Workplace Toxic Exposures Involving Adolescents Aged 14 to 19 Years

One Poison Center’s Experience

Alan D. Woolf, MD, MPH; Elizabeth Flynn, BA

Background: While many previous reports describe injuries to adolescents in the workplace, few focus on toxic substance exposures among such injuries. Yet low-skill, entry-level jobs pose a particular hazard of toxic exposure owing to the frequent use of cleaning agents, solvents, and/or other chemicals in carrying out assigned tasks.

Objective: To analyze the types and severity of adolescent occupational toxic exposures.

Design: Secondary analysis of calls to a single regional poison control center (PCC).

Setting: Massachusetts PCC poisoning consultations between 1991 and 1996.

Subjects: Children aged 19 years or younger reporting toxic exposures occurring in the workplace.

Results: Of 7024 occupational toxic exposures recorded by the PCC in the 6 years of study, 269 incidents (3.8%) involved adolescents aged 14 to 19 years (median age, 18 years; 124 aged 14-17 years and 145 aged 18-19 years; 65% were male). The most frequently involved agents were cleaning compounds (27.8%); paints, solvents, and glues (9.0%); caustics (8.7%); hydrocarbons (8.7%); and bleaches (7.3%). Of 88 cases (32.7%) in which a worksite was identified, food services (30.7%), automotive services (14.8%), and general retail stores (12.5%) were the most common locations. One hundred fifty-six patients (58.0%) were triaged to an emergency department; 7 were hospitalized. Forty-three subjects (16.0%), 18 who were between the ages of 14 and 17 years and 25 who were aged 18 or 19 years, were judged to have moderate to severe injuries. There were no deaths.

Conclusions: This study confirmed the usefulness of PCC surveillance as a source of information about adolescent toxic exposures occurring in the workplace. The occupational toxic exposures reported here most commonly involved cleaning agents, solvents, paints, caustics, and bleach used in those entry-level jobs most frequently filled by adolescents. We conclude that occupational toxic exposures are an underrecognized adolescent injury, and that PCC experience can be used to fill a gap in the surveillance of such workplace-associated events.


Editor’s Note: Now these are classic examples of poisoning adolescents against work.

Catherine D. DeAngelis, MD

AS MANY as 4 million children and adolescents are legally employed in the United States, an additional 1 to 2 million are suspected to be employed in violation of the Fair Labor Safety Act. A recent report from the Institute of Medicine (Washington, DC) on adolescent work injuries observed that as many as 80% of high school students hold jobs during some part of the school year. Injuries suffered by children and adolescents in the workplace have long been recognized as an important public health problem. As many as 64,000 work-related injuries among children and adolescents are treated in emergency departments annually, which projects to an estimated 200,000 such injuries occurring in the United States.

In reviewing adolescent workplace injury types, many authors cite a theoretical risk to adolescents of exposure to toxic agents such as solvents, hot liquids, and grease (from fast-food or full-service restaurants), benzene, lead and pulmonary sensitizers (from gas stations and automobile repair shops), or pesticides and nicotine (used in agricultural jobs). Yet there are few data defining the number of incidents involving youth exposed to toxins in the workplace. There are anecdotal reports of adolescent deaths from toxic ex-
MATERIALS AND METHODS

We analyzed computer-coded telephone records of toxic exposures reported to the Massachusetts Poison Control System, Boston, from 1991 to 1996. Only those records involving adolescents aged 14 to 19 years and in which the site of the toxic exposure was coded as the worksite were included. Cases were excluded if the written record could not be found. Because we were interested only in those toxic injuries specific to a worksite, if the record indicated that this was a suicide attempt, then the case was excluded. Each medical record was retrieved and reviewed for information regarding the patient’s age and sex, the toxin involved, the site, time, and circumstances (if available) of the exposure, any related symptoms or signs of toxic effects, triage to health care, disposition, and medical outcome. In cases in which the type of worksite was not noted, but the correct telephone number of the worksite was recorded, sites were called to classify the type of worksite.

For certain analyses, toxins implicated in the exposure were classified into 14 larger descriptive categories. Table 1 gives examples of how individual products and chemicals were sorted into these 14 categories. Medical records were reviewed for notations about the circumstances of the poisoning. Worksites were classified into 10 industry sectors (Table 2). Medical outcomes defined previously by the American Association of Poison Control Centers19 include the following:

- No effect: The patient developed no symptoms as a result of the exposure.
- Minor effect: The patient exhibited some symptoms, but they were minimally bothersome. The symptoms resolved rapidly.
- Moderate effect: The patient exhibited symptoms that were more pronounced, more prolonged, or more systemic in nature than minor symptoms but were not life-threatening. Usually some form of treatment was indicated.
- Major effect: The patient exhibited some symptoms that were life-threatening or resulted in significant residual disability or disfigurement.
- Not followed up, judged as nontoxic exposure: The patient was not followed up because the substance was judged to be nontoxic.
- Not followed up, no or minimal medical effects possible: The patient was not followed up because the exposure was likely to result in only minimal toxic effects.
- Unable to follow up, judged as a potentially toxic exposure: The patient was lost to follow-up and the exposure was significant and may have resulted in toxic manifestations with a moderate, major, or fatal outcome.

