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Childhood Poisoning During the COVID-19 Pandemic

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What is already known on this topic?

- *Poisoning is a preventable cause of morbidity and mortality in children.*
- *Poisoning is common in children under the age of 5 years.*
- *While accidental intake is frequent in young children, suicide attempts are more common in adolescence.*

What this study adds on this topic?

- *The majority of poisoning cases occurred at home during the pandemic period.*
- *More than half of the poisoning agents were non-pharmacological agents. Caustic-corrosive substances were the most common poisoning agents.*
- *Rates of poisoning via caustic-corrosive substances, alcohol (hand sanitizers), and gases increased during the pandemic compared to a study conducted in the same region before the pandemic.*

ABSTRACT

Objective: To determine changes caused by the effect of the COVID-19 pandemic by examining the children admitted to our hospital because of poisoning during the pandemic and comparing these with data from a study conducted in the pre-pandemic period.

Materials and Methods: A retrospective examination was made of children who were admitted to our pediatric emergency department with poisoning between March 2020 and March 2022.

Results: Of the 82 (0.7%) patients admitted to the emergency department, 42 (51.2%) were girls, the mean age was 6.43 ± 5.62 years, and the majority of children (59.8%) were under 5 years of age. The poisonings were determined to be accidental in 85.4% of cases, 13.4% were suicide attempts, and 1.2% were iatrogenic. Poisonings occurred most frequently (97.6%) at home and most frequently (85.4%) by digestive tract. The most common causative agent (68%) was non-pharmacological agents. Caustic-corrosive substances were determined in 39% of cases, medical drugs in 32%, toxic gases in 11%, alcohol (hand sanitizers) in 8.5%, insecticide-pesticide in 6.1%, food in 1.2%, and animal bites in 1.2%. Compared to the study conducted in our hospital in 2013-2014, the difference in terms of factors causing poisoning was statistically significant ($P < .001$). Of the current study cases, 14 (17.1%) were followed up in the intensive care unit, and no mortality developed.

Conclusions: The period of the COVID-19 pandemic was seen to cause an increase in poisoning rates with caustic-corrosive substances, alcohol (hand disinfectants), and toxic gases. Families should be made aware of this issue and take special precautions.

Keywords: Child, corrosive, COVID-19, pandemic, poisoning

INTRODUCTION

Poisoning is defined as the entry of a toxic substance into the body through the digestive, respiratory, skin, eye, or intravenous route or the ingestion of a higher dose than normal of a non-toxic substance.[1] Poisoning is a preventable cause of morbidity and mortality in children. Although it can be seen in all pediatric age groups, more than half of cases are under the age of 5 years.[2] The factors resulting in poisoning vary according to geographical region, season, sociocultural and religious beliefs, education level, family structure, job, age, and gender. While accidental intake is frequent in young children, attempted suicide is more common in adolescence.[3] Due to the factors that vary according to the location and age, it is necessary to know the causes of poisoning according to the age groups and countries or even regions and to take the necessary measures accordingly.[4] Since poisoning causes undesirable consequences such as death and disability in childhood, which can continue throughout their lives, an emergency response should be exercised with the worst-case scenario in mind.[5] Each region should determine and update its own epidemiological data in order to determine prevention and treatment approaches, to train healthcare personnel, and to increase public awareness.

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The COVID-19 pandemic caused many changes in daily life. Eating habits, time spent at home, sleep patterns, shopping styles, exercise habits, and house hygiene patterns all changed. Therefore, there was also a difference in environmental factors to which children are exposed compared to before the pandemic. This change in environmental and behavioral factors can also be expected to cause variances in childhood poisoning.

From this point of view, the aim of this study was to examine the cases of pediatric age group poisoning that occurred in our province during the COVID-19 pandemic and to compare these data with the results of another study conducted in the same province between 2013 and 2014 and thereby to determine the changes made by the pandemic in terms of poisoning factors.

MATERIALS AND METHODS

A retrospective analysis was made of the files of cases aged 0-18 years, who were admitted to the pediatric emergency department of Süleyman Demirel University Faculty of Medicine between March 2020 and March 2022 due to poisoning. Age, gender, date of admission, time until admission, substance to which exposed, referral status, place of poisoning, routes of exposure, clinical and physical examination findings, interventions, complications, whether the child was in intensive care or inpatient units, and hospitalization periods of the children were examined from the files. After a thorough evaluation by the principal investigator, children with suspected intoxication without a clear etiology were excluded from the study. Cases with missing data were also excluded from the study.

