Thirty-three-year experience on childhood poisoning

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By comparing our data for the period 1985-2008 with findings from a previous report covering the period 1975-1984, we aimed to share our experience with poisoning cases in order to contribute toward its prevention, diagnosis and treatment. The records of patients admitted to the Pediatric Intensive Care Unit with acute poisoning between November 1985 and October 2008 were evaluated retrospectively. The records of 2251 patients with acute poisoning could be retrieved. Poisoning mostly occurred in the home (92%), via the oral route (92.5%) and by a single intoxicant (81.3%). Two distinct peaks were observed: in boys between 1-5 years of age and in girls between 13-16 years of age. It was noted that 67.4% of poisoning cases were accidental, whereas 25.9% were suicidal and 6.7% were a result of a therapeutic error. Nearly two-thirds (64%) of cases were drug-related, while 36% were non-drug-related. Analgesics-antipyretics ranked first among the drug-related cases, whereas ingestion of a corrosive substance was most common among cases with non-drug poisoning. Colchicine was associated with the highest fatality, while among the causes of non-drug poisoning, carbon monoxide was the deadliest. The overall mortality rate in this study was 1.9%. Mortality from non-drug poisoning was higher than from drug-related causes (3.9% vs. 1.3%). Almost all cases of poisoning below the age of 6 years are potentially preventable. The results of this study highlight the need for reforms in industrial and health policies, with the aim of increasing awareness regarding potential toxins, appropriate storage of potential toxins, and general precautions to promote safety in the home.

Key words: poisoning, intoxication, childhood.

Poisoning is a common and potentially fatal public health problem, which contributes to the added costs of both emergency and in-patient care. The cause of poisoning varies with age, gender, education, and cultural background, and also shows seasonal variations. Causative agents also differ between countries, making it important for every nation to establish its own poisoning profile and to identify the associated risk factors, while at the same time implementing preventive measures.

Although poisoning may occur at any age, children are at particular risk. According to the most recent data from the National Poison Center at the Refik Saydam National Public Health Agency in Turkey, 56% of 78,679 reported poisoning cases were children[1]. In a 2006 publication by the *American Association of Poison Control Centers* (AAPCC), 64.5% of poisoning cases in the United States were children under the age of 19 years[2].

Epidemiological identification and documentation of childhood poisonings are very important for prevention and for the development of industrial and health policies and treatment plans. Hincal et al.[3] previously reported the epidemiologic portrait of childhood poisoning cases who were admitted to the Children's Hospital of Hacettepe University between 1975 and 1984.

In this study, we attempted to share the experience of a single center on childhood poisoning over a period of 33 years. Demographic and clinical characteristics are presented, while changes over time with regard to diagnosis and treatment are also discussed. The main purpose of the study was to determine the factors associated with mortality to help in the diagnosis, management and prevention of poisoning.

Material and Methods

In this retrospective study, the records of children aged 0-19 years who were admitted to the Pediatric Intensive Care Unit at Hacettepe University İhsan Doğramacı Children's Hospital, in Ankara, Turkey, for acute poisoning between November 1985 and October 2008 were reviewed systematically. In addition, the results of this study were compared with Hincal et al.'s[3] report, which demonstrated the epidemiologic portrait of childhood poisoning cases who were admitted to the same hospital between 1975 and 1984. The traditional policy of our hospital for acute poisonings is admitting them to the Pediatric Intensive Care Unit in order to provide essential vital monitoring.

Information recorded included: age, sex, weight, date and time of presentation, time from poisoning to arrival at the emergency department, prior interventions either at home or at a previously visited health center, nature/purpose of the toxin(s) consumed, site/route by which toxin was consumed, the person responsible for the error (in case of accidental/therapeutic poisoning), the number of previous suicide attempts (in case of toxin consumption with suicidal intent), means of acquisition of the toxin, presence of poisoning symptoms on presentation, treatments administered in the pediatric emergency department or intensive care unit, treatment-related complications, and the overall survival rate of patients.

