SSR Institute of International Journal of Life Sciences
ISSN (O): 2581-8740 | ISSN (P): 2581-8732
Dey *et al*., 2025
doi: 10.21276/SSR-IIJLS.2025.11.1.29

Original Article

open access

Clinico-epidemiological Profile and Outcomes of Hydrocarbon Poisoning in Paediatric Patients at a Tertiary Care Center in West Bengal

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Received: 09 Aug 2024/ Revised: 08 Oct 2024/ Accepted: 27 Nov 2024

ABSTRACT

Background- Hydrocarbon poisoning is a significant health concern in pediatric patients, particularly among those under five years of age. Given the common accessibility of various hydrocarbon products in domestic environments, this study aims to analyze the clinical profile, demographics, and outcomes of hydrocarbon poisoning in children admitted to a tertiary care center.

Methods- An observational study was conducted at Burdwan Medical College and Hospital over 18 months. Children presenting with a history of hydrocarbon poisoning were included, resulting in a sample size of 200 participants. Relevant data on age, gender, socioeconomic status, type of hydrocarbon ingested, presenting symptoms, timing of presentation, treatment received, and clinical outcomes were recorded. Statistical analysis was performed using SPSS V.24 to summarize and evaluate the collected data.

Results- The findings revealed that 81% of the cases involved children aged ≤5 years, with kerosene accounting for the majority of exposures (75.5%). The most prevalent symptoms included fever (60%) and vomiting (59%). A significant number of children (71%) presented to the hospital within 12 hours post-exposure, and the average duration of hospitalization was 7.57 days. The outcome was favorable, with a discharge rate of 99% and only 1% mortality reported.

Conclusion- This study underscores that hydrocarbon poisoning predominantly affects young children due to accidental ingestion, with kerosene being the most common agent. Prompt medical intervention and effective management lead to high recovery rates, emphasizing the importance of preventive measures, including enhanced awareness and supervision among caregivers to mitigate the risk of poisoning.

Key-words: Clinico-epidemiological Profile, Outcomes of Hydrocarbon Poison, Paediatric Patients, United Nations Children's Fund (UNICEF)

INTRODUCTION

A common medical emergency among youngsters is poisoning. Most poisonings in youngsters are unintentional. In India, poisoning accounts for 1.6% to 6% of hospital beds for children and 3.9% of pediatric intensive care unit beds [1]. The World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) claim that childhood poisoning is prevalent because kids are naturally interested and utilize all their senses to investigate their surroundings, most often by mouthing [2]. Due to factors like easy availability to poison, children with behavioral and temperamental problems, increasing screen time, inadequate supervision, etc., poisoning in children is regrettably becoming more widespread. These mishaps are avoidable since ignorance, inattention, and a lack of adult supervision are the primary causes of these instances.

How to cite this article
Dey S, Banerjee M, Sarkar S, Lama K. Clinico-epidemiological Profile and Outcomes of Hydrocarbon Poisoning in Paediatric Patients at a Tertiary Care Center in West Bengal. SSR Inst Int J Life Sci., 2025; 11(1): 6809-6814.

Access this article online
https://iijls.com/

doi: 10.21276/SSR-IIJLS.2025.11.1.29

In clinical settings, "hydrocarbon ingestion" refers to the oral ingestion of petroleum distillates such as motor oil, mineral oil, kerosene, gasoline, lamp oil, cigarette lighter fluid, and naphtha, along with other products like toluene, turpentine, cosmetics (such as baby oil, hair oil, and sunscreens), and cleaning solvents (such as wood oil and metal cleansers, spot removers). There are three distinct types of hydrocarbons based on their chemical and medicinal characteristics, such as aliphatic hydrocarbons. There are four classes of hydrocarbons based on viscosity: extremely low, low, intermediate, and high viscosity hydrocarbons, as well as halogenated and aromatic hydrocarbons. Given the prevalence of hydrocarbon compounds in homes, this is not surprising. In the winter, children have access to kerosene, and in the summer, they can use charcoal lighter fluid. Often, visually appealing, and scented products—like furniture polishes—are stored incorrectly in drinking glasses, water bottles, or unlabeled containers. The degree of exposure, the hydrocarbon's volatility, and its viscosity all influence the inflammatory response in the lungs [3,4]. A higher risk of aspiration and lung damage is linked to hydrocarbons with higher volatility, low viscosity, and decreased surface tension because they can readily enter the bronchial tree and spread across the respiratory mucosal membrane. They can be prevented because the majority of these chemical accidents or ingestions occur in households [5].

