YOUNG WORKERS

DAWN N. CASTILLO, MPH
LETITIA DAVIS, SCD
DAVID H. WEGMAN, MD, MSC

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DAWN N. CASTILLO, MPH
LETITIA DAVIS, ScD
DAVID H. WEGMAN, MD, MSc

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From the National Institute for Occupational Safety and Health
Morgantown, West Virginia (DNC)
and
Massachusetts Department of Public Health
Boston, Massachusetts (LD)
and
University of Massachusetts
Lowell, Massachusetts (DHW)

Reprint requests to:
Dawn N. Castillo, MPH
National Institute for Occupational Safety and Health
1095 Willowdale Road, MS P-180
Morgantown, WV 26505

Early efforts to address occupational health and safety in the United States were prompted in part by concerns about the welfare of children. This concern led to passage of state child labor laws and eventually, in 1938, of federal law to protect the educational opportunities, health, and well being of young workers—children and adolescents less than 18 years old.[86,87] Substantial revisions in federal and many state laws have not been made in decades. Consequently, many laws do not reflect changes in youth employment patterns, changes in the nature of work, and new knowledge about occupational health and safety risks. Additionally, enforcement of the laws is limited.[25]

Recent efforts at occupational injury surveillance reveal that concerns about young workers cannot be relegated to the past. While work can provide important benefits for youth, such as enhanced self-esteem, job skills, and income, it also poses substantial health risks. Young workers in the U.S. today routinely confront safety and health hazards on the job, and each year tens of thousands are injured, hundreds are hospitalized, and at least 70 are killed. In addition, working more than 20 hours per week while going to school has been linked with a number of adverse psychosocial outcomes such as increased fatigue and substance abuse, issues important to consider within a broad definition of child and adolescent health.[72]

In considering the health and safety concerns of young workers, it is important to distinguish between frankly exploitative situations, such as sweatshops, and what we will refer to

here as "youth employment."[30] The former typically involves minority children working out of economic necessity and hidden from public view. Exploitative child labor continues to be a reality for a comparatively small number of young people in the U.S. Youth employment, on the other hand, is the norm in American society. Failure to differentiate between frankly exploitative child labor and youth employment enables society at large to distance itself from the problem—to focus on the extreme conditions and overlook risks faced by youth in common, everyday jobs. Both issues need to be addressed.

This chapter focuses on the health and safety risks faced by children and adolescents employed in the U.S. Many of the issues are relevant to youth employment in other industrialized countries.[32,47,55,98] There is less of an overlap with child labor in newly industrializing countries, where the ages of working children tend to be lower, the types of work conducted by children differ, and there are many human rights as well as health and safety concerns.[11,12,37,44,45,75] While exposure to toxins brought home by working parents or incurred by children when they accompany their parents to work are important public health considerations, they are beyond the scope of this review.[63]

DEFINING THE POPULATION

Work is an integral part of adolescent life in the U.S. According to the U.S. Department of Labor (DOL), an average of 34% of 16- to 17-year-olds—over 2.6 million teens—were employed during 1997.[17] The official estimates of youth employment undercount the true number of employed youths.* For example, they exclude 14- and 15-year-olds who are legally allowed to perform a variety of tasks in formal work situations, as well as younger children who are allowed to work under federal law as news carriers and in family businesses such as farming.[86,87] Surveys of youth indicate that 80% have worked for pay by the time they leave school.[54,84] While working youth historically contributed to the support of their families, most youth today report that they primarily work for discretionary income.[49,99] A minority work to provide financial support for their families. Although comparisons with other countries are difficult, available data suggest that more children in the U.S. work while going to school than in other industrialized nations.[46,60]

Young workers typically are employed in part-time, low-paying jobs, and they move in and out of the work force. When employed, they spend substantial numbers of hours at work. In 1995, according to estimates by the U.S. Bureau of Labor Statistics, 15- to 17-year-olds averaged 19 hours of work per week when they were working.[14] In a recent nationwide survey, 17.9% of high-school students reported working more than 20 hours per week during school.[78] Half of working youth are employed in the retail sector, predominantly grocery stores and restaurants, where they constitute 10% and 14% of the work force, respectively (Fig. 1). About a quarter are employed in service industries such as nursing homes, and about 8% are employed in agriculture.[15] Proportionately more younger children who are employed work in agricultural settings.[72] Youth from low-income families, while less likely to be employed, are more likely to be engaged in high-risk occupations, such as agriculture, manufacturing, and construction.[89] Information about the numbers of children employed in frankly exploitative situations is not available. Kruse, extrapolating from data on child labor violations within the New York City apparel

* The U.S. Department of Labor's formal definition of the labor force excludes persons under the age of 16.