The computerized automation system of the hospital was used for the records after 2000. The older documents were obtained from the classical archival system. A template was designed regarding the previous studies present in the literature. The same investigator completed all the templates in the same manner and double checked the accuracy of the data with the electronic charts when possible.

Statistical analysis was performed using the Statistical Package for the Social Sciences ver. 17.0 (SPSS Inc., Chicago, IL). Independent samples t-test or Mann-Whitney U test was used to compare continuous variables and chi-square test or Fisher's exact test for categorical variables. Mortality-associated risk factors were determined using multivariate (backward) logistic regression analysis. A p value <0.05 was considered statistically significant.

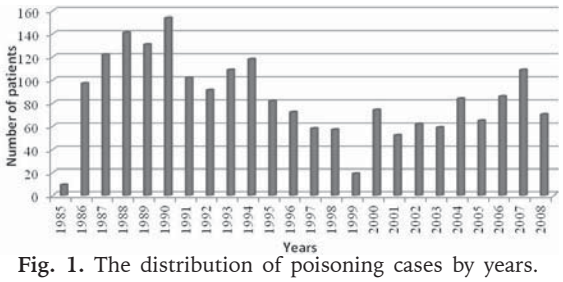

Fig. 1. The distribution of poisoning cases by years.

The study was approved by the Medical Research Local Ethics Committee of Hacettepe University.

Results

A total of 2251 cases of acute childhood poisoning were admitted to the Pediatric Intensive Care Unit in our hospital between November 1985 and October 2008 (Fig. 1). Drug-related poisonings were the cause of poisoning in 64.4% of patients, while non-drug poisoning was encountered in 35.6% of cases.

Overall, the mean age of patients presenting with poisoning was 6.7 years (range: 0.1-19 years). The average age of cases of accidental non-drug poisoning was higher than that of drug-related cases (5.5 years vs. 3.2 years; $p<0.001$). Patients presenting with suicidal poisoning had a mean age of 14.2 years. Children between 1-5 years of age accounted for 56.1% of all cases of poisoning, most of whom were male, whereas 25.5% of cases were between 13-16 years of age, with a female predominance (Fig. 2). Although drugs were the most common cause of poisoning in the 1-5 years age group, cases of non-drug poisoning were not uncommon. Cases of poisoning in the 13-16 years age group were exclusively drug-related (Fig. 3). While cases of poisoning in children less than 5 years of age were mainly accidental, adolescent cases were more commonly suicidal. Therapeutic

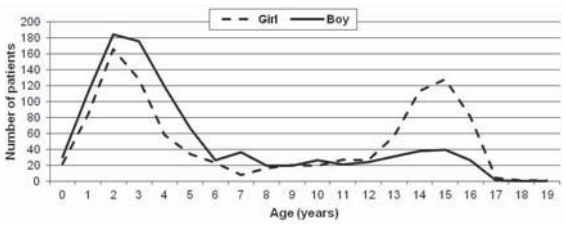

Fig. 2. Sex and age distribution of poisoning cases.

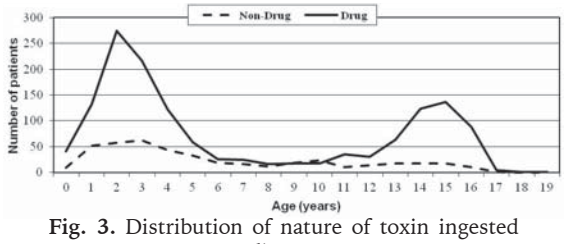

Fig. 3. Distribution of nature of toxin ingested according to age.

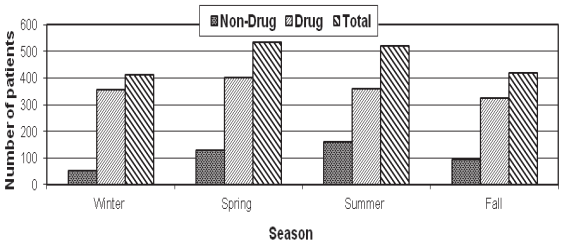

Fig. 5. Seasonal distribution of poisoning cases.

drug poisoning occurred most frequently in children younger than 1 year of age (Fig. 4).

