

Childhood poisoning: a 10-year experience in a tertiary hospital in Enugu State, Nigeria

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Abstract

Childhood Poisoning is a common cause of emergency room presentation, more so in underdeveloped countries where it contributes to a high incidence of hospitalization with variability in morbidity and mortality. This study retrospectively assessed the sociodemographic profiles, poisoning agents, clinical features and management of cases of childhood poisoning admitted at Enugu State University Teaching Hospital, Enugu. It was a 10-year retrospective study of all the cases of childhood poisoning admitted within the period of study at the Children's Emergency Room of Enugu State University Teaching Hospital (ESUTH), Enugu. The prevalence of childhood poisoning in the study was 0.3%. Of all the subjects, 78.4% were ≤ 5 years and more than half were males and from lower socioeconomic classes. Accidental poisoning accounted for 70.3%; the predominant agents were kerosene and organophosphates. Palm oil was used by 67.6% of the participants as an intervention before presentation. Pneumonitis was the most common complication. Patients with peripheral oxygen saturation (SpO_2) $< 95\%$ were 14 times more likely to have complications than those with $SpO_2 \geq 95\%$. The duration of hospital stay was ≤ 3 in 59% of the cases and no mortality was recorded in this study. Childhood poisoning remains prevalent in our environment with kerosene being the commonest agent. Palm oil administration as a predominant pre-hospital intervention worsens outcomes. Duration of hospitalization depends on SpO_2 at presentation, need for antibiotic therapy, and intention.

Introduction

Poisoning is injury or death due to swallowing, inhaling, touching, or injecting various drugs, chemicals, venoms, or gases.¹ Childhood poisoning is a major problem in the pediatric population and remains an important public health challenge.^{2,3} The curiosity and innocence of children in exploring their environment puts them at a significant risk of inadvertently ingesting poisonous substances.⁴ As a result, poisoning is a common cause of emergency room visits, particularly in underdeveloped countries.² This trend contributes to an increasing incidence of hospitalizations and places a significant financial burden on healthcare systems.⁵

Most cases of childhood poisoning are commoner among males, possibly because they are more curious and active.⁶⁻⁹ Woyessa *et al.*, however, recorded more females in Ethiopia.⁵ Concerning age, children less than 5 years are more exposed to childhood poisoning.⁷⁻¹⁰

The incidence of childhood poisoning varies across regions of the world.^{2,3} Gauvin *et al.*¹¹ reported an incidence of 0.06% in Washington, USA; Lee *et al.*⁷ reported 0.27% in Taiwan and Mintegi *et al.*¹² reported 0.28% in Spain. In Nigeria, the incidence

is similar across the regions. In Kano, Northwest, Belonwu *et al.*⁹ reported an incidence of 1.2%, Oba-Daini *et al.*⁸ reported 1.4% in Sagamu and Olatunya *et al.*¹³ 1.54% in Ekiti, both in Southwest Nigeria. While in Enugu, Southeast, Ndu *et al.*¹⁴ reported 0.5%. These variations between the developed and developing countries may reflect the lifestyle and health-seeking behavior in those settings.

Various agents are implicated in childhood poisoning. Some of the common agents include kerosene, organophosphates, pesticides/herbicides, medications, caustic soda, hypochlorite, carbon monoxide, and alcohol-based herbal concoctions.⁸ Whilst in the developed nations, drugs seem to be commoner,^{2,7,12} the story is not the same in the developing nations. Kerosene and other hydrocarbons were reported to be commoner in Ethiopia and Nigeria.^{3,4,5,8,11,15}

The clinical features and complications recorded among cases of poisoning in children vary widely. These are reflective of various factors including the type of poison, quantity ingested, pre-hospital intervention, and quality of healthcare among many others.^{7,8}

The mortality following childhood poisoning is least in developed countries. Sahin *et al.*² in Anatolia and Lee *et al.*⁷ in Taiwan recorded no mortality among the cases seen in their center. In Ethiopia, a mortality rate of 7.10% was recorded by Woyessa *et al.*⁵ Similarly, Oba-Daini *et al.*⁸ and Olatunya *et al.*¹³ recorded case fatality rates of 3.2% and 6.2% respectively. The outcome of children with poisoning has been linked to the predisposing conditions/agents and the quality of medical facilities available.^{4,15}

This study retrospectively assessed the sociodemographic profiles, poisoning agents, clinical features and management of cases of childhood poisoning admitted at Enugu State University Teaching Hospital, Enugu.

Materials and Method

Study setting and period

This study was conducted in the Children's emergency room of Enugu State University Teaching Hospital (ESUTH), Enugu. It covered a 10-year period from January 2013 to December 2022.

Study design

It was a retrospective study of all the cases of childhood poisoning admitted within the period of study.