Pulmonary aspiration is the primary cause of the morbidity and mortality associated with hydrocarbon consumption. The chemical breakdown of surfactant in the alveoli and distal airways is most likely the cause of pulmonary injury. Additionally, the hydrocarbon increases the vascular endothelium's permeability following chemical pneumonitis because of widespread hemorrhagic alveolitis [6]. Due to myocardial hydrocarbon sensitivity to circulating catecholamines, cardiotoxicity typically presents as dysrhythmias. Coma, lethargy, ataxia, and confusion are common systemic symptoms. Abrupt nausea and vomiting are common after ingestion [7]. Since there are no known treatments for hydrocarbon poisoning, care is mostly supportive and symptomatic. Although it is recommended for large volume (>30ml) ingestions or hydrocarbons with intrinsic systemic toxicity, gut cleaning is still a contentious topic [8]. Intubation and mechanical ventilation may be necessary for severe lung injury. Mechanical ventilation and intubation may be necessary for severe lung injury. Because kerosene is still widely used in developing nations for cooking, heating, and lighting, child poisoning incidents are still somewhat regular in places like India, other South American nations, and African nations [9,10].

Because hydrocarbons are widely used for heating, lighting, and cooking in middle- and low-income regions, accidental consumption of these substances is 50 times more prevalent there than in high-income countries. Young children's respiratory and metabolic systems are still developing, making them more vulnerable to accidental intake. Due to their immature sense of taste and smell, they are more inclined to consume. Because people think hydrocarbons are a familiar and enjoyable beverage, they confuse them for water or soft beverages [11,12]. The goal of the current study was to examine the clinical and demographic characteristics of hydrocarbon poisoning in children, who were over 18 months old and presented to a tertiary care facility.

MATERIALS AND METHODS

Study Design and Population- This observational study was carried out in the pediatric department of Burdwan Medical College and Hospital, with an emphasis on children who were admitted to the pediatric ward or pediatric critical care unit as well as those who presented in the pediatric emergency department. The study period spanned from January 2023 to June 2024.

Sample Size Calculation- The sample size for this study was determined using the formula $\mathbf{N=}Z^2pq/d^2$

Where, N represents the sample size,
Z is the value of the Z statistic at a 95% confidence level (1.96),
p is the expected prevalence (15% or 0.15),
q is calculated as (1−p) which equals 0.85,
d is the precision set at 5% (0.05).

The calculated sample size was 195.9, which was subsequently rounded up to 200.

Inclusion Criteria- The study included children who were admitted with a history of poisoning, whether it was accidental, suicidal, or homicidal.

Exclusion Criteria- Children who presented with other chronic conditions that have comparable clinical signs

doi: 10.21276/SSR-IIJLS.2025.11.1.29

and cases involving drug allergies were not included in the study.

Research Design- Numerous factors were investigated in the study, such as age, gender, social and economic standing, nutritional status (including height and weight), vital signs, the kind of poisoning ingested, the onset of symptoms, the time of presentation, the treatment given, the length of hospitalization, and recovery or mortality outcomes. A pre-designed and pre-tested schedule, consent form, BP instrument, stethoscope, and laboratory investigation reports were utilized as study tools. The study technique involved obtaining informed and written consent from each patient selected, conducting a detailed history and clinical examination, and maintaining proper records for follow-up. Essential data concerning laboratory investigations and any interventional management were collected through data gathering from the pediatric emergency department, pediatric ward, or pediatric intensive care unit.

Statistical Analysis- Microsoft Excel was used to tabulate the data, while SPSS V.24 software was used for analysis. The mean and standard deviation of the continuous variables were displayed. Both frequency and percentage were used to display the category data. Relevant tables and graphs have been included with the results.