Although there was no significant difference in overall gender distribution (50.6% girls, 49.4% boys), drug-related poisoning occurred more frequently in girls (53.4% vs. 46.6%; p=0.001), whereas non-drug poisoning was more common in boys (59% vs. 41%; p=0.001).

While only 18% of patients presented within 30 minutes of the initial poisoning incident, 36% presented within 60 minutes, 57% within 2 hours, and 83% after 6 hours. The mean time to presentation to a health facility was 5.1 hours. For accidental cases of poisoning, the mean time to presentation was 4.2 hours, compared to 4.1 hours for suicidal cases. Patients with therapeutic drug poisoning had a mean time to presentation of 18.5 hours. While the mean time to presentation for patients who were discharged after making a full recovery was 5 hours, this duration was 10.3 hours for those who died (p=0.032).

Incidents of poisoning occurred more frequently in the spring and summer months (p=0.001), mostly consisting of non-drug related cases (p=0.001). Carbon monoxide poisoning was the only non-drug cause of poisoning to occur year round. Similarly, drug-related cases did not show any seasonal variations (Fig. 5).

The majority of poisoning incidents occurred at home (92%), involving a single intoxicant (81.3%), mainly administered via the oral route (92.5%).

While 67.4% of all poisoning incidents were accidental, 25.9% were suicidal and 6.7% occurred as a result of a therapeutic error. Almost all (93.2%) cases of poisoning in children under 6 years of age were accidental, with the remaining occurring as a result of a therapeutic error. Accidental non-drug poisoning occurred more commonly in males than in females (57.7% vs. 42.8; p=0.02).

Throughout the 23-year study period, accidental poisoning remained the most frequent cause of childhood poisoning, although there has been a decrease in accidental cases in recent years. In contrast, the number of cases of suicidal poisoning has increased from 1984-2008 (Fig. 6).

Accidental poisoning occurred more frequently in summer and less commonly during the winter months. On the other hand, the number of suicidal poisoning cases peaked in winter, while occurring less frequently during the summer (p=0.001). Seventy percent of children presenting with accidental poisoning acquired an intoxicant, most commonly a drug/medication (82.7%), from a readily accessible location.

Corrosive agents were the most frequently encountered cause of non-drug poisoning in our patients (44.3%; p=0.001). On the other hand, analgesics/antipyretics were the most common cause of drug-related poisoning, aspirin being the number one culprit followed closely by paracetamol. This group was followed

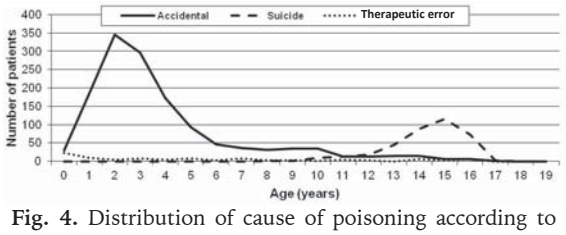

Fig. 4. Distribution of cause of poisoning according to age.

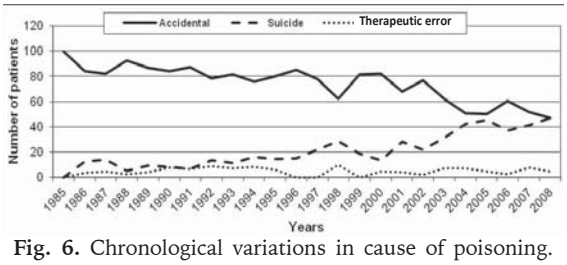

Fig. 6. Chronological variations in cause of poisoning.

