

# Clinical and Evolutionary Aspects of Domestic Accidents in a Tunisian Pediatric Population

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## ABSTRACT

Domestic accidents are a global public health problem. They are responsible for high levels of morbidity and mortality in the pediatric population. In Tunisia, the extent of this problem remains poorly understood. The aim of this study was to determine the nature, prevalence and prognosis of domestic accidents in a Tunisian pediatric population.

This was a monocentric retrospective study that collected cases of domestic accidents in children in the Pediatric Medicine Unit A of the Tunis Children's Hospital over a two-year period (2022 - 2023). Six hundred patients were hospitalized for domestic accidents, representing 6.83% of the department's activity. The sex ratio was 1.06. The mean age of the patients was  $54 \pm 42$  months. The mean time from accident to emergency consultation was  $6 \pm 2.5$  hours [1 hour - 10 days]. The most common accidents were carbon monoxide poisoning (33%), drug poisoning (24.3%), foreign body inhalation/ingestion (10.3%), caustic ingestion (17.7%), pesticide poisoning (4.5%), and hydrocarbon poisoning (4.5%). The mean length of hospital stay was  $1.63 \pm 1.6$  days. The outcome was favorable in almost all cases (99.8%). A serious accident was observed in 0.7% of cases, with an average intensive care unit stay of  $3 \pm 1.4$  days. This study provides an overview of domestic accidents in a general pediatric ward in Tunisia.

**Keywords:** Accident, Child, Domestic, Epidemiology, Prognosis

## INTRODUCTION

Domestic accidents (DA) are a significant public health issue globally, posing a substantial risk to the pediatric population. These accidents contribute to high levels of morbidity and mortality among children. According to the World Health Organization (WHO), accidental pathologies are the leading cause of death in children aged five and over [1]. The WHO highlights that the absolute number of domestic accidents is comparable in both developing and industrialized nations. However, it is highly likely that the mortality and disability rates resulting from these accidents are higher in developing countries [2]. In Tunisia, very few publications have examined the extent of this phenomenon. Thus, the prevalence and morbidity of domestic accidents in children remain poorly understood. The aim of this study was to determine the nature of domestic accidents in pediatrics, their prevalence and prognosis.

## METHODS

This was a retrospective, descriptive, monocentric study conducted in the Children's Medicine A department Tunis Children's Hospital over a two-year period (2022-2023). We included patients under 18 years of age hospitalized for a domestic accident. We did not include infanticide, intentional accidents, suicide attempts and accidental pathologies normally managed in a surgical setting (Burns, public road accidents, traumatic accidents). Unusable files were excluded. Data were collected from patients' medical records. Caustic ingestions

were classified according to Zargar's classification, paracetamolemia was interpreted according to Rumack and Matthew's nomogram, the severity of respiratory distress secondary to drowning was determined according to Szpilman's classification, the severity of viperine envenomations was assessed by Chippaux's classification and that of scorpionic envenomations by El Khattabi's classification.

Qualitative variables were expressed as absolute and relative frequencies. Quantitative variables were expressed as means  $\pm$  standard deviations or medians  $\pm$  interquartile ranges, according to whether they were normally distributed or not.

The study was approved by the Institutional Review Board (Number: 17/2022 obtained October 26th, 2022). All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No conflicts of interest are to be disclosed.

## RESULTS

Six hundred patients were hospitalized in Children's Medicine A during the study period for DA. The management of these patients represented 6.83% of the department's activity. Forty-five patients were excluded due to unusable records. The results for 555 patients are detailed below.

The mean age of patients was  $54 \pm 42$  months [1 month-14 years], with a median of 40 months. Most patients were under four years of age (61%). The sex ratio was 1.06 (286 boys and 269 girls). The average age of the mothers was  $34 \pm 5.9$  years [18-57 years] and that of the fathers was  $40 \pm 6.9$  years [22-68 years]. The parents' level of education was relatively low. Specifically, 206 mothers (42.7%) and 179 fathers (38.3%) had completed primary education, while 134 mothers (27.7%) and 157 fathers (33.6%) had completed secondary education.