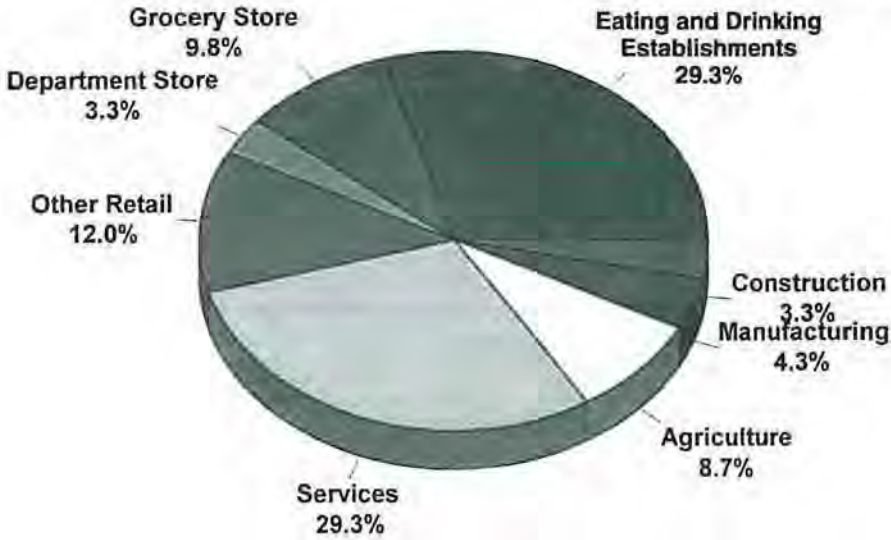

FIGURE 1. Distribution of working youths 15–17 years old by industry in the United States in 1996. (Data from U.S. Department of Labor: Current Population Survey, 1996 (March supplement). Washington DC, Bureau of Labor Statistics, 1996.)

industry, has estimated that 13,000 children in the U.S. currently may be employed in sweatshops.[52]

FEATURES THAT MAKE YOUTH SPECIAL

Society has established different levels of acceptable risk for children and adults in the workplace. Child labor laws establish minimum ages for employment, limit the hours and times of day youth can work, and prohibit employment of youth in certain jobs deemed as too hazardous (Table 1). These laws provide an additional layer of protection above and beyond occupational safety and health standards that apply to all workers.

A number of features raise special concerns about the health and safety of children and adolescents in the workplace. Like all new workers, youths are at increased risk of injury simply from lack of experience. Inexperienced workers are unfamiliar with the requirements of work, are less likely to recognize hazards, and are commonly unaware of their legal rights on the job. Developmental characteristics—physical, cognitive, and psychological—also may place them at increased risk. There is tremendous variability in the size of adolescents, for example, and smaller youth may not be able to reach parts of machines or may lack strength required to do the tasks demanded of them. Some organ systems, such as the musculoskeletal, reproductive, and endocrine systems, undergo periods of growth or activity during adolescence.[71] It is not known if these periods introduce unique youth susceptibilities to chemical or ergonomic insults at work.[67,76]

Adolescence is well recognized as a period of profound psychological change. The psychological transition typically lags behind physical maturation, and psychological immaturity may be obscured by the physical appearance of the adolescent who may be assigned tasks for which he or she is neither emotionally nor cognitively prepared. Focus group research in North Carolina suggests that youth feel

TABLE 1. Hazardous Jobs under the U.S. Fair Labor Standards Act (FLSA)

Nonfarm Work*	Farm Work**
Manufacturing or storing explosives	Operating tractors with horsepower greater than 20 power take-off
Driving a motor vehicle and being an outside helper on a motor vehicle	Operating corn pickers, cotton pickers, grain combines, hay mowers, forage harvesters, hay balers, potato diggers, mobile pea viners, feed grinders, crop dryers, forage blowers, auger conveyors, nongravity-type self-unloading wagons or trailers, power post-hole diggers, power post drivers, nonwalking-type rotary tillers
Coal mining	Operating trenchers or earth-moving equipment, forklifts, potato combines, power-driven saws
Logging and sawmilling	Handling breeding animals, sows with suckling pigs, cows with newborn calfs
Power-driven wood-working machines†	Felling, bucking, skidding, loading, unloading timbers with a butt diameter > 6 inches
Exposure to radioactive substances and to ionizing radiations	Using ladders or scaffolds > 20 feet high
Power-driven hoisting equipment	Driving a bus, truck, or car while transporting passengers or riding as a passenger or helper on a tractor
Power-driver metal-forming, punching, and shearing machines†	Working inside fruit, forage, or grain storage units, silos, or manure pits
Mining, other than coal mining	Exposure to agricultural chemicals classified as Category I or II toxicity
Meat packing or processing (including power-driven meat-slicing machines)†	Working with explosives
Power-driven backery machines	Being exposed to anhydrous ammonia
Power-driven paper-products machines†	
Manufacturing brick, tile, and related products	
Power-driver circular saws, band saws, and guillotine shears†	
Wrecking, demolition, and ship-breaking operations	
Roofing operations†	
Excavation operations†	

* Seventeen hazardous nonfarm jobs are prohibited under the FLSA. Generally, youth under age 18 cannot do work involving these activities.

** Children working on their parents' farms are exempt from the prohibitions of the FLSA. For other children under age 16 working in agriculture, these occupations/tasks are prohibited.

† Limited exemptions are provided for apprentices and student-learners under specified standards.