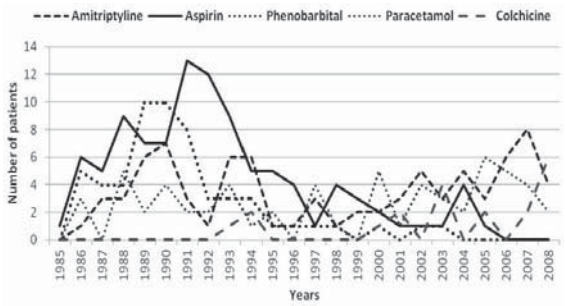

Fig. 7. The distribution of some drug poisonings over time.

by antidepressants and antiepileptics. Among the cases of suicidal poisoning, antidepressants, particularly amitriptyline (Laroxyl®), were the most commonly ingested medication. Cases of aspirin poisoning peaked between 1990 and 1992, while in the last three years of the investigated study period (2005-2008), no cases of aspirin poisoning were reported. The last 10 years, however, have witnessed a gradual increase in amitriptyline poisoning (Fig. 7).

Vomiting was induced by a family member in 8.5% of cases before presentation to a healthcare facility, whereas 7.6% of patients were given either milk or yoghurt. Interventions performed at our hospital and/or other healthcare facilities visited prior to presentation are summarized in Table I. It was observed that use of activated coal has increased over the years (p=0.001).

Overall, 39 patients (1.9%) who presented to our hospital with acute poisoning eventually died. For drug-related poisoning, the mortality rate was 1.3% (19 patients) compared to 3.9% (17 patients) for non-drug poisoning. Most of the patients who died were boys (71.8%; p=0.014). Mortality rates for accidental, suicidal and therapeutic poisoning were 2.2%, 1.4% and 3.2%, respectively. Of all the deaths, 76.9% were a result of accidental poisoning, while 12.8% occurred as a result of suicide. The most fatal intoxicant among the drug-related cases was colchicine, while carbon monoxide was the most common cause of non-drug poisoning (41.2%).

Table I. Interventions Employed at our Hospital and other Health Facilities for the Management of Poisoning

Intervention	Frequency (%)
Gastric lavage	57.5
Single-dose activated coal	52.5
Forced diuresis	39.3
Multi-dose activated coal	24.3
Alkalization	14.9
Supportive treatment	15
Antidote	11.1
Ventilatory support	2.7
Extracorporeal treatments	2.7
Cathartics	1.9
Hyperbaric oxygen therapy	1.6

Of all the interventions employed in the management of poisoning (induced vomiting, milk/yoghurt consumption, gastric lavage, activated coal, forced diuresis, alkalization, cathartics, hemodialysis, and peritoneal dialysis), only activated coal was shown to have significant benefit (Odds ratio: 2.5 [95% confidence interval: 1.6–10.9]; p=0.04).

Discussion

Identification and documentation of epidemiological aspects and other variables in childhood poisonings are of great importance for planning treatment and determining proper preventive measures[3]. The results of our study may reflect the epidemiology of childhood poisonings and alterations over time because our hospital is the largest children's hospital in Turkey. The most striking findings in our study were the increasing cases of amitriptyline poisoning, decreasing cases of salicylate poisoning and rising number of suicide attempts in children over the 33 years. The most deadly poison was colchicine.

Poisoning occurs more commonly in boys, and is mainly due to accidental use of a single agent during the first five years of life. In adolescents, poisoning is more common in girls, usually involving multiple intoxicants with the intent of suicide. We observed that 61.2% of our cases were younger than 6 years of age, a result consistent with findings of previous studies from our institutes and the literature. While most of the patients in the 1-5 years age group were male, those in the 13-16 years age group were mostly female[3-7].

Another expected finding of our study was that non-drug poisoning was more common in boys than in girls (59% vs. 41%; p=0.001). This may be because during the spring and summer months, boys tend to play unattended

Table II. Clinical Characteristics and Substances Involved in Poisoning by Time Period

	Time period	
	1975-1984 (n=1188), %	1984-2008 (n=2251), %
< 5 years of age	60.4	56.1
Admission within 6 hours	51.2	83.2
Drug-related poisoning	64	64.4
Accidental poisoning	69.9	67.4
Suicidal poisoning	12.8	25.9
Therapeutic error-related poisoning	15.1	6.7
Total mortality rate	4.9	1,9
Mortality rate of accidental poisoning	3.4	2.2
Mortality rate of suicidal poisoning	1.3	1.4
Mortality rate of therapeutic error-related poisoning	13.3	3.2

outdoors more often than girls. On the contrary, drug-related poisoning was encountered more commonly in females than in males (53.4% vs. 46.6%; p=0.001), which may be explained by the predominance of girls among cases of suicidal poisoning (93%).