DAs were observed in descending order in winter in 193 cases (34.8%), then in summer in 137 cases (24.8%), followed by spring in 132 cases (23.7%) and finally autumn in 93 cases (16.7%). Admissions peaked in December and January. Most DAs (72%) occurred after midday [12-24 hours]. The highest peaks were recorded between 6pm and 8pm. The mean delay between the occurrence of a DA and a visit to the emergency department was  $6 \pm 2.5$  hours [1 hour-10 days].

The main DAs were poisoning (87.3%), notably carbon monoxide poisoning (33%), drug poisoning (24%) and caustic ingestion (17.7%), followed by foreign body accidents (10.3%) (Table I).

Table I: Distribution by Type of Domestic Accident

Type of domestic accident	N* (%)
Carbon Monoxide poisoning	183 (33)
Drug poisoning	135 (24.3)
Ingestion of caustics	98 (17.7)
Foreign bodies ingestion	36 (6.5)
Pesticide poisoning	25 (4.5)
Hydrocarbon poisoning	25 (4.5)
Foreign body inhalation	21 (3.8)
Non-drug poisoning	18 (3.3)

Drowning	5 (0.9)
Envenomation	4 (0.7)
Electrification	4 (0.7)
Strangulation	1 (0.2)
<b>Total</b>	<b>555(100)</b>
Number	

The mean length of hospital stay was  $1.63 \pm 1.61$  days [1-17 days], with a median of one day [IQ:1-2 days]. The outcome was favorable in almost all cases (99.8%). Transfer to intensive care was indicated in four cases (0.7%), with a mean stay of 3 days  $\pm$  1.4 [2 - 4 days]. In one case, the evolution was marked by recovery with sequelae (esophageal stenosis following caustic ingestion) (Table II).

### A. Carbon Monoxide Poisoning:

The main sources of Carbon Monoxide (CO) were gas water heaters (71.6%), braziers (6.6%) and gas heating (10.4%). Twenty-one patients were asymptomatic. Clinical manifestations were mainly neurological and digestive. The most frequent signs were headache (42.6%), nausea and vomiting (37.7%) and loss of consciousness (26.2%). The mean carboxyhaemoglobin (HBCO) level was  $12.9 \pm 8.1\%$  [0.1-44%]. Normobaric oxygen therapy was indicated in 178 patients (97.3%). Hyperbaric oxygen therapy was indicated in 57 cases (31.1%), but performed in 19 cases only (10.4%), due to a lack of resources on the part of the parents or the absence of a mask suitable for certain age groups. The indications for hyperbaric oxygen therapy were loss of consciousness (17.5%), convulsions (11%), including two cases of convulsive states or HBCO > 25%.

### B. Caustic Ingestions:

Ninety-eight patients were hospitalized for caustic ingestion, i.e. 17.6% of ADs. The most common caustics were bleach (54%) and soda ash (18%). Other caustics were oxidizing agents (56%), strong bases (24%), strong acids (7%), weak acids (7%) and foaming agents (4%). Product storage conditions were not respected in 34% of cases. Esophagogastroduodenoscopy (EDG) was normal in 86% of cases. Endoscopic lesions (N=14) were classified, according to the Zargar classification, as stage I (n=2), stage II a (n=7), stage II b (n=3), stage III (n=1) and gastric involvement (n=1). Management included antibiotic therapy (n=30) and corticosteroid therapy (n=6) with a mean duration of  $11.7 \pm 7$  days [1-44 days]. Depending on endoscopic abnormalities, discontinuation of the diet for a mean duration of  $1.26 \pm 0.96$  days [1-6 days] was indicated in 84% of patients. Proton pump inhibitors were prescribed for 68.4% of patients, with a mean duration of proton pump inhibitor use of  $5.4 \pm 1.9$  days [0-44 days]. Ventilatory support was required for one patient admitted for bleach ingestion with massive inhalation.

