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Occupational Exposures to Air Contaminants at the World Trade Center Disaster Site — New York, September–October, 2001

Amid concerns about the fires and suspected presence of toxic materials in the rubble pile following the collapse of the World Trade Center (WTC) buildings on September 11, 2001, the New York City Department of Health (NYCDOH) asked CDC for assistance in evaluating occupational exposures at the site. CDC's National Institute for Occupational Safety and Health (NIOSH) collected general area (GA) and personal breathing zone (PBZ) air samples for numerous potential air contaminants. This report summarizes the results of the assessment, which indicate that most exposures, including asbestos, did not exceed NIOSH recommended exposure limits (RELs) or Occupational Safety and Health Administration (OSHA) permissible exposure limits (PELs) (*1,2*). One torch cutter was overexposed to cadmium; another worker was overexposed to carbon monoxide (CO) while cutting metal beams with an oxyacetylene torch or a gasoline-powered saw, and two more were possibly overexposed to CO. NIOSH recommended that workers ensure adequate on-site ventilation when using gas-powered equipment and use rechargeable, battery-powered equipment when possible.

Toxic substances of concern included asbestos (from insulation and fireproofing materials), concrete (made from Portland cement and used in the buildings' construction) and the crystalline silica it contained, CO (from fires and engine exhaust), diesel exhaust (from vehicles and equipment), mercury (from fluorescent lights), chlorodifluoromethane (Freon™-22, from air conditioning systems), heavy metals (from building materials), hydrogen sulfide (from sewers, anaerobically decomposing bodies, and spoiled food), inorganic acids, volatile organic compounds (VOCs), and polynuclear aromatic hydrocarbons (PAHs) (from fires and engine exhaust). Environmental sampling during September 18–October 4 focused on search-and-rescue personnel, heavy equipment operators, and workers cutting metal beams (Figure 1) but also included various other occupations. A total of 1,174 air samples was collected, including 804 for asbestos. NYCDOH contractors collected most of the asbestos samples; NIOSH personnel collected all other samples. In addition, NIOSH collected 33 bulk samples of dust, debris, and other materials.

FIGURE 1. A worker clears rubble at the World Trade Center disaster site using an oxyacetylene torch

Photo/National Institute for Occupational Safety and Health

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All samples were collected and analyzed according to the NIOSH Manual of Analytic Methods (*3*) with some modifications.

A total of 29 bulk samples of undisturbed settled material from various locations was analyzed for asbestos; 27 of these also were analyzed for crystalline silica and metals. Of the 29 samples, 26 (90%) had <1% asbestos (by mass); the three others had 1%–3%. All but one of 27 samples had crystalline silica; concentrations (by mass) ranged from 0–18%, with a median (for all 27 samples) of 3.2%. The most abundant metals in the samples were calcium, magnesium, aluminum, iron, and zinc. Lead, arsenic, cadmium, and beryllium concentrations (by mass) were <0.1%. Three bulk samples of fireproofing material on I-beams from the main debris pile were analyzed for asbestos; one was negative, and two had <1% asbestos. A sample of paint from a metal beam had 0.3% lead.

Phase contrast microscopy (PCM) revealed fibers in 358 (45%) of the 804 asbestos air samples. Excluding 30-minute samples, 25 samples had fiber concentrations that, if the fibers had been asbestos, would have exceeded the REL of 0.1 fibers per cubic centimeter of air (f/cc) (*1*). None of the 30-minute sample concentrations exceeded the OSHA short-term excursion limit of 1.0 f/cc (*2*). Of the 25 samples with fiber concentrations ≥0.1 f/cc (range: 0.1–0.5 f/cc) by PCM, 18 were analyzed by transmission electron microscopy (TEM), which can distinguish between asbestos and nonasbestos fibers. All had asbestos concentrations <0.1 f/cc. The seven samples not analyzed by TEM had fiber concentrations ranging from 0.1–0.2 f/cc. Differential analysis by polarized light microscopy of these same 25 air samples revealed most nonasbestos fibers to be fibrous glass, gypsum, and cellulose.

Air concentrations of total (36 samples) and respirable (18 samples) particulate ranged up to 2.3 milligrams per cubic meter (mg/m^3) and 0.3 mg/m^3, respectively, which are below the corresponding RELs of 10.0 mg/m^3 and 5.0 mg/m^3 for Portland cement (*1*). Respirable crystalline silica was not detected in any of 18 air samples. Of 45 air samples analyzed for various metals, one from a 6½-hour PBZ sample from a torch cutter had a cadmium concentration (8.6 microgram per cubic meter [$\mu g/m^3$]) that would have exceeded the PEL (8-hour time-weighted average [TWA]) of 5.0 $\mu g/m^3$ even without further exposure during the remainder of the 8-hour shift. None of the samples had concentrations of lead, arsenic, beryllium, or other metals that exceeded NIOSH or OSHA exposure limits.

