Pediatric Poisonings in Israel: National Poison Center Data

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ABSTRACT: **Background:** Poisonings are a significant cause of pediatric morbidity and mortality. The Israel Poison Information Center provides clinical consultations on poisonings and drug information 24 hours a day.

Objective: To evaluate the epidemiologic characteristics of pediatric poison exposures in Israel.

Methods: We reviewed computerized queries and performed a descriptive analysis of the Poison Center database pertaining to patients under 18 years old during 2007.

Results: A total of 15,005 pediatric poison exposures were recorded, 80.3% of them occurring in children under 6 years old. Of the calls to the Poison Center, 78.6% were made by the public, 20.7% by physicians, and in 74.4% the call was within 2 hours of exposure. Most exposures occurred at home (89.3%) and were unintentional (89.5%). Among adolescents, most exposures were intentional (49.3%, 38.2% suicides), the time lapse until consultation was longer (37% > 2 hours), and more physicians (54.8%) consulted the Poison Center. Most cases were asymptomatic or mildly affected (92.3%), 54.4% in adolescents. The commonest substances involved in single poison exposure were detergents, antimicrobials, topical preparations, acetaminophen and scale removers; in adolescents the most common substances were acetaminophen, methylphenidate, non-steroidal anti-inflammatory drugs, atropine and ethanol. Moderate to severe toxicity was commonly associated with organophosphates, alkali, ethanol, *Vipera palaestinae* and neuroleptics. Most patients could be observed at home (66.6%), while more adolescents were referred to emergency departments (42.2% vs. 9.9%) or hospitalized (14.5% vs. 1.9%).

Conclusions: Pediatric poisonings are a significant health problem. The magnitude of the problem is greater in the young age group but more severe in adolescence, probably due to deliberate self-poisoning. Greater national efforts should be directed towards improved poison prevention, rational management of pediatric poisoning, and creating a national poisoning registry.

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Poisoning is considered one of the significant causes of morbidity and mortality in children and accounts for about 3% of hospital referrals [1-6]. The incidence of poisonings has been continuously increasing [3,7]. Most pediatric poisonings occur at home and are due to chemical or pharmaceutic preparations [2,3,8,9]. Most affected are preschool children and adolescents [3,4,6-8,10-18].

In 2007 the American Association of Poison Control Centers reported 1,588,948 pediatric poison exposures (65% of all exposures recorded). Children under the age of 6 years were involved in 51.3% of all cases; 99.4% of them were unintentional exposures. Moderate to severe poisoning occurred in 35,622 (2.2%) children and 133 (0.008%) died [3]. Different countries show marked differences in poisoning characteristics and severity. These differences are the result of different methods of data collection and evaluation, definitions of clinical severity and levels of health care, and socioeconomic, demographic and cultural variability [3,6,10-13,15,19-22]. For example, pediatric poisoning mortality can be as low as 0.008% in the United States [3] and as high as 11% in Pakistan [6].

Two studies on pediatric poisoning in Israel were published, both involving admissions to an emergency department of one hospital [8,23]. The Israel National Poison Information Center, at Rambam Health Care Campus, provides consultations on clinical toxicology to health care professionals and the general public 24 hours a day 7 days a week. The consultations are provided by physicians, most of them board certified in Internal Medicine, Pediatrics and Clinical Pharmacology.

The method of operation and data collection at this national poison center has been described previously [7,18,24]; however, no national study on pediatric poisonings in Israel has been published. The objectives of the present study were to evaluate the scale of pediatric poison exposures and poisonings in Israel and determine their characteristics. Such data should be used by health care professionals and decision makers for identifying risk factors and improving medical care of the poisoned child, as well as for prevention programs and further research.

PATIENTS AND METHODS

This retrospective observational study analyzes data of all calls pertaining to pediatric poison exposures made to the Israel Poison Information Center during 2007. The Center serves the entire population of Israel, numbering 7,243,600 (2007 data). It is the only poison center in Israel that serves both the general public and health care facilities 24 hours a day. Reporting to the Poison Center is not mandatory. Case records in this database (as in other national poison centers) [3,5] come from self-reported calls; they reflect information provided by the public or health care professionals while reporting an actual or potential exposure.