### C. Drug Intoxication:

We recorded 135 cases of drug intoxication. The most common drugs found were benzodiazepines (18%), followed by analgesics (14%), especially paracetamol (10.5%). The most common clinical signs were neurological disorders (32%) and digestive disorders (24.3%).

Acetaminophen intoxication (n=14) occurred by ingestion of a drinkable suspension in 12 cases and tablets in two cases. The ingested dose exceeded the toxic dose in ten patients, with a mean ingested dose of  $156.3 \pm 60.3$  mg/kg [92-300mg/kg] and a median of 131.5 mg/kg. Most patients were asymptomatic (n=10/14). The remainder had mainly gastrointestinal symptoms: nausea (n=3), vomiting (n=3), abdominal pain (n=1) and asthenia (n=1). None of the patients showed signs of severe disease. Biological abnormalities included hepatic cytolysis at 10 times normal (n=1), hypoglycemia (n=1), and hepatocellular failure (n=1). The mean paracetamol level requested four hours after ingestion was  $35.5 \pm 33.8$   $\mu$ g/ml [0 - 95  $\mu$ g/ml] with a median of 21  $\mu$ g/ml, indicating

a low risk of hepatotoxicity in all cases. At the end of the clinical and biological evaluation, acetaminophen toxicity was classified as stage I in almost all cases (n=13). Gastric lavage was performed in two patients. N-acetylcysteine was administered orally in 11 cases with a loading dose of 140 mg/kg, then 140 mg/kg in 6 doses per day for 24 hours. All cases progressed favorably.

For benzodiazepine poisonings (n=24), the products ingested were bromazepam (n=12), lorazepam (n=8), and clonazepam (n=4). All were rapid-acting benzodiazepines (half-life < 24 hours). The mean ingested dose was  $0.54 \pm 0.46$  mg/kg [1-1.8 mg/kg]. It was below the toxic dose for bromazepam and lorazepam and above the toxic dose for clonazepam. The most common clinical manifestations were ataxia (n=22), somnolence (n=17), and vomiting (n=12). Gastric lavage was performed in one case. Charcoal was administered in two cases. The antidote flumazenil was administered to one patient who presented with coma. The course was favorable in all cases.

#### D. Pesticide Poisoning:

Table II: Summary table of the epidemiological and evolutionary characteristics of each domestic accident type.

	Number	Mean age (Months)	Sex-ratio	Mean consultation time (Hour)	Mean length of hospital stays (Days)	Signs of severity	Intensive care unit stay	Sequelae
Domestic accident	555	54	1.06	6	1.63	38	4	1
CO poisoning	183	67	0.97	2.8	1	2	0	0
Drug intoxication	135	55	0.97	5.1	1.7	27	1	0
Caustic ingestion	98	43	1.13	2	2	1	1	1
Pesticide poisoning	26	21	1.27	5.4	1.2	1	0	0
Hydrocarbon poisoning	26	35	1.6	3	1.7	1	0	0
Inhalation of FB†	21	20	1.1	45	3.8	1	1	0
Ingestion of FB†	36	53	1.6	14.9	1.94	1	0	0
Drowning	5	60	1.5	3	2.8	4	1	0
Envenomation	4	95	3	1.5	1	0	0	0
Electrification	4	91	0.3	2.75	1.25	0	0	0

\* : Carbon monoxide, † : Foreign body

Twenty-five cases of pesticide poisoning were recorded. Insecticides were used in 15 cases and rat poison in nine cases. The type of product was not specified in one case. The most frequent chemical classes observed in

our series were pyrethroids, with fifteen occurrences, followed by organochlorines, present five times, and organophosphates and carbamates, each appearing twice. Inappropriate parental behavior was noted in 18 cases: ingestion of milk in 13 cases, ingestion of olive oil in two cases, and induced vomiting in three cases.

Patients were asymptomatic in 15/25 cases. The manifestations of pesticide ingestion were the onset of muscarinic syndrome in three cases and nicotinic syndrome in two, with a severe picture in one patient. No patient had central syndrome. The mean globular acetylcholinesterase was  $8690 \pm 4084$  U/L [880-12526 U/L]. It was decreased in five patients. Four patients received gastric lavage. Two others received activated charcoal. Only one patient required atropine at a dose of 0.7 mg/kg.

