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Occupational and Environmental Health Equity and Social Justice

Sherry L. Baron and Sacoby Wilson

CASE 1

A 30-year-old man, who was a Mexican immigrant worker, began working for a temporary help agency because he was unable to find a permanent job. His work assignment changed every few months and, with each new assignment, he had to learn about a new manufacturing facility. He began working at a concrete casting company that made 8,000-pound concrete septic tanks, where he assisted a forklift driver in turning over the newly formed septic tanks. He initially received "on-the-job" training through a bilingual co-worker and communicated with the English-speaking forklift driver through hand signals. While he watched carefully to learn from others performing various tasks, he was afraid to ask too many questions because he did not want to lose his job.

One day, he was standing in the forklift driver's blind spot when a boom from the turning device fell and landed on his leg. He was taken to a hospital, where he received emergency care and was warned by physicians that, without extensive physical therapy, he would not likely regain full use of his leg. However, when he inquired with his employer about workers' compensation coverage for his medical expenses, he was informed that his employment agreement stated that he was hired as an independent contractor, which meant that he—and not the company—was responsible for any work-related medical costs. The social worker at the hospital also informed him that, since he was an undocumented immigrant, he would not qualify for any publicly funded medical assistance.

(Note: This case is based, in part, on the Massachusetts Fatal Accident and Control Evaluation [FACE] report, #02-MA-016-01.)

CASE 2

On a local television news program, a reporter provided an update about a recent health scare for rural residents living near a large industrial hog operation in eastern North Carolina. Several local physicians had noticed that many children who lived in a poor neighborhood near several industrial hog operations and attended a nearby elementary school were having diarrhea. Parents of some of the children stated that they too had been having gastrointestinal problems,

especially following recent heavy rains. Neighborhood residents had complained to the local health department and town officials about rainwater runoff from industrial hog operations and odors coming from confinement buildings that housed the hogs, but no action had been taken.

Initially, the local health department did not know why so many parents and children were sick. However, after testing local streams and residential water sources (primarily individual wells), it found high levels of *E. coli* and fecal coliforms in the well water; up to 1,000 times higher than maximum contaminant levels set by the Environmental Protection Agency (EPA). Using online mapping tools, some high school students mapped the industrial hog farms in the area and found that many were near poor and/or African American neighborhoods.

Health equity, the absence of systematic disparities in health between more- and less-advantaged groups, is a fundamental principle of justice and human rights.[1] Yet there is clear evidence of health disparities among racial, ethnic, and income groups in the United States and elsewhere. For example, the relative risk of premature death increases as family income decreases, so members of families that annually earn $20,000 to $30,000 have twice the risk of premature death compared to members of families that annually earn over $100,000. As another example, African Americans have a shorter life expectancy compared to whites, even when those with similar income levels are compared.[2] Recognizing both the importance and challenge of achieving health equity, the U.S. Department of Health and Human Services, in 2000, made the elimination of health disparities its second major goal for *Healthy People 2010*, its 10-year agenda.

Health disparities result, in part, because poor people and people of color are more likely to encounter hazards and stressors in their communities and at work.[2] Neighborhood environmental stressors include ambient air pollution, hazards from unhealthy uses of land (such as incinerators and landfills), and inadequate numbers of health-promoting facilities and resources, such as clinics, schools, and parks. Disparities in work-related exposures arise from disproportionate employment in hazardous jobs, compounded by workplace discrimination, ineffective training and safety communication due to low literacy and language barriers, and restructuring of jobs, which often creates a sense of instability and job stress.

WORKPLACE EXPOSURES AND HEALTH INEQUITIES

Over the last half of the twentieth century, the size and composition of the working population and the organization and content of work changed considerably.[3] In the United States, the workforce became more racially and ethnically diverse and older, and it gained proportionately more women. However, many permanent, full-time, often-unionized manufacturing jobs were replaced by service-sector jobs that were often temporary and often paid lower wages.

Today, almost one-third of U.S. workers have hourly wage rates so low that, even if they worked full time for a full year, their annual earnings would be below the poverty line for a family of four. Low-wage workers are more likely to be female, young, black or Hispanic, and working in an industry with a very high injury rate.[4] Although there have been many significant advances in civil rights in the United States, African Americans and members of other racial and ethnic minority groups remain disproportionately employed in hazardous jobs, while racism and other forms of discrimination—both in the community and the workplace—contribute to additional health risks.[5]

Working Women

Between 1950 and 2000, the proportion of women workers in the U.S. economy increased more than 150%.[3] Almost half of the U.S. workforce is now female, resulting in substantial new career opportunities for women. Among working women age 25 to 64, the proportion of college graduates more than tripled from 1970 to 2007. More than half of managers and professionals are now women. Women's earnings as a proportion of men's also have grown: In 1979,

the earnings of women working full time, on average, were 62% of men's; by 2007, this had increased to 80%. The remaining male-female earnings gap is due in large part to women's disproportionate employment in low-wage jobs. Of all low-wage workers, 59% are women. Compared to female workers with higher wages, low-wage female workers are more likely to be single mothers, have less than a high-school education, and be either Hispanic or African American.[6]

Overall, the rates of reported work-related injuries are lower among female than male workers, largely because women are less likely to work in the most hazardous industries, such as construction and mining (Fig. 4-1). However, in service-related occupations, women sustained 62% of nonfatal injuries while occupying only 57% of the jobs. Most nursing aides, orderlies, and attendants—who comprised the occupational group with the highest rate of work-related injuries and illnesses reported by the Bureau of Labor Statistics in 2008—are women. Assault-related injuries on the job are twice as frequent among women as men. Homicides are the second leading cause of work-related deaths among women. Those committing these homicides of women are 10 times more likely to be family members than perpetrators of work-related homicides of men.[7]

Figure 4-1. Women coal miners. (Photograph by Earl Dotter.)

CASE 3

The manager of a sausage factory reviewed the factory's annual injury logs and noted that female employees were more likely to develop musculoskeletal disorders (MSDs) than men. He recalled reading in a trade magazine that women are more likely to develop carpal tunnel syndrome, and he therefore attributed their relatively higher injury rate to biological factors. A union safety representative also reviewed these injury records and decided to investigate further. He inspected the sausage finishing station, where several of the injuries had occurred, and observed women lifting 40-pound racks of sausages onto a shelf that was designed for much taller workers. After a short discussion, he learned that these women had previously worked in evening-shift jobs that were less stressful ergonomically, but they had recently switched to day-shift jobs that were more stressful ergonomically in order to be home when their children returned from school.

This case illustrates one of the important questions for policy makers and researchers interested in women's health: What are the relative roles of biological factors and occupational exposures in explaining occupational health disparities between male and female workers?[8] For example, toxins that bioaccummulate in fat tissues could act differently in women and men, given gender differences in fat metabolism. However, the relative importance of these physiological differences, in comparison to differences in workplace exposure levels, has been inadequately studied. Most studies have not rigorously collected sufficient exposure information to adequately measure the differences in

exposure between genders, so misleading conclusions may have been drawn. As illustrated in Case 3, the design of a work station may be ergonomically optimal for the average male stature, but it may require significant reaching and awkward postures for short female workers, causing them to have more ergonomic stresses and increased risk of injury. In addition, female workers and their partners experience stress due to conflicts between work and family responsibilities. For low-wage female workers, many of whom are single mothers, the challenge of balancing their roles as wage earners and mothers is often especially stressful.

Racial and Ethnic Minority Workers

CASE 4

In 1930, a subsidiary of a large corporation contracted with a construction firm to dig a 3-mile tunnel through a stone mountain in West Virginia in order to divert the New River and build a hydroelectric energy plant. This project employed thousands of workers, at least 75% of whom were black, in a county whose population was 85% white. Many of these workers came from Alabama, Virginia, North Carolina, and South Carolina, where work was hard to find during the Great Depression and to whom the hourly wage of $0.30 to $0.60 seemed like good pay.

The rock through which they drilled had some of the highest known content of silica. To complete the job quickly, they chose to use minimal water to suppress dust levels. About 1 year after the project began, the local newspaper published a story commenting on "the unusually large number of deaths among the colored laborers. The deaths total about 37 in the past two weeks." Although the initial deaths were attributed to black workers' poor nutritional habits and unusual susceptibility to pneumonia, it soon became clear that they were dying of acute silicosis. As many as 581 of the 922 black workers who worked in the tunnels for at least 2 months of the 24-month project may have died.[9]

Although this disaster, known as the Gauley Bridge Disaster, occurred many years ago and such blatant discrimination against African American and other minority workers is far less common today, many economic and social disparities persist. (See Chapter 18 for a discussion of silicosis.) African Americans and Hispanic workers are more likely to be employed in occupations with higher injury rates (Fig. 4-2). For example, African American men are twice as likely as non-Hispanic white men to work in service and blue-collar occupations, such as laborers, fabricators, and operators, and they are half as likely to be in managerial or professional occupations. African American workers have higher rates of fatal and nonfatal occupational injuries compared to non-Hispanic whites.[10,11] For example, in Massachusetts, African American workers were found to be almost twice as likely as white workers to be hospitalized for a work-related amputation.[11]

In 2000, there were 36 million Hispanics in the United States, 58% more than in 1990, mainly due to increased immigration. During the 1990s, more immigrants entered the United States than during any other decade—about 1 million each year. Hispanic workers comprise about 13% of all U.S. workers, more than half of them immigrants, mostly from Mexico. Hispanics are more likely to work in blue-collar jobs in the service, construction, and other industries, and in farming, forestry, and fishing. Central American and Mexican immigrants, especially those who have been in the United States for less than 10 years, are most likely to work in these sectors.[12] The fatal occupational injury rate for Hispanic workers exceeds that of all other groups of workers—in 2006, it was 25% higher. In 2006, foreign-born Hispanic workers had a fatal occupational injury rate 70% higher than that of native-born Hispanic workers.[13] Hispanic workers also have higher rates of nonfatal occupational injuries than other workers. For example, male Hispanic workers in New Jersey were found to have been hospitalized more often than non-Hispanic workers for work-related falls, motor vehicle accidents, injuries from being struck by objects, and accidents related to machinery.[14]

