

## Epidemiological Pattern of Poisoning in Children under the Age of 15 Admitted to the Referral Teaching Hospitals of Yazd and Taft Cities (2014-2019)

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### ABSTRACT

**Introduction:** Understanding the epidemiological pattern and causes of poisoning is the first step to prevent and reduce complications and mortality due to poisoning in children. Given that no study has been conducted on this subject in Yazd, this study aimed to determine the epidemiology pattern of poisoning in children admitted to the referral teaching hospitals in Yazd and Taft cities during 2014-2019.

**Materials and Methods:** This descriptive cross-sectional study was conducted on 238 children under the age of 15 who have been admitted to Shahid Sadoughi hospital in Yazd and Shahid Beheshti hospital in Taft city during 2014-2019. The data were analyzed by SPSS version 20.0 using descriptive statistics, Pearson correlation, and Chi-square. In all the statistical analyses, a P-value of less than 0.05 was considered significant.

**Results:** The results showed that the frequency of poisonings was higher in girls (58%), in summer (31.1%), and in urban areas (82.8%). Most cases of poisoning aged less than 15 years (75.1%). The main cause of poisoning in children was drug poisoning (60.5%), followed by cleansing products (10.1%). The most common clinical manifestations included neurological signs (33.6%). During 2014-2019, the frequency of drugs and pesticide poisonings decreased; while poisoning due to drug-opioids and cleansing products increased ( $P = 0.04$ ). Also, 3 deaths occurred due to poisoning during this period.

**Conclusion:** The higher prevalence of drug and cleansing products poisoning in children under the age of 15 indicates involuntary poisoning in this group. Therefore, proper storage of these substances and more parental care can reduce poisonings in children.

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### Introduction

Poisoning is a common public health challenge. It is one of the common causes leading to emergency department visits<sup>1</sup>. The rate of poisoning in children is considerable. The results of most studies have indicated a higher rate of

poisoning in children under the age of 5 than children over 5 years<sup>2-4</sup>.

Most cases of poisoning in children can be treated without hospitalization and clinical intervention<sup>5</sup>. A report showed that the rate of poisoning with serious consequences increased by 4.6% from 2000 to 2012<sup>6</sup>. Fallahzadeh et al. stated

that up to 6.4% of children with poisoning who referred to the emergency department needed to be hospitalized<sup>7</sup>.

Poisoning has a different pattern in toddlers and infants. Poisoning may be unintentional or intentional, but most of these cases in children are involuntary and out of curiosity<sup>8</sup>. Easier access to drugs, detergents, chemicals materials, and also, willingness of children to contract objects in their mouth have increased the rate of poisoning in children. Due to the involuntary nature of poisoning in children, the rate of poisoning in them can be reduced by educating parents and preventive interventions, such as proper storage of chemical materials, drugs, and cleansing products.

The pattern of poisoning in children varies according to geographical areas, social, economic, and cultural characteristics. In addition, the pattern of poisonings has changed in different seasons and genders. It is widely supposed that boys were more likely poisoned than girls<sup>9-12</sup>.

The pattern of poisoning in children has also changed in recent years. Sadeghi-Bojrd and Khajeh reported that drug poisoning in children has increased, and poisoning due to toxins and pests has decreased in recent years<sup>5</sup>. The following factors can be the reasons for a child to reach toxic substances, including the inherent curiosity at this age, immature function of their organism which increases the sensitivity to toxic effects of drugs, lack of proper packaging, and improper storage<sup>12</sup>.

The access to drugs and cleansing products improves with the improvement of the economic situation of the countries. Consequently, poisoning due to the use of drugs and cleansing products increases. Parents' negligence in storing medicines and putting them in the refrigerator, overdose of medication, imitating the behavior of parents, and on the other hand, the use of attractive colors and packaging by pharmaceutical companies can be the reasons for children's desire to take drugs. Moreover, troubles for determining the correct dose of medicines and self-medication by parents are the factors that increase poisoning in children. Taking preventive and educational interventions to reduce the rate of poisoning in children needs to

have access to updated documents and reports. In recent years, few studies have been conducted to investigate the epidemiological status of poisoning in children<sup>9-10</sup>.

Given that no study has been conducted on this subject in Yazd province, the researchers conducted this study to determine the epidemiological pattern of poisoning in children admitted to the referral teaching hospitals in Yazd and Taft cities in 2014-2019.