Classification of Patients and Poisoning Agents

The cases were divided into groups according to age ranges as under 5 years old, 5-12 years old, and over 12 years old. Poisons were divided into groups as pharmacological and non-pharmacological agents (caustic/corrosive substance, toxic gases, plants, foods, hydrocarbons, insecticides, and scorpion bites). The drugs were also grouped according to the system and mechanism in which they acted. The type of poisoning itself was grouped as accidental, attempted suicide, or iatrogenic. The route of exposure to the substance was grouped as digestive, respiratory, skin, and intramuscular.

Assessment

The results of the study were compared with the results of the study conducted by Dereci et al[6] in our hospital before the pandemic (2013-2014).

Ethical Approach

The study was approved by the Clinical Research Ethics Committee of the Süleyman Demirel University Research Hospital (decision no: 232, date: August 26, 2022). Written informed consent was obtained from the children and/or parents or legal guardian. The study was conducted in accordance with the Helsinki Declaration.

Statistical Analysis

Statistical analyses were performed using Statistical Package for Social Sciences (SPSS) version 26.0 software (IBM Corp.; Armonk, NY, USA). First, the Shapiro–Wilk test was used to analyze whether continuous variables were normally distributed. The results of continuous variables with normal distribution were given as mean ± standard deviation (SD) values, and those not showing normal distribution as median (min-max) values. Categorical data were presented as frequency (n) and percentage (%). The Chi-square (χ^2) test was used to examine whether the distributions of categorical variables differed from each other. Fisher's exact test was used when the expected number of observations was less than 5. For all statistical tests, values of $P < .05$ (2-tailed) were considered statistically significant.

RESULTS

Demographic Features

Of the 11 854 cases admitted to the pediatric emergency department within the defined 2-year period, 82 (0.7%) were evaluated with the diagnosis of poisoning. Of these cases, 42 (51.2%) were girls (boys/girls: 0.95). The median age of the patients at the time of admission was 43.5 months (range: 5-213 months). When evaluated according to age groups, 49 (59.8%) cases were aged <5 years, 13 (15.9%) between 5 and 12 years, and 20 (24.3%) >12 years. In the age group of <5 years of age, 51% of the cases were boys and in the group aged >12 years, 65% were girls. Of the total cases, 32 (39%) were admitted in 2020, 43 (52.4%) in 2021, and 7 (8.5%) in 2022. The admissions were seen to be mostly in March (n = 13, 15.9%) and May (n = 10, 12.2%). Poisonings were most common in spring (36.6%) followed by autumn (24.4%).

Characteristics of Poisonings

The reasons for the poisonings were found to be 85.4% accidental, 13.4% suicide attempt, and 1.2% iatrogenic. Accidental intake was determined in all cases except 1 iatrogenic poisoning case under 5 years of age and in all cases between 5 and 12 years of age. The boy/girl ratio was 1.04 in the first 5 years, 1.6 in the 5-12 years age group, and 0.53 over 12 years old. Of the 20 cases over the age of 12 years, 11 (55%) were suicide attempts and the rest were accidental. All of the attempted suicides were over 12 years old and the boy/girl ratio was 0.57. The median age of accidental poisoning cases was 36 months (5-213 months), and boys constituted the majority (51.4%) of this group. The mean age of attempted suicide was 15.42 ± 1.46 years and the majority of this group was girls (63.49%).

Of the total poisoning cases, 80 (97.6%) occurred at home, 1 (1.2%) at school, and 1 (1.2%) in a health center. One of the poisonings that took place outside the home was an overdose of the Bacille Calmette-Guérin (BCG) vaccine, and the other was the accidental drinking of hand sanitizer at school. Of all the cases, 72 (87.8%) were exposed to a single substance and 10 (12.2%) were exposed to more than one substance. When the causes of poisoning were evaluated as accidents or suicide attempts, there was no statistically significant difference between these 2 groups in respect of multiple agents intake ($P = .10$) (Table 1). The route of exposure to the poison was through the digestive system in 70 (85.4%) cases, the respiratory system in 10 (12.2%), through the skin in 1, and intramuscularly in 1. The median time to admission to hospital after the poisoning incident was 3 hours (0.5-48 hours): 22 (26.9%) in the first hour, 35 (42.8%) in the first 2 hours, and 45 (55%) in the first 3 hours. Of the total 82 cases, 59 (72%) were referred from another health center.

Table 1. Comparison of Accidents and Suicide Attempts

	Accidents (n = 70) (n/%)	Suicide Attempts (n = 11) (n/%)	*P*
Multiple agents intake	6/8.6	3/27.3	.10*
Pharmacological agents	16/22.9	9/81.9	<.001
The rate of hospitalization	48/68.6	11/100	.029

*Fisher's exact test.