Young Workers

In many parts of the world, child labor is widespread and children often work in dangerous

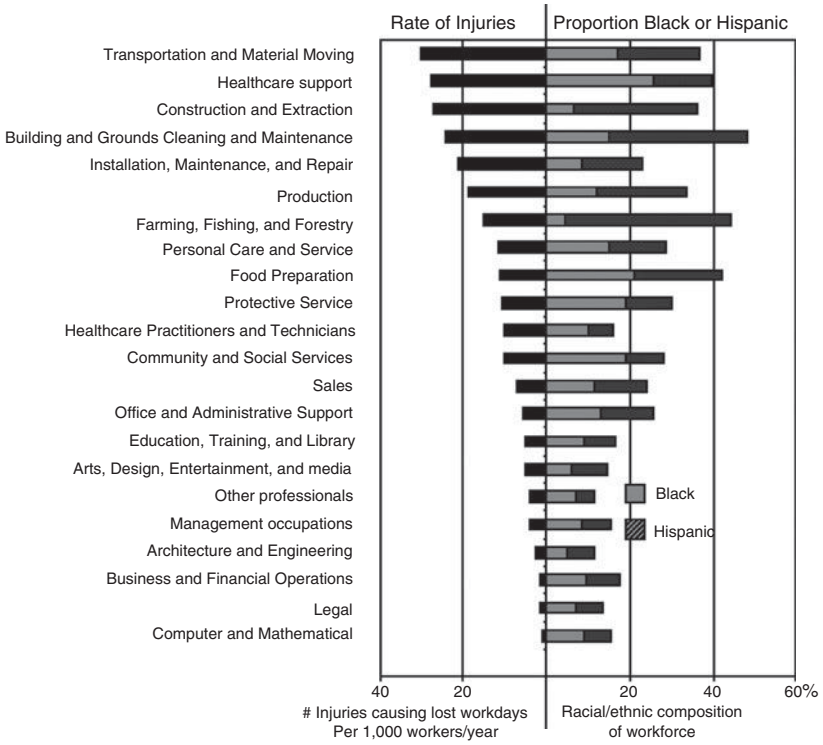


Figure 4-2. Racial and ethnic composition of occupations and job injury rates.

conditions (Box 4-1 and Fig. 4-3A). (See Special issue: Child labor and protecting young workers around the world. International Journal of Occupational and Environmental Health 2010; 16:103-237.) However, in the United States and other developed countries, since passage of strong federal child labor laws in the 1930s, exploitative child labor has been rare. However, youth employment is extremely common (Fig. 4-3B). An estimated 44% of 16- and 17-year-olds work sometime during the school year, and up to 80% of teenagers work sometime during their high school years.[15] Whether the exposure comes from the general environment or the workplace, children may face disproportionate risk (Box 4-2).

Box 4-1. Child Labor

Susan Gunn

In 2008, there were 305 million children under age 18 engaged in some form of work. For many of these children, work was age appropriate and in line with international law on minimum age (ILO Convention 138 concerning the Minimum Age for Admission to Employment). An estimated 215 million children (14% of all children in the 5-17 year age group), however, were engaged in *child labor*—the work they were doing or the conditions in which they worked posed a real danger to their physical, mental, and social health or development. Of particular concern is that between 2004 and 2008, the number of children age 15 to 17 engaged in hazardous work increased from 52 to 62 million.

Almost all countries have child labor, most often in the informal economy, such as in small workshops, eating places, and family farms where workers are not unionized and which labor inspectors seldom visit. The largest proportion of working children age 5 to 17 (60%) is in agricultural work. Twenty-six percent is in services—mainly children working as domestic servants.

Children are at higher risk of occupational injuries and illnesses than adults because they have proportionately more skin surface area, deeper breathing, less mature nervous and reproductive systems, and less developed judgment. In 2007 in the United States, 38 children under age 18 died of work-related injuries and more than 150,000 suffered from work-related injuries or illnesses. Data for developing countries are less reliable, but rates of work-related injuries and illnesses in children in these countries

(*Continued*)

Box 4-1. Child Labor (Continued)

are probably much higher than in the United States and other developed countries.

Throughout the world, the adverse health effects of child labor can be very serious. For example, many of the estimated 1 million children who work in mining and quarrying suffer neurological problems from handling mercury (used to extract gold from rock) and musculoskeletal disorders from carrying heavy loads of rocks and stones. In small auto repair shops, children work under precariously balanced cars and handle lead-based compounds or organic solvents. In agriculture, children are injured by farm equipment and exposed to pesticides. As domestic servants, children may work 16 or more hours a day, suffering not only from fatigue but also from isolation, beatings, and sexual abuse.

The emotional impacts on children of job stress caused by the speed of production, repetitive work, violence, and intimidation are of as much concern as physical impacts (see Chapter 14). For example, an ILO study in Cambodia on the adverse effect of work on children's health found that each additional hour of work per week increased the probability of injury or illness by about 0.3%. The psychosocial impacts of work on children's health, however, remain inadequately researched. There need to be better methods for population-based research on such issues.

Child labor is not only a danger to children's health and education. It also locks families into an ongoing cycle of poverty, and it hinders achievement of national development goals. Concerned about the persistence of child labor and the emergence of new forms, the International Labor Organization (ILO) launched a major campaign to eliminate the worst forms of child labor by 2016. Over 80 countries have now established programs to address child labor, and public attitudes have markedly shifted from indifference and denial to active concern.

Health workers can help to maintain this concern and address child labor issues by doing the following:

1. Documenting the problem by being alert to work-related injuries and illnesses in children. For example, Brazil has pioneered an innovative occupational safety and health surveillance system, training thousands of primary health care workers to recognize and report occupational injuries and illnesses among children.
2. Testing practical ways of reducing risks so that children of legal working age can work safely. These young people need to receive training on health and safety, and employers need to be made aware of how vulnerable young people are to occupational injury and illness.
3. Serving as a resource to schools and vocational training programs in disseminating information on occupational hazards and ways of reducing them, as well as on young workers' rights.
4. Participating in processes to establish, legally mandate, and regularly revise lists of hazardous work prohibited for children under age 18. These lists are required of countries that have ratified ILO Convention 182 (Convention Concerning the Prohibition and Immediate Action for the Elimination of the Worst Forms of Child Labor). Almost all countries have ratified the Convention. These processes provide excellent opportunities for health workers to collaborate with trade unions, employers, and labor inspection services in working toward the common goal of protecting children from abusive work.

Further Reading

The following Web sites of the ILO accessed on August 6, 2010, offer much useful information:

Action against child labour: IPEC Highlights 2008. Available at: http://www.ilo.org/public/libdoc/ilo/P/09322/09322(2008)highlights.pdf

Combating trafficking in children for labour exploitation: A resource kit for policy makers and practitioners. Available at: http://www.ilo.org/ipecinfo/product/viewProduct.do?productId=9130

Modern policy and legislative responses to child labour. Available at: http://www.ilo.org/ipecinfo/product/viewProduct.do?productId=8192

Child labour: A textbook for university students. Available at: http://www.ilo.org/ipecinfo/product/viewProduct.do?productId=174

Eliminating the worst forms of child labour: a practical guide to ILO Convention no. 182. Available at: http://www.ilo.org/ipecinfo/product/viewProduct.do?productId=1200

Accelerating action against child labour: Global report. Rights at Work. Geneva, Switzerland: ILO, 2010. Available at: http://www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/documents/publication/wcms_126752.pdf

Safe Work for Youth kit (Packet for Administrators; Packet for Employers: Keep Them Safe; Packet for Youth: Stay Safe) http://www.ilo.org/ipecinfo/product/searchProduct.do?userType=3&type=normal&title=safe%20work%20for%20youth&selectedSortById=4&createdMonthFrom=-1

In 2007 in the United States, approximately 2.6 million adolescents age 15 to 17 worked, most commonly in food services (37%) and retail trade (24%). While employment provides many benefits to youth, including increased self-confidence, job skills, and income, it also poses potential hazards. In 2007 in the United States, 38 young workers under age 18 died from occupational injuries.[16] In 2006, an estimated 4.2 injuries occurred per 100 full-time workers age 15 to 17.[17] The total societal cost of these injuries may have been considerable, given the potential for long-term impairment, high medical expenses, school absences, and parents' lost workdays.