In our study, nearly two-thirds of poisoning cases were drug-related, while the remaining one-third were cases of non-drug poisoning. A similar result was reported from a previous study from our center covering the period 1975-1984[3] (Table II). According to published data from the National Poison Center at Refik Saydam National Public Health Agency, 43,939 cases of childhood poisoning (0-19 years) were reported nationwide between 2000 and 2004, 71.4% of which were drug-related[1]. The results from our center are also consistent with findings from other hospitals in Turkey[8-11].

The introduction of child safety caps in 1970 led to a 40% decrease in the number of drug-related cases of poisoning, with a similar decrease in poisoning-associated mortality[12-18]. This supports the idea that by taking the necessary precautions, it could be possible to decrease drug-related poisoning rates to the levels of developed countries. Although the use of child safety caps has unequivocally been demonstrated to prevent accidental drug-related poisoning and to decrease morbidity and mortality associated with poisoning, only a limited number of medications are sold with such caps in Turkey, and there is a dire need for a government policy that makes use of such a precautionary measure mandatory.

According to our study results, 83.2% of patients were brought to medical attention within 6 hours of the initial poisoning incident, compared to 51.2% of patients in the previous study covering 1975-1984[3]. This may be attributed to a higher level of awareness among parents with regards to the importance of early intervention in cases of poisoning.

In our study, we also observed that patients with poisoning due to a therapeutic error tended to be brought in later than patients with accidental or suicidal poisoning. This may be because symptoms of poisoning are often mistakenly attributed to the disorder that required treatment initially. Other contributory factors may be parental exhaustion brought on by the demanding nature of the underlying chronic condition, or delay in seeking medical attention for fear of legal or social retribution.

As reported in numerous studies, most of the cases of poisoning in our study occurred during the spring and summer months[9,10,19]. With the exception of carbon monoxide poisoning, cases of non-drug poisoning occurred most commonly in summer. Drug-related poisoning did not show any seasonal variation. The higher frequency of non-drug poisoning in summer may be attributed to an increased use of farming chemicals as well as increased consumption of unwashed, toxin-contaminated fruits. Unsupervised outdoor play may also increase the likelihood of encountering toxic materials, plants and mushrooms. Renovation and remodeling work is usually undertaken during the summer months, which may also make potentially toxic drugs more accessible

to children. During winter months, on the other hand, children spend most of their time indoors, making their supervision easier[9].

The cause of poisoning in children shows geographical variations, also influenced by economical status. In developed and industrialized countries, poisoning is most frequently from drugs, cosmetics and beauty products, household cleaning products, and alcohol, while for developing countries, where the economy is based on agriculture, common causes of poisoning are hydrocarbons, pesticides, traditional medicines, and mushrooms[2,20-24]. In our study, 44.3% of cases of non-drug poisoning were due to corrosive agents, followed by pesticides and farming agents, at 37.4%. Interestingly, during the period 1975-1984, almost all cases of non-drug poisoning were due to pesticides, followed by toxic plants and mushrooms as well as petroleum products, with corrosive agents in fourth place[3]. This finding suggests a drift from agriculture to industry over the years. The increased incidence of poisoning with corrosive agents in Turkey could be attributed to a higher number of industrial areas, with lesser dependence on agriculture. Furthermore, corrosive agents have found their way into the household for daily consumption, making them readily accessible to children. Additionally, the sale of smaller amounts of such products in unconventional containers, such as water or beverage bottles, may also contribute to accidental poisoning in children.

In our study, analgesics/antipyretics, antidepressants and antiepileptics were the three groups of drugs responsible for almost all cases of single drug-related poisoning. For the period 1975-1984, analgesics were followed by barbiturates as the most common cause of drug poisoning[3] (Table III). The number of cases of antidepressant poisoning has increased with time, perhaps representative of sociocultural change.