#### **E. Hydrocarbon Poisoning:**

Twenty-six patients were treated for hydrocarbon (HC) poisoning, or 4.68% of ADs. 23 were treated for gasoline thinner, two for tar, and one for naphthalene. Eight patients (31%) were asymptomatic. Respiratory signs were most common (62%), followed by gastrointestinal signs (46%) and neurological signs (35%). Chest radiographs were normal in 73% of cases. Abnormalities observed (n=5) were alveolar syndrome (n=4) and interstitial syndrome (n=1), associated with a biological inflammatory syndrome in three patients. Treatment was mainly symptomatic and included intravenous infusion (n=14), antibiotic therapy (n=18), injection of proton pump inhibitors (n=7), oxygen therapy (n=2) and non-invasive ventilation with high-flow glasses (n=1).

#### **F. Foreign Body Inhalation:**

Twenty-one cases of foreign body (FB) inhalation were recorded, representing 3.78% of DAs. Penetration syndrome was present in 17 cases. Coughing fits were present in 19 cases and cyanogenic in nine cases. The FB was radiopaque in three cases. Airway endoscopy was performed in 14 patients. Flexible fibroscopy was performed in five cases and rigid bronchoscopy in nine cases. The mean time to endoscopy was  $2.7 \pm 2.3$  days [1-11 days]. Six patients had a negative endoscopy. FB was seen in eight cases. It was in the left mainstem bronchus (n=5), the right mainstem bronchus (n=2) and the intermediate mainstem (n=1). Endoscopic extraction was possible in eight patients: seven by rigid bronchoscopy and one by flexible fibroscopy. Corticosteroid therapy was indicated in 11 patients. Most patients were treated with prophylactic antibiotics (n=15). Nebulized epinephrine (n=3) and terbutaline (n=9) were also indicated. One patient developed bronchospasm complicated by shock requiring filling and vasoactive medications with a 48-hour stay in the intensive care unit.

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#### **H. Drowning:**

Five children were hospitalized due to accidental drowning. In four cases the drowning occurred in seawater and in one case in fresh water (bathtub). The mean immersion time was  $3.2 \pm 1.79$  minutes [1 - 5 minutes]. The severity of drowning was classified as stage III in four cases and as stage II in one case. The most common clinical signs were respiratory distress in all patients, associated with neurological deficits in three patients. Chest radiographs showed inhalation pneumonitis in one case and diffuse bilateral alveolar images consistent with acute respiratory distress syndrome in another. Oxygen therapy was administered with a high concentration mask in four patients and with a simple nasal cannula in one. One patient required mechanical ventilation with a four-



day stay in the intensive care unit.

### **I. Envenomation:**

Four children were hospitalized for envenomation: two scorpion stings and two viper bites. In all cases, the two patients had only local signs and the envenomations were classified as Grade I. All four patients received local care and analgesic treatment with a favorable outcome. None of the patients had received anti-venom immunotherapy.

### **J. Electrocutation:**

Four children were admitted to the hospital for accidental electrification. Three cases involved low-voltage electricity and the other involved a high-voltage power line. The point of entry was identified in three cases, with redness adjacent to the point of entry: temporal (n=1), index finger (n=1), thumb and index finger (n=1). Two patients experienced convulsions. Rhabdomyolysis was observed in one case requiring hyperhydration. Management was mainly focused on local care and analgesic treatment. No patient required antibiotic therapy or excision. The outcome was favorable in all cases.

### **K. Strangulation:**

An 11-year-old boy was the victim of accidental strangulation with a necktie in the evening at home, resulting in loss of consciousness and apnea. On examination, he had cervical ecchymosis and bilateral subconjunctival hemorrhages, with an intraorbital hematoma on ophthalmologic examination. The outcome was favorable, with no sequelae, and the patient was hospitalized for nine days.