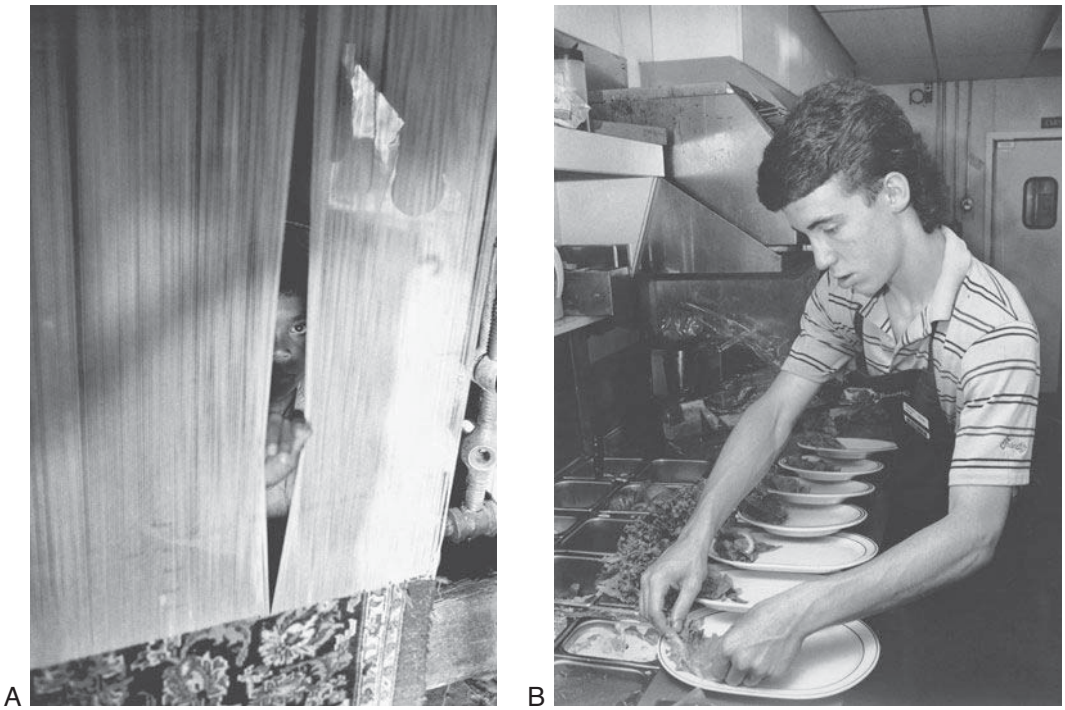


Figure 4-3. In both developing and developed countries, young-child and adolescent workers face multiple hazards: (A) Young girl working as a carpet weaver in India. (Photograph by David L. Parker.) (B) Teenage short-order cook in the United States. (Photograph by Earl Dotter.)

Box 4-2. Children as a Special Population at Risk for Environmental Hazards

Adam Spanier

One summer afternoon, a frantic mother brought her 5-year-old son to an emergency department for evaluation. "He was just out playing in the barn," she told a physician there. "When I went to check on him, he was sweating, confused, vomiting, having difficulty breathing, and had wet himself." The physician noted a decreased heart rate, decreased blood pressure, and excessive tearing of his eyes. From a detailed environmental history, he learned that the child lived on a farm and was exposed to an organophosphate pesticide. He removed the child's clothing to decrease any continued exposure, asked the nurse while wearing gloves to bathe the child, and treated him with pralidoxime (2-PAM) and atropine.

Children are not just small adults. There are many reasons why a child's risk of environmental exposure differs greatly from that of an adult. Children may be particularly vulnerable to a specific chemical. For example, in this case the likelihood of unintentional exposure to pesticides is higher in children than adults, and the dose needed to produce equivalent symptoms is lower in children than adults. Each of the stages of child development holds unique health risks from various environmental exposures.

Anything that may interfere with development of the fetus, which is undergoing rapid growth and organogenesis, can cause serious long-term effects. Low-molecular-weight compounds (such as carbon monoxide), fat-soluble compounds (such as ethanol and polycyclic aromatic hydrocarbons, or PAHs), and some heavy metals (such as lead and mercury) can cross the placental barrier. During fetal development there are specific periods of elevated risk during which organs are developing. During these periods, some environmental exposures, some medicines, and use of tobacco, alcohol, and recreational drugs can lead to devastating results. For example, thalidomide can cause severe birth defects of the limbs, ethanol can impair brain development, and diethylstilbestrol (DES) can later cause vaginal cancer and other reproductive system defects.

Children may face numerous other environmental risks. Breastfed children may be exposed to toxic chemicals in milk, such as pesticides, lead, mercury, nicotine, and polychlorinated biphenyls (PCBs)—and their metabolites as well as medicines that a nursing mother has taken. In addition, infant formula mixed with tap water may contain toxic contaminants from the formula or the tap water.

Toddlers, who have increasing mobility and persistent mouthing behaviors, may ingest toxins in their environment, such as pesticides, lead (in house dust), and arsenic (in treated wood). Since they are close to the ground, they are more likely to breathe heavier airborne particles,

(*Continued*)

Box 4-2. Children as a Special Population at Risk for Environmental Hazards (Continued)

such as some airborne allergens and mercury. In addition, children generally have higher respiratory rates than adults and are therefore exposed to more airborne toxins, such as environmental tobacco smoke. Since children ingest, per body weight, more water and food than adults, they are at increased risk of ingesting contaminants of water and food, such as pesticides.

Children also have larger body surface-to-mass ratios than adults, so dermal exposures to hazardous substances that are absorbed through the skin, such as organophosphate pesticides, may pose proportionately more risks for children than for adults.

Children are at increased risk of physical injury from a variety of hazards, including open windows, swimming pools, stairs, roads, and pots of boiling liquid on stovetops.

School may present new hazards for children. For example, some schools are built on property that is less than desirable. In Cincinnati, a school was built on a former shooting range and the schoolyard was found to have elevated soil lead levels, likely due to use of lead shot. As another example, most schools use pesticides, most of which have not been tested for adverse neurodevelopmental effects.

Adolescents often take more risks than adults, so they face threats such as motor-vehicle, gun-related, and other injuries, and exposure to environmental toxins, such as cigarette smoke. Adolescents who work are at increased risk of occupational injuries.

The Association of Occupational and Environmental Clinics (http://www.aoec.org) has established a network of Pediatric Environmental Health Specialty Units throughout North America to provide education and consultation for health professionals concerning the impact of the environment on children's health.

CASE 5

A 16-year-old boy was anxious, but excited, as he began his first job at a neighborhood hamburger restaurant. His job was to clear tables, wash dishes, and clean the counter. He had hoped that, by the end of the school year, he would have learned enough to become a "fry cook" and earn an extra $1 per hour. One Saturday, a cook had to leave early, and he eagerly volunteered to help close the grill. He had watched the cook do the necessary tasks for months and felt confident that he knew what to do. One task was to empty the grease from the deep fryer. He grabbed a container—not realizing it was the refuse container for the meat scraps and would melt when filled with hot grease—and emptied the hot grease from the fryer into it. As he walked out to the dumpster, the hot grease burned a hole in the bottom of the container and fell onto his legs, causing severe burns.

This case demonstrates some characteristics of young workers that raise concerns about their safety and health. Like all new workers, young workers are at increased risk for injury. Since the level of physical and cognitive development varies among teenagers, developmental characteristics may also place them at risk. Shorter teens may have difficulty reaching machines and may not have the physical strength required for certain tasks. Even when young workers have reached adult stature, their psychological and cognitive maturity may lag behind in conventional wisdom or ability. Employers may assign them tasks to which they are not yet cognitively prepared. Their enthusiasm and desire to do well—positive attributes—may make them uncomfortable asking questions or expressing concerns about their ability to perform a challenging task.

In addition to the specific hazards young workers may face, there may be unintended consequences affecting their ability to function and succeed in their school and social lives. Using a relatively arbitrary cutoff, policy makers and researchers divide youth labor into high-intensity labor (those who work more than 20 hours per week) and low-intensity labor. Low-intensity labor is associated with future postsecondary education, but high-intensity labor is associated with substance abuse, inadequate sleep, and less eventual educational attainment.[15] Between 1997 and 2003, 23% of high school freshmen and 75% of high school seniors in the United States worked at some time during the school year, and about 25% of working freshmen and 56% of working seniors worked 21 or more hours, on average, per week.

The Fair Labor Standards Act of 1938 includes protective legislation for young workers. The Act empowers the U.S. Department of Labor to establish *(a)* specific rules pertaining to child

labor, which include limits on the hours of work for children under age 16, and *(b)* documents called *hazardous orders* that identify certain tasks, such as operating power-driven woodworking equipment, that cannot be performed by youth under age 18 in nonagricultural work (or under age 16 in agricultural work). However, violations of these rules are common. A nationwide survey of teen workers found that over one-third of workers under age 16 worked past 7 p.m. on school nights, which is prohibited by law. More than 50% of male and 43% of female teen workers reported having performed one or more of five hazardous tasks that are prohibited by the federal government.[18]

Older Workers

The average age of U.S. workers is increasing due to 80 million "baby boomers," who were born between 1946 and 1964, and a decreasing U.S. fertility rate. Between 1990 and 2000, the number of U.S. workers age 25 to 44 did not change, but the number age 45 to 64 increased by more than 12 million. People age 55 and older account for almost 19% of the workforce—the highest share held by this age group since the Department of Labor started reporting labor-force statistics in 1948.

Older workers, on average, are retiring at later ages. About 16% of people age 65 and older were in the U.S. workforce in 2008, compared with 14% in 2003.[19] This trend may be due to *(a)* changing policies regarding Social Security and the restructuring of many pension programs, which has caused workers to delay retirement; and *(b)* the return of some retired people to part-time employment, for financial and/or social needs. The economic recession, which began in 2007, reduced the value of many retirement funds, leading older workers to delay retirement. Those workers who are forced to delay retirement because of financial necessity appear more likely to have depression than those who continue working for personal fulfillment.[20]

As health researchers and policy experts explore the impact of the increasing age of the workforce, two major concerns are the effects of aging on health and working capacity, and the effect of working on the aging process. Although these effects may be partially dependent on a worker's job, researchers are examining the relative importance of *(a)* physiological and cognitive deterioration associated with aging, and *(b)* positive attributes of older workers' experience and expertise.[21] (See Chapter 38.)

Nonfatal occupational injury rates decrease with age, possibly due to job selection factors, improved vigilance and work experience, and/or changes in injury reporting patterns. However, when injuries occur in older workers, they are more severe than in younger workers, as measured by lost workdays. In addition, the fatal occupational injury rate in older workers is higher than in younger workers.