The consultation process includes history, assessment of the patient's condition and exposure, advice on first aid, survey of data, triage, and management recommendations. All toxicologic consultation data are recorded in a comprehensive structured form that includes caller and patient demographic details; substance/s involved; route, site and circumstances of exposure; time elapsed until consultation; clinical manifestations in a system-oriented approach; evaluation (including laboratory confirmation of exposure whenever possible); and management and follow-up recommendations. Follow-up is performed for moderately to severely poisoned patients and whenever possible. The clinical severity of each case is graded according to previously published criteria [3,7] as minor, moderate, major, death, unknown or not applicable. The severity grading reflects the patient's condition at the time of consultation and may not represent peak effect or subsequent deterioration. In addition, each case is classified according to a previously prepared list of categories, classifications and sub-classifications available at the Poison Center. All data are then entered and stored in a designated tailored database using Access 2007 (Microsoft Corporation, USA) on SQL server. All records are subjected to routine quality control.

To obtain the epidemiologic characteristics of poison exposures and poisonings for the year 2007, computerized queries were performed using the various fields of the toxicologic medical record pertaining to three pediatric age groups: under 6 years, 6–12 years and 13–18 years (adolescents). The demographic and clinical characteristics retrieved included identification of the caller and health care facility; age and gender of the patient; time elapsed between exposure and call to the Poison Center; route, site and circumstances of exposure; agents involved; severity of poisoning; and management recommendations. Data were subjected to descriptive analysis. Frequency distribution of the various characteristics among the different age groups and the severity categories were compared using chi-square analysis where relevant. This method of data collection and evaluation of Poison Center consultations was described in detail previously [7,18,24]. The study was approved by the Institutional Review Board of Rambam Health Care Campus, Haifa.

RESULTS

During the study period, a total of 26,767 poison exposure cases were recorded at the Poison Center, of which 15,005 (56.1%) pertained to children and adolescents under the age of 18. Using this figure and data from the Israel Central Bureau of Statistics for 2007, the prevalence of pediatric poison exposures in the pediatric population (0–18 years) was $617.3/10^5$.

Of the calls relating to children in the two youngest age groups (0–5 and 6–12 years), 82.7% and 74.5% came from the public and 16.1% and 23.9% from physicians, respectively; contrarily, in adolescents 42.8% came from the public and 54.8% from physicians ($P < 0.001$). In the two youngest age groups (0–12 years), 8.7–12.4% of the calls came from community clinics and 7.7–12% from hospitals; in adolescents 11.3% were from community clinics and 44.4% from hospitals ($P < 0.001$).

More males than females were involved in the 0–5 and 6–12 year age groups (51.7–52.8% males vs. 39.1–41.5% females) compared with the 13–18 year old group (40.3% males and 53.2% females) ($P < 0.001$).

The time elapsed from exposure to calling the Poison Center was significantly longer in the 13–18 year old group: 47.7% of the calls were made within the first 2 hours of exposure (68.9–77.9% in the 0–5 and 6–12 year old groups, 47.7% in adolescents), and 37% were made 2–24 hours post-exposure (13.1–19.9% in the two youngest age groups, 36.9% in adolescents) ($P < 0.001$).

Most (89.3%) pediatric poison exposures occurred at home: 92% in the 0–5 year old group and 78.5–79% in the 6–12 and 13–18 year old groups. In the youngest age group 2.4% of exposures occurred outdoors compared with 7.8–9.8% in the two older groups. Exposures at school occurred in 3.3–3.4% of the two older age groups; 0.4% of the youngest group were exposed in nurseries and kindergartens. All these differences were significant ($P < 0.001$).

Table 1 shows the distribution of circumstances of poison exposure according to age group. Unintentional (mainly "general") accounted for most exposures in the two young age groups (90.7–93.4%) compared with intentional exposures (mainly suicides) in the adolescent group (43.5%) ($P < 0.001$).

