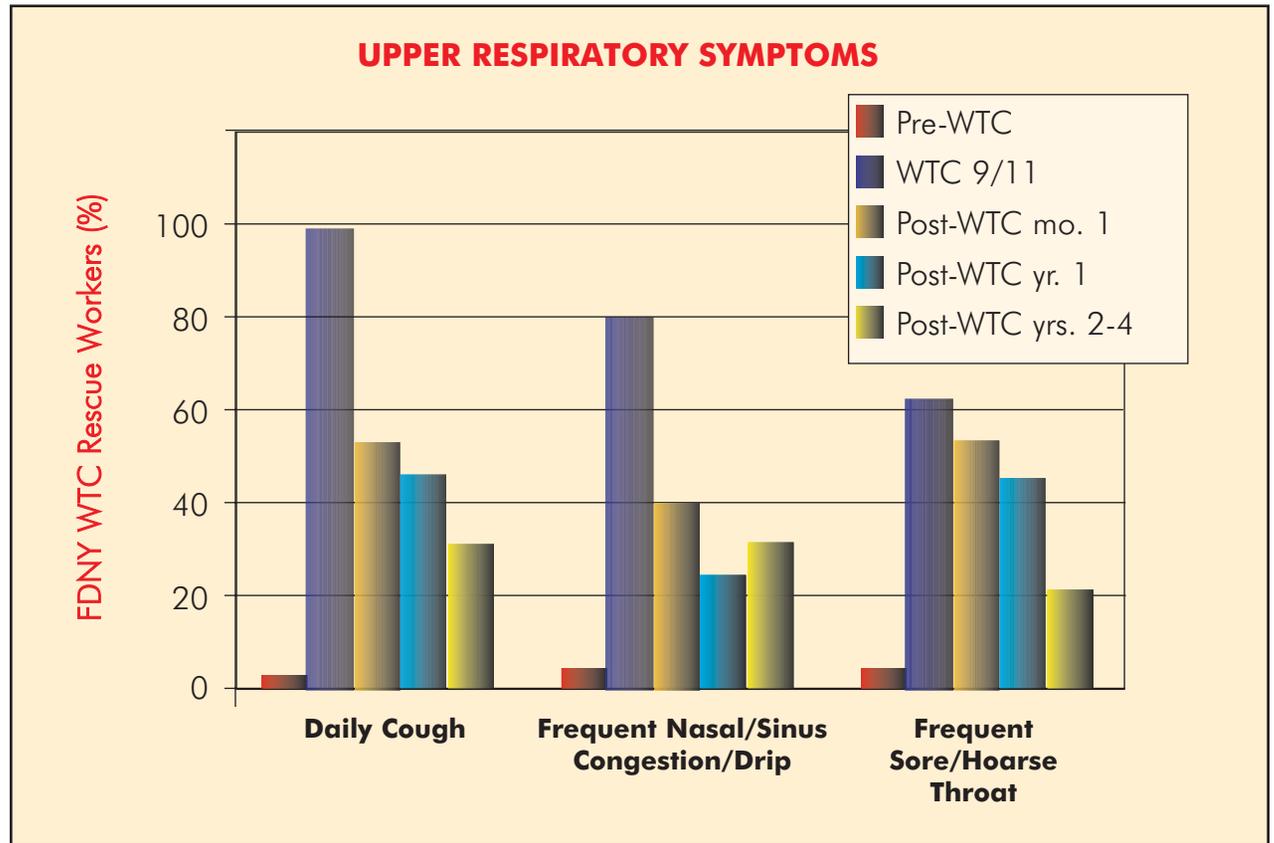
Year 1 Post-WTC

- 46% had a daily cough
- 25% had frequent nasal congestion
- 46% had frequent sore throat