Agents of Poisoning

When evaluated according to the substances that caused the poisoning, 56 (68%) cases had non-pharmacological agents and 26 (32%) included pharmacological agents. While 54 (77.4%) of accidental poisonings were non-pharmacological agents, 9 of the suicide attempts (81.9%) were pharmacological agents. The percentage of suicide attempts with pharmacological agents was statistically significantly higher than accidental poisoning ($P < .001$) (Table 1). The agents of poisoning were caustic-corrosive substances in 32 (39%) cases, medical drugs in 26 (32%), toxic gases in 9 (11%), alcohol in 7 (8.5%), insecticide-pesticide in 5 (6.1%), food in 1 (1.2%), and scorpion sting in 1 (1.2%). Compared to the findings of the study by Dereci et al (2013-2014), the difference in terms of factors causing poisoning was statistically significant (Fisher's exact test value = 57.72, $P < .001$) (Table 2).

The top caustic-corrosive substances were bleach in 10 cases (31.3%), drain opener in 6 (18.8%), and descaling agent in 3 (9.4%). Central nervous system drugs, cardiovascular drugs, and analgesic-antipyretics were the most common pharmacological agents that caused poisoning in 9 (10.9%), 6 (7.3%), and 5 (6.1%) cases, respectively. Other pharmacological agents are shown in Table 3. Drug poisoning was seen to be the most common poisoning factor in winter, spring, and autumn, and poisoning with caustic-corrosive substances was most common (56.3%) in summer. Carbon monoxide poisoning was frequently seen in winter and autumn. Corrosive substance was the most common cause of poisoning in children aged <5 years (27 cases, 55.1%), toxic gases were the most common (4 cases, 30.8%) in the 5-12 years age group, and pharmacological drugs were most common in the >12 years age group (10 cases, 50%).

Clinical Status of Poisoning

Clinically, 28 (34.1%) patients were asymptomatic. Nausea and vomiting were seen in 29 (35.4%), respiratory distress in 6 (7.3%), and cough in 5 (6.1%) patients. Other symptoms and findings are shown in Table 4.

Table 2. Comparisons Between Dereci et al's[6] Study and the Current 2022 Study

Toxic Agents	Dereci et al's Study (n = 77) (n/%)	2022 Current Study (n = 81) (n/%)
Caustic-corrosive agents	3/3.9	32/39.5
Medical drugs	63/81.8	26/32.1
Toxic gases	1/1.3	9/11.1
Alcohol	0/0	7/8.6
Insecticides-pesticides	5/6.5	5/6.2
Foods	3/3.9	1/1.2
Animal poisoning	2/2.6	1/1.2

Fisher's exact test value = 57.72, $P < .001$.

Table 3. Pharmacological Agents Causing Poisoning

Drug Groups	n (%)
Central nervous system drugs	8 (9.8)
Analgesic-antipyretics	4 (4.9)
Cardiovascular system drugs	3 (3.7)
Minerals and vitamins	3 (3.7)
Anticoagulant medications	2 (2.4)
Vaccines	1 (1.2)
Gastrointestinal system drugs	1 (1.2)
Hormone-containing drugs	1 (1.2)
Cold and flu medications	1 (1.2)
Antibiotics	1 (1.2)
Musculoskeletal system drugs	1 (1.2)

Treatments of Poisoning

As part of the management of the cases, gastric lavage was performed in 16 (19.8%) patients and activated charcoal was given to 18 (22%), to prevent absorption of toxic substance. Two (2.4%) patients were treated with antidote (N-acetyl cysteine), 4 patients with hyperbaric oxygen, 1 patient with vitamin K, and 1 patient with scorpion serum. Other cases were followed up. All patients were closely monitored for potential complications. Sixty (73.2%) cases were hospitalized and 14 (17.1%) were treated in the intensive care unit. The in-patients comprised 68.57% of the cases who were accidentally poisoned and 100% of those who attempted suicide. The rate of hospitalization of patients who attempted suicide was statistically significantly higher than for those who were accidentally poisoned ($P = .029$) (Table 1). After observation in the emergency department, 22 (26.8%) patients were discharged. The median length of hospital stay was 24 hours (range: 1-360 hours). No cases developed mortality.