One specific work-related injury—falls on the same level—provides an example of how age can affect the severity of work-related injuries. About 14% of work-related injuries result from these types of falls. For most workers, these falls usually result in mild bruises, sprains, or strains, but, for older workers, 30% of these falls result in a fracture and these falls are five times more likely to be fatal—usually due to head trauma—than in younger workers.[22]

CAUSES OF WORK-RELATED HEALTH INEQUITIES

Disproportionate Exposures

Inequities in work-related injuries and illnesses result from inequities in workplace exposures. Minority and low-income workers and others are disproportionately employed in occupations known to have more work hazards, and they therefore suffer disproportionately higher rates of adverse health outcomes. Disparities in rates of reportable work-related injuries for African American and Hispanic workers, as compared to white workers, are largely due to their different employment patterns.[23] Differences in exposure to physical and psychosocial stressors have explained apparent disparities in injury rates between hospital workers with the highest incomes (such as administrators and professionals) and those with the lowest incomes (semi-skilled workers).[24]

Disproportionate employment, however, does not explain all occupational health disparities. For example, Hispanic construction workers have a higher risk of dying from a work-related

injury than non-Hispanic workers in the same job category.[25] Similarly, African American workers in the South have a higher work-related fatality rate compared to African American workers living elsewhere in the United States, even after accounting for differences in regional employment patterns.[26] Therefore, well-documented disparities in work-related injuries and illnesses by race, ethnicity, gender, and social class arise not only from inequities in job opportunities but also from coexisting social, political, and economic factors.[2] Several of these are further described in the next section.

Workplace Injustice

Workplace injustice, including abuse, mistreatment, discrimination, and harassment, has been linked to mental and physical health problems; and it accounts for some work-related health inequities. For example, workplace discrimination, based on race, gender, age, or sexual preference, can occur in many forms, including preferential hiring, firing, or job placement, as well as co-worker or supervisor hostility—all of which can cause job stress and chronic physical and mental health problems. (See Chapter 14.) One manifestation of such discrimination is the wage gap between white and black workers. In 2005, the median hourly wage for black men in low-status jobs was $10.23, compared to $13.08 for white men—a gap that persisted even after accounting for worker, job, and employer differences.[27] In 2004, 39% of African Americans stated that race and gender discrimination was widely practiced at their workplaces.[28]

Beyond its psychological toll, workplace discrimination may lead to differential exposure to workplace physical or chemical agents. Racial attitudes can also interfere with important worker-to-worker communication of safety advice, especially for new employees. Discrimination in job placement can mean that less-favored workers are assigned to more hazardous work tasks. For example, a study in North Carolina of immigrant poultry workers from Mexico and Central America found an association between retaliatory behavior by supervisors and a 10%–30% increase in adverse health outcomes. Workers reported that native-born workers were given the easier and cleaner jobs and that undocumented immigrants were more frequently

Figure 4-4. Worker in a commercial laundry. (Photograph by Earl Dotter.)

asked to work unpaid overtime or, if they refused, were assigned unpleasant tasks.[29]

A population-based study of workers in the United Kingdom examined the association between experience of workplace discrimination and mental health problems in six ethnic populations as compared to a white, nonethnic population. It found that experiences of racial insults (both at and outside of work) and unfair treatment at work were associated with common mental health disorders.[30] When workers experience discrimination in one job, the psychological effects can follow them into future jobs as they develop heightened "vigilance" and anxiety because of their previous experiences of discrimination.[31] The psychological toll of workplace discrimination can also have a negative impact on workers' family members, who experience greater psychological distress.[31]

Some workers also commonly experience other forms of injustice in the workplace. For example, more than two-thirds of 1,200 unionized low-wage workers in various workplaces reported workplace abuse, most commonly "being screamed or yelled at," perpetrated by co-workers or supervisors. Racial discrimination was reported by 58% of workers of color compared to 37% of white workers.[32] These experiences of workplace injustice contribute to disparities in injuries and illnesses. In a study of British civil servants, some of the gradient in cardiovascular disease between high- and low-status workers was due to differences in indicators of workplace justice, such as being unfairly criticized or receiving inconsistent or insufficient information from supervisors.[33]

Another form of discrimination at work is workplace segregation, in which one group of workers is disproportionately working—and sometimes feeling stuck—in certain jobs. This segregation is most apparent in many lower-status jobs (Fig. 4-4). For example, in 2008, 42% of bus drivers and security guards and 48% of nursing and home-health aides were African American or Hispanic. African Americans, especially those in the middle class, who perceive that they are in a "black job" experience greater psychological distress.[34] African American and white workers, who worked in jobs having more than 20% African American workers were found to report poor or fair overall health more often.[35] Workplace segregation also affects others. For example, 90% of health care support workers are women, but over 90% of construction workers are men. When women take jobs in traditionally male occupations, they can face discrimination and harassment (Box 4-3).

Globalization and the Rise of Insecure Work

Globalization, the worldwide movement of goods and services, capital, technology, and labor, has profoundly changed the character of work everywhere. Corporations have reorganized both industrial production and provision of services so that they now extend across multiple national borders. This restructuring of the global economy has had significant impacts on

Box 4-3. Women Construction Workers: An Example of Sexual Harassment in the Workplace

Sexual harassment of women workers, in the form of gender stereotyping, sexist jokes, and demeaning behavior remains a problem, and it has been associated with both mental health problems, such as depression and anxiety, and physical health problems, such as high blood pressure. Although present in many sectors of the economy, some very clear examples have been documented in traditionally male-dominated occupations, such as construction work. Researchers found the following comments in focus groups with women construction workers.

Regarding personal protective equipment:

"They gave me a welding leather jacket that was a foot longer than my hand…and they said they couldn't order anything smaller. They gave me gloves, humongous, I couldn't even pick anything up."

Regarding the need to prove themselves:

"…a lot of times, I feel like I've got to do this because I'm a girl because if I don't they're going to say, 'See, whad I tell ya, she's a girl, she can't lift it."

Regarding issues related to misperceptions about sexual interactions:

"(The foreman) hired her very quickly. Until the wife showed up. And then it changes…she got every dirty job that was there. He more or less forced her to quit."

Adapted from Goldenhar L, Sweeney MH. Tradewomen's perspectives on occupational safety and health: a qualitative investigation. American Journal of Industrial Medicine 1996; 29: 516–520.

the organization of work that can affect workers' safety and health.[36] To compete more effectively, many companies have reorganized by downsizing workforces, increasing reliance on temporary and contractor-supplied workers, and adopting more flexible and "lean-production" technologies.[37] Globalization has also resulted in the export of hazardous substances from developed to developing countries (Box 4-4).

Even before the global economic recession that began in 2007, workers increasingly experienced downsizing and corporate reorganizations that created a fear of layoffs—job insecurity.[38] In the United States, employment in the manufacturing sector has steadily declined—from 22% of jobs in 1979, to less than 10% in 2008. Many of these manufacturing jobs, such as in the automobile industry, were well-paid jobs, with good

Box 4-4. The Export of Hazard

Barry S. Levy

The export of hazardous substances from developed to developing countries continues with relatively few restrictions. Factors in developing countries that enable this practice include their limited financial resources, limited numbers of experts in occupational and environmental health and related fields, limited enforcement of lax regulations, workers' desperation for jobs, and government's desperation for economic development. Major categories of exported hazards include pesticides and other chemicals, asbestos, tobacco products, hazardous waste, and potentially hazardous medications—as well as hazardous industries.

The use of many pesticides—herbicides, insecticides, fungicides, and rodenticides—is banned or restricted in many developed countries, including France, Germany, the United States, Great Britain, and Switzerland. Nevertheless, these are the leading countries that produce and export pesticides.

Despite various national and international attempts to ban or significantly reduce the export of pesticides, it has continued. As examples, the United States banned DDT from export in 1972, but export continued for another 20 years, and it banned ethylene dibromide (EDB) from export in 1982, but export continued for another 14 years. In 1989, two United Nations agencies, the Food and Agricultural Organization and the United Nations Environmental Program, adopted a policy of prior informed consent by the importing country; however, compliance has been voluntary under this policy.

In 1994, $700 million worth of pesticides banned in the United States were sold to other countries. Overall, the United States annually exported 683 million pounds of pesticides in 1992–1996 and 803 million pounds in 1997–2000. Between 1997 and 2000, the United States reduced its export of "severely restricted" pesticides from 7.6 million pounds in 1997 to 4.7 million pounds in 2000. However, during the same period, it increased its annual export of "never registered" pesticides from 10.5 million to 11.2 million pounds. As specific examples, during this period it increased its annual export of aldicarb from 4.7 million to 8.9 million pounds, and its annual export of paraquat from 1.1 million to 2.7 million pounds. During the same period, the United States totally eliminated its export of methyl parathion, Lindane, captafol, and mirex. Many of the banned or restricted pesticides are carcinogens, teratogens, endocrine disruptors, and other types of toxins.[1]

During the 2001–2003 period, U.S. export of banned and restricted pesticides decreased. However, exports still included more than 27 million pounds of pesticides that are banned for use in the United States. These exports included more than 500,000 pounds of known and suspected carcinogens, most of which were exported to developing countries.[2]

The following recommendations have been made to reduce the export of banned and restricted pesticides:

1. "Aggressive efforts should be made to implement alternatives to chemical-intensive agriculture.
2. Exporting countries should assume [a] proactive, precautionary stance in regard to pesticides.
3. The quality and quantity of information regarding pesticide production, trade, and use must be improved.
4. Hazardous pesticides should be phased out when safer alternatives exist."[2]

The Stockholm Convention on Persistent Organic Pollutants (the Global POPs Treaty) initially targets the elimination of 12 high-priority chemicals (mostly pesticides), including dioxins, polychlorinated biphenyls, DDT, Lindane, paraquat, pentachlorophenol, and aldicarb.[3] This treaty was signed in 2001 by more than 100 countries; as of May 2009, a total of 162 countries and the European Union, but not the United States, were parties to the Convention.