## Materials and Methods

### Study design

This study is a cross-sectional study conducted in the referral teaching hospital in Yazd and Taft cities during 2014-2019. The research population included children under the age of 15 admitted to Shahid Sadoughi hospital in Yazd and Shahid Beheshti hospital in Taft city due to poisoning from the beginning of March 2014 to the end of February 2019.

### Data gathering

The required data were extracted from medical files of patients in hospitals according to a checklist. Patients' files were in the form of paper files in Shahid Sadoughi Hospital and were electronic files in Shahid Beheshti Hospital.

Demographic and clinical characteristics, including age, gender, place of residence (urban, rural), season of poisoning, cause of poisoning (drugs, oil, food, drugs-opioids, cleansing products, pesticides, CO, plants, and bites like insect stings), clinical symptoms (lack of consciousness, neurological symptoms (headache, dizziness, hallucinations, and seizures), respiratory (shortness of breath), eyes (red eyes and dilated pupils), hypoglycemia, other symptoms (drowsiness, fever and chills, swelling, and gastrointestinal symptoms), and no symptom or sign), duration of hospitalization, route of exposure to poisonous agents (swallowing/ breathing/ injection/skin and eyes), and poisoning outcome were extracted from the medical files of patients and were recorded in the checklist.

### Data analysis

Data analysis was performed in SPSS version 20.0 using descriptive statistics, Pearson

correlation and Chi-square. In all the statistical analyses, a p-value of less than 0.05 was considered significant.

**Ethical Issues**

The study protocol was approved by the Ethics Committee of Shahid Sadoughi University of Medical Sciences, Iran (IR.SSU.SPH.REC.1399.034).

**Results**

The results of the present study showed that 238 children under the age of 15 were hospitalized in Shahid Sadoughi Hospital in Yazd and Shahid Beheshti hospital in Taft city during 2014-2019 with a final diagnosis of poisoning.

According to the results, the main cause of poisoning in children was drug poisoning (60.5%), followed by cleansing products (10.1%) (Table 1). Table 2 reveals that most common clinical manifestations included neurological symptoms, such as headache, dizziness, hallucinations, and seizures (33.6%), followed by hypoglycemia (31.1%). In addition, 22.7% had symptoms, such as drowsiness (12.6), restlessness and lethargy (4.2), swelling, gastrointestinal symptoms, etc., recorded in the "other symptoms" section. In terms of route of exposure to poisonous agents, 93.2% were poisoned by swallowing, 5.5% by skin contact, and 1.3% by breathing (Table 1).

**Table 1:** Frequency distribution of poisoned children based on injury characteristics

Variables		N	%
Cause of poisoning	Drugs	144	60.5
	Oil	11	4.6
	Food	6	2.5
	Drugs-opioids	20	8.4
	Cleansing products	24	10.1
	Pesticides	19	8
	CO	2	8
	Plants	1	4
	Bites	11	4.6
Clinical symptoms	Neurological	80	33.6
	Respiratory	3	1.3
	Eyes	16	6.7
	Lack of consciousness	2	8
	Hypoglycemia	74	31.1
	Other sign	54	22.7
Route of exposure to poisonous agents	No sign	9	3.4
	Swallowing	222	93.2
	Breathing	3	1.3
	Skin contact	13	5.5

**Table 2:** Frequency distribution of poisoned children based on socio-demographic characteristics

Variables		2014	2015	2016	2017	2018	2019	Total (%)	P-value
Gender	Boy (n = 100, 42%)	13(41.9)	38(45.2)	6(28.6)	4(40)	14(40)	25(43.9)	100(42)	0.83
	Girl (n = 138, 58%)	18(58.1)	46(54.8)	15(71.4)	6(60)	21(60)	32(56.1)	138(58)	
Living area	Urban (n = 197, 82.8%)	27(87.1)	68(81)	16(76.2)	9(90)	30(85.7)	47(82.5)	197(82.8)	0.87
	Rural (n = 41, 17.2%)	4(12.9)	16(19)	5(23.8)	1(10)	5(14.3)	10(17.5)	41(17.2)	

There was a clear trend of changes in the causes of poisoning during 2014-2019. The results showed that the frequency of drug poisoning was 74.2% in 2014 that decreased to 59.6% in 2019, and the frequency of pesticide poisoning was 12.9% in 2014 that decreased to 5.3% in 2019. Conversely, the frequency of drugs-opioids poisoning was 6.5% in 2014 that increased to 10.5% in 2019, and the frequency of cleansing products (p = 0.0001) poisoning was 3.2% in 2014 that increased to 17.5% in 2019.

