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Occupational Injuries: Epidemiology, Prevention, Treatment

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Much of the material in this
chapter is excerpted from a
chapter on "Child Labor" by
the same authors that
appeared in Rom WN,
*Environmental and
Occupational Medicine*, 2nd
ed., Boston, Little, Brown
and Co., 1992. It is reprinted
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Work is a significant part of life for millions of
adolescents in the United States, and work-related
injury has become an important contributor to the
continuing epidemic of adolescent injury. This chap-
ter reviews current data on patterns of adolescent
employment and examines the epidemiology of
work-related injuries among American adolescents.
It discusses the contribution of work-related trauma
to adolescent injury. It summarizes the legal protec-
tions that have been created in the United States to
protect adolescents against exploitation and injury in
the workplace, and it analyzes the erosion of those
measures that has occurred since 1980. Finally, this
chapter offers recommendations for the diagnosis
and prevention of occupational injury among ado-
lescents.

Patterns of Adolescent Employment

More than 5 million adolescents and children in
the United States are legally employed.¹⁸ Of 15-
year-olds approximately 25% are employed. Among
16- and 17-year-olds, more than one half work.
Older adolescents who work average more than 21
hours of paid employment per week.³⁰ According to
data from the U.S. Department of Labor, both the
number of children working in the late 1980s and the
number of hours worked represent substantial in-
creases from a decade earlier.

Adolescents are employed in a wide variety of industries and occupations. These include retail sales, construction, commercial fishing, fast food, restaurants, manufacturing, and agriculture. In the past decade, particularly rapid increases have occurred in the number of children employed in the service sector—making hamburgers, delivering pizzas, cooking in restaurants, and waiting on tables.^{12,16}

Illegal labor among adolescents and children is also widespread. Despite the popular belief that this problem was remedied long ago, illegal child labor has in fact persisted in the United States and appears to be on the increase.¹⁸ An estimated 1 to 2 million American adolescents are employed illegally—working for long hours, at less than the legal minimum wage, on dangerous and prohibited machinery. The illegal employment of children and adolescents occurs today in all industrial sectors in the United States, including manufacturing, service, construction, and agriculture.²⁶ Between 1983 and 1989, detected violations of federal child labor law increased four-fold.²⁹

Sweatshop employment is a particularly difficult problem.²⁸ A sweatshop is defined as any establishment that routinely and repeatedly violates federal wage and hours laws as well as the laws protecting occupational safety and health. Traditionally, these shops have been considered fringe establishments, such as small firms in the garment and meat-packing industries. Increasingly, however, chain restaurants and grocery stores, not typically considered to be sweatshops, have been found to fulfill the definition of sweatshop.²⁸

Health and safety conditions in sweatshops are often very hazardous. For example, fire hazards may be created by blocked exit doors, accumulations of combustible materials and inadequate ventilation; electrocution hazards result from overloaded electrical supplies, work stations located close to exposed wire, and bare fuse boxes. The large number of fire code violations being discovered by the inspectors of the Garment Industry Task Force of the New York State Department of Labor suggests that sweatshop workers, including children, are at very high risk for dying of fire if these conditions are not alleviated.

The Legal and Historical Context of Child Labor

Modern-day child labor began in Europe and America during the 1700s as a consequence of the need, created by the Industrial Revolution, for large numbers of workers. In that era, "most mill owners preferred to hire children rather than adults. Above all, they were cheaper . . . but also more tractable, and as labor unions developed, less likely to strike."²⁷ Children as young as 11, especially girls, were sent by their families to work in the mills because wages they could earn far exceeded the income of their parents at home on rural farms.

In the United States, despite federal and state legislation, child labor continued to be a major problem during the first third of the twentieth century. Inadequate enforcement of statutes contributed to this persistence. The need for enforcement was tragically demonstrated by the Triangle Shirtwaist Fire in New York City. Late on a Saturday afternoon in March 1911, a fire broke out on the eighth floor of a building in the garment district that housed the Triangle Shirtwaist Company. Having recently lost their strike for a 40-hour week, 500 women and children on the seventh, eighth, and ninth floors of the building were still laboring as part of their 59-hour work week. Since "the factory doors were locked each day to keep the workers in and the union organizers out" and the interior doors opened inward, fire escapes seemed the only recourse, but they broke under the weight of the desperate workers. The fire-engine ladders reached only to the sixth floor. Ultimately, 147 young women, many of them under the age of 18, lost their lives.³¹

Legislation to control child and adolescent labor has always been vigorously opposed in the United States, and that historical opposition continues to the present time.¹⁹

This opposition has two major points of origin: (1) certain members of the business community who wish to avail themselves of cheap labor, and (2) moralists who argue that work keeps children off the streets, teaches them the importance of money, and inculcates good living habits.²² For 50 years, pediatricians have been among the leaders of the movement opposing exploitative employment of children and adolescents.