Two instantaneous peak CO measurements (1,239 and 1,368 parts per million [ppm]) exceeded 1,200 ppm, the level NIOSH considers an immediate danger to life and health (*1*). One was from a torch cutter and the other from a gasoline-powered saw operator. In 99 air samples, concentrations

of CO ranged from 0.2 to 242.0 ppm; the highest finding (in a 32½-minute PBZ sample from a saw operator) exceeded the NIOSH limit of 200 ppm and would have exceeded the PEL of 50 ppm (8-hour TWA) had it been sustained for 2 hours (*1,2*). CO concentrations of 41 ppm and 45 ppm in PBZ samples from torch cutters and 40 ppm in a GA sample near a saw operator, with sampling durations of ½, 5, and 2½ hours, respectively, would have exceeded the REL of 35 ppm had they represented full-shift exposures (*1,2*).

Hydrogen sulfide was present in seven of 10 samples, one or more inorganic acids in all 27 samples, mercury in five of 16 samples, and one or more VOCs in 14 of 76 samples; all concentrations were below applicable NIOSH and OSHA exposure limits except for two benzene concentrations (0.4 mg/m^3 and 0.5 mg/m^3) that exceeded the REL of 0.3 mg/m^3 (*1*). Both were in GA samples from a smoke plume and did not represent any specific worker's exposure. The highest concentration of elemental carbon (an indicator of diesel exhaust) was 0.023 mg/m^3. Neither NIOSH nor OSHA has a numerical exposure limit for diesel exhaust, but the American Conference of Governmental Hygienists has proposed a limit of 0.2 mg/m^3 (measured as elemental carbon) (*4*). No Freon™-22 was detected in any of five samples. Small amounts of various PAHs were present in all 12 samples, but not at concentrations that exceeded individually or collectively any applicable NIOSH or OSHA exposure limit.

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Editorial Note: In addition to the physical hazards associated with work at the WTC site, hazardous exposures to toxic dusts and gases were suspected initially. Asbestos exposure, in particular, was an occupational and community health concern. The findings of this survey documented no occupational exposure to asbestos, at least after September 18, in excess of NIOSH or OSHA occupational exposure limits. The seven air samples that had fiber concentrations (determined by PCM) higher than the REL for asbestos probably would have had asbestos concentrations <0.1 f/cc if analyzed by TEM. In many other samples, asbestos concentrations determined by TEM tended to be lower than those determined by PCM. The NIOSH asbestos sampling did not provide data about occupational exposures before September 18 and was designed to assess occupational exposures, not community exposures, which probably were lower.

The absence of exposure to respirable crystalline silica, despite its presence in the bulk samples, indicates either that the crystalline silica in the dust at the site consisted of larger, nonrespirable particles or that work activities were not causing the dust to become airborne. In the absence of effective dust-control measures, the former explanation seems more likely. Although the air sampling indicated the presence of respirable airborne particulate, this material was apparently not crystalline silica. One torch cutter had cadmium overexposure, and excess CO was associated with workers using oxyacetylene torches and gasoline-powered saws. To reduce CO exposure, NIOSH recommended replacing gasoline-powered saws with rechargeable, battery-powered saws.

At the time of the NIOSH sampling, the ambient air did not appear to be contaminated with toxic substances from the buildings or their contents or with combustion products to an extent that posed an occupational health hazard. However, the presence of hazards related to specific work activities at the WTC disaster site underscores the importance of assessing suspected occupational exposures. In response to the WTC disaster, NIOSH has issued guidelines for addressing a variety of occupational safety and health hazards at disaster sites (*5*).

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References

1. National Institute for Occupational Safety and Health. NIOSH pocket guide to chemical hazards. Cincinnati, Ohio: U.S. Department of Health and Human Services, CDC, National Institute for Occupational Safety and Health, 1997 (DHHS publication no. 97-140).
2. Occupational Safety and Health Administration. Toxic and hazardous substances, 29 C.F.R. 1910 Subpart Z. U.S. Department of Labor, Occupational Safety and Health Administration. Available at http://www.osha-slc.gov/OshStd_toc/OSHA_Std_toc_1910_SUBPART_Z.html.
3. National Institute for Occupational Safety and Health. NIOSH manual of analytical methods, 4th ed. Cincinnati, Ohio: U.S. Department of Health and Human Services, CDC, National Institute for Occupational Safety and Health, 1994 (DHHS publication no. 94-113).
4. American Conference of Government Industrial Hygienists. Threshold limit values for chemical substances and physical agents & biological exposure indices. Cincinnati, Ohio: American Conference of Governmental Industrial Hygienists, 2001.

5. National Institute for Occupational Safety and Health. Suggested guidance for supervisors at disaster rescue sites. Cincinnati, Ohio: U.S. Department of Health and Human Services, CDC, National Institute for Occupational Safety and Health. Available at http://www.cdc.gov/niosh/emhaz2.html.

