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Original Article

Paediatrics Section

Profile of Acute Poisoning and Its Outcome in Children Admitted to a Tertiary Care Hospital in Northeast India: A Cohort Study

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ABSTRACT

Introduction: Acute poisoning in children is an important public health problem. It is a significant paediatric emergency in both developing and developed countries, leading to preventable morbidity and mortality. While there is substantial research literature on acute childhood poisoning from developed countries, there is a lack of data from developing countries like India due to inadequate and poor surveillance of poisoning-related data.

Aim: To investigate the clinical and epidemiological profile, as well as the outcome, of acute poisoning in children admitted to the paediatric emergency department of a tertiary care hospital in Northeast India.

Materials and Methods: This prospective cohort study was conducted in the Paediatrics department of Assam Medical College and Hospital, Dibrugarh, Assam, India, from April 1, 2021, to March 31, 2022. All children under the age of 12 years who presented to the paediatric department with a history of exposure to toxic substances were included in the study. The admitted children were assessed in terms of demographic variables, type of poison, route of poisoning, time of presentation, circumstances of poisoning, storage place of poison, clinical presentation, and interventions provided. Data were presented as mean and frequency.

Results: A total of 78 children under 12 years of age were enrolled in the study, with a mean age of three years and three months at presentation. The majority of cases (96.2%) involved accidental poisoning, while a small proportion (3.8%) was due to suicidal poisoning. Of the two reported cases of suicidal poisoning, one involved a male child and the other involved a female child. Both children were above six years of age. The most common causes of poisoning were kerosene (34.6%), organophosphorus compounds (10.3%), and liquid mosquito repellents (9.1%).

Conclusion: This study revealed both unintentional and intentional poisoning cases, with a high prevalence of accidental poisoning observed in children below three years of age. Kerosene was identified as the most common cause of childhood poisoning.

Keywords: Child, Insecticides, Morbidity, Mortality, Toxic substance

INTRODUCTION

Acute poisoning in children is an important public health problem and is one of the leading causes of all unintentional injuries globally [1]. It is an important paediatric emergency in both developing and developed countries, with preventable morbidity and mortality [2]. According to World Health Organisation (WHO) statistics, acute poisoning is responsible for more than 45,000 deaths every year among children and youth below the age of 20 years [3]. The profile and outcome of childhood poisoning vary across countries and are influenced by demographics, socio-economic status, level of education, local cultural practices, and the availability and quality of medical facilities [4,5].

Acute poisoning in children is of vital importance because the morbidity and mortality associated with it can be significantly and effectively controlled by appropriate preventive and educational measures. Toddlers are especially predisposed to such mishaps as they are mobile, inquisitive, and unable to differentiate between harmful and harmless things. Studies from developed countries show that common nontoxic household products are now implicated in most paediatric poisonings [6-8]. Cases of poisoning related to toxic drugs and chemicals are reduced in developed countries because of childproof packs and bottles [9], measures which are yet to be implemented in many developing countries. Childhood poisoning accounts for 1-6% of bed occupancy in paediatric hospitals and 3.9% in paediatric intensive care units in India [10-14]. There is substantial research literature about acute childhood poisoning from developed countries. However, there is deficient data from developing countries like India due to inadequate and poor surveillance of poisoning data [15].

Dibrugarh is an industrial city in upper Assam, in Northeast India. Assam Medical College and Hospital (AMCH) is a tertiary referral center for upper Assam and areas in neighbouring states, including Arunachal Pradesh. There are a few studies from India that describe the profile of poisoned paediatric patients from different regions, but the majority of these studies are based on hospital records rather than being prospective in nature [4,10,11,14,16]. Additionally, these studies are now a decade old, and so far, no study is available from this part of India.

Hence, the main objective of the present study is to determine the clinical and epidemiological profile of children brought to the paediatric emergency department of a tertiary care hospital in Northeast India with a history of acute poisoning, along with the outcome of the poisoning.

MATERIALS AND METHODS

This hospital-based prospective cohort study was conducted in the Paediatrics department of Assam Medical College and Hospital from April 1, 2021, to March 31, 2022. The study commenced after obtaining approval from the ethics committee of Assam Medical College (approval no. AMC/EC/5927 dated June 10, 2021). Informed written consent was obtained from the parents or legal guardians of the children included in the study.