This research was approved by the Committee on Clinical Investigation at Children’s Hospital, Boston, Mass.

Table 1. Toxins Involved in Accidents in the Workplace Among Adolescents

<table>
<thead>
<tr>
<th>Category</th>
<th>Examples</th>
</tr>
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<tbody>
<tr>
<td>Cleaners (not including bleach)</td>
<td>Industrial cleaners, disinfectants (nonbleach), ammonia cleaners, drain cleaners, glass cleaners, bathroom cleaners</td>
</tr>
<tr>
<td>Caustics</td>
<td>Corrosives (alkaline), potassium hydroxide, sodium hydroxide, hydrofluoric acid, muriatic acid, battery acid</td>
</tr>
<tr>
<td>Automotive products</td>
<td>Antifreeze, oil, ethylene glycol</td>
</tr>
<tr>
<td>Pesticides/herbicides/ fertilizers</td>
<td>Insecticides, fertilizers, garden fungicide</td>
</tr>
<tr>
<td>Bleach</td>
<td>Hypochlorite bleaches</td>
</tr>
<tr>
<td>Paints, glues, and solvents</td>
<td>Adhesives, paints (including lead paint), paint thinner, wood sealer, turpentine</td>
</tr>
<tr>
<td>Miscellaneous chemicals</td>
<td>Copper, bromine, chlorine, sodium, mercury</td>
</tr>
<tr>
<td>Biologicals</td>
<td>Fish stings, spider bites, mold, spoiled food</td>
</tr>
<tr>
<td>Building and construction products</td>
<td>Fiberglass, asphalt, tar, fluorescent lightbulbs</td>
</tr>
<tr>
<td>Hydrocarbons</td>
<td>Gasoline, kerosene, xylene, diesel fuel</td>
</tr>
<tr>
<td>Refrigerants</td>
<td>Freon, refrigerants</td>
</tr>
<tr>
<td>Drugs</td>
<td>Caffeine, nicotine, acetylaminophen, aspirin</td>
</tr>
<tr>
<td>Cosmetics</td>
<td>Nail polish remover, nail glue, aloe vera</td>
</tr>
<tr>
<td>Unknown/miscellaneous</td>
<td>Other chemicals, no substance found</td>
</tr>
</tbody>
</table>

National Traumatic Occupational Fatalities surveillance system from 1980 to 198911 discovered 20 deaths from poisoning in male adolescents aged 16 or 17 years, a rate of 0.28 deaths per 100,000 full-time equivalents.

A few studies of morbidity related to adolescent occupational injuries refer obliquely to toxic exposures. In a Massachusetts investigation of 2651 adolescent workers’ compensation claims, 29 claims were related to chemical burns.12 A similar New York study of 9656 workers’ compensation claims included 49 adolescents with chemical burns and 17 cases of poisoning.13 Several studies of adolescent workers presenting to emergency departments with injuries sustained on the job include numerous cases of chemical burns and scalds from grease, deep fat fryers, or hot water.14-16 In a study of 1361 work-related injuries suffered by adolescents and treated in one emergency department in Dunedin, New Zealand, during 1990 to 1993, there were 27 cases of chemical burns to the eye.17 Among 37,405 adolescent injuries reported by emergency departments to the Consumer Product Safety Commission’s National Electronic Injury Surveillance System (Washington, DC) in a 6-month period, there were 4629 burns, 3553 of which were sustained in the service industry. Of these 3553 burns, 14.8% were from exposure to caustic liquids.18

The databases currently recommended for surveillance with regard to adolescent workplace injuries include workers’ compensation records, the Annual Survey of Occupational Injuries and Illnesses, hospital discharge data, the Census of Fatal Occupational Injuries, the National Electronic Injury Surveillance System, and the National Traumatic Occupational Fatalities System.19 All of these sources of data are likely to

posures in the workplace.7-9 In a review of North Carolina medical examiners’ cases between 1981 and 1989, Dunn and Runyan10 reported that 5 of 71 childhood deaths on the job were related to poisoning. An analysis of the
undercount toxic exposure involving adolescents because (1) death from an occupational toxic exposure is very rare, (2) many injured adolescents do not self-refer to the emergency department, (3) many adolescents are not eligible for or will not file a claim for workers' compensation, (4) small businesses (or private residences) where adolescents often work may not be required to report such injuries, (5) businesses that are required to report injuries may not enforce this rule, or (6) a toxic exposure in the workplace may not be recognized as the cause of an adolescent's symptoms or death.

