

# Factors associated with hydrocarbon ingestion in children

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## Abstract

**Objective:** To investigate the types of hydrocarbon ingested by children and identify factors associated with hydrocarbons ingestion.

**Patients and Methods:** It was a hospital based case control study in which medical records of sixty seven children with hydrocarbon ingestion, admitted through emergency department between January 2001 to December 2005 of Aga Khan Hospital were reviewed. Variables such as age, sex, types of hydrocarbons, amount ingested, socioeconomic status, family size, number of children, type of containers, trend of ingestion during hot weather, length of stay at hospital along with the outcomes were evaluated.

**Results:** Out of 67 patients, 53(79%) were male and 14(21%) were female. Majority of children 36(54%) were between the ages 2-5 years. Kerosene oil 59(88%) was the most commonly ingested hydrocarbons. Socio-economically 48(71%) children belonged to lower middle class. Children with large family size ( $\geq 3$  siblings/family) were more commonly affected. Hydrocarbon were mostly 41(61%) stored in beverages and mineral water bottles. The accident occurred in 43 (65%) during summer, whereas 34 (56%) patients had presented with fever and cough. Consolidation of lungs was found in 38 (56%) cases. Majority 53(79%) of the patients were discharged from the hospital within the first 24 hours of admission. Male, age <2 years, large family size, poor socioeconomic status, hot weather (afternoon and summer vacations), kerosene oil, unsafe containers were the major factors leading to hydrocarbon ingestion in this study.

**Conclusion:** There is a need for strategic planning with parent awareness programs to reduce the hydrocarbon poisoning in our children (JPMA 58:608; 2008).

## Introduction

Chemicals are the natural and important part of our environment. Hence chemicals are inevitably used daily by us.<sup>1</sup> Hydrocarbons are one of the natural chemicals that we use in our kitchens, cabinets, basements, and garages. Moreover, most accidents related to spilling or ingestion of such chemicals occur mostly in homes (75-99%), therefore being preventable.<sup>2</sup> Children are exposed to hydrocarbons either by ingestion, inhalation or having contact with the skin.

Poisoning ranked 6th among the causes of injury related preventable death in (under 14 years) children.<sup>3</sup> It ranked 12th among the common causes of admission in the paediatric ward.<sup>4</sup> According to consumer product safety commission in United States, incidence of poisoning in children was 450/100,000 population in 1998.<sup>2</sup>

Kerosene oil is the commonest hazardous substance which has been ingested accidentally by children in developing countries as Pakistan, India, Sri Lanka and Middle East.<sup>5-7</sup> In Pakistan limited data is available on hydrocarbon ingestion and its associated risk factors. However few studies have been done focusing on kerosene oil poisoning, their clinical effect and consequences.<sup>8</sup>

Hydrocarbons are composed of large number of

organic compounds made up of carbon and hydrogen atoms that are classified in two broad categories high viscosity products and low viscosity products. High viscosity products include substances like vaseline and motor oils, while low viscosity products include furniture polish, spirits, kerosene oil and turpentine oil. Chlorinated hydrocarbon (organo chlorine) insecticides, solvents, and fumigants are also widely used. These compounds are highly toxic. The toxicity of these agents depends on their molecular size, volatility and the dose ingested.<sup>1</sup>

Low viscosity products are more likely to be ingested and cause more damage to lung and nervous system. Most of these accidental poisonings occur in children. Ingestion is rarely more than 10 ml but as little as 2 ml entering in to the tracheobronchial tree can cause severe chemical pneumonitis.<sup>9</sup> Kerosene oil has less systemic effects because it is not absorbed from the gastrointestinal tract.<sup>10</sup>

The objective of this study was to investigate the common types of hydrocarbon ingestion presenting at the Aga Khan University Hospital, Karachi.

## Methods

This was a retrospective case series of paediatric patients admitted to the Aga Khan University Hospital

during the five year period from January 1, 2001 till December 31, 2005. Medical records of all admitted patients during the study period were searched for admission and discharge diagnoses of "hydrocarbon" (kerosene, gasoline, turpentine, spirit and furniture polish) ingestion. Children with history of drugs/chemicals or corrosives ingestion were excluded.