DISCUSSION

Poisoning can be clinically asymptomatic in children or can lead to organ damage, disability, and even death of the child. Knowing the regional characteristics of poisonings, which can cause emergency department admissions and hospitalizations

Table 4. Poisoning Symptoms and Signs

Symptoms and Findings	n (%)
Nausea and vomiting	29 (35.4)
Respiratory distress	6 (7.3)
Cough	5 (6.1)
Stomach ache	4 (4.9)
Headache	4 (4.9)
Dizziness	4 (4.9)
Somnolence	4 (4.9)
Fainting	4 (4.9)
Blurred vision	3 (3.7)
Swelling and redness of the tongue and lips	3 (3.7)
Diarrhea	3 (3.7)

Other findings: clouding of consciousness 2, fever 2, foaming at the mouth 2, burning in the throat 2, bad breath 2, palpitation 2, bruising 2, flushing 1, numbness in extremities 1, hematuria 1, conjunctivitis 1, chills 1.

in the pediatric age group, is important both in terms of taking preventive measures and to be able to provide early appropriate treatment.[7-9]

It has been reported in the literature that poisoning constitutes 0.13%-3.6% of emergency admissions.[8-12] In Dereci et al's study conducted in our region between 2013 and 2014, this rate was found to be 3.6%.[6] One possible reason can be speculated as stemming from the excessively high number of unnecessary admission of outpatient clinic patients to the emergency unit of our hospital (i.e., for a simple viral infection), lifestyle changes of families during the pandemic, and the effective operations of national poison counseling services.

Some studies have shown a predominance of boys in poisoning cases, and in others, girls were dominant.[7,10] As in the study by Güngörer and Kökten Yıldırım[11] (64.6% females), females were predominant in the current study. It has been reported that accidental poisoning is especially common in boys younger than 5 years of age, and poisoning due to attempted suicide is more common in girls aged >12 years.[12-15] Güngörer and Kökten Yıldırım[11] stated that 62.2% of the girls in that study took drugs for a suicide attempt. The frequency of accidental poisoning in boys younger than 5 years of age may be due to the fact that boys are more mobile with greater motor skills, they are curious, they have less ability to control and protect themselves at that age than other age groups, they cannot distinguish between medicine and food, and they tend to identify and categorize every substance they find by putting it in their mouths. It may also be due to families keeping medications or cleaning agents in easy-to-reach places, and not within child-proof packages. The reasons why the girls were in majority in respect of suicide attempts over the age of 12 years is usually thought to be due to comparatively higher social and familial pressure and intrapersonal conflicts during adolescence. In accordance with the literature, 59.8% of the current study cases were younger than 5 years, and 24.4% of the cases were older than 12 years. The boy/girl ratio was 1.04:1 in the <5 years age group and 0.53:1 in the >12 years age group.

Previous studies have reported that poisonings are frequently seen in spring and summer.[6,12-17] In the current study, the highest number of cases (36.6%) was seen in spring, and in March and May. This could be attributed to lack of supervision as parents are engaged in gardening and agricultural work, increased exposure to insecticides used for agricultural purposes, and corrosive and toxic substances left unattended due to cleaning and painting work in houses. Children can reach toxic substances more easily as they spend more time playing outside, increased contact with animals, and deteriorated food being more readily present outdoors in this period. It has been reported that corrosive substance intoxication is more common in summer months.[16,18] In the current study, caustic-corrosive substances were the most common poisoning agent in summer at the rate of 56.3%.

The time of admission to hospital has been reported to range from 3.5 to 5 hours, with an average time of 3.6 hours for patients aged <5 years and, 6.7 hours for those aged >12 years.[6,12] In a study, the rate of patients reaching the hospital within 2 hours was 66%, and the rate of patients who reached the hospital within 6 hours was 87.7%.[18] From the current study findings, it can be said that families had easier access to the hospital and/or were more careful in paying attention to the poisoning.

Previous studies have reported that 66%-96% of poisonings occur at home [6,15-21], and this rate was found to be 97.6% in the current study. This high rate may be related to the high number of isolations during the COVID-19 pandemic and the fact that families spent more time at home. Studies have shown that 65.7%-98.6% of poisonings occurred orally (via the digestive system).[8,15,21] In the current study, the most common route of exposure was also the digestive system at the rate of 85.4%, which could be related to the high number of patients younger than 5 years and the fact that this age group puts objects in their mouth for identification.

In a study by Ozan et al.[22] it was reported that clinical severity, length of hospital stay, and multiple drug intake were higher in the attempted suicide group than in accidental poisonings. It has been reported in the literature that the causes of poisoning were accidental in 64.5%-91.9% of cases, suicide attempts in 8.1%-35.5%, and iatrogenic in 0.3%-5.1%.[23] Consistent with the literature, 85.4% of the cases in the current study occurred by accident, and attempted suicide was seen at a low rate.