Ethical Approval- The study was only carried out after receiving the appropriate ethical approval from BMCH's institutional ethical council. Before being enrolled in the study, each subject gave their signed and informed consent.

RESULTS

A distribution of age among individuals indicated that 81.0% of the sample population were aged ≤5 years, 16.5% were between 6-10 years old, and 2.5% were older than 10 years. Additionally, the mean age of the population was reported as 4.04±2.66 years. The distribution of gender indicated that 72.5% were male and 27.5% were female. The distribution of socioeconomic status among the individuals showed that 10.0% were classified as upper class, 16.5% as middle class, and the majority, 73.5%, fell into the lower socioeconomic status category. The distribution of the season of presentation among the individuals showed that 55% of the cases were presented during the summer, 7.5% during the rainy season, 16% during winter, and 21.5% during spring. The distribution of the nature of poison among the individuals indicated that 75.5% of cases involved exposure to kerosene, 21.0% to turpentine, and 3.5% to naphthalene.

Table 1 presents the distribution of symptoms among individuals. It shows that fever and vomiting are the most prevalent symptoms, each reported in 60% and 59% of cases, respectively. Other common symptoms include cough (39.0%), breathing difficulty (36.0%), and pain abdomen (32.5%). Less common symptoms include constipation (6%) and seizure (4%).

Table 1: Distribution of Symptoms.

Symptoms	N	%
Fever	120	60.0%
Vomiting	118	59.0%
Cough	78	39.0%
Breathing difficulty	72	36.0%
Pain abdomen	65	32.5%
Constipation	12	6.0%
Seizure	8	4.0%

The distribution of the time of presentation among individuals is presented in Fig. 1. It indicated that 71.0% of cases presented within 12 hours of the incident, 18.5% between 12-24 hours, and 10.5% presented more than 24 hours after the incident. The mean duration of presentation was reported as 12.22±7.26 hours. The distribution of radiograph findings among individuals showed that, among the radiograph findings, pneumonitis was reported in 36.0% of cases, and 54.0% of cases showed normal radiograph findings.

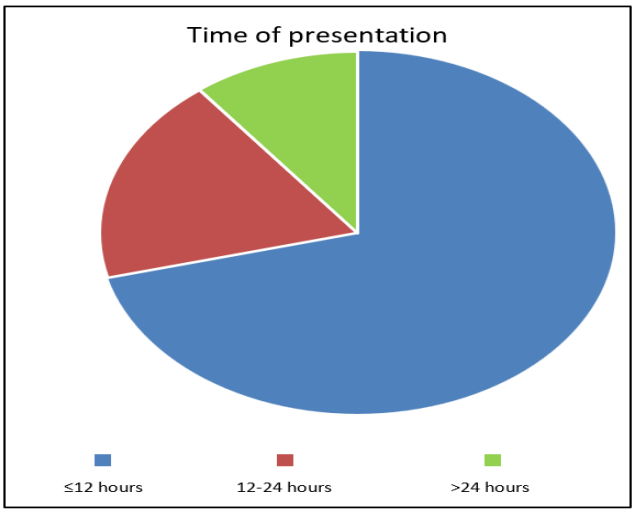

Fig. 1: Distribution of time of presentation.

doi: 10.21276/SSR-IIJLS.2025.11.1.29

Fig. 2 displays the distribution of the treatment. Moist O_2 inhalation was given to 36.0% of the patients, Nebulization with bronchodilators was given to 37.5% of the patients, IV Benzodiazepines were given to 4.0% of the patients, Pyrigesics was given to 60.0% of the patients and Antiemetic was given to 59.0% of the patients.