The results showed that the frequency of hospitalized poisonings was higher in girls (58%) and urban areas (82.8%). In the present study, 82.8% of hospitalized children lived in urban areas, and 17.2% lived in rural areas. The results showed that taking drugs was the main reason for poisoning in urban areas (p = 0.002), and insect

stings were the most common cause of poisoning in rural areas (p = 0.02). The frequency of poisoning based on gender and place of residence showed that the frequency of poisoning cases leading to hospitalization was higher in girls than boys, and in urban areas was higher than rural areas (Table 2).

In addition, most cases of poisoning were under the age of 5 (75.1%) with a peak of under the age of 1 (26.5%). Regarding the duration of hospitalization, most cases were hospitalized for 1-2 days, and only 11.8% were hospitalized for more than five days (Table 3). The results of the Pearson test indicated that there was no statistically significant relationship between age and duration of hospitalization (P = 0.46). The frequency of poisonings was higher in summer (31.1%), followed by winter (26.5%) (Table 3).

**Table 3:** Frequency distribution of cause of poisoning based on socio-demographic characteristics

Variables		Drugs	Oil	Food	Drugs-opioids	Cleansing products	Pesticides	CO	Plants	Bite
Gender	Boy (n = 100, 42%)	63(43.8)	2(18.2)	2(33.3)	10(50)	10(41.7)	9(47.4)	1(50)	0(0)	3(27.3)
	Girl (n = 138, 58%)	81(56.2)	9(81.8)	4(66.7)	10(50)	14(58.3)	10(52.6)	1(50)	1(100)	8(72.7)
P-value*		0.59	0.08	0.5	0.3	0.57	0.39	0.66	0.58	0.24
Living area	Urban (n = 197, 82.8%)	128(88.9)	8(72.7)	5(83.3)	14(70.0)	20(83.3)	13(68.4)	2(100)	1(100)	6(54.5)
	Rural (n = 41, 17.2%)	16(11.1)	3(27.3)	1(16.7)	6(30)	4(16.7)	6(31.6)	0(0)	0(0)	5(45.5)
P-value*		0.002	0.28	0.72	0.1	0.6	0.08	0.68	0.82	0.02
Season	Spring (n = 45, 18.9%)	22(15.3)	1(9.1)	1(15.7)	6(30)	4(16.7)	5(26.3)	0(0)	0(0)	6(54.5)
	Summer (n = 74, 31.1%)	49(34)	5(45.5)	0(0)	4(20)	5(20.8)	6(31.6)	0(0)	1(100)	4(36.4)
	Autumn (n = 56, 23.5%)	36(25)	3(27.3)	2(33.3)	6(30)	5(20.8)	2(10.5)	1(50)	0(0)	1(9.1)
	Winter (n = 63, 26.5%)	37(25.7)	2(18.2)	3(50)	4(20)	10(41.7)	6(31.6)	1(50)	0(0)	0(0)
P-value*		0.26	0.63	0.32	0.38	0.33	0.51	0.56	0.52	0.008
Age (Year)	< 1 (n = 63, 26.5%)	35(24.3)	2(20.0)	0(0)	12(60)	4(16.7)	6(31.6)	1(50)	0(0)	3(27.3)
	1-2 (n = 54, 22.7%)	25(17.4)	3(30.0)	1(16.7)	5(25.0)	12(50)	6(31.6)	0(0)	0(0)	2(18.2)
	3-5 (n = 61, 25.6%)	45(31.3)	3(30.0)	2(33.3)	2(10)	4(16.7)	4(21.1)	0(0)	0(0)	1(9.1)
	6-10 (n = 29, 12.2%)	19(13.2)	2(20.0)	1(16.7)	1(5.0)	2(8.3)	1(5.3)	1(50)	1(100)	1(9.1)
	11-15 (n = 30, 12.6%)	20(13.9)	0(0)	2(33.3)	0(0)	2(8.3)	2(10.5)	0(0)	0(0)	4(36.4)
P-value*		0.03	0.67	0.39	0.005	0.02	0.74	0.4	0.12	0.16