Years 2-4 Post-WTC

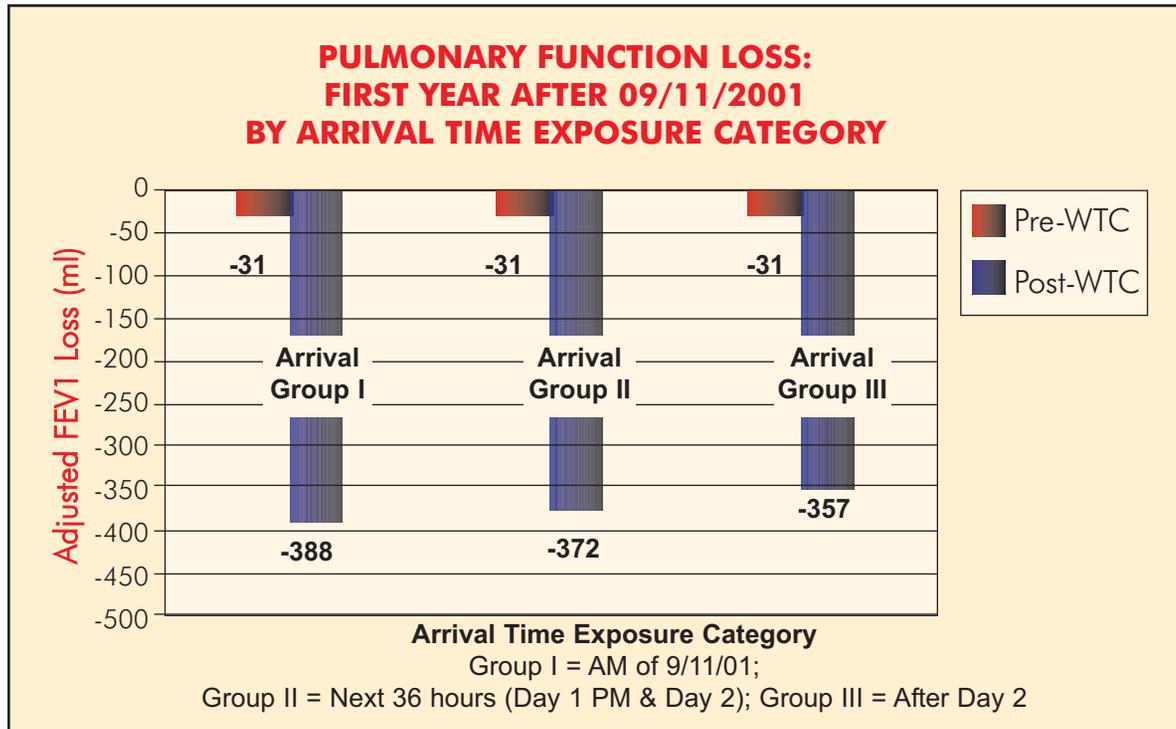
- 31% had a daily cough
- 32% had frequent nasal congestion
- 22% had frequent sore throat

Upper respiratory symptoms were the most common problems experienced by FDNY rescue workers, but these symptoms, while persistent in many, have also shown great improvement over time.⁶



Upper respiratory symptoms (cough, nasal/sinus congestion/drip, sore/hoarse throat) have all followed a similar evolution during the four years following 9/11/01. On Day 1, more than half of our work force experienced all of the above symptoms. One year later, more than half of our rescue workers were still reporting upper respiratory symptoms and 2-4 years later, about 25% were still struggling with daily or frequent symptoms. Particulate matter analysis has shown a highly alkaline pH of WTC dust (like lye), which is extremely irritating to upper and lower airways.