In 1938, after several unsuccessful attempts to enact federal legislation regulating child labor in the United States, the Fair Labor Standards Act was passed. The Fair Labor Standards Act remains the major federal legislation governing child labor in the United States today. This legislation established uniform federal standards for minimum wage, overtime pay, and maintenance of records on wages and hours for employees of all ages. Additionally, it established child labor standards, including lists of permitted work hours and prohibited occupations, and it raised the age limit for full-time work to 16.

Under the Fair Labor Standards Act, no child under the age of 16 years may work during school hours, and a ceiling is set on the number of hours of employment permissible for each school day and each school week. Employment in any hazardous nonagricultural occupation is prohibited for anyone less than 18 years old. No child under age 18 may work in mining, logging, brick and tile manufacture, roofing or excavating, or as a helper on a vehicle or on power-driven machinery. Meat processing machinery, delicatessen slicers, and supermarket box-crushers are specifically prohibited.

In agriculture, the restrictions imposed by federal statute are much less stringent than those in other sectors. Hazardous work is prohibited in agriculture only until age 16, and all work on family farms is totally exempted from legal protection. This differential protection under the law appears to account in large measure for the fact that agricultural employment is associated with the highest rates among all industrial sections of injury and death to working children.

Federal law on child and adolescent labor is buttressed in each state by state law and regulations. These vary from state to state, but are generally similar to each other and are required to be at least as stringent as federal law. Table 1 illustrates the provisions of a model state child labor law.¹²

Work permits are an important aspect of child labor regulation in many states. To be legally employed in those states, a child or adolescent under 18 years of age must possess a work permit signed by school officials and also, in many states, by a physician. The physician's signature is needed to certify that the youngster is physically fit to work. This required medical encounter at the start of employment represents an important but insufficiently exploited opportunity for pediatricians to educate adolescents

TABLE 1. Model State Child Labor Law

Major provisions of the model state child labor law would:

1. Significantly revise and update the list of Hazardous Occupation Orders (occupations, machines, and work sites that are prohibited for minors under 18).
 2. Provide equal protection under the law for migrant and seasonal farmworker children by setting a minimum age of 14 for employment and by prohibiting minors from dangerous agricultural occupations and substances.
 3. Establish a linkage between educational fulfillment and continuation of work.
 4. Reasonably restrict employment for all minors under 18.
 5. Require work permits as a means to monitor employment and facilitate investigations.
 6. Acknowledge the vulnerability and inexperience of working minors through requiring labor education prior to employment so that minors learn the laws protecting them in the workplace.
 7. Provide enhanced enforcement provisions and specific enforcement financing.
 8. Establish stiff penalties for child labor law violators.
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about the hazards of work, especially illegal work, and to intervene to curb some of the worst abuses in the workplace.

The current resurgence of child and adolescent labor in the United States reflects a convergence of economic and social factors similar to those that produced major increases in child labor at the beginning of the Industrial Revolution.¹⁸ These factors are:

- **Increased poverty.** Despite a relatively strong economy, more American children live below the poverty line today than 20 years ago. For the 20% of American children who live in conditions of poverty, financial need constitutes a compelling reason to seek employment.¹⁷

- **Unstable world conditions**—particularly war and poverty in Central America, the Caribbean, and Southeast Asia, which have led increasing numbers of undocumented immigrants to enter the United States. These immigrants, particularly children without parents, are highly vulnerable to exploitation in the workplace because of their overwhelming need for income and their fear of discovery by immigration officials.

- **Relaxation since 1980 in enforcement of federal child labor law**—including relaxation of the provisions limiting the maximum permissible hours of work and the prohibitions against use of dangerous machinery. “Industrial home work,” defined as industrial piece-work undertaken in the home, is a particular problem. The repeal by the Reagan-Bush administration of the ban on industrial homework that was created 40 years ago specifically to protect women and children from industrial exploitation in the home has further undermined the historic intent of child labor law.

Hazards of Child Labor

The hazards associated with child labor fall into two categories: 1) risks of injury, illness, and toxic exposure; 2) threats to education and development.

