Poisoning Hospitalizations and Deaths from Solids and Liquids among Children and Teenagers

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Abstract: Twenty-four deaths and 4,271 hospital admissions due to poisoning occurred in the 0–19 year age group in Maryland during 1979–82. Four-fifths of the deaths (83 per cent) and two-thirds of the admissions involved teenagers. Among teenagers, four out of five admissions and deaths were of suicidal or undetermined intent. Black males had the highest hospitalization rate among young children, and White females among teenagers. The most common poisons ingested by children aged 0–4 years were aspirin, solvents and petroleum products, tranquilizers, and iron compounds. Among teenagers, aspirin, tranquilizers, sedatives, and antidepressants were the most common substances ingested, with antidepressants and stimulants most common among the fatalities. Reducing the availability and toxicity of the most hazardous drugs is important if morbidity and mortality from poisoning are to be prevented. (*Am J Public Health* 1986; 76:657–660.)

Introduction

In 1981, there were 394 deaths from poisoning under age 20 years in the United States.* While the number of deaths among young children has decreased dramatically in the past 20 years, poisoning morbidity is still a significant public health problem among both children and teenagers. In teenagers, a substantial proportion of poisonings are suicidal.[1]

In order to make meaningful comparisons among various subgroups, a population-based study was undertaken of all children and teenagers who were hospitalized and/or died from poisoning during a four-year period in Maryland.

Methods

Discharge summary data tapes which included all hospital discharges from the 53 short-stay general hospitals in Maryland were analyzed for 1979–82. The study group included children aged 0 through 19 years who were admitted to the hospital with a diagnosis of ingestion of a solid or liquid poison. Diagnoses were coded according to the 9th revision of the International Classification of Diseases Clinical Modification (ICD9-CM) and included codes 960–985 and 988–989 (poisonings by solids and liquids), excluding 989.5 (venom).[2,3] Children treated outside of hospitals or in the hospital emergency room and then released were not included in the study population. Patients with a diagnosis of adverse reactions to drugs in therapeutic use (ICD9-CM E930–E949) were excluded from the study, as were lead poisoning admissions (non-acute cases generally identified through screening programs).

Variables analyzed included age, race, sex, substance ingested (specified in 85 per cent of the cases), length of stay, and reported intent—i.e., whether unintentional ("accidental"), suicidal, or undetermined. Information on intent was provided by the ICD9-CM E-codes for external cause of injury and poisoning, which were available for 80 per cent of all teenage discharges. E-codes included E850–866 (unintentional poisoning by solids and liquids); E950 (suicide and self-inflicted poisoning by solids and liquids); and E980 (poisoning by solids and liquids, undetermined whether accidentally or purposefully inflicted). Hospitalization rates were calculated using mid-year residential population data from the 1980 census. Poisoning deaths during the study period were identified from data provided by the Maryland Center for Health Statistics. Additional information on the poisoning deaths was obtained from files at the Office of the Chief Medical Examiner of Maryland (OCME).

Results

Over the four-year period, 4,271 children aged 0–19 years were hospitalized in Maryland for treatment of poisoning. Twenty-seven per cent (1,151) were children under age 5, 6 per cent (266) were aged 5–12, and 67 per cent (2,854) were aged 13–19. Poisoning rates for the four-year period formed a bimodal pattern, with rates highest for ages 1–2 and 15–17 (Figure 1).

The average length of stay for all hospitalized cases was 4.3 days, with a median of 1.6 days. Twenty-four deaths occurred: four were children under age 5, and 20 (83 per cent) were from 13 to 19 years old. Half of the 24 deaths had not been admitted to the hospital. The ratio of deaths to hospital discharges was 3.5 per 1,000 discharges in children under age 5, zero for ages 5–12, and 7.0 per 1,000 in teenagers.

Poisonings in Young Children

The hospitalization rate for children under age 5 was 110 per 100,000 population, 97 for Whites versus 138 per 100,000 for Blacks. Rates for Black males were almost double the rate for White males at age 1, and were substantially higher than rates for Black females at ages 1 and 2. Among Whites, differences between the sexes were minimal.

Seventy per cent of the hospitalizations were for ingestions of drugs and medications (ICD9-CM codes 960–979). Hospitalizations for acute poisonings were due most often to the ingestion of salicylates or aspirin substitutes, petroleum products and other solvents, tranquilizers, and iron compounds (Table 1).