Data from U.S. Department of Labor: Child Labor Requirements in Nonagricultural Occupations Under the Fair Labor Standards Act (WH pub no 1330); and Child Labor Requirements in Agriculture Under the Fair Labor Standards Act (WH pub no 1295). Washington DC, DOL, 1990.

powerless at work and are reluctant to raise concerns with managers out of fear of being fired or reprimanded.[100] Since adolescence is a time of exploration and risk-taking, a common explanation given for workplace injuries among adolescents is irresponsible acts associated with risk-taking behavior. Interviews with adolescents injured at work in Massachusetts, however, suggest that it is frequently young workers trying to act responsibly and demonstrate new independence and skills who are injured at work.[56,57] Many of adolescents' positive traits, such as energy, enthusiasm, and a need for increased challenge, combined with a reluctance to ask questions or make demands on employers can result in adolescents taking on tasks they are not capable of doing safely.[26]

Finally, while the presence of youth in the workplace raises special health and safety concerns, there also are special opportunities and resources for prevention of occupational injuries and illnesses in this population. In addition to the federal and state child labor laws that protect working children and adolescents,[35,57,62,91] innovative efforts involving adults, who have important roles to play in safeguarding the health and safety of young workers, should be considered. Parents and guardians retain legal and social responsibility for their children's well-being. Educators also play a role in youths' work lives: in approving work permits, providing or facilitating work experiences, and preparing students for the world of work. In some states,

health care providers are required to sign off on work permits. Thus, the community can be prevailed upon to promote the health and safety of working youth. Examples of ongoing efforts include: incorporation of health and safety education into school-to-work initiatives and/or middle- and high-school curricula; development of peer leadership programs; and information dissemination about health, safety, and workers' rights through community organizations, offices of health care providers, and local media.[50,57,67]

Notably, community-based educational interventions to increase the knowledge and skills of adults and youths with respect to workplace health and safety should not detract from a focus on the work environment itself, nor from the primary prevention goal of reducing hazards in the workplace. It remains the ultimate responsibility of the adult employer, who profits economically from the labor of youths, to provide a safe, appropriate work environment with adequate supervision and training. Community resources can be marshaled to shift community norms and help ensure that this responsibility is met.[43]

THE OCCUPATIONAL HEALTH STATUS OF YOUNG WORKERS

Hazards

Interviews with working youth direct attention to the prevalence of exposures to known safety and health hazards, and to the problem of infrequent safety and health training. For example, North Carolina youth with work experience reported hazards at work such as working on ladders or scaffolding (36%); using forklifts or tractors, or riding mowers (31%); and working around very loud noises (31%).[34] Massachusetts high-school students with work experience reported additional hazards: about half used cleaning chemicals or case cutters; over one-third used ladders, and 19% and 13% used food slicers and box crushers, respectively.[5,57] Only 50% of the interviewed youths reported receiving any health and safety training. Pooled survey results from four geographic areas (Philadelphia, Pennsylvania; Brockton, Massachusetts; Oakland and South Central Los Angeles, California) demonstrate that youths often are involved in potentially hazardous tasks without adequate safety training, and that 15–20% of youths work often or always without supervisors present at the worksites.[6] Interviews with youths injured at work likewise suggest that approximately 50% of young workers do not receive relevant health and safety training at work.[51,57]

Violations of federal child labor laws are another measure of youth exposure to unsafe environments. The DOL has identified 17 activities in nonfarm work, termed "hazardous orders," that are considered especially dangerous and prohibited for youth less than 18 years of age (Table 1). Many of the activities reported by youths in surveys involve work in these hazardous orders; specifically, the use of forklifts (power-driven hoisting equipment), powered food slicers (meat-packing or processing machines), and box crushers (power-driven paper-products machines).[86] Between 1983 and 1989, the DOL detected almost 40,000 cases in which youth less than 18 years of age were working in hazardous jobs prohibited by federal child labor laws (Table 1).[90]

Occupational Injury and Illness Data

Mounting evidence indicates that occupational injuries to youth are a significant public health concern. No single source of data captures all occupational injuries, and injuries to working youth may be even less likely to be recognized and

recorded than injuries to adults because youth often are not thought of as "workers." This especially is true for children working on family farms and in other family businesses where distinctions between family and work life are not clear-cut. Findings based on any single data source therefore should be considered conservative estimates. Taken together, numerous studies provide a picture, albeit incomplete, of work-related injuries experienced by youth in the U.S.

Nonfatal Injuries

Close to 59,000 injuries to children and adolescents were identified during 1987–1988, based on workers' compensation data from just 26 states.[90] Other estimates from workers' compensation records come from Washington state, where data on all injuries regardless of lost worktime are collected; over 4400 workers less than 18 years old were awarded workers' compensation benefits each year during 1988–1991.[58] In New York state alone, more than 1200 youths annually received compensation for occupational injuries, resulting in 8 or more days lost worktime during 1980–1987; 43.5% of the injured youth suffered permanent disability.[3] The social costs of disabling injuries to youths who are just starting their working lifetimes is not known, but probably are reflected in limits to future career opportunities and overall quality of life.