Data was collected on a pre designed and pre tested proforma. Information about the age, sex, type of the hydrocarbon and amount ingested, socioeconomic status, family size, number of children and type of containers used for storage were collected. We also tried to observe the effect of hot weather, the summer vacations and the timing of ingestion and relate it to the incidence of hydrocarbon ingestion in children. Duration of stay in hospital and complications, treatment and clinical manifestations were also noted. Ages were divided into four groups, the toddlers (1-2 years), Pre-School (2-5 years), Early School (5-10 years) and Early Adolescent (10-14 years). Socio economically families were divided in four groups (high, middle, low and very low) based on the per capita income and number of family members (Pakistan Statistics IFAD, International Fund for Agriculture Development)<sup>11</sup>. Parents of the children were contacted on phone about queries.

Descriptive statistics (frequency, percentage and mean) were calculated. The study variables were analyzed for their association with the out comes (risk factors) by applying the one sample test, calculating the SD and 95 % CI. The data was analyzed on SPSS (14.0 Version).

### Results

The total numbers of admission in the paediatric department during the 5 year study period were 13,987. Out of these, 67 (0.5%) patients were admitted with history of hydrocarbon ingestion. There were 53 (79%) males, and 14 (21%) females. Male to female ratio was 3.7:1. Majority of patients in our study 36 (54%) were between 2 to 5 years of age. Second most common group was of less than 2 years, comprising of 28 (42%) children.

In this research majority of the affected children had a large family size 48 (72%), with three or more siblings (Fig I). Most of the victims of hydrocarbon ingestion belonged to middle class 33(49%) (Fig I). These families kept hydrocarbons in beverage bottles 21 (31%) or in mineral water bottles 20 (30%), thus creating confusion and hence ingestion. The reason might be the paucity of risk assessment or small available spaces and cabinets for these chemicals to keep the hazardous solution safely locked.

Kerosene oil 59 (88%) was the most common type of hydrocarbon ingested, followed by 04 (6%) patients who had history of gasoline ingestion. Medical records identified

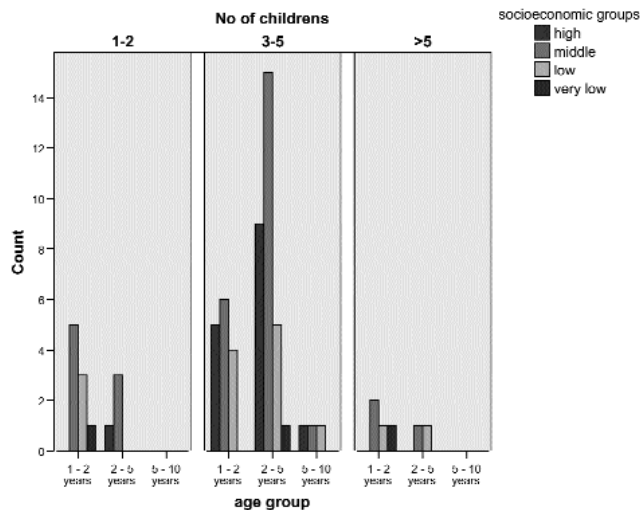


Figure I: Age, No. of Children and Socioeconomic Relation.

47 (70%) children who had ingested <5 ml, while 15 (22%) children had taken approximately 5 -10 ml. Five had history of >10 ml of hydrocarbon ingestion. The mean amount of oil ingested was 1.37 ± 0.6 ml.

The hot weather of Karachi plays an important role in increasing the incidence of hydrocarbon ingestion in children. In this study we observed that 43(65%) children had a history of hydrocarbon ingestion during the hot summer season (April to September). The more interesting observation was that during summer vacations (June and July) there was an increased frequency. The figures increased to 44% during summer. (Fig II).

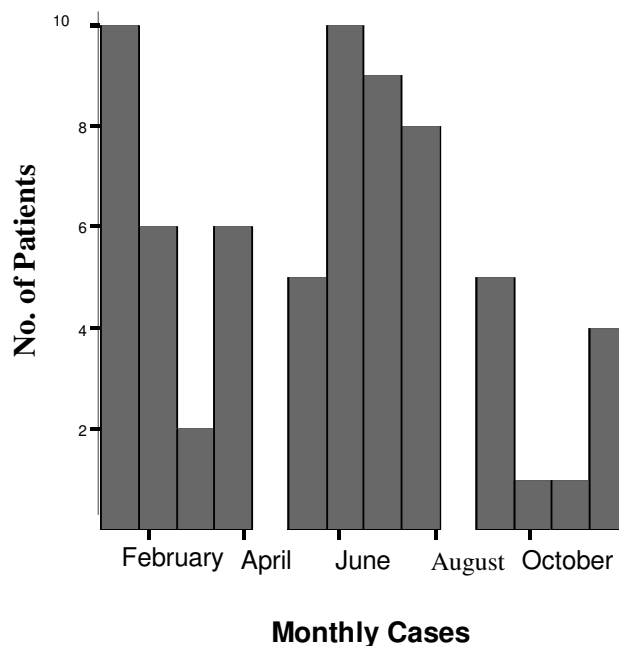


Figure II: Seasonal Variation.