White children were hospitalized for poisoning due to antidepressants at twice the rate of Black children (3.1 vs 1.6 per 100,000). On the other hand, hospitalization rates for Black children were three times the rate for Whites for anticonvulsants (4.6 vs 1.5 per 100,000), and almost twice the rate for Whites for corrosives or caustics (11.1 vs 5.9 per 100,000) and for tranquilizers (13.7 vs 8 per 100,000). Males had higher hospitalization rates than females for petroleum

*National Center for Health Statistics: Deaths from each cause by 5-year age groups, race, and sex: United States, 1981. Unpublished data, NCHS, 1984.

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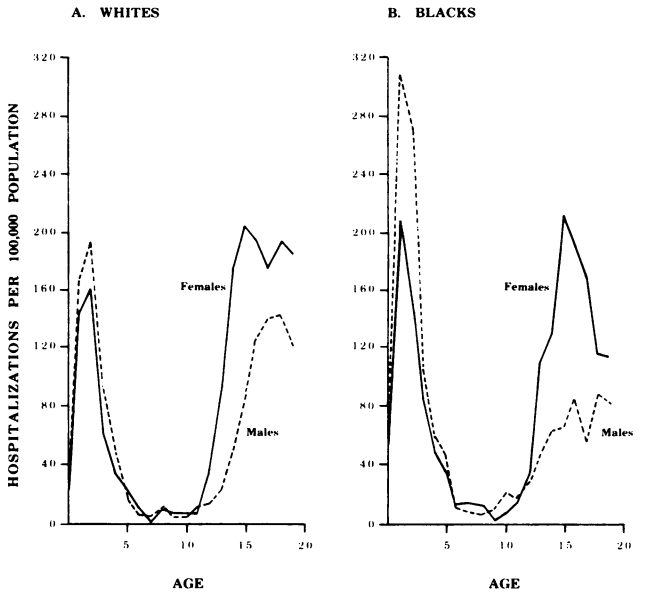

FIGURE 1—Poisoning Hospitalization Rates by Age, Race, and Sex (n=4271)

and solvent poisoning (13.8 vs 7.7 per 100,000) and for iron compound ingestion (10.6 vs 6 per 100,000). For both sexes, rates dropped sharply after age 2 for virtually every substance studied.

The peak in non-drug ingestions occurred at age 1, compared to the peak in ingestions of drugs and medications which occurred at age 2; hospitalizations among Black children peaked at age 1, compared to age 2 for Whites.

Teenage Poisonings

In contrast to childhood poisoning, the majority of poisoning hospitalizations among teenagers (58 per cent) were coded as intentionally self-inflicted (attempted suicide). There was almost no racial difference in the distribution by intent. Sex differences in intent were pronounced: females were hospitalized at more than twice the rate of males for suicidal poisoning, but at a similar rate for unintentional poisoning (Table 2). Drugs and medications were involved in 95 per cent of the teenage hospitalizations (Table 3).

Overall, female teenagers had poisoning hospitalization rates nearly twice those for males. Rates for Whites were slightly higher than for Blacks. White females had the highest hospitalization rates, followed by Black females, 175 and 150 per 100,000, respectively; rates for White males and Black males were 102 and 73 per 100,000, respectively.

Rates for White females rose sharply until age 15 and remained high through age 19 (Figure 1). Rates for Black females were similar to rates for White females until age 17, when rates for Black females steeply declined. For males aged 11–14, rates were higher for Blacks than for Whites; this pattern was reversed after age 14.

Rates were highest among females except for alcohol poisoning, which had slightly higher rates in males (5.8 vs 7.1 per 100,000). Among females, aspirin and aspirin substitutes were the leading substances (29 per 100,000), whereas among males tranquilizers were the most common (15.1 per 100,000). For all medications combined, the female rate was twice the male rate (61.5 vs 32 per 100,000). Hospitalization rates among White teenagers were over twice the rates among Blacks for alcohol, sedatives, and antidepressants; the reverse was true for antibiotics.

TABLE 1—Poisoning Hospitalization Rates, Ages 0–4 Years, Maryland, 1979–82 (n = 1151)

Substance Ingested	Rate per 100,000 Population
Aspirin and substitutes	12.7
Tranquilizers	9.9
Iron compounds	8.7
Cardiac drugs	5.0
Anticonvulsants	2.5
Opiates/other analgesics	3.5
Antidepressants	2.8
Sedatives/hypnotics	2.4
GI drugs	3.1
Other drugs	29.4
Subtotal—drugs	80.0
Petroleum products/solvents	11.2
Corrosives & caustics	7.4
Alcohol	2.9
Pesticides	2.6
Other non-drugs	5.4
Subtotal—non-drugs	29.5
Total—All ingestions	109.5

The ratio of deaths to admissions was highest for the antidepressants and stimulants category, and for opiates and other analgesics. Three categories of drugs—antidepressants/stimulants, analgesics, and sedatives/hypnotics—accounted for 75 per cent of all teenage poisoning deaths but only 20 per cent of the hospital discharges (Table 4).