All possible routes of exposures were involved. Ingestion was by far the most common route of exposure, especially in the youngest age group compared with the two older groups (81.4% vs. 62.3–71%, respectively). Inhalation and bites and stings were less common in the youngest age group compared with the older ones (2.4% vs. 5.6–5.8% and 1.1% vs. 5.4–8%, respectively). These differences were significant ($P < 0.001$).

Forty-nine percent of the children and adolescents were exposed to pharmaceuticals, 41.3% to chemicals, 4.1% to

Table 1. Distribution of main circumstances of exposure according to age groups*

	0–5 yrs	6–12 yrs	13–18 yrs	Child, unknown age
Unintentional	11,258 (93.4%)	1,451 (90.7%)	594 (49.3%)	128 (87.1%)
General**	8,386 (69.1%)	731 (45.7%)	226 (18.8%)	71 (48.3%)
Therapeutic error§	1,834 (15.2%)	303 (18.9%)	121 (10%)	25 (17%)
Accident	379 (3.1%)	144 (9%)	88 (7.3%)	11 (7.5%)
Misuse§§	297 (2.5%)	84 (5.3%)	57 (4.7%)	6 (4.1%)
Bite/sting	139 (1.2%)	132 (8.3%)	66 (5.5%)	5 (3.4%)
Intentional	5 (0.04%)	40 (2.5%)	524 (43.5%)	0 (0%)
Suicide	0 (0%)	30 (1.9%)	460 (38.2%)	0 (0%)
Malicious	2 (0.02%)	2 (0.1%)	6 (0.5%)	0 (0%)
Abuse	0 (0%)	7 (0.4%)	40 (3.3%)	0 (0%)
Drug information	308 (2.6%)	50 (3.1%)	22 (1.8%)	9 (6.1%)
Unknown	486 (4%)	60 (3.8%)	66 (5.5%)	10 (6.8%)

P < 0.0001

* Percent calculated from number of exposures in age group

** "General": exposures that could not be classified otherwise; usually reflects child's curiosity and experimentation

§ "Therapeutic error": incorrect use of a pharmaceutical by caregivers or health care professionals (including prescription and dispensing errors)

§§ "Misuse": improper or incorrect use of a non-pharmaceutical substance

poisonous plants and venomous animals ("biologicals"), and 4.8% to miscellaneous agents. Adolescents were relatively more exposed to pharmaceuticals (58.4%) and less to chemicals (27.3%): (43.4–46.7% pharmaceuticals and 33.4–42.1% chemicals in the two youngest age groups). The intermediate age group was more exposed to biological agents (11.1%; 2.2 and 6.9% in the two other age groups). All these differences were significant ($P < 0.0001$). Young children were more exposed to poisonous plants compared with the older age groups (56.6% vs. 28.1–40.7%, respectively). The intermediate age group was more exposed to animals compared with the youngest and oldest age groups (71.9% vs. 43.4–59.3%, respectively, $P = 0.0001$). Table 2 shows the distribution of substances and agents most frequently involved in pediatric single poison exposures.

The body system most affected in all age groups was the gastrointestinal tract (19.9–21.9%) followed by the neurologic (13.5–18.9%) and respiratory (9.6–13.5%) systems. The ocular and dermatologic systems were less affected in the youngest age group (3.7% and 2.4%, respectively) compared with the older groups (6.9–9.6% and 6–7.1% respectively). The cardiovascular system was more affected in adolescents (8.9% vs. 1.3–3.8% in the two youngest age groups). All these differences were significant ($P < 0.0001$).

Table 3 shows the distribution of severity of poisoning according to age group. The youngest age group was affected significantly less than the oldest ($P < 0.001$). Table 4 shows the distribution of substances and agents most frequently involved in moderate to severe pediatric single poison exposures.

The commonest substances causing severe poisoning or death from ingestion of one tablet by a toddler (< 2 years) [14,25] that were recorded in the Poison Center's database are: beta blockers (n=12), carbamazepine (n=5), calcium channel blockers (n=5), warfarin (n=5), oral hypoglycemics (n=4), opioids (n=3), phenothiazines (n=3), amitryptylline (n=1) and digoxin (n=1).