We observed that 47 (70%) children had ingested the hydrocarbon in the afternoon between 1100 hrs to 1600hrs (Fig III).

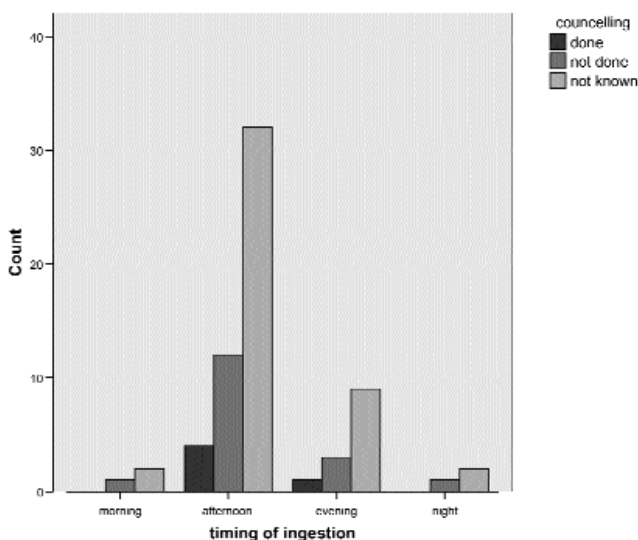


Fig-III: Counselling and Timing of Ingestion.

Majority of the effected children 45 (67%) were rushed to the ER by their care givers within 60 minutes of ingestion. Out of those, 31 (69%) children received immediate treatment within 30 minutes of ingestion either in the study centre or in a nearby hospital. The mean time was  $1.96 \pm 1.06$  hours (95% CI- 1.70-2.22).

Review of records showed that 33 (49%) cases had either non specific or no symptoms at all, while 34 (51%) had history of fever, cough, vomiting, accompanied with increased respiratory rate and other systemic findings.

The chest examination was normal in 25 (37%) children, while 38(57%) had radiological consolidation of either of the lung fields with or without obvious clinical findings, 4 (6%) had signs of effusion, and 2 (3%) patients needed ventilatory support. Only one patient expired due to complications.

Of the total, 56 (84%) children were found to be alert with no CNS involvement, 5 (8%) cases presented with lethargy and 6(9%) became drowsy during the course of the disease.

Parents were contacted on phone regarding the queries about the counseling they received. Only 4 (6%) got the appropriate counseling, while 15 (22%) did not receive any counseling at all. (Fig III)

Most of our patients 53 (79%) were discharged from hospital within the first 24 hours of admission. Five patients had a stay of a week or more with a mean of  $1.31 \pm 0.65$  days (95% CI- 1.1-1.4). Other patients either left against

medical advice or were lost to follow up. Interestingly no records were found regarding the counseling of parents related to the preventive/safety measures.

## Discussion

Hydrocarbons are stored in houses for multiple purposes such as cleaning, painting, or mixture in insecticides. Very low income families even use it as a fuel in their cooking stoves. Hydrocarbon ingestion especially kerosene oil is the most common hazardous chemical ingested accidentally by children in under developed countries like Pakistan, India, Sri Lanka and Middle East.<sup>5-7</sup> Poisoning in children ranges from 0.64 to 11.6%.<sup>12</sup> while hydrocarbon ingestion constitutes 0.23 to 3.3 % of the total poisoning cases. This is still one of the preventable and cost effective health problem in children.<sup>13,14</sup>

Most research shows that hydrocarbon ingestion remains a significant cause of poisoning in children when compared with other hazardous substance ingestion.<sup>15,16</sup> Curiosity and adventurous behaviour place children at a considerably higher risk of poison exposure than adults. Children are easily attracted by colourful packages.<sup>17</sup>

Studies on hydrocarbon ingestion in children in South East Asia were mostly hospital based thus the prevalence and incidence cannot be accurately evaluated. National data base and literature are not able to estimate the prevalence rate of hydrocarbon poisoning in Pakistani children. Most of the studies conducted had either focused on the presentation and management or discussed the complications of hydrocarbon ingestion. Few international studies tried to stretch out the risk factors of hydrocarbon ingestion, but these did not highlight the risk for our children.