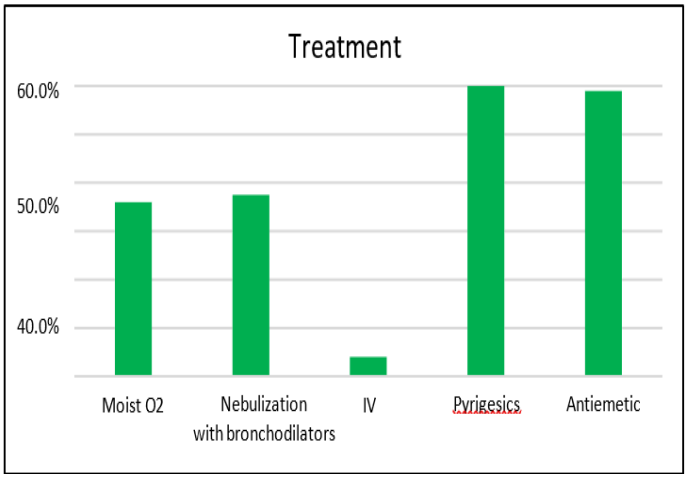

Fig. 2: Distribution of the treatment.

Table 2 displays the distribution of hospital stay durations by individual. 62.5% of patients stayed in the hospital for less than five days, 23.5% for six to ten days, and 14.0% for more than ten days, according to the data. The mean duration of hospital stay is reported as 7.57±3.49 days. The distribution of the outcomes showed that 99.0% of the patients were discharged and 1.0% died.

Table 2: Distribution of duration of hospital stay.

Duration of hospital stay	N	%
≤5 days	125	62.5%
6–10 days	47	23.5%
>10 days	28	14.0%
Mean duration	7.57+3.49	

DISCUSSION

The goal of this study was to examine the clinical and demographic characteristics of hydrocarbon poisoning in children. It found that 81% of the sample population was under the age of ten, 16.5% were between the ages of six and ten, and only 2.5% were over the age of ten. The mean age of the population was reported as 4.04±2.66 years. Supporting this finding, Thilakavathi *et al.* [13] noted that among their analyzed age groups, 4% of children were less than one year old, with a predominant 88% falling within the 1-to-2-year range; additionally, 5% were between 3 to 6 years old, and 3% belonged to the 6 to 12-year category. This suggests that the greatest number of incidents happened in children between the ages of one and three. According to Jadhav *et al.*[14] the majority of impacted children (84%) were between the ages of 1 and 5; 14% were between the ages of 5 and 10.

In a study examining the distribution of gender among cases of poisoning, it was found that 72.5% of the subjects were male, while 27.5% were female. Supporting this finding, Jadhav *et al.*[14] reported on a total of 50 cases analyzed, which included 36 boys and 14 girls, indicating that the incidence of poisoning was significantly higher in males at 72%, nearly three times that of females at 28%. A p-value of 0.003 indicated that this gender gap was statistically significant. Furthermore, Thilakavathi *et al.* [13] noted a similar pattern in their study, indicating that 61% of the respondents were male, with 71 male children and 45 female children.

In a present study, the distribution of poison exposure revealed that 75.5% of cases involved kerosene, 21.0% involved turpentine, and 3.5% involved naphthalene. This result is consistent with that of Jadhav *et al.,* who found that the most common poisoning was hydrocarbon poisoning, especially from kerosene, which accounted for 32% of all cases. Insecticide poisoning came in second at 10% [14]. Studies by Ashgar *et al.* [15] and Kohli *et al.* [16] showed similar findings, indicating a frequency of 27%.

In contrast, research conducted in Ethiopia identified drugs—both prescription and over-the-counter—as the most common agents responsible for poisoning incidents [17]. Additionally, Palmer *et al.* highlighted that gasoline accounted for 24.6% of total cases, followed by lubricating oils and motor oils at 19.9%, other hydrocarbons at 14.9%, lamp oils at 11.3%, and lighter fluids or naphtha at 10.3% [18]. Furthermore, Suting *et al.* found that drugs and medications were the leading agents in poisoning cases, representing 19.2%, with prallethrin following closely at 13.7% [19].