Injuries. Injuries are the leading cause of death in children older than 1 year, and they account for 45% of all mortality in 5- to 14-year-olds in the United States. Approximately 10,000 children die from injuries each year.^{1,6,15}

Work is a major and, until now, an insufficiently appreciated contributor to the ongoing epidemic of adolescent and childhood injury. Recent reports have documented that each year work accounts for more than 30,000 injuries among children and adolescents, for 20,000 compensation claims, for thousands of cases of permanent disability,¹⁸ and for more than 100 deaths.²⁴ Injuries to working adolescents include amputations, burns, scalds, scalplings, fractures, eye loss, and electrocutions.³

In New York State in the decade of the 1980s, 9,656 adolescents received workers' compensation awards for job-related injury; 4,201 of these compensated adolescents (43.5%) suffered permanent disability; 31 died.³ Injury rates were higher in males than in females and higher in 16- and 17-year-olds than in younger adolescents. The most dangerous occupations were newspaper delivery for 14- and 15-year-olds and agriculture for adolescents of all ages.³

It is important to recognize that these officially notified numbers of injury cases almost certainly represent a substantial undercount of the numbers of work-related injuries that actually occur. Reasons for underreporting include lack of knowledge about workers' compensation, intimidation by employers, and fear of losing a job, especially if a child is working in violation of the law or if the family's immigration status is uncertain.³ Lack of health insurance and lack of a primary health provider may deter adolescents from seeking medical care. Lack of awareness by health professionals that adolescents might have been injured at work also appears to contribute to underreporting; many physicians do not take histories of occupational exposure. Finally, the restrictive

eligibility criteria that exist in many states for workers' compensation awards contribute to underestimates of the true injury rate.

Hazards of Illegal Child Labor. Particularly severe hazards are associated with illegal child labor and with sweatshop employment. The extreme hazards of illegal employment of children and adolescents are illustrated by the following calculation:

1. At least 70% of work-related injuries among children are concentrated in the approximately 1 million children (20% of the workforce) who are employed illegally;
2. The remaining 30% of injuries occur in the 4 million children (80% of the total workforce) who are employed under legal conditions;
3. The risk of injury is therefore almost 10 times greater among children who are employed under illegal conditions than among those working in compliance with the law.

Food slicers illustrate the hazards to working adolescents of the use of prohibited power-driven equipment. Although adolescents under 18 years of age are legally prohibited from using food slicers, these machines have been shown to be sources of serious injury.

In the early 1980s an adolescent in New York City was brought to an emergency room with an amputated arm; he said he had been "helping out" in a butcher shop. A few months later, another adolescent was brought to the same emergency room with his arm amputated after having been in the same shop. He, too, had just been "helping out." In reality, it was found that both adolescents had been operating an unguarded band saw to cut meat.

Recently, a 17-year-old girl in New York City amputated several fingers when a power-driven bakery dough slicer came down on her hand; use of such equipment is legally prohibited below the age of 18 years. The fast food industry is among the most rapidly growing industries and is one of the largest employers of youth in the United States today. Lacerations and burns are common hazards in fast-food establishments. There is also risk of electrocution.

The delivery of pizzas and other hot food items has proven to be extremely hazardous to working children. The rash promise made by a midwestern pizza company that all pizzas would be delivered within 30 minutes of the time of placing an order has been shown to encourage reckless driving by young, often inexperienced, motor vehicle operators. A total of 17 fatalities among adolescents working in pizza delivery and among persons with whom they collided has been documented within the past year to be associated with the ill-conceived delivery policies of this firm.¹²

Toxic Exposures and Chronic Illness. Little information is available on the incidence or severity of work-related illness in children caused by toxic occupational exposures. Children are, however, known to experience a variety of toxic exposures at work, including formaldehyde and dyes in the garment industry, solvents in paint shops, organophosphates and other pesticides in agricultural work and lawn care, asbestos in building abatement, and benzene in pumping unleaded gasoline (unleaded gasoline contains 5% benzene by weight). Given the wide occurrence of these exposures, it is not inconceivable that some still undefined fraction of adolescent asthma might be related to occupational exposures to dusts or formaldehyde or that some cases of leukemia in adolescents and young adults may be the consequence of occupational exposure in adolescence to benzene in unleaded gasoline. Previous studies have shown unequivocally that workers exposed early in life to asbestos can later develop lung cancer and mesothelioma²³ and that young persons exposed to benzene can develop leukemias and lymphomas.²⁰

Health Risks of Agricultural Child Labor. Adolescents in rural areas are employed extensively in agriculture, both on family farms and commercially. The types of

injuries most frequently associated with agricultural work include lacerations, amputations, and crush injuries from farm machinery; blunt trauma from large animals; motor vehicle accidents involving farm vehicles on public roads; suffocation in grain elevators and silos; and exposure to pesticides. Hearing loss has been shown to be a particular hazard to high school farm workers, presumably because of their unprotected exposure to noisy machinery.⁵

Inadequate legal protection of child and adolescent farm workers is a major cause of the high rate of injuries among these groups. Small physical size and inexperience may superimpose an additional risk for young workers. Although the numbers of adolescents and children working in agriculture are not so large as the number employed in other sectors, the potential hazards (especially those involving machinery and large animals), coupled with the historical lack of regulation of agriculture, combine to create an important problem, particularly in rural states. According to the National Institute for Occupational Safety and Health (NIOSH), agriculture has come to surpass mining as the most dangerous occupation, accounting for 41 fatalities per 100,000 workers throughout the decade of the 1980s. Perhaps for this reason, much of the scanty literature available on work-related injury and illness in adolescents and children focuses on agriculture.^{8,25}