Although loss of lung function can be linked directly to arrival time, all exposure groups experienced an unprecedented decline in lung function within the first 12 months following the WTC attacks.⁷



Since 1997, FDNY rescue workers have participated in a periodic medical evaluation (every 12 to 15 months) to track health problems and determine work eligibility. One part of the evaluation is a pulmonary function test (PFT), which measures forced vital capacity (FVC) and forced expiratory volume after 1 second (FEV1). FVC is the total amount of air one can forcibly breathe out. FEV1 is the amount of air one can forcibly breathe out in the first second. As we grow older, both FVC and FEV1 decline naturally at an average rate of 20-30 ml per year. In this graph, we see a connection between arrival time at the WTC and pulmonary function loss, with members of Arrival Group I demonstrating a greater loss in FEV1 than members of Arrival Groups II and III. Although the reduction in pulmonary function was greatest for those present during the collapse, FEV1 and FVC was decreased even in FDNY rescue workers arriving at later time periods. Similar findings were found for the FVC. Data obtained after September 2002 now are being analyzed and future FDNY-WTC monitoring will allow us to determine if this decline plateaus, improves or continues. For those with symptoms, we believe that treatment is the best way to ensure appropriate diagnoses and improvement.

Pre-WTC

- On average, FDNY rescue workers lose 31 milliliters (ml) of FEV1 each year (similar to US population averages)

Within the First Year Post-WTC

- Members in Arrival Group I lost 388 ml of FEV1 on average (more than 12 times the average pre-WTC annual loss)
- Members in Arrival Group II lost 372 ml of FEV1 on average (12 times the average pre-WTC annual loss)
- Members in Arrival Group III lost 357 ml of FEV1 on average (more than 11 times the average pre-WTC annual loss)

⁷ Data analysis collected from PFTs by FDNY rescue workers Jan. 1996-Sept. 2002.