Data collection

The case notes numbers of children who presented with childhood poisoning within 10 years were obtained from the admission register. The case notes were retrieved from the hospital records library; thereafter relevant data were extracted from the case notes and entered into a proforma designed for the study. Data obtained from the case notes included the socio-demographic data (age, sex, place of domicile, socioeconomic class),¹⁶ poison ingested, duration before presentation, accidental/non-accidental, comorbidities, presenting symptoms and signs, home remedy, complications, duration of hospital stay and outcome.

Data processing and analysis

The data was analyzed using SPSS version 20 (IBM Inc., Chicago, Illinois, USA). Results were presented in prose and tables.

Ethical considerations

Ethics approval was obtained from the Ethics and Research Committee of the ESUTH, Enugu (REF NO: ESUTHP/C-MAC/RA/034/VOL.3/204).

Results

Out of the 12,534 admitted within the 10-year study period, 37 were cases of childhood poisoning, giving a prevalence of 0.3%. Twenty-nine (78.4%) of the subjects were ≤ 5 years and the mean age was 4.29. There were more male (56.8%) participants than

Table 1. Poisoning circumstances and home intervention.

	Frequency	Percent
Period of the year		
1 st quarter	8	21.6
2 nd quarter	6	16.2
3 rd quarter	13	35.1
4 th quarter	10	27.0
Time Before Presentation		
<5 hrs	21	56.8
≥ 5 hours	16	43.2
Agent		
Organophosphate	12	32.4
Kerosene	18	48.6
Hydraulic fluid	1	2.7
Bleach	1	2.7
PCM	2	5.4
Alcohol	3	8.1
Accident		
Accidental	26	70.3
Non-accidental	11	29.7
Intervention		
Palm oil	25	67.6
Herbal concoction	2	5.4
Milk	2	5.4
None	8	21.6

Table 2. Clinical features.

Clinical Features	Frequency	Percent
Symptoms		
Vomiting	15	40.5
Difficulty/fast breathing	19	51.4
Altered consciousness	5	13.5
Weakness	9	24.3
Fever	8	21.6
Cough	8	21.6
Diarrhea	3	8.1
Convulsion	2	5.4
Excessive cry/restless	2	5.4
Signs		
Tachypnoea	18	48.6
Tachycardia	17	45.9
Crepitations	8	21.6
Rhonchi	6	16.2
Dehydration	4	10.8
Pallor	3	8.1
Arrhythmia	1	2.7

females, and 97.3% resided in the urban area. More than half of the participants (59.4%) were from the lower socioeconomic class, while 29.7% and 10.8% were from the middle and upper socioeconomic class respectively. Table 1 shows that 35.1% and 27% of the cases, respectively, occurred in the 3rd and 4th quarters of the year while 56.8% presented to the hospital less than 5 hours after the poisoning. The predominant agents were kerosene (48.6%) and Organophosphate (32.4%). Of all the cases, 70.3% were accidental. Palm oil was used by 67.6% of the participants as an intervention before presentation. Table 2 shows that difficulty/fast breathing (51.4%) and vomiting (40.5%) were the commonest symptoms at presentation while tachypnea (48.6%) and tachycardia (45.9%) were the commonest signs. Nine (24.3%) of the cases were complicated: eight (21.6%) had pneumonitis while one (2.7%) had meningitis. Six of the eight cases of pneumonitis had chest X-ray

changes while chest X-ray was not done for the other two, thus the diagnosis of pneumonitis was made clinically. The duration of hospital stay for 59% and 41% of the participants is ≤ 3 days and >3 days respectively. Table 3 shows no significant association between the demographic characteristics and duration of hospital stay ($p > 0.05$). Table 4 shows that peripheral oxygen saturation (SpO_2) was significantly associated with the duration of hospital stay ($p = 0.017$, OR = 0.170, 95% C.I = 0.040-0.726). Patients with SpO_2 less than 95% were less likely to have shorter (1-3 days) duration of hospital stay than those with $SpO_2 \geq 95\%$. Participants whose ingestion was accidental were significantly 7 times more likely to have shorter (1-3 days) duration of hospital stay than the non-accidental victims. Twenty-two patients had empirical antibiotics. Patients on antibiotics were significantly associated with longer duration of hospital stay ($p = 0.043$, OR = 0.208, 95% C.I

Table 3. Association between demographic characteristics and duration of hospital stay.