Variables	Drugs	Oil	Food	Drugs-opioids	Cleansing products	Pesticides	CO	Plants	Bite
1 (n = 81,434%)	50(34.7)	2(18.2)	2(33.3)	7(35)	8(33.3)	7(36.8)	0(0)	0(0)	5(45.5)
2 (n = 75, 31.5%)	49(34)	5(45.5)	1(16.7)	5(25)	4(16.7)	7(36.8)	1(50)	1(100)	2(18.2)
3 (n = 34,414.3%)	19(13.2)	3(27.3)	3(50)	5(25)	2(8.3)	1(5.3)	0(0)	0(0)	1(9.1)
4 (n = 20, 84%)	13(9)	0(0)	0(0)	1(5)	4(16.7)	2(10.5)	0(0)	0(0)	0(0)
5 (n = 28, 11.8%)	13(9)	1(9.1)	0(0)	2(10)	6(25)	2(10.5)	1(50)	0(0)	3(27.3)
P-value	0.46	0.41	0.12	0.66	0.07	0.81	0.42	0.7	0.32

\* Chi-square

Comparison of causes of poisoning by age group showed that poisoning with drugs (p = 0.03), drugs-opioids (p = 0.005), and cleansing products (p = 0.02) often occurred in children under the age of 5 (P = 0.01) (Table 3).

Examination of the cause of poisoning based on seasons showed that poisoning due to insect stings occurred more in spring and summer (p = 0.008). Other poisonings had almost the same distribution in different seasons.

The current study indicated that the highest duration of hospitalization (1-2 days) was related to poisoning with drugs, cleansing products, pesticide, and insect stings (p = 0.36) (Table3). Moreover, children with respiratory symptoms and decreased level of consciousness had the highest

duration of hospitalization (more than 3 days) (p = 0.28).

In the present study, the poisoned children consisted of 42% boys and 58% girls. The relationship between the cause of poisoning and gender showed that the frequency of all causes of poisoning was higher in females than males except for CO and drug poisonings, which were the same in males and females (P = 0.71) (Table 3). The relationship between gender and age showed that the frequency of poisoning in children under the age of 5 was higher in girls than boys, and the frequency of poisoning in the age range of 5-15 years was higher in boys than girls. This difference was statistically significant (P = 0.009) (Figure 1).

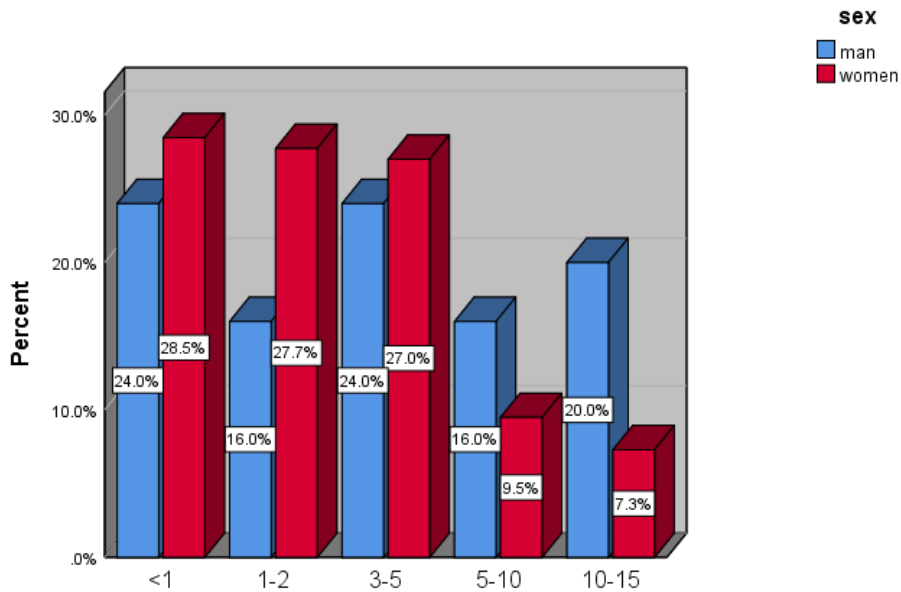


Figure 1: Frequency Distribution of Poisoned Children based on Age and Gender

The results showed that 2 cases of poisoning occurred due to suicide. In addition, 3 deaths occurred due to poisoning. According to the results, deaths were related to two girls under the age of 1 in rural areas in spring and one 7-year-old boy in urban areas in autumn. The causes of death included poisoning with drugs, drugs-opioids, and CO. In all three cases, they had symptoms of hypoglycemia.