Many investigators have used workers' compensation records to document the extent of the problem in individual states.[2,8,19,29,41,73,80,83] Even these data could be undercounts of compensable injuries. For example, there is some evidence that young workers with occupational injuries are even less likely than adults to enter the compensation system.[8,36] One factor may be the eligibility criterion of missed work days: part-time workers, such as students who only work on weekends, may not meet the requirement. In such cases, lost worktime also is limited as an indicator of injury severity for young workers.

Emergency department records are an important source of information about work-related injuries to youth because they capture not only the most serious injuries, but also less disabling injuries that do not necessarily require time away from work. Brooks, et al., in a study based on Massachusetts emergency department data from the early 1980s, estimated that 7–13% of all medically treated injuries among 14- to 17-year-olds occurred at work.[9] Findings based on data from samples of emergency departments nationwide suggest that between 70,000 and 105,000 individuals in this age group were seen in hospital emergency departments for occupational injuries in 1996.[68,96] It has been estimated that about 34% of occupational injuries are treated in emergency departments;[24] therefore, the total number of youth work injuries is likely to be 210,000–315,000 each year. Followup with a subset of emergency department cases revealed that 25% experienced limitations in their normal activities for more than a week.[51]

Again, interviews with young workers also shed light on the extent of the problem. Of teens who have worked, 7–16% report being injured at work seriously enough to seek medical care.[5,34,74,97]

All of these reports provide a clear mandate for attention to the problem of youth work injuries. Rates of youth work injuries add to the justification. Because youths usually work part-time and intermittently, the numbers of injuries to adolescent workers produce quite high estimates of injury rates per hour worked. The few studies where injury rates have been calculated across age groups suggest that 16- to 17-year-olds are among groups with the highest rates of work injuries.[24,28,58] The rates for work-related injuries treated in emergency departments for 16- to 17-year-old

males and females in 1996 were 6.0 and 3.9 injuries/100 full-time equivalent workers, respectively.[24] This is all the more striking when compared to results for workers of all ages (3.3 and 2.1/100 full-time equivalent workers for males and females, respectively).

Adolescent males have consistently greater numbers and higher rates of injuries than adolescent females.[2,3,8,9,53,58,73,74,80] Also, the numbers and rates of work-related injuries increase with age through adolescence, with 16- to 17-year-olds accounting for over 85% of the injuries.[2,3,8,9,41,53,58,80] As would be expected, most injuries occur in those industries in which the greatest numbers of youth are employed—retail trades, predominantly restaurants and food stores.[2,3,8,9,53,58,80] Efforts to identify high-risk workplaces suggest restaurants (close to 40% of youth work injuries treated in emergency departments) and food stores (8–14%).[23,53] Other leading locations include general merchandise stores, nursing homes, and farms. Data suggest that agricultural injuries are especially common among youth less than 16 years of age,[3,38,41,58,80] and that injuries sustained in agriculture may be more severe than injuries in other industries.[38,41]

National statistics can obscure regional variations in injury patterns by industry; state-specific data reveal findings important for targeting local interventions. For example, hotels and motels were the most common sites of work-related injuries to youth in Vermont (27%), and cleaning and garment services accounted for 16% of injuries among young workers in Alaska. In Hawaii, nearly one fourth of the incidents occurred in construction.[23]

Injury rates as well as numbers are key in setting prevention priorities. Nationwide, the retail trade sector not only had the highest frequency, but also the highest rate of adolescent work-related injuries treated in emergency departments.[53] Besides retail trades, high rates of injuries generally have been seen in the manufacturing and construction sectors.[3,8,53,58] In several states, youth in public administration appear to have high injury rates. Miller and Kaufman report that most of these youths held summer jobs, such as groundskeeper and lifeguard.[58]

Lacerations, sprains and strains, contusions, burns, and fractures are the most common nonfatal work injuries to youth.[2,3,8,9,19,23,53,58,73,74,80,83] Types of injury vary by industry (Fig. 2). As with adults, approximately half of the sprains and strains involve the back. Back pain is atypical in adolescents. Given that a history of back pain has been identified as a risk factor for new back injuries, this finding in young workers raises important concerns about long-term health impacts.[92]

While the association between nonfatal injuries and violations of child labor laws has not been formally evaluated, several studies suggest that illegal work may be a contributing factor to the large numbers of teens injured on the job. The DOL found 1475 serious injuries among youth employed in violation of child labor laws between 1983 and 1990.[89] Knight, et al. reported that 19% of youth with nonfatal work-related injuries treated in emergency departments appeared to have been injured in jobs declared to be hazardous or typically prohibited for their age under federal child labor laws.[51] In a sample of businesses where minors were severely injured in Washington state, 56% were found to employ youth in violation of child labor laws.[95]

Fatal Injuries

Each year during 1992–1997, 62–70 youths less than 18 years old died from injuries at work according to the Census of Fatal Occupational Injuries (CFOI).[16,18,31] A strength of the CFOI over previous traumatic occupational fatality surveillance systems is that it does not rely on a single source of information, but combines data from