Inclusion criteria: All children under the age of 12 with a history of exposure to toxic substances, who were admitted to the paediatric emergency department during the study period, were included in this study. The diagnosis of poisoning was based on the history provided by the parents or caregivers and clinical examination.

Exclusion criteria: Cases of food poisoning, snake bites, dog bites, rat bites, and adverse drug reactions were excluded from the study.

Procedure

The investigator collected data through interviews with the patient attendants, preferably primary caregivers, and by reviewing hospital records. The collected data included the patient's demographic profile, the time interval between poisoning and hospitalisation, the type of poison, clinical manifestations, treatment provided to the patient, outcome, and circumstances of poisoning. These data were documented on a pre-structured proforma. The modified BG Prasad classification, updated for the year 2021, was used to classify the socio-economic status [17]. Data confidentiality was maintained throughout all stages of the study.

STATISTICAL ANALYSIS

The collected data were entered into a Microsoft Excel 2007 spreadsheet. Descriptive statistics, including frequency, percentage, mean, and standard deviation, were calculated. Appropriate significance tests were conducted based on the type of data. The chi-square test was used for qualitative data. A p-value less than 0.05 was considered to be significant.

RESULTS

A total of 78 children under the age of 12 were enrolled in the study, with a mean age of presentation of 39.14±35.17 months or three years and three months. The majority of the children, 50 (64.1%), were below three years of age. The minimum age reported was 11 months, with only one case, while the rest of the 17 cases were in the 12-month age group. In terms of gender, male children outnumbered female children, with 52 (66.7%) males and 26 (33.33%) females. The majority of incidents, 22 (28.2%), belonged to lower-middle-class families. The maximum number of cases, 51 (65.4%), were reported from Dibrugarh district, while 28 (34.6%) cases were referred from outside the district [Table/Fig-1].

Socio-demographic characterstics		Number (n=78)	Percentage %
Age	0-3 years	50	64.1
	>3-6 years	12	15.4
	>6-9 years	10	12.8
	>9-12 years	6	7.7
Sex	Male	52	66.7
	Female	26	33.3
Educational status of mother	Illiterate	21	26.9
	High school	46	59.0
	Graduate	6	7.7
	Postgraduate	2	2.6
	Data missing	3	3.8
Educational status of father	Illiterate	13	16.7
	High school	51	65.4
	Graduate	7	9.0
	Postgraduate	4	5.1
	Data missing	3	3.8
Socio-economic status	Class-I	10	12.8
	Class-II	12	15.4
	Class-III	11	14.1
	Class-IV	22	28.2
	Class-V	15	19.2
	Data missing	8	10.2
District from which referred to hospital	Within district	50	64.1
	Outside district	28	34.6

[Table/Fig-1]: Socio-demographic characteristics of study population.

The median time of presentation to the Paediatric emergency department was between 1-6 hours in 56 cases (71.8%). Only 11 (14.1%) patients were brought to the hospital within one hour of exposure to the poisoning agent. A total of 63 (80.8%) patients were symptomatic at the time of presentation. Clinical manifestations were dominated by respiratory distress in 36 patients, neurological features in 14 patients, followed by gastrointestinal manifestations in 13 patients. Gastric lavage could only be performed in 12 patients (14.4%). A specific antidote was given to seven patients (9%). Most of the patients improved with adequate symptomatic and supportive treatment (84.6%). Out of the 78 patients enrolled, 69 were discharged, seven Left Against Medical Advice (LAMA), and two expired [Table/Fig-2].

		Number (n=78)	Percentage %
Circumstance of poisoning	Accidental	76	97.4
	Suicidal	2	2.56
Type of poison	Organophosphorus#	8	10.3
	Kerosene	27	34.6
	Petrol	6	7.7
	Datura	6	7.7
	Mosquito repellent	7	9
	Medications/Drugs	4	5.1
	Benzodiazepine	1	
	Oxcarbamazepine	1	
	5% Permethrin	2	
	Other hydrocarbons	9	11.5
	Diesel	5	
	Thinner	4	
	Other corrosives (Phenol)	1	1.3
	Unknown	10	12.8
Route of exposure	Oral	77	98.7
	Inhalation##	1	1.3
Time of presentation to emergency department since exposure	<1 hour	11	14.1
	1-6 hours	56	71.8
	6-12 hours	5	6.4
	12-24 hours	4	5.1
	>24 hours	1	1.3
	Data missing	1	1.3
Clinical features	Symptomatic	63	19.2
	Asymptomatic	15	80.8
Intervention	Medical care and observation	66	84.6
	Gastric lavage	12	14.4
Antidote	Given	7	9
	Not given	71	91
Outcome	Expired	2	2.6
	Survived discharged	69	88.5
	Survived LAMA	7	9