In our study, 67 patients of hydrocarbon poisoning were admitted in hospital during the 5 year period. Similar numbers of cases were reported by studies from different parts of world including Pakistan and India.<sup>8,18-20</sup> Total numbers of children included in these studies ranged between 40-109 and the study periods was from 3 to 6 years.

It has been proven that boys are more involved in trauma and injuries. Similarly in our study male children were more involved in hydrocarbon ingestion that was probably because of the inquisitive behaviour of boys.<sup>12,13,21</sup>

In our observation, younger children ingested hydrocarbons more than the older ones. Studies have shown that the age between 2-5 years is most adventurous. Moreover these children participate in reckless actions.<sup>22,23</sup> In our study 95.5% children were below 5 years of age. Our experience was favoured by the results of other experts.<sup>7,8,18,19</sup>

The volume ingested by children was small probably because of the taste of hydrocarbons and the quantity stored. The exact calculation was impossible because they were not kept in the desired containers with markings, rather families kept them in different types of household bottles making the measurement very difficult.<sup>21</sup>

The containers in which the kerosene oil is stored plays an important role in attracting the children, because they are usually familiar with them such as cup, can, glass, mineral water bottle and attractive beverage bottles. Sixty one percent cases of ingestion occurred because children mistook the hydrocarbon for a cola drink.<sup>17</sup> One reason was that people were not cautious enough to buy a separate container and mark it as dangerous and keep it away from the reach of children. They simply utilized the empty bottles of beverages lying around the house.<sup>19</sup>

A high incidence of morbidity and occasional mortality was observed mostly in low socioeconomic groups.<sup>20,21</sup> These families lived in small houses with over crowded dwellings. They store every thing on the floor or in areas easily accessible to children. In our study all cases were from the urban area, and majority being from middle to low income communities.<sup>21-23</sup> Large family size and numbers of children also contributed to increased chance of accidental ingestion as identified by Chaung<sup>24</sup> and Akhtar.<sup>25</sup>

The temperature of Karachi is hot especially between April to September requiring frequent intake of water. As kerosene oil is colourless and difficult for children to smell it, that might lead to incidental ingestion, mistaking it for water. In our study we tried to emphasize on summer vacations, during which our children spend most of their time at home. We experienced that approximately one out of three of our children were found to be effected during the months of summer. Interestingly similar findings were observed by Lifshitz.<sup>21</sup>

We observed that most of our children had ingested the hydrocarbon (kerosene) in the afternoon. This was probably because of the temperature severity and more over it is during these hours that children are at home. In our society the house wives tend to sleep or rest for about two to three hours in the afternoon, hence the children are free and have maximum exposure to the hazardous substances in the house, especially if kept unlocked. (Fig III)

Aga Khan Hospital, where our research was conducted, is located in the centre of the city and is easily reachable. Most of the affected children reached the hospital within one hour after ingestion as against the study by Faqbule.<sup>19</sup> This shows that the parents realize the gravity of hydrocarbon ingestion and rush their child to a tertiary care hospital, thus reducing the complications and mortality.

The clinical features manifested were quite similar to other studies.<sup>18,21</sup> Fever, cough and tachypnea were the most common presentations,<sup>18</sup> with respiratory system involvement and consolidation of single or both lung fields. Some patients had CNS involvement.<sup>21,26</sup>

Almost all of our patients were discharged (98.5%). However we were not able to identify any documentation regarding the counseling of parents or care givers on the safety measures of chemical storage, and prevention of similar accidents in future.

## Limitations

The prevalence of hydrocarbon ingestion in Pakistan is unknown. Karachi has more than a large number of public sector hospitals which take care of patients with hydrocarbon ingestion. Vast majority of patients visit these public hospitals with hydrocarbon ingestion. Being a private hospital, our limitation was the small number of patients with hydrocarbon ingestion during the study period of five years.

## Conclusion

Males, children younger than 5 years of age, kerosene oil, poor socioeconomic status, overcrowding with large family size, 3 or more siblings, improper storage of dangerous household products and hot weather especially summer vacations were identified as leading cause of hydrocarbon ingestion in children.

Lack of awareness on part of parents regarding the appropriate storage of hazardous substances also exists.

## Recommendation

We need to raise the level of awareness and guidance to parents regarding the safety measures.

Uses of media (print and electronic) would be helpful in increasing the level of awareness amongst the parents and helps in reducing the chance of ingestion/exposure of dangerous chemicals by children.

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