Many studies from developed and developing countries list analgesics as the most commonly encountered drugs in cases with childhood poisoning[2,7,25-27]. In Turkey, analgesics-antipyretics, most of which are packaged in bottles with child safety caps, are available over the counter, without the need for a doctor's prescription, making them readily available in the home within children's reach.

After Reye's syndrome was described in 1986, many pediatric formulations of acetylsalicylic acid were removed from the market[7]. This, combined with the change in habits of doctors in prescribing aspirin as an antipyretic, may have contributed to the decrease observed in poisoning cases due to aspirin. While aspirin poisoning comprised 91.2% of all cases of poisoning from analgesics in patients presenting from 1975-1984, its frequency has decreased with time, and no cases were observed in the last three years of our study period[3].

Antidepressants were the most frequently used drug group among cases of suicidal

Table III. Substances Involved in Poisoning in the Two Time Periods

		Time period			
		1975-1984 (n=1188), %		1985-2008 (n=2251), %	
Drugs	Analgesics-antipyretics	24.5		21	
	Antidepressants	4		14.2	
	Antiepileptics	27.3		14	
	Other drugs of central nervous system	7.8	64	11	64.5
	Cardiovascular drugs	4.8		10	
	Anticholinergics	3.8		4	
	Other drugs	27.8		25.8	
Non-drugs	Carbon monoxide	3		10.9	
	Caustic-corrosives	6		44.3	
	Plant-mushroom	21		17.3	
	Pesticides	56	36	11.1	35.5
	Petroleum distillates	7		8.2	
	Alcohol	1		2.3	
	Other	6		6	

poisoning by a single agent, particularly amitriptyline (Laroxyl®). In contrast, cases of suicidal poisoning from 1975-1984 were mostly with analgesics (44.1%), while tricyclic antidepressants were responsible for only 3.4% of cases[28]. In a different study from Turkey, on adult patients presenting with poisoning from 1997-2002, it was observed that the number of cases of poisoning with psychoactive drugs, including antidepressants, had increased with time, while cases due to analgesics showed a gradual decrease[29]. Amitriptyline is one of the most commonly prescribed tricyclic antidepressants, and the last 10 years have witnessed a dramatic increase in amitriptyline-related cases of poisoning in Turkey[30-33]. This drug is preferred by local doctors mainly because of its efficacy and low cost, and a combination of prescription habits along with the wide availability of the drug nationwide may have contributed to the sharp increase in the number of cases of amitriptyline poisoning.

In our study, accidental, suicidal and therapeutic poisoning was determined in 67.4%, 25.9% and 6.7% of patients, respectively. The corresponding frequencies for 1975-1984 were 69.9%, 12.8% and 15.1%, respectively[3,28]. Although the rate of accidental poisoning has remained unchanged through the years, the number of suicidal cases of poisoning has nearly doubled, while poisoning due to therapeutic error has decreased by half. Similar trends have been reported from Northern Ireland and the United States[2,34,35]. These changes are suggestive of a negative impact of social westernization that renders some children more likely to attempt suicide.

In 70% of children in our study, the responsible intoxicant was stored within their easy reach, particularly with respect to drug-related poisoning (82.7%). Precautionary measures that may be implemented to prevent access include storing potential intoxicants in high places beyond the reach of children, preferably in locked cupboards.

Vomiting was induced by parents in 8.5% of children before they were brought for medical attention, whereas 7.6% were given yoghurt or milk. A comparison with the period 1975-1984 revealed a two-fold increase in the parental practice of induced vomiting (4.5% vs. 8.5%), while consumption of yoghurt and/or milk remained generally the same (8.7% vs. 7.6%)[3]. Our study, along with another study from Israel, failed to demonstrate any added benefit of these practices on mortality[6]. Since 63.2% of our patients presented to a healthcare facility more than an hour after the initial poisoning incident, it would seem that some patients underwent unnecessary gastric lavage. In two prospective studies on childhood poisoning from Norway, use of gastric lavage in patients with acute poisoning decreased from 36% in 1980[27] to 9% for the period 2003-2005[36]. Gastric lavage is associated with a 3% complication rate, which highlights the need for diligence when making a decision to go through with the procedure.