## **DISCUSSION**

In this study, we analyzed DAs in a global way and then detailed each type of DA. This work described in detail the epidemiologic, clinical and evolutionary profile of each DA. The number of patients enrolled was substantial compared to other studies. We recorded 600 cases of DA in two years. However, due to the retrospective nature of this study, 45 patients were excluded, representing 7.5% of patients admitted for DA during the study period. Furthermore, the study of long-term sequelae of DA was not possible due to lack of information in the patient records.

DA constituted 6.83% of the department's activity during the study period. The prevalence of DA in children varies from country to country. It varies from 6.9% to 15.5% in African and Asian countries. The prevalence ranges from 69 cases per 1000 admissions to 155 cases per 1000 admissions [2],[3].

The mean age of our patients was  $54 \pm 42$  months [1 month-14 years], with the majority being less than four years old. The mean age was four years in the study of Rafai et al [2] and 4.2 years in the study of Mohamed et al [4]. This result was also found in several other studies [2],[3],[5]. The tendency towards a younger age of DA victims, both in our context and elsewhere, could be attributed to the fact that young children are difficult to supervise due to their growing curiosity.

The sex-ratio was 1.06 with a variation in the sex-ratio depending on the type of DA. Envenomations, drownings, FB ingestions, organophosphate and HC poisonings were predominantly male. Electrocutation and drug poisoning were more common in girls. This male predominance has been reported by several authors [1], [3]-[6] and could be explained by the fact that young boys are more restless, impulsive and curious about their environment.

The mean age of the mothers of our patients was 34 years and that of their fathers 40 years. This result agrees with that of Koko et al. in Libreville, who found a mean age of 32 years for mothers and 41 years for fathers [5]. Most mothers were housewives (58.9%), while fathers were blue-collar workers (42.9%). Authors had reported a higher frequency of DA in children of parents with low socioeconomic status [3],[5].

In our study, the most common season for DA was winter (34.8%). In most publications, there was a

preponderance of DA in the summer, which was explained by extended school vacations [3],[4]. A winter peak was reported by Mohamed et al. in their study of DA in Senegal [7]. In our context, the inversion of the ratios is explained by the very cold climate in winter and the low socioeconomic level, which necessitates the use of CO-generating heaters. CO intoxication was the most common DA in our study.

71.5% of accidents occurred after midday, with a peak in the late afternoon and evening. Another Tunisian study, carried out in the south of the country, reported that 67.8% of DAs occurred between 1 p.m. and 11 p.m. [5]. These data concur with the findings of other authors, with a peak between 6 and 8 p.m. in a study carried out in Senegal [4], and a peak between 3 and 10 p.m. for Mohamed et al. [7]. This suggests that children are better protected from AD in kindergartens and schools, where most intoxicants are not used (CO, drugs, organophosphates, hydrocarbons). After school, on the other hand, parents are probably less vigilant at the end of the day.

The average consultation time to the emergency department was six hours. According to Padonou et al, 89.24% of DA patients were seen within 24 hours [3]. In 59.7% of the cases, the consultation time was less than two hours, which means that accidents are taken quite seriously by parents and that the delay is explained by the time it takes to get to the hospital. A longer delay, between 3 and 24 hours, was observed in 23.7% of the cases. This can be explained by transfers from other governorates, as the Tunis Children's Hospital is a level 3 structure that covers the whole northern part of the country.

In our work, the main ADs found were intoxications. In the literature, we have noted that the incidence of DA varies from one country to another and from one study to another. There are also variations over time.

CO intoxication was the most common cause of intoxication during the study period which is consistent with the findings of Aşirdizer [8] who reported that CO intoxication was the most common cause of all DAs. In the United States of America (USA), approximately 50,000 emergency room visits are attributed to CO intoxication [10]. We recorded 183 cases of CO poisoning corresponding to an annual recruitment of 92 cases/year. As reported by Guven, 380 cases of CO poisoning were recorded between 2017 and 2021, corresponding to 95 cases per year [10].