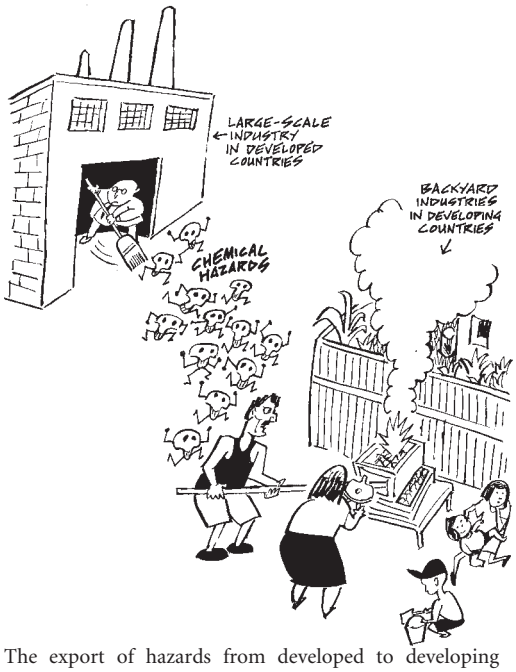
The export of asbestos and asbestos products to developing countries remains a major problem.[4] The leading asbestos producers, including Russia, China, Kazakhstan, Canada, and Brazil account for most of this export. Together, these five countries account for approximately 90% of asbestos production worldwide. The United States ceased production of asbestos in 2003, but it continues to export almost 400 million of asbestos products annually.

For most of the twentieth century, the United States accounted for huge amounts of export of tetraethyl lead. This chemical was developed in 1928 to boost octane levels in gasoline. Starting in 1973, worldwide use of this chemical decreased, with the phase-out of leaded gasoline. Current production of tetraethyl lead is still 50 million pounds annually, but use is declining by about 20% per year as countries phase out or reduce the content of lead in gasoline.[5]

(*Continued*)

Box 4-4. The Export of Hazard (Continued)

The export of tobacco products from the United States and other developed countries to less developed countries, especially China, Middle Eastern countries, and countries in Central and Eastern Europe is a major problem.[6] Various measures have been taken to reduce demand for tobacco products, including price and tax measures, protection from exposure to tobacco smoke, regulation of contents and disclosures, packaging and labeling, education and awareness raising, and smoking cessation activities. In addition, measures have been taken to reduce the supply of tobacco, including reduction of illicit trade, prevention of tobacco sales to and by minors, and support for economically viable alternative activities. The WHO Framework Convention on Tobacco Control, which was the first treaty negotiated under the auspices of WHO, reaffirms the right of all people to the highest standard of health and asserts the importance of strategies to reduce both the demand for tobacco products and supply of these products.[7] As of January 2010, a total of 168 countries, not including the United States had signed the Framework.



The export of hazards from developed to developing countries causes multiple problems. (Drawing by Nick Thorkelson.)

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benefits and pensions. In 1984, about one-half of all 40–45-year-old workers in the United States had worked for the same employer for at least 10 years, but by 2008 this had decreased to one-third.

To maintain productivity levels and compete more effectively, employers have implemented new methods of organizing workflow. For example, "just-in-time" warehousing and production methods take advantage of improved communication, transportation, and inventory systems to speed the flow of parts and supplies—intensifying the pace of work.[39]

Employers have also increased the use of *temporary and contract workers*, also known as *contingent or precarious labor*.[38,40] Corporations, by employing temporary workers, drive down labor costs by reducing employment during periods of low production. In this way, they reduce costs of paying for workers' benefits, such as health insurance and pensions.[40] Temporary employment arrangements also allow companies to recruit and screen new employees by contracting with temporary-help companies for short-term assignments, during which they can identify the most desirable candidates for longer term jobs.

Yet all of these attributes that make temporary workers attractive to employers can also make temporary work more hazardous.[40,41] Increased injury and illness rates have been attributed to increased workloads, longer working hours, decreased training, and breakdown in workplace communication. For example, temporary workers have little input into their working conditions and some, especially those working for temporary-services agencies, may not even know their employers.[37] Pressure to maximize output

and minimize time can lead temporary workers to cut corners and take greater risks. A study found that contingent workers have less knowledge of their work environment and less job training, and they believe that it is difficult to criticize working conditions and to get their views heard by management.[42]

Contingent workers are those who are not employed full time and long term by a single employer. In 2005 in the United States, there were about 43 million contingent workers—about 31% of all workers.[41] Contingent workers span all economic strata and include some who choose to work in more flexible or part-time arrangements. Contingent workers are twice as likely as standard full-time workers to have annual family incomes below $20,000, and more than 80% less likely to have employer-provided health insurance. Contingent workers are also more likely to be young, female, and African American or Hispanic.[43] Many are not protected by key workforce protection laws that are designed to ensure proper pay and safe, healthful, and nondiscriminatory workplaces.[41] The trend toward use of contract labor is not limited to the private sector. Between 2000 and 2006, the number of federal contract workers in the United States increased from 1.4 to 2.0 million; by 2006, 43% of employees who performed work for the federal government were employed by *private* businesses.[44]

Temporary workers have higher rates of mental health problems, especially depression; musculoskeletal disorders; and both fatal and nonfatal work-related injuries.[38] In Washington State, temporary workers have had higher rates of work-related injury and illness claims than those employed in standard work arrangements.[45] In Spain, temporary workers have experienced an almost three-fold greater rate of nonfatal work-related injuries than permanent workers.[46] Official government records of occupational injuries and illnesses are likely to underestimate the actual numbers among temporary workers because of barriers to recognizing, reporting, and recording them by workers, employers, and physicians (see Fig. 1-7 in Chapter 1). These barriers are likely to disproportionately affect low-status and temporary workers because of their job insecurity, job mobility, and lack of health insurance.[47]

Informal employment, also called the *underground economy*, is another—and perhaps the most extreme—form of contingent employment. The International Labor Organization (ILO) defined informal employment in the 1970s as "the activities of the working poor who were working very hard but who were not recognized, recorded, protected or regulated by the public authorities." Each day, over 100,000 day laborers in the United States wait on street corners or at hiring centers, seeking very temporary employment in construction, landscaping, and moving and hauling. Like other contingent workers, informal workers have high rates of work-related injuries. There is a strong association in many countries between the proportion of jobs in the informal sector and rate of disability-adjusted life years (DALYs) lost due to all diseases.[48]

Permanent, full-time employees who remain in the workforce when companies downsize experience fears of job insecurity. Increased work-related injuries, musculoskeletal disorders, psychological distress, and cardiovascular disease have been attributed to increased workloads, longer working hours, decreased training, and breakdown in workplace communication.[38,40] Job insecurity may also lead workers to postpone necessary treatment for work-related injuries, resulting in more severe problems. A study of low-wage, African American, mainly female, poultry workers living in a rural community reported that, when one woman was advised to seek follow-up medical care for a possible musculoskeletal disorder, she was reluctant to do so because "there are 300 people in line behind me for my job."[49]

As globalization and economic restructuring have increased, the proportion of workers in unions has decreased. In the private sector in the United States, the proportion of workers in unions decreased from a high of 35% in 1950 to less than 8% in 2008. Even in workplaces that are unionized, temporary and contract workers are frequently not covered by union contracts. Unions promote workplace safety through training programs, union-management safety and health committees, and provision of protection against retaliations when workers speak out about unsafe conditions. When a union is not present, workplace safety may suffer. A study found that those states with low density of

unions and low rates of labor grievances and those states with *right-to-work laws*, which allow workers to opt out of union membership, had higher work-related fatality rates, after accounting for differences in industrial structure.[50]

International Trade Agreements

Increasing globalization of markets has emphasized the need for multinational trade agreements. Countries govern their international trade through international financial institutions and trade agreements. The contemporary system of international trade agreements began in the aftermath of World War II, when the Bretton Woods Accords were negotiated to stimulate economic growth in Japan and European countries. These accords led to the creation of the International Monetary Fund, the World Bank, and the General Agreement of Tariffs and Trade (GATT). With acceleration of global trade, the World Trade Organization (WTO) in 1994 replaced the GATT. The WTO is a more-formalized organization overseeing international trade, including more than 150 member countries and representing more than 90% of world trade. Many of its agreements are *free-trade agreements*, which remove both tariff and nontariff barriers to trade. Tariffs include taxes and other financial disincentives on imported goods that protect national industries against international competition. Nontariff barriers include rules and regulations that could limit trade, such as regulations to control environmental contamination and promote workplace safety. For example, a Canadian corporation that manufactured the gasoline additive methyl tertiary butyl ether (MTBE) filed a $1 billion lawsuit against the United States when California enacted regulations that limited use in gasoline of MBTE because of its carcinogenicity, claiming these regulations represented a nontariff trade barrier. Although the WTO permits "measures necessary to protect human, animal or plant life or health," these exceptions are difficult to implement.[51]

The North American Free Trade Agreement (NAFTA), which took effect in 1994, included special "side agreements" to address concerns about workplace and environmental protections. Trinational bodies, representing Mexico, United States, and Canada, were established to monitor progress. By 2004, seven formal complaints had been filed concerning gaps in protection of workplace safety and health. These complaints against all three countries, included claims of lack of government enforcement of workplace safety regulations, such as in factories owned by multinational corporations in Mexico and by companies employing immigrant workers in the United States. Comprehensive investigations in most of these cases identified gaps in enforcement. However, because "government-to-government consultations" either did not have or did not exercise their power to enforce changes, no actions were taken to improve workers' health and safety.[52] A recent assessment by the U.S. Government Accounting Office (GAO) of four other free-trade agreements with Singapore, Morocco, Chile, and Jordon found similar results. The GAO found that "with respect to the labor obligations the responsible U.S. agencies have made little or no effort, or a belated effort, to identify labor compliance concerns after NAFTA enactment, and engagement with these partners on labor issues has been a low priority most of the time."[53]

Migrant Labor

As international financial institutions, national governments, and corporations embraced free trade and introduced new forms of work, tens of millions of peasants and millions of workers, in search of work, began to migrate both within their own countries and also abroad. The mass migration of workers, as a result of globalization, has brought a whole new series of political economic and social challenges. The ILO estimated in 2003 that globally there were 120 million international migrant workers and family members.