Discussion

Poisoning by solids and liquids is often considered to be primarily a problem of early childhood. The results of this study show that hospital admission rates for poisoning are almost as high in teenagers as in young children. Moreover, teenagers account for more than 80 per cent of all poisoning deaths among Marylanders aged 0–19 years. This finding was similar to that of a study of childhood injuries in Massachusetts in which 81 per cent of poisoning deaths under age 20 involved teenagers.[4]

The Maryland study is the first population-based analysis showing the strongly bimodal distribution of poisoning hospitalization rates among children and teenagers. The two age groups differ in terms of high-risk subgroups, apparent intent, and poisoning agents. The data suggest, however, that the availability of various poisoning agents is a major determinant of the epidemiology of serious poisoning cases in both young children and adolescents.

Among young children, for example, the peak in non-drug ingestions at age 1, compared to the peak at age 2 for medicines, reflects the fact that substances such as cleaning agents are more likely than medicines to be stored within reach of the child who is still crawling or just learning to walk.

In young children, Black males had the highest poisoning hospitalization rates. The reasons why hospitalization rates among Black males are so much higher than for White males are not readily apparent. The fact that rates peak at age 1 for Black children and at age 2 for Whites is probably due to a number of factors, one of which may be the earlier age of onset of walking in Black children, leading to earlier access to poisonous substances.[5]

Racial differences in the prevalence of certain illnesses may result in differing levels of exposure to certain medica-

TABLE 2—Poisoning Hospitalization by Intent and Sex, Ages 13–19 Years, Maryland, 1979–82 (n = 2273)*

Intent	Male		Female		Total	
	Rate/100,000	%	Rate/100,000	%	Rate/100,000	%
Unintentional	15.3	21.4	15.0	11.2	15.2	14.8
Suicidal	36.6	51.2	89.5	66.4	62.7	61.0
Undetermined	19.6	27.4	30.3	22.4	24.9	24.2
Total	71.5	100.0	134.8	100.0	102.8	100.0
	n = 803		n = 1470		n = 2273	

*Rates and per cent distribution provided for the 80 per cent of cases with complete E-code information.

TABLE 3—Poisoning Hospitalization Rates, Ages 13–19 Years, Maryland, 1979–82 (n = 2854)

Substance Ingested	Rate per 100,000 Population
Aspirin and substitutes	19.5
Tranquilizers	17.8
Sedatives/hypnotics	9.3
Antidepressants/stimulants	8.5
Opiates/other analgesics	7.2
Antihistamines	4.9
Antibiotics	3.0
Other drugs	46.4
Subtotal—drugs	116.6
Alcohol	6.5
Other non-drugs	6.0
Subtotal—non-drugs	12.5
Total—All Ingestions	129.1

tions; for example, the greater prevalence of seizure disorders among Blacks[6] may explain the higher rates among Black children of poisoning by anticonvulsants.

Similarly, availability of a substance also appears to be a primary factor in self-poisoning. Ninety-four per cent of cases in one study stated that they ingested the first substance they found. One-third said they ingested a medication prescribed for themselves, one-third took medication prescribed for a friend or relative, and one-third took over-the-counter medications.[7] In another study of 100 hospitalized cases of self-poisoning in New Zealand, only five patients stated that they obtained a specific substance with which to poison themselves; the vast majority ingested an available substance on impulse.[8]

Circumstances surrounding the poisoning deaths in this study further illustrate the importance of drug availability. One teenager ingested the contents of a parent's prescription medication which had been filled earlier that day; another ingested cyanide available in her workplace. Three teenagers swallowed whatever was in the family medicine cabinet, while three others ingested their own prescription medications. Efforts aimed at preventing teenage self-poisoning can be organized using a framework suggested by Haddon (Appendix). This framework consists of strategies aimed at preventing an agent from reaching susceptible persons in amounts or at rates that exceed injury thresholds, and at minimizing the consequences of injury.[9]

One-fourth of the teenage poisonings were classified as intent undetermined, a category which was not part of the ICD classification prior to the 8th revision. A study comparing coding of suicides between the 7th vs 8th revisions found that addition of the undetermined category resulted in a large underestimate of the suicides.[10] While this study dealt only with deaths, it is likely that suicidal poisonings have been underestimated in our sample as well.