In various studies, drug-related poisoning rates have been reported to range from 21.9% to 76%.[6-10,23] Although drug poisoning rates were high in most studies, corrosive substances were found to be the most common substance with 70.6% in the study by Akçay et al.[23] Unlike the study conducted by Dereci et al[6] in our hospital before the pandemic, caustic-corrosive substances were seen to be the leading agent in the current study. This change may be due to increased interest in cleaning agents during the isolation and lockdown periods of the pandemic, more frequent use of chemicals such as bleach, detergent, and oil solvent in daily life, storing these products in the lower rows of kitchen and bathroom cabinets where children can easily reach in homes, and the sale of these products in open and unprotected packages, mostly in PET bottles. In addition, the increased use of hand sanitizers and their presence in all places, including schools, during the COVID-19 pandemic led to an increase in alcohol poisoning caused by hand sanitizers. In the current study, alcohol poisoning caused by hand sanitizers was seen at the rate of 8.5%.

The rate of asymptomatic cases in studies varies between 45.9% and 52.3%.[21,24] In a previous study, common symptoms were reported to be nausea-vomiting (10%), tendency to sleep (6.6%), and dizziness (4.3%).[24] The most common symptom in studies conducted in Turkey was seen to be nausea-vomiting.[25,26] In the current study, 34.1% of the cases were asymptomatic, and the most common finding was nausea-vomiting in 35.4% of cases.

Early initiation of the treatment process, gastric lavage, and administration of activated charcoal in the first hour are effective in reducing morbidity and mortality. In the literature, a symptomatic approach as the treatment method varies between 16.3% and 42%, with gastric lavage reported at 12.8%-52.2%, activated charcoal administration at 21%-52.2%, and antidote administration at 3.6%-9.7%.[6,26] In the current study, the low rates of gastric lavage and activated charcoal

administration may be due to the fact that the intake of corrosive substances was higher than in other studies, and in such cases, gastric lavage and activated charcoal administration is contraindicated. In the literature, the mean length of hospital stay for poisoning cases varies between 20.55 and 69.6 hours.[6,26] In the current study, the median length of hospital stay was 24 hours.

Aydın et al[27] stated that poisoning rates increased from 3.4% to 5.5% during the COVID-19 pandemic ($P < .001$). A study conducted in Fez, Morocco, also showed that accidental poisonings increased from 77.88% in 2019 to 82.02% in 2020. Caustic substance poisonings increased from 20.38% in 2019 to 24.24% in 2020, and pesticide poisonings decreased from 19.41% in 2019 to 13.63% in 2020.[28] In the current study, there was a similar increase in caustic-corrosive substance poisoning compared to previous studies.

In a study conducted in Canada, although emergency department admissions decreased during the pandemic, it was determined that all poisonings increased by 122.5%, accidental poisonings by 127.8%, and suicide-related poisonings by 104.2% compared to total emergency department visits.[29] Another study in Iran showed that hospitalization rates due to ethanol and methanol exposure were significantly higher in 2020 than in 2019 ($P < .001$). During the COVID-19 pandemic, patients aged <15 years were significantly more likely to be poisoned by hand sanitizers than alcoholic beverages, while exposure to alcoholic beverages was 6.7 times more common among those aged 15-18 years ($P < .001$).[30] Similarly in the current study, an increase was found in poisoning due to exposure to hand-sanitizer-based alcohol.

As stated by Yıldız et al.[31] some cases may not present directly with a history of poisoning. They may present with nonspecific symptoms as in mercury poisoning and some symptoms that can mimic rheumatic disease. All physicians should be vigilant in terms of poisoning and keep the threshold of suspicion low. A detailed history in terms of poisoning should be taken when patients present with clinical findings that they cannot explain.[31]

The limitations of this study are that it was retrospective and regional. The small number of cases in the "suicide attempt" group reduces the power of the study.

CONCLUSION

The findings of this study demonstrated that the frequency of poisoning with caustic-corrosive substance, alcohol (disinfectant), and carbon monoxide increased during the COVID-19 pandemic compared to the pre-pandemic period. Since the majority of poisonings occur at home and especially accidental poisonings are common in children under 12 years of age, it can be said that families should take protective measures in this regard. In addition, attention should be paid to the use of disinfectants and those with a spray-style, and locked mechanism should be preferred.

Ethics Committee Approval: Ethical committee approval was received from the Ethics Committee of Süleyman Demirel University, (Approval No: 232).

Informed Consent: Written informed consent was obtained from the children and/or parents or legal guardian.

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