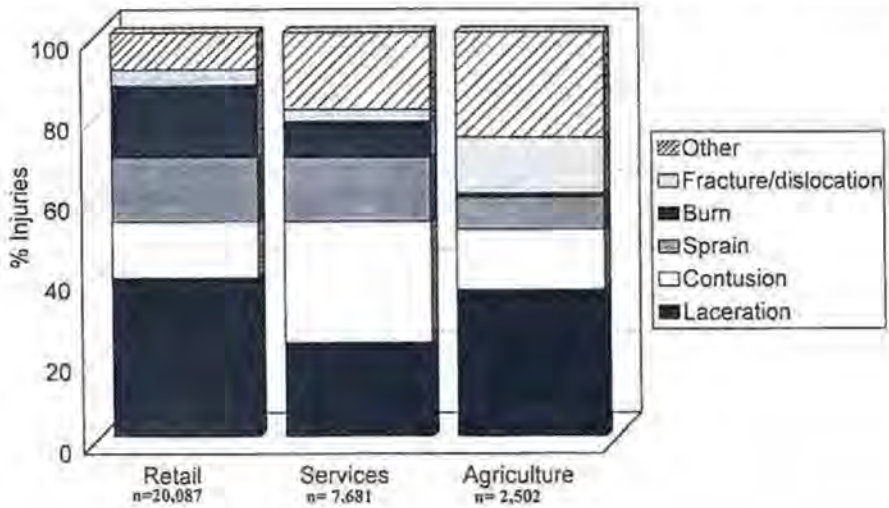

FIGURE 2. Type of injury by industry, youths 14–17 years of age treated in emergency departments for work-related injuries, July–December 1992. (Data from National Electronic Injury Surveillance System, NIOSH; published in Layne LA, Castillo DN, Stout N, Cutlip P: Adolescent occupational injuries requiring hospital emergency department treatment: A nationally representative sample. Am J Public Health 84:209–216, 1994.)

multiple sources. Analyses of these data show that the majority of deaths occur among older youths (16- 17 years old); but, unlike for nonfatal injuries, younger workers accounted for a substantial proportion (40%) of fatalities, with 19% of the fatalities among youth 13 or younger. As with adults, most youth work fatalities occur among males (90%).[16,20,21,29,31,33] In light of special exemptions from child labor laws for agriculture,[87] it is important to note that this industry accounted for more fatal injuries among young workers (38%) than any other industry, half of which occurred among youth working on family farms.[31] Among youth less than 16 years old, employment in family agricultural businesses was even more predominant, accounting for 31 of 51 fatalities. Among 16- to 17-year-olds, there were more deaths in retail trades than in agriculture, and deaths in the construction industry also were relatively common.

A review of a death certificate data base thought to include about 80% of work-related deaths[48] found that motor vehicle–related incidents, homicides, and machine-related incidents were the leading causes of fatal occupational injuries to 16- to 17-year-olds from 1980 through 1992.[20,21] Death certificates are suspected to undercount motor vehicle–related incidents and homicides,[48] and may specifically undercount youth.[21,33] Nonetheless, motor vehicle–related events were the leading cause for males; homicides for females. One third of the motor vehicle–related deaths involved youth driving motor vehicles, despite the fact that federal law during this time period all but prohibited workers under 18 from driving for work.[86] There are no data on occupational homicides among youth specifically, but data on fatal occupational injuries among workers of all ages indicate that most occupational homicides occur during the course of robberies in retail trades.[18,65] Youth working on tractors and forklifts accounted for most of machine-related deaths among youth.[20,21]

The work-related fatality rate for 16- and 17-year-olds for 1990–1992 was 3.5 deaths/100,000 full-time equivalent workers.[21] This compares to rates of about 4

deaths/100,000 full-time equivalents for age groups between 18 and 44. Though a small difference, it is cause for concern, since child labor laws prohibit youths from working in particularly dangerous jobs. Even though youth are known to work in violation of child labor laws, employment data suggest that, overall, youth are employed to a much lesser extent than adults in the most dangerous industries.[22] Youth occupational fatality rates may be closer to, or even exceed, those of adults if the rates were for comparable types of work.

Violations of both child labor and health and safety laws have been associated with occupational deaths of youth. Of 104 deaths of children and adolescents investigated by the Occupational Safety and Health Administration (OSHA) 1984–1987, citations of safety standard violations were issued in 70% of the deaths.[85] Employment of youths in jobs prohibited by child labor laws has been reported to be associated with 38–85% of deaths.[20,33,85,90]

Although aggregate statistics are good at demonstrating the magnitude of youth work injuries and deaths, they often lack information about the common events leading to these injuries and the impact on the lives of young people and their loved ones (Table 2).