### Discussion

The present study aimed to determine the epidemiology of poisoning in children admitted to the referral teaching hospital in Yazd and Taft cities (2014-2019). There was a clear trend of changes in the causes of poisoning during 2014-2019. The results showed that the frequency of drug and pesticide poisoning decreased during 2014-2019. Conversely, the frequency of drug-opioids and cleansing products poisoning increased during 2014-2019 ( $p = 0.04$ ). The cleansing products are from the category of materials causing poisoning both through swallowing and breathing. On the other hand, today, the use of cleaning products has increased in homes, and the manufacturers are also forced to produce these materials with attractive colors and packaging, and this is a reason for increasing poisoning in children. Therefore, keeping cleansing products away from children is a key factor in reducing child poisoning. Allen et al. examined the trend of drug poisoning in children in the United States and showed that drug poisoning in children had a significant increasing trend from 2000 to 2009; and from then until 2015, there was a slowly decreasing trend, which according to the author was due to anti-drug laws<sup>13</sup>.

The results of the current study confirm the results of the previous studies in this field. The current study found that the most poisonings occurred under the age of 5 with a peak of under the age of 1. Mowry et al., reported that children aged 1-2 years were more likely to be poisoned<sup>14</sup>, which is consistent with similar studies conducted in Isfahan (2008-2010), Tabriz (2014-2015), and Shiraz (2009-2010)<sup>2-4</sup>. A study

in India showed that poisoning in children was more common in age range of 1-5 years<sup>15</sup>. Similar studies conducted in Tehran (1997-2001) and Ardabil (2007-2001) showed a higher prevalence of poisoning in children aged 1-4 years<sup>9, 12</sup>. Pirzadeh et al. studied the prevalence of poisoning in children in Qazvin (2009-2013) and reported that the frequency of poisoning in children aged 1-6 years is higher<sup>11</sup>. In developing countries, most cases of poisoning in children have been reported in children under the age of 5, which were often involuntary and out of curiosity<sup>8</sup>. Therefore, children under the age of 5 are considered a risk group for accidental and unintentional poisoning. The higher prevalence of poisoning during this age range can be due to the start of movement and walking, a sense of curiosity and search around, failing to distinguish harmful materials, and putting objects into the mouths. Therefore, proper storage of drugs, cleansing products, chemicals material, and pesticides by parents can reduce the incidence of poisoning in children during this age range. Alghadeer et al. believed that poisoning due to drugs in Saudi Arabia may be due to the tendency of Saudi families to store old medications for future use; while most medicines can be easily obtained from pharmacies without a prescription<sup>16</sup>.

This study indicated the higher prevalence of poisoning in girls during 2014-2019, which is consistent with the study by Haghghat et al. in Shiraz and Alghadeer et al. in Saudi Arabia<sup>4, 16</sup>. A retrospective study of poisoned children and adolescents (0-18 years) in South Korea during 2003-2013 showed that 52.8% of poisonings were related to girls<sup>17</sup>. However, some studies have indicated a higher prevalence of poisoning in boys than girls in this age range<sup>9-12</sup>. Further analysis showed that the frequency of poisoning in the age group of less than 5 years was higher in girls than boys; and the frequency of poisoning in the age range of 5-15 years was higher in boys than girls. Due to the fact that girls stay at home more than boys and considering that the frequency of poisoning with indoor substances, such as drugs and cleansing products was higher in children under the age of 5, it is logical that the frequency

of poisoning in girls was higher than boys in this period. On the other hand, boys spend most of their time outdoors, and according to the results, the frequency of poisoning due to external factors (such as insect bites) was higher in children older than the age of 5. Therefore, it is logical that the frequency of poisoning in the age range of 6-15 years in boys was higher than girls. So, parental care of both genders seems necessary to reduce cases of poisoning.

The results showed that the frequency of hospitalized poisonings was higher in summer than in other seasons, which is consistent with the other studies<sup>10, 18-21</sup>. Given children spend more time outdoors in summer (yards, parks, recreation centers, etc.) and parental supervision and care are less, the possibility of poisoning is much higher in summer. The relationship between the cause of poisoning and the season showed that poisoning due to insect bites was significantly higher in summer. The results also showed that the frequency of poisoning was higher in summer of 2015-2016 and at the same time the frequency of poisoning due to bites was higher.