Drug intoxication was the second most common cause of DA in our series. In studies from Egypt [11] and Turkey [12], drugs were also the second most common cause of pediatric poisoning. In contrast, in France [13] and Pakistan [14], drug intoxication was the leading cause of poisoning. The most ingested drugs in our patients were bromazepam and lorazepam, in contrast to research in the USA, where alprazolam and clonazepam were the most ingested benzodiazepines [15]. The most common clinical manifestations in our patients were ataxia, somnolence and vomiting. Ataxia was also the main symptom reported in 90% of benzodiazepine poisonings [16].

Ninety-eight patients were hospitalized for caustic ingestion. The incidence of caustic ingestion ranges from 1,000 to 1,500 cases per year in France to 5,000 cases per year in the USA [17]. In developing countries, the incidence seems to be increasing. In Turkey, it increased from 2.2% in 1997 to 5.9% in 2003 and 8.1% in 2004 [17]. EDG was performed in 77% of our patients, in contrast to other series where it was performed in all patients [18]. In fact, a few years ago, EDG was systematically performed for any ingestion or suspected ingestion of caustics. Nowadays, with better knowledge of the products on the market and their composition, which must be indicated on the packaging, EDG is no longer performed systematically, but is discussed on a case-by-case basis. According to Casanovas et al, the frequency of caustic esophagitis/gastritis ranged from 14% to 86%. On the other hand, severe grade II and III lesions were more frequent, ranging from 36% to 69% [18]. This difference may be explained by the size of the sample, the criteria used by the different teams to perform the EDG, and the relative frequency of ingestion of different caustics in the population studied.

Twenty-five cases of pesticide poisoning were recorded. The prevalence of pediatric pesticide poisoning was 2.1/100,000 children in Texas between 2004 and 2013 [19]. Pesticides are a common cause of poisoning in developing countries. In Egypt, pesticides were the leading cause of non-drug poisoning in children and the main reason for admission to the poisoning treatment center in Cairo from 2009 to 2013 [20]. In South Africa, pesticide

poisoning accounted for 11% of all pediatric poisonings between 2003 and 2008 [21]. Clinically, muscarinic syndrome was found in 12% of cases, nicotinic syndrome in 8% with only one patient having signs of severity. Zwiener and Ginsburg [22] also found that nicotinic and muscarinic signs were more frequent in symptomatic patients. For other authors, the main signs of organophosphate poisoning in children were neurological and digestive [23],[24]. The differences observed could be explained by the nature of the products ingested, i.e. the proportion of different pesticides.

Twenty-one cases of FB inhalation were reported. FB inhalation accounted for 2.2% to 18.6% of the total da recorded in the different series [2],[4]. In France, an estimated 500 to 600 admissions to pediatric emergency departments per year are due to suspected FB inhalation [25]. In the USA, FB inhalation was the fourth leading cause of accidental death in children in 2005 [26]. They reported 66,000 calls to poison control centers and more than 40,000 emergency department visits between 2000 and 2009 [27].

The paucity of other EDs in this study (drowning, envenomation, electrocution and strangulation (0.2%)) did not allow us to draw any conclusions.

## CONCLUSIONS

Our study has illuminated the prevalence and characteristics of DA within the Tunisian pediatric population. Through comprehensive data collection and analysis, we have been able to construct a detailed portrait of this condition, focusing on its epidemiological and socio-demographic aspects. Epidemiologically, our findings reveal significant insights into the incidence and distribution of DA among children. Socio-demographically, the study sheds light on the various factors that may influence the prevalence of DA. These include socioeconomic status, educational background of parents, and access to healthcare services. By understanding these factors, we can better identify at-risk populations and tailor our preventive strategies accordingly.

Our research underscores the urgent need for preventive measures tailored to the Tunisian context. The data we have gathered serves as a crucial foundation for developing strategies that address the specific needs of our population. For instance, public health campaigns can be designed to raise awareness about DA, emphasizing early detection and intervention. Additionally, healthcare policies can be formulated to improve access to diagnostic and treatment services, particularly in underserved regions.

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