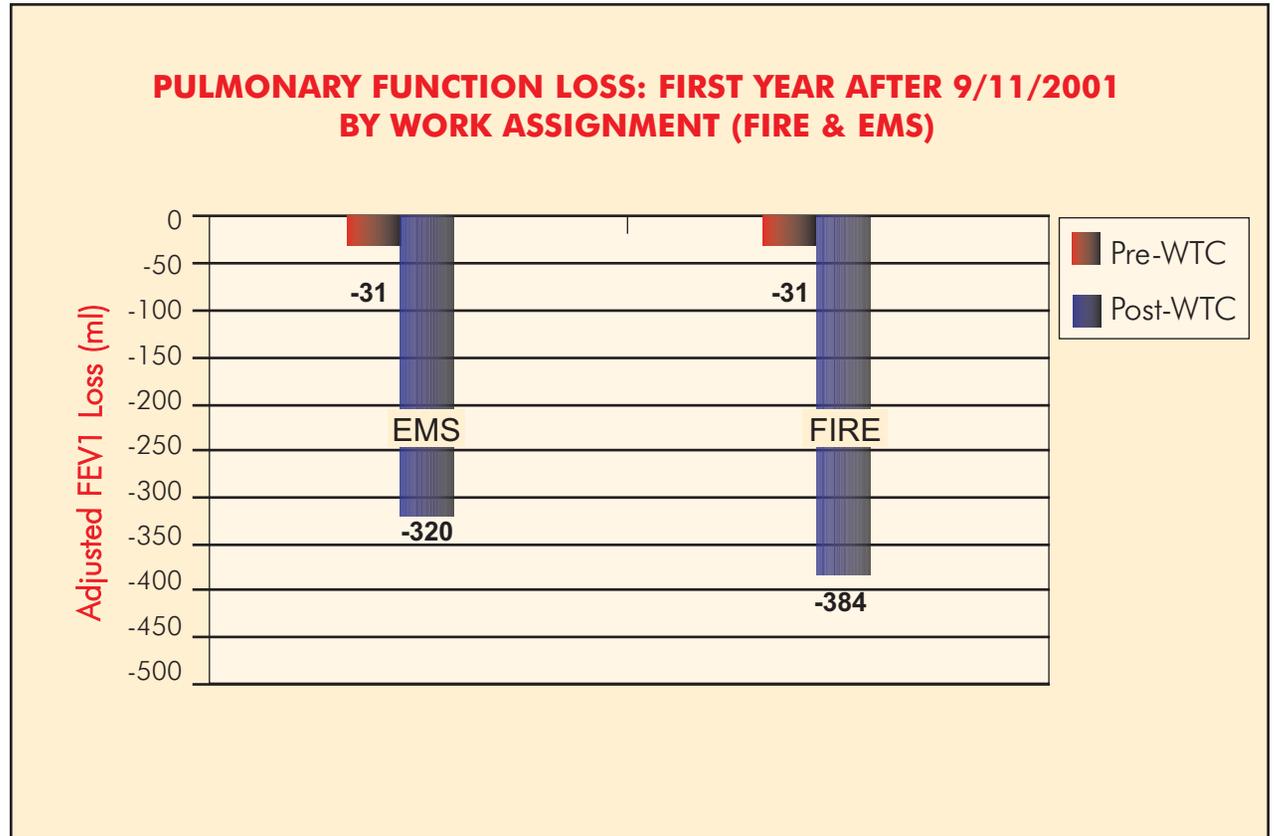
Pre-WTC

- Entire FDNY rescue worker population loses 31 ml of FEV1 each year (near national average)

First Year Post-WTC

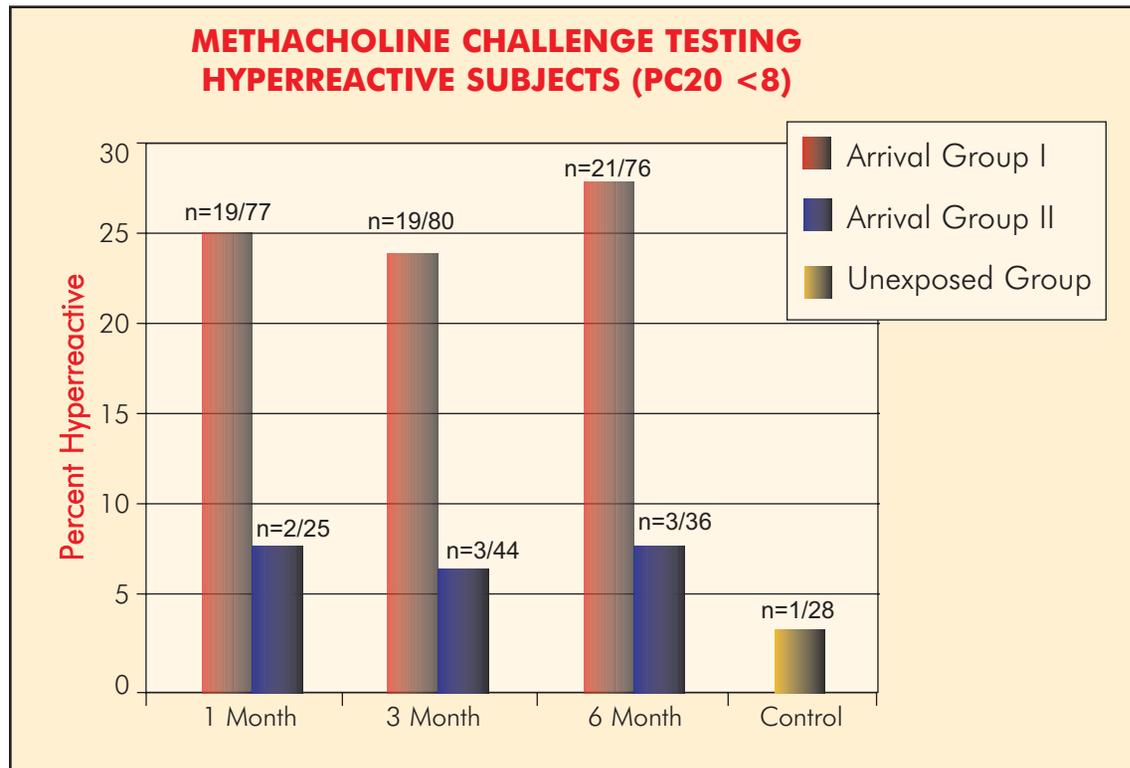
- EMS employees lost 320 ml of FEV1 on average (more than 10 times the average pre-WTC annual loss)
- Firefighters lost 384 ml of FEV1 on average (more than 12 times the average pre-WTC annual loss)
- Firefighters had 20% greater decline in FEV1 than EMS employees