Occupational Illnesses

Surveillance programs have greatly improved our understanding of youth occupational injuries. Little is known, however, about the extent to which youth experience *acute or chronic illnesses* as a result of work-related exposures. Some data are available from the Bureau of Labor Statistics' annual survey of employers, but it is well-recognized that occupational illnesses are undercounted in this system.[70,88] Illnesses identified in this system tend to be acute and have obvious associations

TABLE 2. Sample Cases of Serious and Fatal Youth Work Injuries

- A 14-year-old employed by a packing company suffocated in a storage bin while helping to package dried beans.
- A 15-year-old working in a restaurant was severely burned while changing the oil in a fryer. The youth slipped while carrying the hot oil and suffered second- and third-degree burns over 14% of his body.
- A 15-year-old was killed in a tractor rollover incident on a tobacco farm. The youth, along with his brother and another boy, was using a tractor to plow a field. As he tried to turn the tractor around near the edge of a small ravine, one of the wheels went over the ravine and the tractor overturned. It landed on the boy, and he died immediately.
- A 16-year-old employed by a construction company died of massive head injuries after falling 30 feet from the roof of a building.
- A 16-year-old working on a farm was seriously injured when he became entangled in a silo unloader. It took an hour for a rescue team to extract the youth from the machinery so that he could be airlifted to a hospital. The boy's leg was amputated below the knee, and his right foot was seriously injured.
- A 17-year-old working for a retail operation was injured while operating a meat grinder. The youth's finger was caught in the grinder and broken, causing him to miss 2 months of work.
- A 17-year-old working in a sandwich shop was sexually assaulted and robbed at gunpoint. The crime occurred while the youth was working alone after 11.00 PM.
- A 17-year-old working for a wood products company was injured when the forklift he was operating rolled over. His back was severely bruised, causing him to miss 5 days of work.
- Three young workers, ages 17–23 years, were found shot to death in a walk-in freezer at a restaurant. A fourth youth was critically wounded. The murders were committed late in the evening; robbery was the apparent motive.

From National Institute for Occupational Safety and Health: Special Topic: Working Children and Adolescents [developed for individual states]. Morgantown, WV, Division of Safety Research, 1995.

with workplace exposures. Youth occupational illnesses identified through the survey include dermatitis, tendinitis, and carpal tunnel syndrome.[13]

Data from outbreak investigations and special surveys also document work-related illnesses among youth. For example, youth were among the ill in an outbreak of green tobacco sickness in Kentucky.[7] Audiometric testing of students in Wisconsin found that 57% of students who lived and worked on a farm had noise-induced hearing loss compared to 33% of students with little or no farm exposure.[10]

The extent to which youth work exposures contribute to chronic illnesses in adulthood is unknown. Young workers potentially are exposed to a number of hazardous substances or conditions documented or hypothesized to contribute to latent illness. For example, in a North Carolina survey, 27% of youth who had worked reported exposures to very loud noises, 24% reported working with gasoline, and 19% reported working with pesticides or other chemicals.[34] Because youth typically work part-time, their exposures may not exceed existing standards, which assume a lifetime of eight-hour workdays and 40-hour workweeks. The fact that they are exposed for relatively short periods of time may reduce the likelihood of long-term health impacts. The fact that they are exposed at all raises important research questions about the potential increased susceptibility of young workers, the effects of age at first exposure, and the combined effects of multiple exposures over a working lifetime. It also raises important policy considerations about acceptable health risks for working youth.[72] Washington state, for example, has recently revised its child labor laws to prohibit youth from working in occupations involving potential exposure to carcinogens or blood-borne pathogens.[93]

Psychosocial Outcomes

In recent years, increasing attention has been devoted to the psychosocial consequences of youth employment. There is a substantial body of research, primarily within the sociological literature, examining both the positive and negative outcomes of youth employment. This research has focused mainly on the impact of employment and hours of work on teens simultaneously working and going to school. Research on the consequences of employment is necessarily complicated by selection factors that lead children with certain characteristics to choose to work substantial hours while attending school. However, a number of longitudinal studies that attempt to control for confounding factors shed light on the impact of youth employment on adolescent development, behavior, and education.[72]

Employment during school has been associated with positive outcomes, including enhanced self-esteem and independence. However, negative consequences have been reported among children working more than 20 hours per week. Problems include increased substance abuse (smoking and use of alcohol and illicit drugs) and daytime fatigue, both of which may contribute to injuries in other arenas as well as work.[72]

The impact of youth work on educational performance while still in high school is uncertain. One possible explanation for the failure to find a consistent association is that American high-school students devote an average of 4 hours per week to homework.[84] The observed impact on school performance appears to vary among different student populations and with the quality of work.[72]

The effect of youth work on future educational attainment and wages is complicated. Working during high school has been associated with increased employment rates and earnings in the years immediately following high school. Research has suggested that long work hours (> 20 hours/week) are associated with decreases in eventual post-secondary educational attainment while low-intensity work is associated

with positive educational attainment.[72] A recent economic study of data from the National Longitudinal Study of Youth found that working during high school had no significant effects on men's wages at age 27. Going to school full-time and *not* working appeared to result in higher wages.[42]

Special Subgroups

Within the population of all working youth, there are subgroups that merit specific attention. One includes children and adolescents employed in frankly exploitative conditions by employers in flagrant violation of child labor laws. Examples are children working in sweat shops within the garment industry or as door-to-door salespersons. Other subgroups that demand special consideration are: children working in agriculture who have less protection under child labor laws[67,86,87] and who experience a disproportionate number of fatalities in comparison to share of employment; children with special education needs, who are often disproportionately concentrated in vocational education;[4,67,94] and children with physical disabilities. The needs of disabled workers are addressed elsewhere in this volume, but are raised here as a reminder that disabled workers may be young workers. Accommodations that take age as well as disability into account may be warranted.