Multivariate logistic regression analysis of the potential benefit of specific interventions employed, such as induced vomiting, milk/yoghurt consumption, gastric lavage, activated coal, forced diuresis, alkalization, cathartics, hemodialysis, and peritoneal dialysis, revealed that only activated coal was associated with a 2.5-fold decrease in mortality (Odds ratio: 2.5 [95% confidence interval: 1.6–10.9]; p=0.04). Being gleaned from retrospectively gathered data makes this statistically impressive result a scientifically weak conclusion. Activated charcoal administration in acute overdose remains a controversial problem. Use of activated coal for acute poisoning was first introduced in 1989, and by 1994, more than 70% of cases of poisoning were subject to such treatment, which has been reported to be most effective when administered within one hour of the initial poisoning incident[37]. While 52.5% of our patients had received at least a single dose of activated coal, overall, only 36.8% of the cases of acute poisoning were brought to medical attention within one hour of being poisoned. Measures to ensure timely administration of such a life-saving procedure, such as making activated coal readily available in primary healthcare centers as well as in ambulances, should be implemented to help improve the outcome of acute poisoning.

Although deaths from poisoning are far more common in adults than in children[2,12], children remain at greater risk. According to data published by the AAPCC in 2006, children under 19 years of age comprise 64.5% of all cases of poisoning, whereas poisoning-related

deaths occurred in only 8.1% of patients in this age group[2]. In another publication by the AAPCC, of the 15,447 deaths reported since 1983, 540 (3.5%) were children under 6 years of age, 402 (2.6%) of whom were younger than 2 years of age[12].

In our study, we established a mortality rate of 1.9% among patients admitted to the Pediatric Intensive Care Unit at our hospital with acute poisoning. This is a 65.3% decrease from the mortality rate of 4.9% reported in a previous study covering the period 1975-1984[3]. A similar trend has also been reported in western countries[24,27,38]. This decrease in mortality may be attributed to greater parental awareness regarding poisoning in general, resulting in them seeking medical attention earlier. This is supported by the observed increase in the number of cases that presented to a healthcare facility within six hours of an initial poisoning incident (51.2% between 1975-1984 vs. 83% between 1985-2008). Other factors include the accumulation worldwide of knowledge regarding poisoning, emergency department staff who are better educated and trained in the management of poisoning, technological advances in intensive care, recall of commonly known intoxicants from the market, production of less toxic corrosive agents, and the increased use of containers with child safety caps, especially for drugs with higher fatality rates.

Many studies on childhood poisoning have reported higher mortality rates for suicidal poisoning compared to accidental poisoning[2,22,39]. In our study, on the other hand, we observed increasing mortality rates of 1.4%, 2.2% and 3.2% in patients with suicidal, accidental and therapeutic poisoning, respectively. Mortality rates for 1975-1984 were 1.3%, 3.4%, and 13.3%, respectively[3]. In contrast to other reports from western countries, our findings show that the mortality rate of accidental poisoning is higher than that for suicidal poisoning. This may be explained in terms of intent behind the suicide attempts. In most cases in Turkey, the main purpose is to draw attention and/or scare one's parents, rather than to inflict real harm or cause death. This is of course achieved by taking less toxic drugs in smaller amounts.

Nearly 85% of all cases of poisoning in children under the age of 6 years, including all fatalities, could have been avoided if necessary preventive precautions had been implemented, particularly since in 70% of cases the intoxicating agent was kept in an easily accessible location. The result of this study highlights the need for reforms in industrial and health policies, with the aim of increasing awareness regarding potential toxins, their appropriate storage, and general precautions to promote safety in the home. Of course, every country needs to establish its own poisoning profile, while at the same time identifying specific risks, which may help in developing preventive measures. Establishing an epidemiological profile of poisoning that correctly represents the whole country would require centers nationwide to share and combine their experiences through prospective and retrospective studies.

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