The characteristics of moderate to severe pediatric poisonings according to age groups are as follows

- 0–5 years: females (56.6%), unintentional exposures (98.5%), exposure to chemicals (53.2%; 35.1% pharmaceuticals, 11.7% biological agents)
- 6–12 years: females (53.2%), unintentional exposures (87.2%), exposure to either pharmaceuticals or chemicals (36.4% each; 27.3% biological agents)
- 13–18 years: males 50.6%, intentional exposures (70.4%; 35 suicides, 15 substance abuse), exposure to pharmaceuticals (49.4%; 42.4% chemicals, 8.2% biological agents).

The gender differences among the three age groups were not significant ($P = 0.76$). The differences between the circumstances of exposure and the causative agents among the age groups were significant ($P = 0.001$ and $P = 0.014$, respectively).

The site for management recommended by the clinical toxicologist differed significantly between the age groups. Compared with the two youngest age groups, adolescents were referred significantly more to emergency departments (9.4–13.8% vs. 42.2%, respectively), to wards (1.2–2.3% vs. 11.2%, respectively), and to intensive care units (0.5–1.1% vs. 3.3%, respectively). Of children under the age of 6 years 72.1% could be managed at home with Poison Center follow-up as needed, compared with 25.1% in adolescents. All these differences were significant ($P < 0.0001$).

DISCUSSION

The results of our comprehensive survey show that 56.1% of poison exposure cases reported to the Israel Poison Information Center involved children, mainly under the age of 6 (80.3%). Most of the calls were made by the public, and within the first 2 hours of exposure. Most poison exposures occurred at home, by the oral route, were unintentional, and were asymptomatic or of minor severity. In adolescents, however, most calls were made by physicians and more than 2 hours after exposure. Relatively more adolescent exposures involved females and pharmaceuticals, were intentional and of greater severity. These differences can be explained by the proximity of parents or caretakers of young children during exposure and by the high rate of deliberate self-poisoning in adolescents (38.2%) [18].

Therapeutic errors are an important cause of poison exposures in all age groups, especially in the two younger age groups. While pharmaceuticals accounted for more poison exposures, chemicals were slightly more responsible for

Table 2. Substances and agents most frequently involved in pediatric single poison exposures according to age groups*

PHARMACEUTICALS (n=7351, 49%)					
0–5 yrs		**6–12 yrs**		**13–18 yrs**	
Substance	**n**	**Substance**	**n**	**Substance**	**n**
Antimicrobials	667	Antimicrobials	89	Acetaminophen	71
Topical preparations	539	Atropine	80	Methylphenidate	47
Acetaminophen	511	Acetaminophen	64	NSAIDs	43
NSAIDs	500	NSAIDs	60	Atropine	35
Cold & cough preparations	332	Topical preparations	55	Antimicrobials	30
Eye/ear/nose preparations	269	Cold & cough preparations	42	Dipyrone	25
Vitamins A+D	254	Methylphenidate	28	Benzodiazepines	23
Beta-2 agonists	238	Beta-2 agonists	24	SSRIs & SNRIs	18
Iron 220		Eye/ear/nose preparations	21	Cold & cough preparations	16
Oral contraceptives	178	Pediculocides	19	Complementary medicines	16
Antihistamines	177	Antihistamines	17	Drugs of abuse	16
Complementary medicines	118	Iron	14	Topical preparations	14
Disinfectants	114	Benzodiazepines	12	Iron	12
Benzodiazepines	83	Disinfectants	11	Carbamazepine	10
Antileukotrienes	80	Oral contraceptives	10	Antihistamines	10