[Table/Fig-2]: Pattern of poisoning, clinical features, treatment, and outcome.
#Exact nature of OPP agent was not mentioned in proforma. Hence, it was not asked to patient's parents; ##Inhalation route was for organophosphorus poisoning

In the present study, most of the poisoning cases were due to kerosene, followed by organophosphorus compounds and liquid mosquito repellents. There were six (7.7%) cases of petrol poisoning, the second most common hydrocarbon poisoning observed in this study. In the category of "Other Hydrocarbon" poisoning, there were five cases of diesel poisoning and four cases of mineral spirits, commonly known as "Thinner" used in painting. Six (7.7%) cases of Datura poisoning were reported, and all six cases occurred in the same family. Among the four cases of medication/drug poisoning reported, two were due to a scabicidal agent (Zeroscab or 5% Permethrin), and one each was due to oxcarbamazepine and benzodiazepine. Only one case of corrosive agent poisoning (Phenol) was reported. The exact nature of the

poisoning agent could not be determined in 10 (12.8%) of the enrolled patients [Table/Fig-2].

The most common route of exposure was oral, with 77 cases (98.7%), followed by inhalation in one case (1.3%). Regarding the storage of the offending agent, 65 respondents (83.5%) reported that the chemical/medicine was stored in places easily accessible to the child. Only in 13 cases (16.5%), the chemical/medicine was stored in places that were not easily approachable by the child. The majority of accidental poisonings, 27 cases (35.5%), were due to kerosene, and the circumstance of poisoning was significantly associated with the type of poison (p=0.02). In 20 out of the reported 27 cases of kerosene poisoning, the offending agent was stored in an easily accessible place. Even agricultural fertilisers like organophosphorus were stored in easily reached areas in five out of the eight reported cases of organophosphorus poisoning [Table/Fig-3].

DISCUSSION

During the one-year period of this study, there were 78 admissions. The majority of cases were reported in children below the age of three, which is consistent with findings from other studies in developing countries such as India [4], Pakistan [18], Iran [19], Bangladesh [20], and Ethiopia [21]. Males outnumbered females in this study, which aligns with previous research [4,18-21]. A similar finding was observed in a previous study from the USA, where approximately 60% of children were under the age of three, and 50.6% were male [22,23].

Childhood poisoning can occur both unintentionally and intentionally. In this study, the majority of poisoning cases were accidental, which is consistent with findings from other studies [4,18,21,24]. Nearly 97.4% of reported cases in this study were of accidental nature.

		Poison type n (%)									p-value
		OP	Kerosene	Petrol	Datura	Mosquito repellent	Medications/ Drugs	Other hydrocarbons	Other corrosives	Unknown	
Circumstance of poisoning	Accidental	6 (7.9)	27 (35.5)	6 (7.9)	6 (7.9)	7 (9.2)	4 (5.3)	9 (11.8)	1 (1.3)	10 (13.2)	**0.02**
	Suicidal	2 (100)	0	0	0	0	0	0	0	0	
Storage place of poison	Out of reach	3 (23.1)	7 (53.8)	0	0	0	2 (15.4)	1 (7.7)	0	0	0.094
	Easily reached	5 (7.7)	20 (30.8)	6 (9.2)	6 (9.2)	7 (10.8)	2 (3.1)	8 (12.3)	1 (1.5)	10 (15.4)	
Outcome	Death	1 (50.0)	1 (50.0)	0	0	0	0	0	0	0	0.166
	Survived	7 (9.2)	26 (34.2)	6 (7.9)	6 (7.9)	7 (9.2)	4 (5.3)	9 (11.8)	1 (1.3)	10 (13.2)	

[Table/Fig-3]: Type of poison and relation with circumstance of poisoning, storage place and outcome.

In most cases, poisoning was accidental, with 76 patients (96.2%), compared to 2 cases (3.8%) of suicidal poisoning. Both cases of suicidal poisoning involved one male and one female child, both above the age of six. Appropriate police information was provided for both cases, and both patients were referred to a child psychologist for counseling due to consuming organophosphorus after a trivial quarrel with siblings. No cases of homicidal poisoning were reported.

