

Children's acetaminophen exposures reported to a regional poison control center

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The use of nonprescription medication is an essential aspect of health care in the United States. More than 100,000 nonprescription products are now sold in a variety of stores and service centers in the United States.^{1,2} It has been estimated that 70% of illnesses are treated with nonprescription medicines.³

Since the commencement of the American Association of Poison Control Centers (AAPCC) Toxic Exposure Surveillance System, over 36 million poisoning exposures have been reported by participating poison control centers (PCCs). Poisonings remain an important cause of morbidity and pose a marked economic burden in the United States.⁴ A report from the Committee on Poison Prevention and Control estimated that the economic burden of poisoning was \$12.6 billion annually based on the societal lifetime cost of injury.⁵

Among drug exposures reported to PCCs in the United States, analgesics are the substances most frequently involved.⁶ In 2003, 780,324 pharmaceutical-related poison exposures occurred in children less than 19 years of age. Of these, 66,224 (8.5%) (38,989 in children of <6 years and 27,235 in children between 6 and 19

Purpose. The patient characteristics, doses taken, and types of exposures in children with acetaminophen-related exposures reported to a regional poison control center (RPCC) were studied.

Methods. A retrospective review was conducted of all acetaminophen exposures that occurred between October 31, 2000, and October 31, 2003, in children younger than 18 years who were managed by an RPCC. Children were grouped into three age categories: less than 6 years (group 1), 6–12 years (group 2), and 13–17 years (group 3). Data collected included patient demographics, drug details, type of exposure, time since exposure, exposure site, and caller site.

Results. There were 473 exposures to acetaminophen: 76% in group 1, 3% in group 2, and 21% in group 3. Sex was distributed equally among groups, except group 3 was 83% females. The majority of callers seeking information on acetaminophen ingestion in children younger

than 12 years were family members (62%), whereas health professionals (61%) were the most common callers for children over 12 years. Unintentional ingestion was the most common type of exposure in group 1 (100%) and group 2 (93.7%). In group 3, intentional ingestions were more common (91%), with females representing far more of these exposures than males (87% versus 14%, respectively). Acetaminophen doses over 200 mg/kg were ingested by 47% of children in group 3.

Conclusion. Most acetaminophen exposures reported to an RPCC occurred in children less than six years of age and were unintentional, whereas exposures in children over 12 years were more likely to be intentional overdoses.

Index terms: Acetaminophen; Adolescents; Age; Analgesics and antipyretics; Dosage; Pediatrics; Poisoning; Toxicity

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years) were caused by acetaminophen exposures.⁶ Differences in acetaminophen exposures among children of various ages have not been extensively studied. Therefore, we set out to describe the patient characteristics, doses taken, and types of exposures and to compare acetaminophen-

related exposures in different age groups in children.

Methods

A retrospective review of all acetaminophen exposures in children managed by an AAPCC-certified regional poison control center (RPCC)

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was conducted. The RPCC's electronic medical record database (Visual Dotlab, version 3.3.4, WBM Software) was queried to identify all acetaminophen exposures that occurred between October 31, 2000, and October 31, 2003. Any call to the RPCC regarding acetaminophen (e.g., intentional overdoses, adverse drug effects) was classified as an exposure. To be included in this study, the patient had to be less than 18 years of age.

Data collected included patient demographics (age, sex, weight, and caller relation to the patient), drug details (drug or product name, dose, and number of doses), time from the exposure to the call to the RPCC (time of ingestion and time of call), type of exposure (unintentional, intentional, and adverse drug reaction), exposure site (residence, workplace, health care facility, school, public area, and other place), and caller site (residence, workplace, health care facility, and other place). The data were deidentified by an honest broker in the RPCC and provided to the principal investigator. An honest broker is an individual, organization, or system acting for or on behalf of the covered entity to collect and provide health information to research investigators in such a manner that it would not be reasonably possible for the investigators or others to identify the corresponding callers or patients directly or indirectly. The deidentification was conducted in accordance with the regulations of the Health Insurance Portability and Accountability Act, and the institutional human rights committee approved the study.

Children were grouped into three age categories: <6 years of age, 6–12 years of age, and 13–17 years of age. Comparisons were made among age groups for various attributes, such as demographics, dose taken, and type of exposure. The data were analyzed with SPSS, version 13.0, statistical software (SPSS Inc., Chicago, IL). Chi-square analysis was

used for categorical variables, and the independent-sample *t* test was used for continuous variables. The a priori level of significance was 0.05.