In 2007, almost 13% of U.S. residents were immigrants—a 22% increase since 2000. The two largest immigrant groups are Mexicans, accounting for 31% of all immigrants, and South and East Asians, accounting for 24%. Of the 45 million Hispanics in the United States, 39% are foreign born; of the 13 million Asians and Pacific Islanders, more than 66% are foreign born. Employment profiles of immigrants vary substantially by region of birth. South and East Asian workers are overrepresented in science, engineering, and health-related occupations.

Mexican immigrants are overrepresented in many high-hazard occupations, such as jobs in construction, agriculture, food processing, food services, and cleaning and maintenance.[12]

CASE 6

A young man, in search of a job, crossed the border from his native Mexico to the United States. He had a cousin living in Los Angeles, who told him that construction jobs were easy to obtain. Once he arrived, he found a job working as a sandblaster for a small construction company, which did not ask for any official documents, and paid him "under the table." Although sandblasting creates much dust, his employer gave him no respiratory protection. To avoid breathing too much dust, he tied a bandana around his face, as farmworkers in his small home town in rural Mexico had done when they sprayed pesticides. He earned a good income and regularly sent money back to his family in Mexico. However, after a few years doing this job, he began to cough and wheeze. When he barely had enough energy to make it through the work day, he saw a doctor who diagnosed him with advanced silicosis. Unable to work and without medical insurance, he returned to Mexico and died a few years later.

Since the demand for work visas in the United States each year far exceeds the quota set by the federal government, millions immigrate for work, although they have no legal documentation. These unauthorized immigrants may be at especially high risk for work-related injuries and illnesses, as their immigration status and economic desperation drive them to take hazardous jobs that others have refused because of low pay and unsafe working conditions. The combination of language barriers, lack of familiarity with programs to protect workers, and fear of "speaking up" may compound the inherent risk in these jobs.[54] Unauthorized immigrants are two to five times more likely to be employed as agricultural or construction laborers, building maintenance workers, groundskeepers, and food preparation workers. Low educational levels and limited specialty skills further limit job opportunities. In the United States, over half of immigrant adults and three-fourths of Mexican immigrants do not speak English well. Among unauthorized immigrants age 25 to 64, almost half have less than a high school education.

A survey in five community clinics in Boston of 1,500 patients, two-thirds of whom were born in other countries, illustrates the barriers that immigrants face.[55] Three-fourths of foreign-born respondents had never heard of the Occupational Safety and Health Administration (OSHA), and more than half had never heard of workers' compensation—despite having resided in the United States for an average of 12 years. Fewer than half had received written information or training about workplace safety; for the one-third who received training or written materials, it was in a language they did not understand well. Even when safety-training materials are translated into workers' native languages, they may not effectively communicate safety messages, especially if the terms, images, and formats are not consistent with the literacy levels and cultural backgrounds of workers.

Immigrant workers' high job mobility and their desire to remain invisible make it difficult to determine their work-related injury and illness rates. The only government data on work-related injuries that include nativity are those for work-related fatalities. Between 1997 and 2001, foreign-born workers were 18% more likely to die at work than native-born workers.[56]

Unequal Access to Medical Care and Sick Leave

There are great inequities in access to medical care, especially for the working poor, who are disproportionately uninsured or underinsured, which may contribute to the severity of work-related injuries and illnesses. In 2008 in the United States, about 22% of employed adults age 18 to 64 were uninsured for at least part of the year, and an additional 14% were underinsured. Minority workers and workers employed in service, blue-collar, and agricultural jobs were those who were least likely to be insured.[57] Between 1999 and 2009, health insurance coverage decreased in the United States, and this trend

disproportionately impacted Hispanic workers, especially Hispanic blue-collar workers.[58] The proportion of contingent workers receiving health insurance is smaller than the proportion of standard full-time workers. An estimated 13% of contingent workers received health insurance through their employers in 2005, compared to 72% of standard full-time workers.[41] (It remains to be seen to what extent health reform legislation in the United States will improve these problems.)

Disparities in insurance coverage are compounded by additional inequities in access to occupational health services and workers' compensation coverage. While all workers face significant barriers to obtaining adequate coverage for workers' compensation (Chapter 31), racial and ethnic minority workers are disproportionately impacted.[59] For example, among low-wage garment workers in New York City, African American, Asian, and Hispanic workers have been more likely to be denied workers' compensation payments for carpal tunnel syndrome compared to their white co-workers.[60] Among workers who filed workers' compensation claims for low back pain, African American workers and workers of low socioeconomic status had, after settling their claims, higher levels of pain intensity, psychological distress, disability, and financial struggle.[61]

Job insecurity and fears of retaliation, such as being labeled a "careless" employee, may mean that many low-wage workers do not report work-related injuries.[47] For example, a study of hotel room cleaners in Las Vegas found that almost 20% did not report work-related injuries, many claiming that they were either "afraid" or that it was "too much trouble."[62] In some cases, medical costs are shifted to private insurance, but often workers absorb the costs themselves. For example, Hispanic construction workers were half as likely as non-Hispanic white construction workers to have a work-related injury covered by workers' compensation and four times more likely to pay out-of-pocket expenses—on average, almost $2,000.[63]

Another way that low wages influence health is through the availability of paid sick leave. When sick workers do not stay at home—a phenomenon called *presenteeism*—they and their co-workers can develop adverse health effects. And when workers cannot take time off to care for sick children, the health of their children and others in the children's schools and day care centers can be adversely affected. Low-income workers with family incomes below 200% of the federal poverty level who have children at home are less likely to have paid sick leave and less likely to take time off from work to care for themselves or sick family members compared to higher wage workers.[64]

ENVIRONMENTAL EXPOSURES AND HEALTH INEQUITIES

CASE 7

A father from a small community on the outskirts of a city testified in court about how, for the previous 15 years, a landfill near his property has adversely affected his health, his family members' health, and the quality of life in his neighborhood. He described odors from the landfill and, when the wind blew in his direction, headaches, a bad cough, and burning of his eyes, nose, and throat. He described the noise from trucks bringing garbage to the landfill and seeing rats in the woods near the landfill and buzzards flying overhead. He stated that he did not understand why more was not being done to monitor the landfill. He noticed that family members and many neighbors were sick. For 15 years, they complained to the local health department and the state environmental protection agency. They finally contacted the EPA and found out that tests of local well water 20 years before found that the groundwater was not safe for consumption because it contained high levels of metals and other contaminants that cause cancer, birth defects, and neurological disorders. The EPA stated that anyone who lived within 2 miles of the landfill should not drink well water and should tap into the closest publicly regulated drinking water system or drink only bottled water.

During testimony from town officials, the man learned that the city knew about this contamination and provided alternate water sources to people living in affluent neighborhoods near the landfill, but not to poor people, immigrants, or people of color.

When the judge questioned town officials about their actions, they stated that they disseminated public notices and held stakeholder meetings, but nobody from the man's neighborhood had responded.

This case is not unique. For over 20 years, researchers have demonstrated that many low-income populations, communities of color, immigrant communities, underserved populations, and marginalized and disenfranchised groups live in neighborhoods that experience disproportionate risks from the burden of, and exposure to, environmental hazards. These hazards include many noxious land uses, such as landfills, incinerators, publicly owned treatment works (POTWs, such as sewer and water treatment plants), industrial animal operations, Superfund sites, facilities reporting releases of priority chemicals to the EPA's Toxic Release Inventory (TRI) program, energy production facilities, chemical plants, heavily trafficked roadways, and other locally unwanted land uses (LULUs).[65-75] This disproportionate burden results in increases in exposure to adverse environmental conditions, low environmental quality, and high levels of pollution. The cumulative impact of environmental injustice, due to the spatial concentration of environmental hazards, factories, and noxious land uses, leads to increases in adverse health outcomes and community stress as well as lower quality of life and community sustainability.