Out of the 78 patients, two died, while 76 patients survived without any residual morbidity. The first patient who expired was a one-year-old female child from Tinsukia district who accidentally ingested kerosene. She presented to the Paediatric emergency department within six hours of ingestion with severe respiratory distress. Despite receiving care in the Paediatric Intensive Care Unit (PICU), she expired eight hours after hospital admission. The second patient who expired was a two-year-old male child from Lakhimpur district who presented to our Paediatric emergency department more than six hours after accidental ingestion of organophosphorus and died within 24 hours of hospital admission.

Accidental poisoning was more common in the younger age group of 0-3 years, with 50 cases (65.8%), while one case each of suicidal poisoning was observed in the 6-9 years and 9-12 years age categories, respectively. The association between the circumstance of poisoning and age group was found to be statistically significant (p=0.035). The occurrence of poisoning was higher in males than females in all age groups. Most cases of poisoning in male children occurred in the 0-3 years age category (n=50), and this trend decreased with advancing age, but males still outnumbered females in all age categories [Table/Fig-4].

		Age category				p-value
		0-3	3-6	6-9	9-12	
Circumstance of poisoning	Accidental	50 (65.8)	12 (15.80)	9 (11.8)	5 (6.6)	**0.035**
	Suicidal	0	0	1 (50.0)	1 (50.0)	
Sex	Male	34 (65.4)	8 (15.4)	6 (11.5)	4 (7.7)	0.971
	Female	16 (61.5)	4 (15.4)	4 (15.4)	2 (7.7)	

[Table/Fig-4]: Age group of poisoning and relation with sex, circumstance of poisoning.

However, two cases of intentional poisoning were reported, both of which involved children between the ages of 6-12. The high prevalence of accidental poisoning in children under the age of three can be attributed to their newfound mobility, curious nature, and tendency to put objects in their mouths [14]. It is suggested that young boys may be more active than girls, making them more vulnerable to such accidents [25]. It is unfortunate to observe cases of suicidal poisoning as children age, which may be related to stress associated with academic excellence, peer and family relationships, and societal pressures. Factors such as increased independence, easy access to mobile phones, less parental supervision, and an inability to understand cause and effect due to immaturity may also contribute to childhood suicidal poisoning [25].

The two most common poisoning agents in this study were kerosene, followed by organophosphorus compounds. These agents were easily accessible in 83.5% of cases. The prevalence of kerosene poisoning as the most common cause in childhood poisoning is consistent with studies from India [26] and Bangladesh [20]. The geographic and socio-demographic profile of Bangladesh and Assam are similar, and Assam even shares an international border with Bangladesh. The use of kerosene for domestic purposes, making it easily available in households, is likely the reason for its high prevalence as a poisoning agent in this study [26]. In almost all cases of kerosene poisoning, it was stored in soft drink plastic bottles, leading children to mistake it for a soft drink. Ingestion was the most common route of poisoning. According to the World report on child injury prevention, fuels such as kerosene, pharmaceuticals, and cleaning agents are common agents of poisoning in low-income and middle-income areas [27], which is consistent with the findings of this study.

The second most common poisoning agent in this study was pesticide, specifically organophosphorus compounds. Out of the eight reported cases, two were of suicidal nature. Both children were between the ages of 6-12 and consumed the poison after a fight with their siblings. Both cases were referred to a child psychologist for counseling. The easy availability of organophosphorus compounds in areas with tea plantations, which is an important industry in upper Assam, may be a contributing factor. Organophosphorus