Much of the decline in childhood poisoning deaths has

TABLE 4—Poisoning Deaths by Substance and Intent, Ages 13–19 Years, Maryland, 1979–82

Substance Category	Intent	Age	Race	Sex	Substance(s) identified
Antidepressants & stimulants	undetermined	16	W	F	methamphetamine
(32 deaths/1000 discharges)	undetermined	16	W	F	phendimetrazine
	undetermined	17	W	F	caffeine-containing anorectics
	suicide	19	W	M	imipramine
	suicide	19	W	M	amitriptyline
	suicide	19	W	F	doxepin
Analgesics (including opiates)	suicide	16	B	M	methyl salicylate
(31 deaths/1000 discharges)	suicide	18	B	M	codeine, propoxyphene
	suicide	18	W	M	oxycodone, propoxyphene, acetaminophen
	unintentional	18	W	F	morphine, doxylamine
	unintentional	19	W	M	methadone
Sedatives/hypnotics	undetermined	18	W	M	trichloroethanol
(20 deaths/1000 discharges)	suicide	13	B	F	non-barbiturate sedatives
	suicide	17	W	M	multiple barbiturates
	unintentional	13	W	F	ethyl alcohol
Other drugs	undetermined	15	B	F	theophylline
(3 deaths/1000 discharges)	suicide	14	W	F	Inderide (propranolol and hydrochlorothiazide)
	suicide	16	W	F	unidentified substance
	suicide	18	W	F	chlorpromazine
	suicide	19	W	F	cyanide

been the result of reducing children's access to poisons—especially through the Poison Prevention Packaging Act, which, beginning in 1973, regulated packaging of some of the most harmful substances, as well as those in widespread use. Using data on emergency room visits for poison ingestion, Walton found that from 1973 through 1978 emergency room visit rates per 1,000 children under age 5 declined for regulated poisons and remained unchanged for unregulated poisons.[11]

Another intervention, voluntarily adopted by manufacturers in 1968, was the packaging of baby aspirin in bottles containing sub-lethal doses.[12] Reducing toxicity or available amounts could also prevent deaths from highly toxic drugs such as antidepressants and cardiovascular drugs, which nationally cause 13 per cent of all poisoning deaths in young children but only 1 per cent of reported poisonings.[1]

The relatively high ratio of teenage poisoning deaths to hospital admissions and the recent increases in teenage death rates from suicide[13] underscore the importance of identifying causal factors and developing preventive measures that will reduce not only the morbidity from poisoning but the fatal outcomes for several hundred teenagers each year.

ACKNOWLEDGMENTS

The authors would like to thank James C. Anthony, Mary Monk, and Stephen P. Teret for their thoughtful review of this manuscript. This research was supported by Grant Number 7762 from the Robert Wood Johnson Foundation. The views expressed in this article are those of the authors and no official endorsement by the Robert Wood Johnson Foundation is intended or should be inferred.

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APPENDIX

Examples of Measures to Prevent Adolescent Self-poisoning

Strategies	Preventive Measures
1. Prevent the creation of the hazard	Ban the production or manufacture of a drug or medication. This strategy could be employed for a substance with limited therapeutic value, especially if a safer substitute is available, (e.g., discontinuing manufacture of the sedative methaqualone).
2. Reduce the amount of hazard that is created	Establish quotas limiting the production of a drug (e.g., limiting production of amphetamines or of combination drugs with unnecessary components such as caffeine-containing aspirin preparations).
3. Prevent the inappropriate release of a hazard or reduce the likelihood of release	Do not prescribe certain substances to adolescents; substitute another drug with lower injury potential. Provide counseling for teenagers with emotional problems.
4. Modify the rate or spatial distribution of the hazard from its source	Provide limited quantities of a drug to adolescents, especially if they are depressed or suicidal. Dispense sub-lethal doses of prescription drugs. Package products such as aspirin in bottles containing sub-lethal doses.
5. Separate in time or space the hazard from that which is to be protected	Provide certain medications at outpatient clinic dispensaries and require adolescents to receive them there. Have a health provider make home visits to administer long-acting parenteral doses of medications.
6. Interpose a material barrier between the hazard and that which is to be protected	Dispense medications in blister packaging which requires extra time and effort to unwrap each pill, making it more difficult to swallow a large quantity of pills.
7. Modify the relevant basic qualities of the hazard	Incorporate in a drug small quantities of an emetic, which will induce vomiting after ingestion of potentially fatal quantities.
8. Increase the susceptible population's resistance to damage from the hazard	Place overweight teens on supervised diets to eliminate the desire to use anorectics.
9. Begin countering damage already done by the hazard	Provide access to emergency facilities which have personnel trained to treat drug overdoses. Administer narcotic antagonists, chelating agents, emetics, gastric lavage.
10. Stabilize, repair, and rehabilitate the injured person	Provide medical care and therapy as needed. Provide treatment aimed at restoring patient's mental health.