In the 1980s, the environmental justice (EJ) movement emerged to address the disproportionate burden of environmental exposures on low-income and minority communities.[65,66] Concerned communities raised awareness of the many environmental and health issues that they faced and asked the federal government to respond. Two groundbreaking studies provided the initial set of evidence that supported the claims of grassroots activists who had been fighting against environmental injustice in places like Warren County, North Carolina; Oakland, California; "Cancer Alley" (a heavily industrial area along the Mississippi River in Louisiana); and Native American reservations and territories in the Great Plains, the Southwest, the South, and Alaska. The first study by the GAO in 1983, *Siting of Hazardous Waste Landfills and Their Correlation with Racial and Economic Status of Surrounding Communities*, which examined the distribution of landfills in EPA Region IV (eight southeastern states), found that 75% of communities containing large hazardous waste landfills were mainly African American. In addition, the study found that African Americans were overrepresented in communities with waste sites.[76] The second study, by the Commission for Racial Justice of the United Church of Christ in 1987 (under the leadership of Charles Lee, director of the EPA Office of Environmental Justice), *Toxic Waste and Race in America,* demonstrated that ZIP codes without a toxic facility had a population with less than 12% persons of color, those with one toxic facility had 24% persons of color, and those with multiple toxic facilities or one of the five largest landfills had 38% persons of color.[77] The major conclusion of this study was that 60% of African Americans and Hispanic Americans lived in communities with toxic waste sites.[77] In 1990, at the Conference on Race and the Incidence of Environmental Hazards, one of the first national environmental justice conferences, researchers presented results that documented and supported the conclusions of the studies cited earlier.[75]

Published in 2007, the *Toxic Wastes and Race at Twenty* report, a follow-up to the 1987 study, provided additional evidence about the disproportionate burden of environmental hazards, industrial facilities, and noxious land uses on disadvantaged populations.[71] The report demonstrated that, nationally, people of color are approximately three times more likely to live in neighborhoods that host a commercial hazardous waste facility than whites.[71] The study found that *(a)* proportionately more African Americans, Hispanics, and Asians reside in neighborhoods that host toxic facilities than in "non-host" neighborhoods, and *(b)* in metropolitan areas, proportionately more poor people live in "host" neighborhoods than "non-host" neighborhoods. There is now a large body of literature on environmental justice, which has documented the disproportionate burden on poor populations, people of color, and other disadvantaged groups of environmental hazards, unhealthy land uses, and other built-environment

problems, such as hazardous waste sites, landfills, refineries, petrochemical plants, industrial facilities, and large highways.[65,66,68,78,79] (See also Chapters 10, 33, and 38.)

Environmental Injustice

CASE 8

At a local community meeting in a poor segregated neighborhood, its primarily Latino, African American, and Asian residents discussed government plans to build another highway in the neighborhood. As a result of highways built earlier, motor vehicle traffic and air pollution increased in the community, causing respiratory problems. During summers, many "ozone-alert" days made children and elderly residents stay inside, and heat waves caused many hospitalizations for exhaustion and heat stroke. Residents complained of dirty, black diesel smoke from trucks that drove through the neighborhood and transit and school buses that idled throughout the day.

A Department of Transportation (DOT) official at the meeting stated that an environmental impact assessment of the planned highway showed that it would not increase air pollution. Town officials stated that the new highway could help promote economic development and bring in new industries, businesses, and consumer traffic. A local physician reported that many of his young patients had asthma and many of his adult patients, especially those who lived near the bus stops and highway exit ramps, were having respiratory and cardiovascular problems. Some residents, who lived near an incinerator (which was also near a middle school) that released pollutants into the atmosphere, observed that the building of highways in the neighborhood had been accompanied by the construction of polluting factories.

Asthma, a prime example of a health disparity resulting from environmental injustice,[68] is more prevalent among people of color than white people. In 2005 in the United States, the following disparities were present:

- Puerto Ricans had a prevalence of asthma 125% higher than non-Hispanic white people and 80% higher than non-Hispanic black people.[68]
- American Indians, Alaska Natives, and blacks had a 25% higher prevalence than whites.
- The asthma hospitalization rate for blacks was 240% higher than it was for whites.
- Blacks had an asthma mortality rate twice that of whites.

Several pollutants in ambient air appear to contribute to asthma attacks, including particles with a diameter less than or equal to 2.5 microns ($PM_{2.5}$), particles with a diameter less than or equal to 10 microns (PM_{10}), ozone, oxides of nitrogen, and sulfur dioxide (see Chapter 6). Exposure to one pollutant may exacerbate the adverse effects of another. In the ambient air, these pollutants may act synergistically to increase respiratory health disorders among exposed vulnerable populations.

There are likely multiple explanations for asthma disparities. Disadvantaged communities tend to live in areas with higher rates of exposure to environmental toxicants. Racial minorities are more likely to live in counties that exceed the 24-hour air quality standard of 65 $\mu g/m^3$ for $PM_{2.5}$. In addition, asthma is influenced by social factors. Minority and low-income communities encounter a higher burden of social stressors, including unstable employment and community violence,[80] which can exacerbate asthma and increase its prevalence—possibly with synergistic effects of environmental exposures. Disadvantaged populations also have limited access to quality medical care, including proper treatment for asthma (see Box 18-1 in Chapter 18).

Environmental factors can contribute to adverse pregnancy outcomes. Residential proximity to environmental hazards increases the risks not only for preterm birth, low birthweight, and birth defects but also for childhood cancer and autism.[81,82] Many studies that have examined the relationship between toxic exposures and birth outcomes have revealed how environmental disparities contribute to adverse pregnancy outcomes and disorders of children, including the adverse effects of place of residence on health. (See Chapter 20.)

Residential Segregation

Residential segregation leads to disproportionate exposure to environmental risk factors—physical, social, and economic—that adversely affect health and lead to health disparities in both urban and rural areas.[65-68] In many urban areas, social, economic, and political forces along with historical patterns of community development, disinvestment, industrialization, and zoning and planning (including for highway development and expansion) have segregated populations of color in impoverished communities that have few resources and increased environmental risks.[65,66] *Redlining* (the practice of denying, or increasing the cost of, services such as banking and insurance) and institutional discrimination have also contributed to segregation of disadvantaged populations.[67,69,70] In these communities, relatively few municipal services are available, infrastructure has deteriorated, and the physical and natural environments have been eroded.[80] Many segregated populations are exposed to high levels of *criteria air pollutants*, such as carbon monoxide, particulate matter, sulfur dioxide, and oxides of nitrogen, released from vehicles and factories in or near these neighborhoods.[68] (See Chapter 6.) Exposure to these pollutants can cause lung cancer or nonmalignant respiratory disorders, such as asthma.[65,66,68] For example, black-white segregation has been correlated with increased levels of sulfur dioxide, PM_{10}, and ozone in metropolitan areas.[2,66] In addition, segregation is associated with *(a)* greater exposure of populations of color to hazardous air pollutants (HAPs) and *(b)* increased risk of cancer, even after controlling for socioeconomic status (Fig. 4-5).

Segregated communities are characterized by concentrated poverty, limited economic infrastructure, and low-quality social services and medical care. These factors act synergistically to raise levels of stress, increase vulnerability, and limit capacity of burdened populations to overcome disease and increase health status.[65-68] The spatial distribution of unhealthy land uses in disadvantaged and marginalized areas, such as hazardous waste facilities, chemical plants, landfills, incinerators, sewage treatment plants, coal-fired power plants, and heavily trafficked roads, are important contributors to unhealthy environmental conditions to which segregated populations are exposed.

Figure 4-5. Children's play area near an industrial facility. (Photograph by Earl Dotter.)

Community Planning and Development

Many factors contributed to inequitable development in urban, suburban, and rural areas in the United States, including suburbanization (population movement from within cities to the rural-urban fringe, which leads to urban sprawl), discriminatory housing policies, segregation, massive highway construction, deindustrialization, and poor zoning and planning.[67,69] As a result, many areas have been divided by race, ethnicity, and socioeconomic status, creating environmental injustice. The segregation and spatial variation in planning and development in communities with different racial, ethnic, and socioeconomic composition have arisen from conditions and policies in different time periods. These conditions and policies have included *Jim Crow policies* in the South—state and local laws in the United States enacted between 1876 and 1965 that mandated racial segregation in all public facilities with a supposedly "separate but equal" status for African Americans. They have also limited access for non-whites to low-interest home loans after World War II, exclusionary zoning, racial covenants, and redlining.[69] The uneven nature of community planning, zoning, and development has led to *fragmentation* (the division of metropolitan areas into multiple smaller municipal districts), *gentrification* (the restoration of run-down urban areas by the middle class, resulting in the displacement of low-income residents), and sprawl and the spatial concentration of environmental hazards and unhealthy land uses in communities affected by environmental injustice. Spatial fragmentation and gentrification have limited sustainable economic development which, in turn, has adversely affected the quality of schools, housing, transportation, civic engagement, and social climate.

Although zoning and planning are sometimes perceived as objective processes, they are, in reality, highly political, class-conscious practices. Early in the twentieth century, zoning became widespread in the United States because it effectively regulated land use, making it difficult or impossible for less-affluent people to cross community boundaries. For example, in New York City, zoning was a social and political process, in which much of the boroughs of Bronx, Brooklyn, and Queens was zoned as unrestricted, which promoted—for economic reasons—development of hazardous industrial facilities in poor and working-class areas.[83] Zoning and race were closely related. For example, the Bronx had the highest concentration of poor and minority residents as well as large increases in areas zoned for manufacturing; in contrast, more affluent Manhattan had the greatest decrease in manufacturing.[83] Land zoned for manufacturing in the Bronx exposed nearby residents to disproportionate amounts of environmental toxins. This zoning pattern occurred in other U.S. cities, including Chicago, Atlanta, Detroit, and Los Angeles.