The symptom distribution among individuals revealed that fever and vomiting were the most prevalent, reported in 60.0% and 59.0% of cases, respectively. Other frequently observed symptoms included cough (39.0%), breathing difficulty (36.0%), and abdominal pain (32.5%), while less common symptoms included

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constipation (6.0%) and seizures (4.0%). Supporting this, Karthika *et al.* found that fever and vomiting were noted in 57% of cases, accompanied by cough and respiratory distress in 38% [20]. Additionally, Thilakavathi *et al.* highlighted cough as the predominant symptom in kerosene poisoning, affecting 62% of cases, with breathlessness in 43% and fever in 41%, often lasting 2-6 days. Symptoms such as vomiting, abdominal pain, and CNS manifestations like drowsiness and seizures were also documented, with all cases improving following treatment [13]. In contrast, Suting *et al.* observed that most cases were asymptomatic, with vomiting as the primary symptom [19], while other studies reported respiratory distress and unconsciousness as common presentations, particularly where drug poisoning was prevalent [21].

The study also analyzed the distribution of presentation times among individuals following poisoning incidents. The findings revealed that 71.0% of cases presented within 12 hours of the incident, while 18.5% presented between 12 to 24 hours, and 10.5% sought medical attention more than 24 hours after exposure. The mean duration of presentation was calculated to be 12.22±7.26 hours. The majority of patients (78%) arrived at the hospital for therapeutic intervention within 4 hours of ingesting the toxic agent, according to Jadhav *et al.* [14]. It is noteworthy, however, that six patients experienced a delay of more than 24 hours between ingestion and presentation.

Radiograph findings among individuals revealed that pneumonitis was reported in 36.0% of cases, while 54.0% exhibited normal radiograph results. According to Thilakavathi *et al.,* only 5% of children had normal chest X-rays, whereas 45% had right lower lobe infiltrates, 32% had left lower lobe infiltrates, and 18% had bilateral lower lobe infiltrates [13]. Furthermore, Karthika et al. reported that of the 19 patients who had chest X-rays (90.5%), 12 patients (57%), one patient (4.6%), and one child developed pleural effusion as shown on a follow-up chest X-ray taken on the fifth day of hospitalization; interestingly, the chest X-ray was normal in 33% of cases [20].

In our study, the distribution of treatments administered to patients included Moist O2 inhalation for 36.0%, nebulization with bronchodilators for 37.5%, IV benzodiazepines for 4.0%, pyrigesics for 60.0%, and antiemetics for 59.0%. According to Karthika *et al.,* eight children (38%) received antibiotic treatment for respiratory distress that was accompanied by fever, neutrophilic leucocytosis, and elevated CRP levels, six (28.6%) required oxygen therapy, and two (9.2%) needed intensive care unit care [20]. After a 24-hour observation period, Jadhav *et al.* observed that most patients merely needed supportive treatment in the form of gastric lavage and antacids, enabling them to be released; interestingly, none of the patients needed mechanical breathing [14].

LIMITATIONS

The current study includes several limitations that need to be noted despite our best efforts. First, the findings may not be as broadly applicable as they may be due to the limited sample size. Furthermore, the study was only carried out at one location, which might have limited the population's diversity and the findings' generalizability. Finally, because the study was conducted at a tertiary care hospital, there is a chance that hospital bias will have an impact on the results because the cases might not accurately represent the situations that arise in primary or secondary healthcare facilities.

CONCLUSIONS

Hydrocarbon poisoning is a significant cause of acute poisoning in children, predominantly affecting those under five years old, often through accidental exposures, with kerosene being the most common agent involved. Effective management protocols for acute hydrocarbon poisoning can help avoid unnecessary investigations and limit the use of antibiotics, which are only needed when secondary bacterial infections arise. Timely hospital presentation and diligent monitoring lead to excellent outcomes, typically without mortality. To prevent such incidents, enhanced parental supervision is essential. For cases involving drug ingestion, aggressive treatment through gastric lavage and appropriate doses of activated charcoal is recommended. In instances of suspected organophosphorus poisoning, immediate administration of atropine should be initiated while simultaneously conducting decontamination. During all poisoning scenarios, continuous monitoring of the airway, breathing, and circulation is critical, with intravenous lines established to enable prompt medical intervention as necessary.

doi: 10.21276/SSR-IIJLS.2025.11.1.29

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Data collection- Karisma Lama
Data analysis and interpretation- Subhendu Dey
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Article editing- Subhendu Dey
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