The definitions used in this study were obtained from AAPCC.⁶ Type of exposure was coded according to the following definitions:

- Unintentional general: all unintentional exposures other than environmental, occupational, therapeutic error, misuse, food poisoning, bite or sting, and unknown exposures.
- Unintentional therapeutic error: an unintentional deviation from a proper therapeutic regimen that results in the wrong dose, incorrect route of administration, administration to the wrong person, or administration of the wrong substance.
- Intentional suicidal: an exposure resulting from the inappropriate use of a substance for reasons that are suspected to be self-destructive or manipulative.
- Intentional misuse: an exposure resulting from the intentional improper use of a substance for reasons other than the pursuit of a psychotropic or euphoric effect.
- Intentional abuse: an exposure resulting from the intentional improper or incorrect use of a substance in which the victim was likely attempting to achieve a euphoric or psychotropic effect.
- Adverse reaction: an adverse event occurring with normal, prescribed, labeled, or recommended use of the product, as opposed to overdose, misuse, or abuse.

Results

A total of 473 pediatric exposures to acetaminophen were identified.

These involved 273 girls (57.7%) and 200 boys (42.3%). Females had a mean ± S.D. age of 6.3 ± 5.9 years, compared with 3.5 ± 3.9 years for males (*p* < 0.001). The sex distribution by age group is provided in Table 1. Most acetaminophen exposures occurred in children younger than six years (359 of 473, 75.9%). Although the sex distribution was similar in children of <6 years, a significant shift occurred in children 13–17 years of age, with females constituting 82.7% of exposures.

Dose. The mean ± S.D. dose of acetaminophen taken by children was 3,685 ± 6,985 mg (range, 25–62,500 mg). There was no significant difference in the mean dose between males and females in the three age groups (Table 2). The mean ± S.D. dose consumed by children in the group 13–17 years (13,789.9 ± 10,068.3 mg) was far higher (*p* < 0.001) than the mean ± S.D. doses consumed by children of <6 years (1,045.3 ± 1,264.3 mg) and 6–12 years (1,035.6 ± 656.9 mg).

Weights were not available for 79 patients. For those with a recorded weight, the mean ± S.D. acetaminophen dose was 92.9 ± 109.4 mg/kg (range, 1.8–1284.4 mg/kg). A majority of children younger than 6 years (322/336, 95.8%) and all children of 6–12 years (13/13, 100%) ingested less than 200 mg/kg of acetaminophen. In children of 13–17 years, the percentages were more evenly divided, with 53% of children ingesting less than 200 mg/kg.

Time from exposure to RPCC call.

The mean ± S.D. time between the exposure and the call to the RPCC was 3.4 ± 12.1 hours (range, 0.01–120 hours). The time from exposure to call

Table 1.

Distribution of Acetaminophen Exposures

Sex	No. (%)			
	<6 yr (n = 359)	6–12 yr (n = 16)	13–17 yr (n = 98)	Total (n = 473)
Female	184 (51.3)	8 (42.1)	81 (82.7)	273 (57.7)
Male	175 (48.7)	8 (57.9)	17 (17.3)	200 (42.3)

Table 2.
Distribution of Acetaminophen Doses

Dose (mg)	<6 yr (n = 359)		6–12 yr (n = 16)		13–17 yr (n = 98)	
	Female (n = 184)	Male (n = 175)	Female (n = 8)	Male (n = 8)	Female (n = 81)	Male (n = 17)
Mean ± S.D.	927.9 ± 938.8	1,168.7 ± 1,527.1	1,153.7 ± 699.4	917.5 ± 635.3	14,470.2 ± 10,428.8	10,548.8 ± 7,567.5
Range	25–10,000	25–14,000	500–2,500	500–2,400	160–480	25,000–62,500

was categorized into several ranges: <1.00, 1.00–1.99, 2.00–2.99, 3.00–3.99, 4.00–4.99, and ≥5.00 hours. Calls were made to the RPCC within one hour of exposure in 93.3% of children of <6 years and in 68.7% of those 6–12 years of age. In contrast, 41.8% of calls made to the RPCC for children 13–17 years of age were made after five hours of exposure (Table 3).

Type of exposure. Table 4 describes the types of exposures in the three age groups. Unintentional exposures were the most common reason for acetaminophen overdose in children younger than 6 years of age (100%) and 6–12 years of age (93.7%). There were no differences in the sex distribution of unintentional exposures between children less than 6 years of age (51.1% female, 48.9% male) and those 6–12 years of age (46.7% female, 53.3% male). In children of 13–17 years, there were more intentional exposures in females (86.5%) than in males (13.5%) ($p = 0.02$).

Caller, caller site, and exposure site. Family members were more likely to call the RPCC for information on acetaminophen exposure in children less than six years old and represented 62.4% of those callers. For children 6–12 years and 13–17 years of age, family members accounted for 43.8% and 26.5% of callers, respectively. Health care professionals (61.2%) were the most common type of caller in children 13–17 years of age.

The most common caller site was a residence for children of <6 years (90.8%) and 6–12 years (81.3%). In children 13–17 years of age, the most

common caller sites were a health care facility (64.3%) and a residence (28.6%). The most common site for acetaminophen exposure was a residence for all the age groups.