New movements in planning and community development, including *new urbanism* (an urban design movement that focuses on the development of walkable communities) and *smart growth* (an urban planning approach that focuses on concentrated growth, mixed-use development, compact, walkable, pedestrian-friendly, transit-oriented neighborhoods to reduce sprawl and improve neighborhood sustainability), have been adopted by planners, local government officials, architects, and environmental organizations to improve health, sustainability, and quality of life in neighborhoods, towns, and cities. Unfortunately, these movements have not gone far enough in addressing environmental injustice and social inequalities, and they may lead to more segregation, gentrification, and uneven planning, zoning, and development.[67,69] For example, the adverse social, economic, environmental, and health impacts of urban revitalization on disadvantaged populations are evident in the destruction of core urban neighborhoods in large cities and displacement of underserved and disadvantaged residents. Therefore, economically advantaged populations, who benefited disproportionately from the suburbanization movement, may benefit disproportionately from new revitalization efforts, while historically disadvantaged populations may be adversely affected.[69] Without equity-based policies, the elimination of environmental injustice and health disparities in disadvantaged communities through new forms of planning and community development may not occur.[69]

Publications on environmental justice have recognized how inequitable zoning and planning

and community development contribute to lack of access to basic amenities, such as sewer and water infrastructure, good housing stock, parks, green space, recreational facilities, and pedestrian-friendly residential environments in rural areas and small towns.[67,69,70,84] The problems of unjust transportation planning and urban sprawl have been studied in Atlanta and Southern California,[79,85] revealing how transportation inequities can contribute to environmental injustice and public health problems. There is also a high concentration of *pathogenic infrastructure*, such as fast-food restaurants, liquor stores, and check-cashing facilities, in poor neighborhoods and communities of color in Southern states, such as North Carolina, and large cities, such as Detroit.[86,87]

Many low-income populations and populations of color live in neighborhoods that are differentially burdened, due to discriminatory and exclusionary zoning, by toxic land uses and polluting industrial facilities, such as landfills, hazardous waste sites, incinerators, sewer treatment plants, TRI facilities, petrochemical plants, and large highways.[65–75,78] The higher burden of noxious land uses and pathogenic infrastructure in disadvantaged and underserved communities leads to higher exposure to unhealthy physical environments, increased health risks, poor health behaviors (such as less leisure-time physical activity and poor diets), and adverse health outcomes and health disparities for asthma, cancer, obesity, diabetes, and cardiovascular disease. Exposure to such noxious conditions has been linked to the exacerbation of preexisting health problems, asthma-related morbidity, premature adult mortality, infant mortality, low birthweight, psychological stress, and higher body burdens of toxic chemicals, such as lead.[65,67]

The Built Environment

CASE 9

A mother of three children attended a parent–teacher association meeting at a local junior high school to find out more information about its new garden. Her children came home after school a few weeks before excited about a new school program in which students would have physical activity and eat organic produce from the school's garden or the local farmers' market. At the meeting, the mother was shocked to learn that the program was established because of high rates of obesity and diabetes among students. Two of her children were overweight and one had been diagnosed with diabetes at age 10. A local professor stated that her neighborhood was a *food desert*, with no supermarkets or grocery stores and fresh fruits and vegetables available only at a gas station's convenience store. The professor stated that the neighborhood had poor access to mass transit, preventing residents from having access to supermarkets in suburban locations, and had 10 times the average number of fast-food restaurants. The mother recalled how often she bought her children hamburgers and french fries from a nearby fast-food restaurant.

In response to the professor's assertions, a community leader stated that the neighborhood was not a *food desert*, but rather that it had been impacted by environmental injustice and *food apartheid*. She said she had been working for 20 years to try to bring about better community development and more supermarkets, but that politicians countered that the neighborhood could not support a supermarket or even a medium-sized grocery store. However, she noted that some progress had been made in turning empty lots into community gardens and cleaning up many of the parks.

The lack of positive and health-promoting features in the built and social environments, which contributes to health inequalities, is a major concern for communities affected by environmental injustice.[67] For example, low-income neighborhoods, urban neighborhoods, and neighborhoods that are predominately African American have less access to supermarkets than wealthier neighborhoods, suburban neighborhoods, and those that are predominantly white.[86] The presence of supermarkets is associated with better diets and lower rates of overweight, obesity, and hypertension.[86] In many segregated and fragmented areas, the lack of health-promoting food resources creates a *food desert*, which is made worse by limited transportation opportunities for local residents. Many of

these poor segregated communities do not have access to personal vehicles or reliable public transit, which limits access to distant supermarkets. These environmental restraints and overabundance of food outlets in convenience stores and gas stations adversely affect diet, lifestyle, and risks for obesity, cardiovascular disease, and diabetes.[67,69] (See Chapter 39.)

Poor and minority neighborhoods impacted by environmental injustice are also less likely to have access to opportunities for physical activity, including green space, parks, and recreational facilities.[67,87] Even when there are facilities, other factors, such as poor neighborhood aesthetics and safety, limit physical activity in these neighborhoods. Limited access to medical care and lower quality of care adversely affect health and increase disparities in disadvantaged neighborhoods.[80] Being both disadvantaged and medically underserved means disadvantaged populations may have higher rates of chronic conditions, drug abuse, emotional problems, poor health behaviors, lower childhood immunization rates, and more hospitalizations for preventable diseases than other populations. In addition, poor and minority communities impacted by environmental injustice are also overburdened by health-restricting infrastructure with *environmental pathogens*.[67] Poor and minority communities have more retail access to fast food, alcohol, and tobacco, and are more frequently targeted by advertisements for fast food, alcohol, and tobacco.[67]

The local environment in disadvantaged communities, especially those affected by environmental injustice, has adverse impacts on quality of life, lifestyles, and behaviors. Taken together, the differential burden of increased exposure to *environmental pathogens* and decreased access to health-promoting resources have important implications for promoting public health and addressing environmental health disparities in these communities.[67] The presence of environmental pathogens in a community can limit the ability of agencies to promote public health because these pathogens may create community stress or promote negative health behaviors. In addition, these pathogens may act as sources of pollution. And, because these communities have little or no access to health-promoting infrastructure, such as parks, open space, and health care facilities, policies to reduce environmental health disparities may be unsuccessful.

COMMUNITY EMPOWERMENT: ONE APPROACH TO ADDRESS HEALTH INEQUITIES

Health inequities resulting from environmental and occupational injustice are challenging to eliminate, especially given the complex social, political, and economic forces that have created and sustained them. New approaches to public health interventions should recognize these complexities and should develop comprehensive and more effective public health prevention programs. One especially promising approach has emerged: community-driven research, also known as *community-based participatory research* (CBPR).[88–92]

With CBPR, community groups utilize their grassroots activism, resources, and expert local knowledge and collaborate with university partners to develop a framework to address environmental and occupational issues at the local level.[88–92] This approach allows for the research process to be more action-oriented, thereby increasing and sustaining the community's capacity to address justice and health issues, and increasing civic engagement by minority and low-income stakeholders.[91,92] By creating a shared responsibility for research, this approach brings equality to the relationships between local experts and academic experts, and ensures that the research is locally relevant.[88–92] Many CBPR projects also emphasize the role and participation of community youth, which creates an intergenerational pipeline of community leaders knowledgeable about these issues. The use of community-driven research methods has helped to empower communities; raise awareness about environmental and occupational justice issues at the local, state, and national level; increase environmental health literacy; and enhance building local capacity to develop sustainable prevention programs.[91,92] As described in the book *Street Science*,[90] El Puente and the Watchperson Project, two community-based organizations in Brooklyn, engaged in CBPR to address asthma and health risks from consuming subsistence diets of locally caught fish. Each organization

built its capacity to collect locally relevant data, working in partnership with scientists and receiving training in data collection methods. Similarly, the West End Revitalization Association, a community-based environmental justice organization in Mebane, North Carolina, developed a community–university partnership with researchers and students, primarily from the University of North Carolina at Chapel Hill. It developed its own research framework and received training on environmental health issues and data collection methods to build community capacity to address environmental health issues associated with infrastructure disparities at the local level.[91,92]

The success of this community-driven approach has also been demonstrated in an evaluation of Partnerships for Communication, a long-term initiative in which the NIEHS, NIOSH, and EPA funded 54 environmental justice and occupational justice projects that addressed exposures in urban and rural communities. Each project required collaboration among a research organization, a community-based organization, and an organization of health care providers. Some projects addressed environmental justice concerns, including exposures from hazardous waste sites, industrial animal operations, water and air pollution, uranium, and pesticides. Others addressed occupational justice concerns, including exposures to lead, organic solvents, pesticides, and other chemicals, among various types of workers, including day laborers, nail-salon workers, floor refinishers, farmworkers, and domestic workers. The initiative also created programs to address workers' rights and language barriers for Asian and Hispanic immigrant workers in meatpacking, agricultural production, and restaurant work.

The evaluation of Partnerships for Communication projects found that they were remarkably successful at developing community training and education programs, creating sustainable community leadership, and producing many new and innovative mass-media campaigns.[93] Many positive public health and public policy impacts were documented, including reductions in community exposures through changes in laws and regulations, changes in government planning and zoning, and adoption of new work practices by employers. For example, some projects led to legislation to control diesel emissions from idling school buses, to prohibit plating operations that used hexavalent chromium from locating in residential or mixed-use neighborhoods, to stop permitting for landfills, and to close a medical waste incinerator. Other projects created safer work environments by successfully promoting the substitution of safer chemicals, by collaborating with a manufacturer to market blueberry rakes that were ergonomically sound, and by developing linguistically and culturally appropriate worker training programs that were adopted by employers.

CONCLUSION

The ambitious goal of eliminating racial and ethnic health disparities, set by the U.S. Department of Health and Human Services in 2000, has yet to be achieved. However, the attention given to these disparities by researchers, public health workers, and communities has led to a clearer understanding of the complex and deeply rooted social and economic factors that sustain these inequities, including those resulting in disproportionate occupational and environmental exposures. Eliminating these disparities will require the commitment not only of public health workers but also of policy makers and actively engaged community members to create a more just society.

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This report provides a clear and succinct overview of the broad range of social and economic determinants that contribute to health inequities.

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The findings and conclusions in this chapter are those of the authors and do not necessarily represent the views of the National Institute for Occupational Safety and Health or the International Labor Organization.