When we break down our rescue workers into two groups, Firefighters had a greater average decline in pulmonary function than EMS members, but both groups still had greater average declines than pre-9/11/01.⁸



The greater decline of FEV1 in Firefighters compared to EMS workers likely is due to the differing roles of each job in the rescue and recovery effort. Fire suppression and search activities kept the Firefighters closer to the burning debris and pulverized rubble. Although EMS workers have lost less lung function than the Firefighters, on average, they still showed a substantial decline in lung function, indicating WTC environmental site exposure. Thus, job-related tasks performed and perhaps proximity to the Ground Zero site played roles in the loss of lung function.

The Methacholine Challenge Test (MCT) is a specialized, objective test used to confirm the diagnosis of asthma in symptomatic FDNY rescue workers who have normal pulmonary function.⁹



Methacholine is a chemical that when inhaled at increasing doses in a controlled setting, identifies who is likely to have asthmatic reactions. In susceptible subjects, this test can provoke an asthma attack (airway spasm). The American Thoracic Society defines significant airway hyperreactivity as a 20% drop in FEV1 at low-dose methacholine levels (<8mg methacholine). Airway hyperreactivity can be especially burdensome to Firefighters who, due to the nature of their job, often are exposed to smoke, fumes or other irritants. Similar to our symptom and PFT data, the methacholine challenge tests indicate a strong correlation with the earliest WTC arrival time. Before the WTC attacks, there was no history of asthma in our Firefighter work force. As shown in the above graph, these new onset cases in FDNY rescue workers were not just acute, temporary effects of exposure. Data we now are analyzing show long-term airway hyperreactivity persistence for 2 to 4 years among those initially affected.

1 Month Post-WTC, in a random sample:

- 24.7% of highly exposed workers have Airway Hyperreactivity (AHR)
- 8% of moderately exposed
- 3.6% of unexposed control group

3 Month Post-WTC, in a random sample:

- 23.8% of highly exposed workers have AHR
- 6.8% of moderately exposed
- 3.6% of unexposed control group

6 Month Post-WTC, in a random sample:

- 27.6% of highly exposed workers have AHR
- 8.3% of moderately exposed
- 3.6% of unexposed control group

⁹Data analysis collected from PFTs by FDNY rescue workers Oct. 2001-April 2002.

15 Years Pre-WTC

- 0 to 5 FDNY rescue workers contract sarcoidosis annually, an average incidence rate of 13/100,000. Most were asymptomatic

9/11/01-9/11/02

- 13 new cases develop in FDNY rescue workers, an 86/100,000 annual incidence rate (or more than a 6-fold increase from pre-WTC levels)

9/11/02-9/11/06

- 13 new cases of sarcoidosis develop in the next four years, an average annual incidence rate of 22/100,000