CHEMICALS (n=6,200, 41.3%)					
0–5 yrs		**6–12 yrs**		**13–18 yrs**	
Substance	**n**	**Substance**	**n**	**Substance**	**n**
Detergents	969	Arts & office supplies	51	Ethanol	35
Scale removers	350	Bleaches	40	Bleaches	25
Arts & office supplies	268	Detergents	33	Arts & office supplies	22
Bleaches	258	Scale removers	24	Irritant gases	20
Alkali	220	Petroleum distillates	21	Alkali	18
Essential oils	158	Alkalis	20	Solvents	18
Petroleum distillates	139	Smoke inhalation	18	Acids	15
Adhesives	123	Irritant gases	16	Detergents	15
Solvents	107	Adhesives	15	Organophosphates	14
Insect repellent	99	Lead	13	Petroleum distillates	13
Deodorizers	90	Asphyxiant gases	11	Soaps	8
Acids	86	Solvents	9	Scale removers	8
Ethanol	60	Perfumes	8	Asphyxiant gases	7
Organophosphates	60	Pyrethrins	8	Adhesives	6
Perfumes	55			Fire extinguishers	5

BIOLOGICAL AGENTS (n= 619, 4.1%)					
0–5 yrs		**6–12 yrs**		**13–18 yrs**	
Agent	**n**	**Agent**	**n**	**Agent**	**n**
Irritant plants (e.g., arum)	46	Scorpions	23	Scorpions	23
Scorpions	26	Spiders	17	Centipede	11
Mushrooms	25	Centipede	16	*Vipera palaestinae*	8
Spiders	24	Bees and wasps	15	Spiders	8
Insects	22	Mammal bites	13	Mammal bites	4
Centipede	19	Irritant plants (e.g., arum)	12	Mushrooms	4
Bees and wasps	17	Insects	11	Datura sp.	3
Mammal bites	12	*Vipera palaestinae*	11	Aquatic creatures	3
Aquatic creatures	6	Aquatic creatures	11	Oleander	2
Snakes	6	Oleander	8	Irritant plants (e.g., arum)	2

MISCELLANEOUS AGENTS (n = 726, 4.8%)					
0–5 yrs		6–12 yrs		13–18 yrs	
Agent	n	Agent	n	Agent	n
Contaminated food	194	Contaminated food	36	Thermometer (Hg)	13
Batteries	127	Foreign bodies	24	Contaminated food	8
Thermometer (Hg)	79	Batteries	23	Batteries	5
Foreign bodies	75	Thermometer (Hg)	21	Foreign bodies	4
Radiation	4	Other	11	Radiation	4

* Multiple exposures were recorded in 466 pharmaceutical and 67 chemical cases

NSAID = non-steroidal anti-inflammatory drug, SSRI = selective serotonin reuptake inhibitors, SNRI = serotonin–norepinephrine reuptake inhibitors

Table 3. Distribution of severity of pediatric poison exposures according to age groups

Severity	**0–5 yrs**	**6–12 yrs**	**13–18 yrs**
No effect	8873 (73.6%)	796 (49.8%)	435 (36.1%)
Minor	2404 (19.9%)	642 (40.1%)	582 (48.3%)
Moderate	72 (0.6%)	40 (2.5%)	68 (5.7%)
Major	8 (0.07%)	6 (0.4%)	17 (1.4%)
Death	1 (0.008%)*	0 (0%)	1 (0.08%)**
Unknown severity	696 (5.8%)	116 (7.3%)	101 (8.4%)

$P < 0.001$

* 3 year old boy, carbon monoxide

** 15 year old boy, asphyxiant abuse

moderate to severe poisonings. Chemicals were responsible for more than half of the moderate to severe poisonings in the 0–5 year old group. This can be explained by the storage of toxic chemical products close to the floor where they are accessible to infants.

The agents most frequently involved in moderate to severe poison exposures were organophosphates, alkali, ethanol, *Vipera palaestinae*, neuroleptics, fire smoke, acetaminophen, carbamazepine, acids and petroleum distillates. Multiple-drug ingestion (in deliberate self-poisonings) and ethanol are

Table 4. Substances and agents most frequently (› one case) involved in moderate to severe pediatric single poison exposures according to age groups*

0–5 yrs		6–12 yrs		13–18 yrs	
Substance	**n**	**Substance**	**n**	**Substance**	**n**
Neuroleptics	8	Alkali	4	Ethanol	10
Organophosphates	7	Neuroleptics	4	Organophosphates	7
Alkali	5	Phenytoin	3	Acetaminophen	5
Smoke inhalation	5	*Vipera palaestinae*	3	Carbamazepine	5
Petroleum distillates	4	Scorpions	2	Alkali	4
Acids	3			*Vipera palaestinae*	4
Beta-2 agonists	2			Benzodiazepines	2
Fluoroacetamide	2			Paraquat	2
Vipera palaestinae	2				