S. No.	Authors name (Reference number)	Place and year of the study	Sample size	Study population	Median age	M:F ratio	Reasons of poisoning
1	Present study	Assam Medical College and Hospital, Dibrugarh, Assam	n=78	Children under 12 years of age	3 years and 3 months	2:1	Most of the poisoning was due to Kerosene (34.6%) followed by other hydrocarbons (11.5%) and Organophosphorus (10.3%)
2	Ahmed A et al., [20]	Dhaka Medical College Hospital, Bangladesh	n=223	Children under 10 years of age	31-35 months	1.5:1	Kerosene was the most prevalent cause (33%) of accidental poisoning while insecticide/pesticide ranked second (26.5%)
3	Molla YM et al., [21]	University of Gondar, Ethiopia	n=82	Children between 0-18 years of age with history of poisoning	<5 years	1.8:1	Venom was the most frequent offending agent (26.8%), followed by insecticides (organophosphates) (21.5%)
4	Gheshlaghi F et al., [19]	Alzahra University Hospital, Isfahan, Central Iran	n=344	Children under 10 years of age	1-3 years	1:1	Drugs were the most common agents causing the poisoning (58.1%), followed by Hydrocarbons (13.1%), and opioids (9.3%)
5	Abbas SK et al., [18]	Liaquat National Hospital, Karachi, Pakistan	n=43	Children under 12 years of age	<3 years	1.2:1	Pharmaceutical products (34.9%) followed by kerosene oil (25.6%)
6	Bhat NK et al., [4]	Himalayan Institute of Medical Sciences, Dehradun, Uttarakhand	n=117	Children under 18 years of age	4 years	1.4:1	Insecticides (37.61%), drugs (25.64%), and Kerosene oil (18.8%) were the agents most frequently implicated
7	Hamid MH et al., [24]	Children's Hospital and the Institute of Child Health Lahore, Pakistan	n=346	Children between 1 month till 15 years of age	18 months	1.4:1	Pharmaceutical products were the leading cause (51%) followed by petroleum products (23%)

[Table/Fig-5]: Table showing similar studies and their comparison with present study [4,18-21,24].
MC: Most common

compounds were also found to be the most common poisoning agent in studies from Uttarakhand in India [14] and Ethiopia [21]. These findings contrast with studies from Pakistan [2,24] and Iran [19], where drugs/pharmaceutical agents were the most common cause of childhood poisoning.

It is important to note that all the poisoning agents, including kerosene, organophosphorus compounds, petrol, thinner, and other corrosives, were not stored in childproof packs or bottles. Instead, they were stored in soft drink or mineral water plastic bottles. Additionally, all these substances were kept in easily accessible areas. Even medications and drugs were stored in easily reached areas. Although parents were aware of the potential harm these substances could cause, they did not take precautions in storing or handling them.

Most of the poisoning cases occurred when parents were at home. In this study, the majority of poisoning cases were from the tea tribe community. These families have low levels of literacy and often live in deprived conditions, with small, overcrowded houses. As a result, household items are stored in a crowded manner in these small rooms. Factors such as low educational status, poor parenting skills, lack of awareness, living in poor socio-economic conditions, and failure to take precautionary measures may contribute to these incidents [25]. This psychological paradox in the region calls for further study.

In terms of outcomes, most children recovered as 71.8% of cases presented to the study facility within six hours. This is a relatively fast treatment-seeking time compared to other conditions, mainly due to the anxiety parents experience when their child ingests a toxic substance. Although 80.8% of children were symptomatic at the time of presentation, the majority only required symptomatic treatment and were kept under observation for any delayed manifestations before being discharged. Specific antidotes were given to seven patients, all of whom had ingested Datura. In this study, two patients died, both of whom were under the age of three. One child died from kerosene ingestion, and the other died from organophosphorus poisoning. A comparison of the findings in this study with contrasting studies is shown in [Table/Fig-5] [4,18-21,24]. The strengths of this study include its relatively large sample size and prospective nature. The study successfully achieved its objective of assessing the various agents of poisoning and the socio-demographic profile of children brought to the Paediatrics department with a history of poison ingestion. Mass media campaigns and awareness programs are needed to promote early prevention and management of accidental poisoning cases. Cases were reported from both urban and rural areas in a uniform manner, with a few cases also reported from the neighbouring state of Arunachal Pradesh. This is a strength of the study as it provides a comprehensive picture of childhood poisoning in upper Assam. The study has important implications for public health and highlights the high prevalence of accidental household poisoning in the Indian population of the northeastern region. It is the first study from this part of the state to highlight this important yet preventable public health problem.

Limitation(s)

This study was conducted during the worldwide Cononavirus Disease-2019 (COVID-19) restrictions, and as a result, some cases, especially from far away areas, may not have reported to present study hospital. Patients who Left Against Medical Advice (LAMA) from the hospital were assumed to have recovered, as they were stable during their stay in the emergency room.

CONCLUSION(S)

Kerosene was the most common cause of childhood poisoning. Simple measures such as parental education, safe storage, and the use of child-proof packaging and containers for drugs and insecticides could significantly prevent a large proportion of morbidity and mortality related to childhood poisoning. Joint efforts from the government, petroleum companies, retailers, and community-based organisations are required to distribute kerosene containers with child-resistant closures that display pictograms discouraging drinking. These measures can help promote awareness and prevent childhood poisoning.

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