State-Specific Trends in Self-Reported Blood Pressure Screening and High Blood Pressure — United States, 1991–1999

High blood pressure (HBP) increases the risk for heart disease and stroke, the first and third leading causes of death in the United States, respectively. An estimated one in four U.S. adults has HBP, which is defined as taking antihypertensive medication or having either a systolic blood pressure (SBP) of ≥140 mmHg or a diastolic blood pressure (DBP) of ≥90 mmHg (*1*). Optimal blood pressure is defined as SBP of ≤120 mmHg or DBP of ≤80 mmHg. To reduce the prevalence of HBP in the United States, the National Heart, Lung, and Blood Institute initiated the National High Blood Pressure Education Program (NHBPEP) in 1972, recommending that all adults aged ≥20 years have their blood pressure (BP) checked at least once every 2 years. Although HBP is easily detectable and can usually be controlled with treatment, greater awareness of BP levels among U.S. adults is needed (*2*). This report summarizes data from the Behavioral Risk Factor Surveillance System (BRFSS) on state-specific trends in recent BP screening and prevalence of HBP (both by self-report). The findings indicate that during 1991–1999, BP screening levels were very high, and the percent of adults reporting HBP increased among some populations. Innovative education and intervention programs are needed to prevent and treat HBP in five high-risk groups: men, blacks, Hispanics, persons with less education, and older adults.

BRFSS is a state-based, random-digit–dialed telephone survey of the civilian, noninstitutionalized U.S. population aged ≥18 years. CDC analyzed BRFSS data from 1991, 1993, 1995, 1997, and 1999 for persons from the 50 states and the District of Columbia (DC). The range of sample sizes for individual states was 1,163–3,404 in 1991, 1,182–4,294 in 1993, 1,184–5,052 in 1995, 1,437–4,877 in 1997, and 1,225–4,914 in 1999. BRFSS CASRO median response rates ranged from 70.9% in 1991 to 55.2% in 1999. These rates reflect both telephone sampling efficiency and the degree of cooperation among eligible respondents who were contacted. Survey participants were asked 1) about how long it had been since they last had their BP taken by a doctor, nurse, or other health-care professional, and 2) if they had ever been told by a doctor, nurse, or other health-care professional that they had HBP. Recent BP screening was defined if the respondent's blood pressure had been checked during the 2 years preceding the interview. Persons who reported that they were ever told they had HBP were classified as having self-reported HBP. Analyses were restricted to persons aged ≥20 years. Data were weighted and analyzed using SUDAAN (version 7.0) to account for the complex sampling design in each state and to obtain prevalence and variance estimates. Prevalences were age-adjusted to the 2000 U.S. standard population. The state-specific percentage point differences between 1991 and 1999 for recent BP screening and HBP were limited to DC and the 47 states that participated in BRFSS during 1991–1999.

During 1991–1999, approximately 100% of adults reported that they ever had their BP checked. The age-adjusted prevalence of adults reporting that they had recent BP screening remained relatively constant at 95.3% in 1991 and 94.5% in 1999 (Table 1). The prevalence of recent BP screening declined in 30 states; the decline was statistically significant in 11 states (California, Georgia, Idaho, Indiana, Mississippi, New Mexico, Oregon, South Carolina, Virginia, Washington, and Wisconsin). Recent BP screening increased significantly in Minnesota, New Jersey, North Dakota, and Vermont.

The age-adjusted prevalence of adults reporting having ever been told that they had HBP increased significantly from 22.9% in 1991 to 24.9% in 1999 (Table 2). In 1999, age-adjusted prevalence of self-reported HBP ranged from 14.0% in Arizona to 31.6% in Alabama. During 1991–1999, statistically significant increases in age-adjusted prevalence of self-reported HBP were observed in 17 states (Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Maine, Maryland, New Mexico, North Carolina, North Dakota, Ohio, South Dakota, Tennessee, Virginia, Washington, and West Virginia). Significant declines were observed in Arizona, Connecticut, and Oklahoma.

In 1991 and 1999, age-specific prevalences of recent BP screening and self-reported HBP were higher among adults aged ≥65 years than among those aged 20–64 years (Table 3). Recent BP screening declined significantly among persons aged 20–44 years and those aged 45–64 years, but increased among those aged ≥65 years. Prevalences of self-reported HBP increased in all age groups except among persons aged 20–44 years. In 1991 and 1999, age-adjusted prevalences of recent BP screening were higher among non-Hispanic blacks, women, and persons with >12 years of education compared, respectively, with those of other racial/ethnic groups, men, and persons with less education. However, recent BP screening declined significantly among non-Hispanic whites, men, women, and persons with ≤12 years of education. In 1999, age-adjusted prevalences of self-reported HBP were higher