MAJOR GAPS IN KNOWLEDGE/RESEARCH NEEDS

There have been substantial advances during the last decade in our knowledge about work-related injuries among youth. This information can and should be used in efforts to keep youth safe at work. However, there remain considerable gaps in information.

Surveillance

Most research to date has been purely descriptive and based on surveillance—focusing on the *magnitude* of youth employment and associated hazards[27,34,52,81] and quantifying and characterizing consequent injuries and illnesses.[2,3,8,9,20,21,23,29,31,32,33,41,51,53,55,58,73,74,80,83] Research is needed to put these data into perspective, identifying groups of youth workers and types of work that are not captured in standard employment surveys and occupational injury and illness sources, and identifying the degree to which different systems examine the same cases. Studies linking multiple sources of data also would be helpful. New methods of ascertainment should be devised to record youth working in sweat shops—an example of a group that is most likely under-represented in standard employment surveys and occupational injury and illness data.

Although there is some information on the short-term outcomes of youth work injuries, defined as time away from normal activities and work,[23,51,57] the long-term impact (for example on functional status, psychosocial well-being, opportunities for future work opportunities, and quality of life) is not known. Anecdotal information suggests that youth work injuries can have profound implications. For example, a 17-year-old Massachusetts youth who had hoped for a career in graphics/printing was told that an injury he incurred when his finger was crushed in a printing press would prohibit a career in that field. Subsequently, he was told by an air force recruiter that the injury also would prohibit a career flying airplanes (personal communication; Ellen Frank, MPH, Massachusetts Department of Public Health). Information on the long-term social and economic consequences of youth work injuries is needed to fully appreciate the scope of the problem. Longitudinal studies of injured youth would begin to address this need.

Etiology

The potential for unique risk factors associated with growth and development has been hypothesized,[61,67,76] but for the most part not rigorously evaluated. Hypothesized risk factors include: an incompatibility between size and strength of developing youth and requirements for safe machinery operation; increased susceptibility to chemical or ergonomic stressors; decreased ability of youth to make judgments about dangers and safe operating practices; and youth taking on tasks for which they are not prepared as a means of demonstrating their maturity and competency. There is, therefore, a compelling need to examine these **nonmodifiable risk factors related to youth development**.[61,67] The roles that size, strength, bone maturity, motor coordination, sleep needs, judgment, and cognitive abilities play in the occurrence of work injuries should be assessed. Furthermore, it is critical to evaluate whether adolescent development is associated with unique susceptibilities to hazardous substances or conditions encountered by youth at work.[67]

Research inquiries should be based on a coupling of available information on youth employment and hazard exposures with knowledge from occupational and adolescent medicine about substances or conditions that affect systems still maturing in puberty and adolescence (e.g., musculoskeletal, reproductive, and immunologic systems).[61,71] Improved understanding of risk characteristics unique to youth is essential to guiding recommendations about appropriate work for youth. Adherence to recommendations may be voluntary, such as following age-appropriate guidelines for work tasks,[61] or may be mandated through regulatory processes such as child labor laws.[35]

Information on the roles that age and inexperience play in the incidence of youth work injuries also is needed. Reporting rates by detailed industry and occupation groupings would allow comparison of injury risks for youths and adults doing similar work. Comparisons will need to control for hours of work, given the disparity of hours worked between youths and adults.[21,24,58,79] An additional challenge is developing methods to address the limitations of analyses based on job title alone, since research findings suggest that job title may be a poor indicator of activities actually undertaken.[6,34,57] For example, while 6% of high-school students reported working as a stock person in a Massachusetts survey, 43% reported stocking shelves (Table 3). Similarly, 6% of the students reported working as a cook or cleaner, yet 43% reported cooking and 50% reported cleaning as part of their job tasks.

Research in specific work settings would provide the opportunity to characterize and control for differences in exposures, which may be related to age, as well as control experience and training. Such studies would need to be conducted in workplaces with sufficient number of youth to support these comparisons. Restaurants, grocery stores and other retail settings, nursing homes, and farms are likely candidates.

Although there is a general need for research into the role of work environments—hazards and organization—in the incidence of work injuries,[66] findings in studies of adults are, in most cases, relevant for youth. The availability of research on adult worker populations and whether studies in a young worker population would produce appreciably different results from studies among adults should be carefully considered before launching such studies in common youth workplaces.