Data on injury in adolescent farm workers are provided in a 1985 paper by Rivara:

Nearly 300 children and adolescents die each year from farm injuries, and 23,500 suffer nonfatal trauma. The fatality rate increases with age of the child; the rate for 15- to 19-year-old boys is double that of young children and 26-fold higher than for girls. More than half (52.5%) [of those injured] die without ever reaching a physician; an additional 19.1% die in transit to a hospital, and only 7.4% live long enough to receive inpatient care. The most common cause of fatal and nonfatal injury is farm machinery. Tractors accounted for one half of these machinery-related deaths, followed by farm wagons, combines, and forklifts.²¹

Contribution of Occupational Trauma to the Epidemic of Adolescent Injury

The fraction of all adolescent injuries that are caused by work appears to be substantial.⁷ Working adolescents, 16 and 17 years old, have the second highest injury rate of all workers, exceeded only by 18- and 19-year-olds. The estimated number of 15- to 19-year-olds killed each year at work ($n=110$)²⁴ is comparable with the number who die in falls ($n=103$), in fires ($n=126$), on bicycles ($n=129$), and by poisoning ($n=191$).⁶ A population-based survey of emergency department visits and hospitalizations in eastern Massachusetts found that 24% of all adolescent injuries were related to work.⁴ By contrast, only 17% of adolescent injuries treated in a Massachusetts emergency department were due to sports trauma.⁶

Specific state-based studies provide further documentation of the importance of work-related injury as a contributor to the overall epidemic of adolescent injury. In North Carolina, a review of the computerized data files of the chief medical examiner found 71 occupational deaths in the 10-year period from 1980 through 1989 among youth through age 20.⁹ Farms were the most frequent location of fatal injury, and events involving tractors were frequently noted. Homicide was the leading cause of fatal occupational injury for adolescent females. A study in Connecticut found 796 workers' compensation reports for adolescents 14 through 17 years of age in a 12-month period.² The overall age-specific injury rate among employed 16- and 17-year-olds was 15 per 1,000; rates increased with age. A survey in Saskatchewan of eleventh and twelfth grade high-school students found that in a one-year period (1982), work was the primary source of adolescent injury.¹⁰

Hazards to Education and Development

Another serious consequence of child labor is interference with school attendance and performance. Employed adolescents risk not having enough time for homework and being tired on school days. Teachers of children in areas where pre-holiday employment is common or industrial homework is escalating have reported declines in the academic performances of previously good students.¹⁸ Excessive work during adolescence, especially under stressful conditions, may be associated with an increased risk of drug and alcohol abuse.^{11,14}

Diagnosis of Work-related Injury among Adolescents

Proper diagnosis of occupational injury in adolescents as job related is important for several reasons:

- Most importantly, proper recognition will prevent recurrence of injury in the affected youngster and will lead to prevention of other similar cases.
- Proper diagnosis will lead to improved statistics on adolescent occupational injury. This will enable more effective targeting of public health resources.
- Proper diagnosis provides a basis for education and counselling.

A brief occupational history is the most effective means of diagnosing an injury in an adolescent as work-related.¹³ Each child who presents to an office, a clinic, or an emergency room with traumatic injury should be asked whether the injury is work-related. Likewise, an occupational history should be obtained in all motor vehicle injuries involving adolescents; fast-food deliveries and other work-related uses of vehicles have been shown to be an important source of work-related trauma. In taking the history, pediatricians need to be sensitive to the fact that adolescents may not wish to indicate that the injury is related to work.

Recommendations

Employment of adolescents and children has reemerged in the United States and has become a serious health hazard. Prevention of injury and illness in working adolescents requires the following actions:

Diagnosis

- Increased diagnostic sensitivity of primary care providers and emergency department staff to the possibility that traumatic injury in children or adolescents may have been caused at work.

Research

- Further worker to identify the types of work situations and events associated with injuries.

Data Collection

- Development of better systems for monitoring the working patterns of adolescents.
- Development of better surveillance methods for identifying work-related injury.

Education

- Better job, health, and safety training, and supervision of employed adolescents.
- Increased awareness among parents, school officials, and employers about child labor laws and the potential hazards of adolescent work.

Legal Measures

- Better enforcement of existing child labor laws.
- Wider extension of child labor laws to cover agricultural employment and other exempt industries.

- Revisions in child labor laws, specifically updating of lists of machinery prohibited for use at work by children and adolescents, based on known hazards.

ACKNOWLEDGMENTS

The authors acknowledge the generous support of the William T. Grant Foundation and the National Institute for Occupational Safety and Health (Grant #OH-02717).

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