Discussion

Acetaminophen is the antipyretic–analgesic most widely used in young children and is one of the most commonly ingested medications. From 2000 to 2003, poison control centers in the United States received a quarter of a million calls regarding acetaminophen poisoning.^{6–9} The RPCC in our study received 473 calls regarding acetaminophen exposures in children during a three-year period. Most of these calls (75.9%) were for children less than six years of age. The majority of the calls were from family members, and most calls originated in their residence. As young children become increasingly mobile, their access to potentially toxic substances also increases. These substances are commonly available in the home. Many poisonings involve substances that have been used by others in the household in the preceding 24 hours.¹⁰ Extreme hand-to-mouth activity, instinctive interest, lack of judgment, and the inability to read make children less than six years of age the most common victims of accidental unintentional poisoning.¹¹ We found that children 6–12 years of age represented the smallest proportion of all acetaminophen exposures. At age 6, children may have learned about poison prevention and have the capacity to understand what substances they should not ingest. Health care professionals should

urge family members to use child-resistant containers and safely store prescription and nonprescription medications where children cannot access them.

Proper dosage and administration of nonprescription drugs are especially important when the smallest patients are involved. A study by Snyder¹² suggests that parents need to know more about the nonprescription drugs they give to their children. This study reported that 88% of the adults administering nonprescription drugs to children demonstrated a definite need for more education about these drugs. Only 40% of caregivers were able to state the correct dosage of acetaminophen for their children during a mock exercise. Even more concerning was that only 43% of caregivers measured the correct amount of the drug for their children. Lack of knowledge on administering proper doses could contribute to therapeutic errors by adults when dosing children less than six years of age.

Acute ingestions of acetaminophen 150–200 mg/kg are associated with a risk of hepatotoxicity, although serious morbidity is unusual and mortality is very rare.^{10,13} In our study, few children (35/394, 8.9%) ingested more than 200 mg/kg. However, this number increases to 47% when only children 13–17 years are considered. In addition, calls to the RPCC for this age group were most likely to occur five or more hours after the exposure. Although the total number of acetaminophen ingestions in these patients was low ($n = 21$), the potential risk of severe toxicity due to in-

Table 3.

Age Distribution of Time from Exposure to Call to Regional Poison Control Center

Time from Exposure to Call (hr)	No. (%)			
	<6 yr (n = 359)	6–12 yr (n = 16)	13–17 yr (n = 98)	Total (n = 473)
<1.00	335 (93.3)	11 (68.7)	24 (24.5)	370 (78.2)
1.00–1.99	6 (1.7)	3 (18.7)	8 (8.2)	17 (3.6)
2.00–2.99	6 (1.7)	0	11 (11.2)	17 (3.6)
3.00–3.99	2 (0.5)	0	5 (5.1)	7 (1.5)
4.00–4.99	6 (1.7)	1 (6.3)	9 (9.2)	16 (3.4)
≥5.00	4 (1.1)	1 (6.3)	41 (41.8)	46 (9.7)

Table 4.

Distribution of Types of Exposure

Type of Exposure	No. (%)			
	<6 yr (n = 359)	6–12 yr (n = 16)	13–17 yr (n = 98)	Total (n = 473)
Unintentional	359 (100)	15 (93.7)	9 (9.2)	383 (81)
General	331	10	3	344
Therapeutic error	27	5	5	37
Adverse drug reaction	1	0	1	2
Intentional	0	1 (6.3)	89 (90.8)	90 (19)
Suspected suicide	0	0	86	86
Misuse	0	1	2	3
Abuse	0	0	1	1

gestion of higher doses and delayed reporting is not trivial.

Children between 13 and 17 years were most likely to have intentional ingestions, and females represented the majority of these exposures. These findings are consistent with those reported in studies of suicides in adolescents.^{14,15} According to the Christchurch Health and Development Study, females had the highest rates of suicide attempts.¹⁴ Although females are more likely to attempt suicide, completed suicide is more common among males.¹⁶ Males tend to use methods that are more immediately lethal, such as hanging and carbon monoxide poisoning. The majority of suicide attempts by females are by intentional overdose, a method that has high toxicity but low lethality.¹⁵

Poison prevention education is effective but not 100% successful. Acetaminophen poisoning in children is a preventable injury, and

methods of prevention should be aimed at the causes of poisoning.¹⁷ Health care professionals can influence safe practices at home and should call attention to the use of child-resistant containers and secure storage to reduce the availability of medications to children.¹⁸ Another essential part of poison prevention education is creating awareness about PCCs.¹¹ PCCs play important roles in poison prevention education, as well as in the management of poisonings.

Conclusion

Most acetaminophen exposures reported to an RPCC occurred in children of <6 years and were unintentional, whereas exposures in children over 12 years were more likely to be intentional overdoses. Girls were more likely to be represented than boys in cases of intentional overdose in children older than 12 years.

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