In the present study, the frequency of poisonings was higher in urban areas (82.8%) than in rural areas, which is consistent with similar studies conducted in other parts of Iran<sup>2, 9, 12, 22</sup>. The higher prevalence of poisoning in urban areas could be due to easy access and greater consumption of drugs, cleansing products, chemicals materials, etc. Also, the existence of medical centers in cities and easy access to them may be the reason for the higher prevalence of hospitalization of children due to poisoning in urban areas.

The findings of the present study indicated that drug and cleansing products were the most common poisonous agents in children. This result is consistent with studies by Feiz et al. and Talebian et al.<sup>8, 12</sup>. The results of most epidemiological studies on poisoning in children have indicated that drugs are the most common cause of poisoning in children<sup>2, 3, 9, 11, 12, 23</sup>. Drugs were also the most common causes of poisoning in studies conducted by Rodrigues et al. in Brazil

(2016) and Gunay et al. in Turkey (2019)<sup>23, 24</sup>. The access to drugs and cleansing products improves with the improvement of the economic situation of the countries. Consequently, the poisoning due to the use of drugs and cleansing products increases. Parents' negligence in storing drugs and putting them in the refrigerator, overdose of medication, imitating the behavior of parents, and on the other hand, the use of attractive colors and packaging by pharmaceutical companies can be reasons for children's desire to take drugs. Self-medication (such as painkillers) by parents may be a factor in drug poisoning in children in this age range. In the present study, the frequency of opioid poisoning increased sharply in children aged 1-2 years and then decreased, so that the frequency of opioid poisoning was 0% in the age range of 10-15 years. This result is consistent with the study by Allen et al.<sup>13</sup>.

In the present study, drug poisoning was higher in urban areas than in rural areas, which is consistent with similar studies<sup>2, 22, 25</sup>. More access to drugs in urban areas could be one of the reasons for this finding. In addition, the most common symptom of poisoning was neurological symptoms, which is consistent with the studies by Gheshlaghi et al. and Mohammadi et al.<sup>3, 26</sup>. Studies by Pirzadeh et al. and Arjmand et al. also showed that neurological symptoms were the most common symptoms of poisoning in children<sup>11, 19</sup>. Sadeghi and Khajeh compared the trend of child poisoning between 1998 and 2008 in Zahedan. The results of their study showed that in both periods, the drug was the most common cause and neurological and cerebral symptoms were the most common symptoms of poisoning in children<sup>5</sup>. Symptoms of poisoning depend on the cause of poisoning and the amount of poisonous agent. Given that drugs affect the central nervous system, the higher prevalence of neurological symptoms in poisoned children is probably due to the higher prevalence of drug poisoning.

The results suggested that the most common route of poisoning in children was ingestion,

which is consistent with similar studies<sup>3, 5, 11</sup>. It seems that the higher frequency of ingestion in children is related to putting objects into their mouth in this age group. In the present study, the highest hospitalization duration in poisoned children was 1-2 days, which is consistent with the studies by Srinivasa et al. and Farzaneh et al.<sup>9, 15</sup>. It seems that the difference in the mean hospitalization depends on the cause of poisoning and the amount of poisonous agent.

The rate of mortality due to poisoning in developed countries is 1% and in developing countries is between 3% to 5%<sup>10</sup>. In the present study, three deaths occurred due to poisoning during 2014-2019, which is higher than Farzaneh et al.'s study (2007-2011) with 2 deaths, and is lower than Gheshlaghi et al.'s study (2008-2010) with 5 deaths<sup>3, 9</sup>.

One of the limitations of the present study was the dependence on the information recorded in the patients' records. Lack of access to patients' records in private hospitals referring to poisoning and not recording parents' education and occupation in the patients' files were among the limitations of the present study.

### Conclusion

The present study indicated that drugs and cleansing products were the main causes of involuntary poisoning in children, and the most common age of poisoning in children was under the age of 5. The frequency of poisoning in children can be reduced by changing family lifestyles and environmental factors. One of the preventive strategies in this field is to keep drugs, cleansing products, and chemical materials out of the reach of children and in a safe place. Placing chemical materials and drugs in special protective containers, placing them in inaccessible places and locked cabinets can be a good solution. Parents should also start educating their children to identify harmful substances, as soon as possible.

The second prevention strategy is related to companies producing drugs and chemical materials. By law, these companies must store chemical substances in durable containers, and

they must also install warning signs and hazard labels on harmful materials. Another strategy to reduce poisoning could be to produce engaging educational content for children through mass media, such as television to increase their awareness.

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### Conflict of interest

The authors declare that there is no conflict of interest.

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