The objective of the current study was to define the frequency, circumstances, and medical severity of adolescent occupational poisonings and toxic exposures occurring in Massachusetts by using a novel database. If such incidents are detectable as "sentinel events," then it might be possible to use the existing health care network not only to manage cases, but also to define high-risk groups and direct population-based preventive interventions.

**RESULTS**

Of 7024 occupational exposures reported to the poison center in the 6-year study period, we identified 313 poison center cases involving adolescents aged 14 to 19 years (Figure 1). Of these, 44 cases did not meet our inclusion criteria (in 33 cases, no medical record could be found, 2 cases were duplicates, and 9 cases were misclassified and no drug or toxin was involved). Thus, 269 cases (3.8%) of occupational toxic exposures and poisonings among adolescents aged 14 to 19 years were entered into the analysis. Of those adolescents, 124 were younger (aged 14-17 years) and 145 were older (aged 18 or 19 years).

Figure 2 gives the age and sex distribution of the 269 cases. The median age was 18 years old; 66% of the victims were male.

**TOXIC AGENTS**

There were 288 individual toxic agents (in 19 of the cases, the adolescent was exposed to more than 1 substance) involved in these exposures. Figure 3 presents the relative frequencies of exposures to different types of toxins, subdivided by route of exposure. Nonbleach cleaning products (27.8%) were most commonly involved; many of these contained upper-airway irritants such as ammonia. Other common substances included paints,
glues, and solvents (9.0%), caustics (8.7%), hydrocarbons (8.7%), and bleach (7.3%).

WORKSITE

In one third of the cases (n = 88), the worksite was identified and was confirmed by a follow-up telephone inquiry. Table 1 identifies the worksites involved in these exposures. Food services had the most toxic exposures (30.7%); more than half of the food service sites were fast-food restaurants. Automotive services and other retail stores were other common sites of exposure.

SYMPTOMS AND SIGNS OF TOXIC EFFECTS

Figure 3 shows frequency of these poisonings defined by the category of toxin involved as well as the route of exposure (inhalation, ocular, dermal, or a combination of routes). The most common routes of exposure included inhalations (27.5%), ocular splashes (27%), skin contamination (21.1%), and ingestions (18.2%). Symptoms often included irritation of the eyes and throat, in cases of exposure to simple irritants such as bleach, ammonia, and cleaning agents. Patients also complained of temporarily impaired vision, nausea, and/or dizziness related to exposure to solvents, bleach, or cleaning agents. Skin burns were frequently the result of exposure to caustics.

SEVERITY AND OUTCOME

One hundred fifty-six (58%) of these adolescents referred themselves to a health care facility or were triaged there by the poison center for further evaluation of their injuries. Forty-three incidents (15.9%) involving 48 separate toxins were coded by a poison center staff member as having had an injury outcome of moderate or major severity. As Figure 4 shows, almost half of these severe injuries involved caustics or cleaning compounds. However, only 7 (2.6%) of 269 adolescents required short periods of hospitalization for observation and there were no deaths.

COMMENT

This study confirms that toxic exposures occur with some frequency among adolescents aged 14 to 19 years working in a variety of occupational experiences; 3.8% of all toxic exposures in the workplace reported to one poison control center in a 6-year period involved children aged 19 years or younger. Almost half of the injuries involved cleaners, bleaching agents, or caustics. It is likely that both food and health service establishments use strong cleaning agents such as bleach or ammonia to sanitize workspaces and equipment, and adolescents come into contact with these substances during...
Adolescent occupational exposures to toxins are an important but underrecognized injury category; poison control center data can be used to fill in gaps in surveillance for this type of workplace-associated injury.
Accepted for publication July 21, 1999.

Dr Woolf is supported in part by a grant from the Association of Occupational and Environmental Clinics (Washington, DC) and the Agency for Toxic Substances and Disease Registry (Atlanta, Ga). This research was also supported in part by National Occupational Research Agenda grant R03 OH03796-01 from the National Institute of Occupational Safety and Hygiene (Washington, DC).

This research was presented in part at the Academic Pediatric Societies meeting in New Orleans, La, April 1998, and at the American Academy of Pediatrics in San Francisco, Calif, October 1998.

We thank the Specialists in Poison Information at the Massachusetts Poison Control Center, Boston, whose documentation of the cases made this study possible.

Corresponding author: Alan D. Woolf, MD, MPH, Massachusetts Poison Control System, 300 Longwood Ave, Boston, MA 02115.

REFERENCES