*Multiple drugs were involved in 4 cases in the 0–5 year age group, 2 in the 6–12 year group, and 11 in the 13–18 year age group

important causes of moderate to severe poisoning in adolescents. Of note is the large number of inadvertent exposures to atropine auto-injectors (148; 80 in the 6–12 year age group), a phenomenon previously reported by us [24].

Young children (< 6 years) were more exposed to poisonous plants than were older age groups. They were less exposed or affected by venomous animals, except for scorpions whose bites were of greater severity in the young.

Most poison exposures were found to be asymptomatic or mild, especially in the youngest age group. There are several reasons for this finding: a) no actual exposure occurred (circumstantial evidence, inability of the young child to provide history), b) early consultation or evacuation before development of clinical manifestations, and c) early institution of treatment.

Two previous studies on pediatric poisonings in Israel involved visits to the emergency department [8,23]. Our study differs in that it includes also community clinics and the general public. One previously published study comprised 1143 children, of whom 28.2% were adolescents compared to 8% in our study. This high rate of adolescents is in agreement with our finding of a significantly higher referral rate of adolescents to emergency departments. While many findings are similar to ours, it seems that more home products, mainly cleaning agents, were reported relative to our study. It is unclear to what extent corrosive home products were involved. In addition, the frequency distribution of pharmaceuticals involved was different (e.g., acetaminophen was the most frequent drug involved) [8].

The other Israeli study included 502 pediatric patients, 88.5% under the age of 5, compared with 80.3% under the age of 6 in our study. The findings of that study are somewhat similar to ours but they show a different distribution pattern of pharmaceuticals (e.g., more hormones) and chemicals (e.g., more petroleum distillates). That study also investigated ethnic differences, which we did not look into [23].

The differences between these studies and ours probably stem from the differences in data collection method (local emergency department versus nationwide), referral populations, ethnic distribution, and the limited number of patients (502–1143 vs. 15,005 in our study).

Many of our findings are similar to those reported in western countries, especially by the American Association of Poison Control Centers [3,10,12,20,22]. For instance, moderate to severe toxicity was observed in 1.4% and 2.2% of the Israeli and American data, respectively, and death in 0.01% and 0.008%, respectively [3]. Striking differences were observed between our data and other countries (e.g., 11% poisoning mortality in Pakistan in 2005 and 40% in Jordan for the same year) [6,13]. These differences may be due to differences in awareness, time to detection of poisoning, evacuation time, availability of health care facilities, and quality of medical care.

LIMITATIONS

The limitations of our study are its retrospective design, partial follow-up, and restricted laboratory confirmation of exposure. The grading of severity reflects the patient's condition at the time of consultation and in some cases underestimates the true severity. The Poison Center data rely on self-reporting and represent solely information provided by the caller. Thus, the data may not directly identify the overall incidence of pediatric poisoning in Israel and reports may vary in accuracy. These limitations are common to reports from other national poison centers, including those from the U.S. [3]. The strength of our study lies in the large number of cases and method of data collection, which includes all health care facilities as well as the public.

CONCLUSIONS

Pediatric poison exposure and poisoning are a significant health problem due to morbidity, anxiety and pain of the child and his/her family; it wastes parents' working hours, and increases the burden on the health care system. In our opinion all this can be reduced by better enforcement of childproof containers, introduction of safer ingredients in household chemical products, less attractive packaging of pediatric medications, educational measures aimed at improving poison awareness, and prevention and increased supervision of children mainly during afternoon and evening hours and during holidays.

A national effort should be made to create a poisoning registry and offer better financial support to the National Poison Center. The Center's round-the-clock availability, its activities

and data collection can rationalize treatment of pediatric poisonings, monitor poison exposures and their trends, identify hazards, focus on prevention education, stimulate clinical research, direct training, and support regulatory actions and national decision making.

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