Training and Health Communication

It is an axiom of occupational safety and health that hazards in the work environment must be clearly explained to all workers, and training on safe work practices and legal rights in the workplace must be provided. It is not known, however, if youth have special needs for training. Given the limited experience that youth bring

TABLE 3. Survey of Working Students in a Massachusetts High School*

Job Title (%)		Tasks Ever Done (%)**		Equipment Ever Used (%)**	
Cashier	29	Cashier	50	Case cutter	47
Sales clerk	10	Cleaning	50	Ladder	37
Office worker	10	Stock shelves	43	Food slicer	19
Work with kids	10	Cook	18	Box crusher	13
Stock shelves	6	Shovel	15	Fat fryer	12
Cook	6	Load trucks	13	Motor vehicle	10
Cleaners	6	Landscape work	10	Power tools	10
Dietary aide	3	Deliver food by car	4	Forklift	6
Other	20				

* Self-reports by students currently working or who had worked in the past.
** Percents sum to greater than 100 as students could report multiple tasks and equipment.
Data from Massachusetts Department of Public Health and University of North Carolina Injury Prevention Research Center; published in Bowling MJ, Runyan C, Miara C, et al: Teenage worker's occupational safety: Results of a four school study. Poster at the 4th World Conference on Injury Prevention and Control, Amsterdam, The Netherlands, May 17–20, 1998.

to the workplace, they may require additional time and attention and different approaches to training than adults. Research is needed on educational/training methods that are most effective for youth. A survey of existing training programs for young workers in companies that employ large numbers of children would be an important early step.

Health communication is an important and necessary tool for ensuring that employers and workers, as well as parents, educators, health care providers, and other adults interested in the well-being of youth, have information on occupational safety and health concerns and prevention measures. For example, with information on child labor laws and common youth work hazards, health care providers could contribute to injury prevention efforts by judicious signing of work permits and by counseling youth on hazards in their work environment, the various means of preventing injuries, and the rights and responsibilities of youth workers. Basic data is needed on what target audiences do and do not know, what types of messages would be compelling and motivate them into action, and which avenues are the best for delivering information. While demonstration projects supported by the National Institute for Occupational Safety and Health (NIOSH) have compiled some data, it may not be generalizable to other communities or the nation as a whole. Particular attention should be paid in health communications research to addressing hard-to-reach subgroups of youth workers; for example, migrant agricultural laborers, youth working in sweatshops, and youth working for very small businesses.

Intervention Effectiveness

Among the more important gaps in knowledge is information on the feasibility and effectiveness of different strategies and programs for preventing youth work injury. Existing interventions as well as new proposals that have been suggested by research and advocacy groups should be evaluated.

Evaluations of existing programs are important to ensure that they are effective, to identify modifications that should be made to increase effectiveness, and to guide the development of new efforts. Examples of existing intervention efforts that could be evaluated include: formal apprenticeship programs with strict requirements for

training and supervision; vocational education programs; federal and state child labor laws and targeted enforcement efforts; and broad-based health communication efforts, such as the Work Safe This Summer Campaign spearheaded by the DOL[82] and mailings of informational materials to high school principals by NIOSH.[69]

It also is important to test proposed intervention strategies to determine if they are both feasible and effective. If proven effective, empirical data can bolster efforts to encourage broad implementation. Examples of proposed intervention strategies which could be tested include: the implementation of multi-faceted recommendations to reduce burn injuries in restaurants;[39,40] youth training in schools and employment settings;[1,77] and community-based efforts.[50,67] Demonstration programs and experimental and quasi-experimental studies are among the methods to approach this type of research. Ideally, injury and illness incidence would be the outcome on which effectiveness would be based. For smaller studies, this may not be possible and reasonable proxies for work injury or illness should be explored. Given the persuasiveness of cost-effectiveness data, when possible, intervention effectiveness studies should carefully identify costs associated with implementation and outcomes.

CONCLUSION

Until recently, today's occupational safety and health experts have paid little attention to safety and health concerns of working youth. Yet with millions of children and adolescents employed each year, young workers are indeed a special population at risk deserving special attention. Occupational safety and health professionals have critical knowledge and skills to contribute to researching special issues for young workers and promoting safe and healthful work for youth. Unique opportunities for intervention hold the potential for new and rewarding partnerships with, for example, pediatricians and adolescent health specialists, child labor regulators, child injury prevention professionals, maternal and child health professionals, educators, and community leaders. Lessons learned in targeting young workers can have important implications for reaching other special populations that have not been well addressed through conventional approaches to occupational safety and health.

In addition, efforts to promote safe and healthful work experiences for today's youth carry tremendous potential for influencing the safety and health of the next generation of workers and employers. Education that goes beyond task-specific safety training can provide young workers with transferable knowledge and skills—hazard recognition, understanding the principals of hazard control as well as legal rights and responsibilities—that they will carry with them throughout their working lives. This is especially relevant in looking towards intervention models that focus on joint labor-management health and safety committees and greater involvement of workers who are empowered to effect change in the workplace. Working with youth now to provide them with knowledge and skills in occupational safety and health will better enable them to be active participants in creating and ensuring safe and healthful work environments of the future. Failure to protect youth in the workplace may result not only in damaged health, but damaged expectations.[59]

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