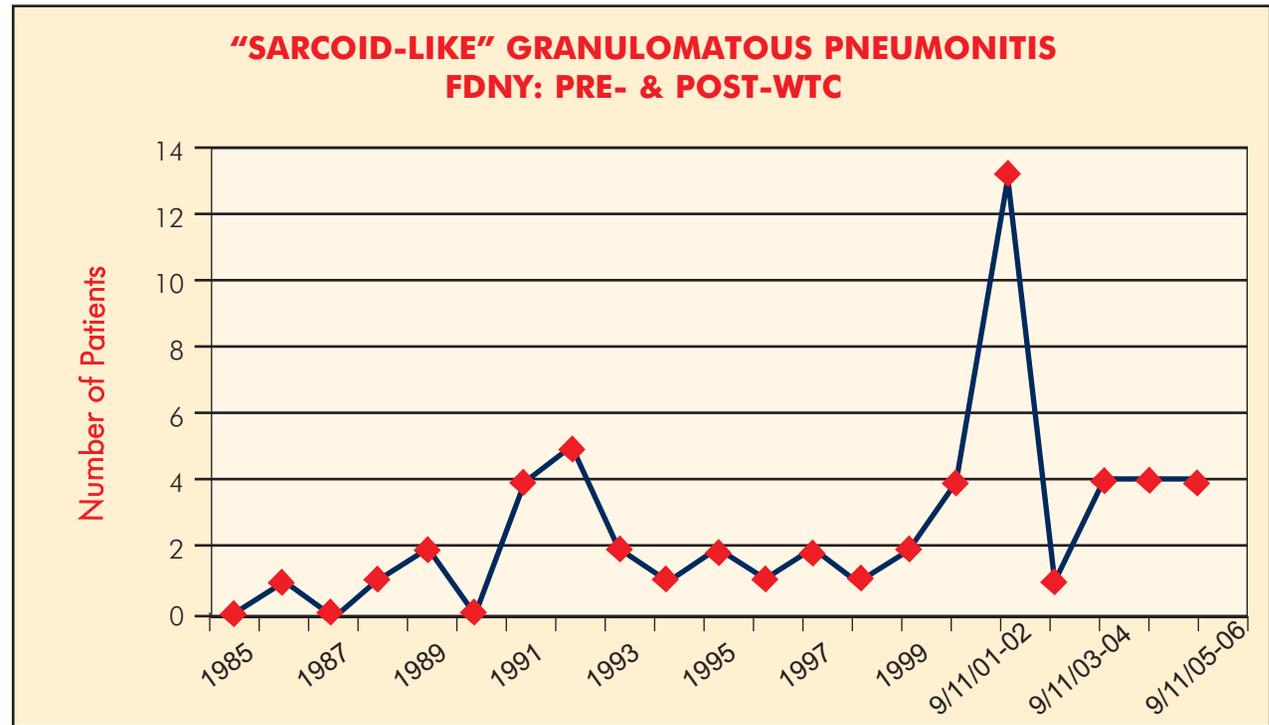
Asthma

- 69% of those diagnosed with sarcoidosis since 9/11/01 had new onset asthma

Airway Hyperreactivity (AHR)

- 8 of 21 (38%) of sarcoidosis patients who take a challenge test have AHR

OTHER RESPIRATORY DISEASES EMERGING AFTER 9/11/01: The incidence of sarcoidosis or WTC sarcoid-like granulomatous pulmonary disease (SLGPD) increased markedly in the first year post-WTC.¹⁰



Sarcoidosis is an inflammatory disease producing tiny lumps of cells (granulomas) in multiple organs, mainly the lungs, lymph nodes and skin, all of which are entry points for occupational and environmental agents. The cause is unclear, but sarcoidosis is associated with exposures to organic and chemical dusts, metals, silica and wood dust or smoke. Compared to population values, FDNY-BHS showed increased incidence of sarcoidosis in FDNY Firefighters during the 15 years pre-WTC, presumably due to smoke exposure. After 9/11/01, the number of new FDNY sarcoidosis cases increased dramatically, especially in the first year post-WTC. In contrast to pre-9/11, most new cases are symptomatic (69%) with shortness of breath, cough and other asthma-like symptoms. Because our cases primarily involve the lung, it may be more accurate to classify them as WTC "sarcoid-like" granulomatous pulmonary disease (SLGPD). Other rare pulmonary diseases in FDNY rescue workers have included 2 with eosinophilic pneumonitis (occurring in 2002 and cured with early diagnosis and treatment) and 4 with pulmonary fibrosis (1 fatality in 2004 and 1 who may need a lung transplant).