	Duration of hospital stay (days)		p
	1 – 3 n (%)	>3 n (%)	
Age			
≤ 5	18 (62.1)	11 (37.9)	0.690*
> 5	4 (50.0)	4 (50.0)	
Sex			
Male	14 (66.7)	7 (33.3)	1.046
Female	8 (50.0)	8 (50.0)	
Domicile			
Urban	21 (58.3)	15 (41.7)	1.000*
Rural	1 (100.0)	0 (0.0)	
Socioeconomic class			
1	0 (0.0)	0 (0.0)	2.869
2	3 (75.0)	1 (25.0)	
3	6 (54.5)	5 (45.5)	
4	12 (66.7)	6 (33.3)	
5	1 (25.0)	3 (75.0)	
Period			
1 st quarter	4 (50.0)	4 (50.0)	1.312
2 nd quarter	4 (66.7)	2 (33.3)	
3 rd quarter	9 (69.2)	4 (30.8)	
4 th quarter	5 (50.0)	5 (50.0)	

*Fisher's exact significance.

Table 4. Association between SpO_2 , Intent, intervention, and duration of hospital stay.

	Duration of hospital stay (days)		p	OR	95% C.I for OR
	≤ 3 n (%)	>3 n (%)			
SpO_2					
$< 95\%$	7 (38.9)	11 (61.1)	0.017	0.170	0.040 – 0.726
$\geq 95\%$	15 (78.9)	4 (21.1)			
Accident					
Accidental	19 (73.1)	7 (26.9)	0.014	7.238	1.484 – 35.310
Non-accidental	3 (27.3)	8 (72.7)			
Antibiotics					
Yes	10 (45.5)	12 (54.5)	0.043	0.208	0.046 – 0.951
No	12 (80.0)	3 (20.0)			
Steroid					
Yes	7 (53.8)	6 (46.2)	0.609	0.700	0.178 – 2.750
No	15 (62.5)	9 (37.5)			

SpO_2 , peripheral oxygen saturation.

= 0.046-0.951). Table 5 shows that SpO₂ was significantly associated with complications (p=0.018, OR=14.400, 95% C.I = 1.567-132.311). Patients with SpO₂ < 95% were 14 times more likely to have complications than those with SpO₂ ≥ 95%. Similarly, Patients on steroids were significantly 6 times more likely to have complications than those not on steroids (p = 0.031, OR = 6.000, 95% C.I = 1.177-30.581). There was no recorded mortality from poisoning within the study period.

Discussion

Childhood Poisoning remains a major and important public health challenge.^{2,3} Identifying predictors of morbidity and mortality following childhood is very important in its management and prevention. Over a decade, poison-related cases comprised only 0.3% of the total morbidities observed in our pediatric emergency department. This finding, notably, falls below the range documented in prior research conducted in Nigeria, where rates varied from 0.43% to 1.54%.^{8,9,11,15,17} This lower incidence could be related to heightened awareness efforts and the recent prohibition of certain agricultural chemicals by the National Agency for Food and Drug Administration and Control (NAFDAC).¹⁸

In this study, the majority of the patients (78.4%) were under five years, with a mean age of 4.91. Several authors have observed similar findings in both developed and developing countries.^{2,3,4,7,8,11-13,15} Children in this age group are more explorative and more likely to put foreign objects/liquids including medicine and chemicals into their mouth, especially when they are colorful or stored in colorful packages/containers. Similar to previous studies involving comparable age groups, there was also a higher prevalence among males.^{2,3,4,7,8,11,13,15} This is not surprising as boys are usually very adventurous and prone to danger, especially in childhood.⁸ However, in adolescence and adulthood, intentional poisoning has been reported more commonly in females.^{5,7,11,19}

The majority of poisoned patients belonged to the lower socioeconomic class, aligning with previous reports from Nigeria.^{2,8,9,11,14,17} Most cases occurred in the second half of the year, with the highest rate between July to September, corresponding to the peak of the rainy and farming season when most farmers use organophosphates as either pesticides or herbicides. Kerosene poisoning was the most commonly observed form, consistent with

previous reports from Nigeria.^{3,4,8,9,13,15,17} It is well established that a geographical area's social, economic, and cultural norms impact the profile of poisoning.^{2,3,4,7} People in the lower socioeconomic class are more likely to be subsistent farmers and unskilled workers with poor living conditions, lacking adequate storage facilities/spaces, have a higher tendency to poorly supervise their children, and use kerosene as biofuel for the household. The common use of kerosene as a biofuel in Nigeria is still alarming despite other renewable energy alternatives. The storage of kerosene and its color may also be a contributor to it as a common agent of poisoning. Kerosene is colorless and typically stored in non-child-proof plastic containers, thus increasing the likelihood of young children mistaking it for water. Despite this alarming rate of poisoning of children with kerosene, minimal effort has been made to implement policies that should curtail this ugly trend.

Organophosphate poisoning was also common, with a prevalence of 32%. This is higher than was observed in the same locality less than a decade ago by Edelu *et al.*¹⁷ Organophosphates in recent times have gained negative popularity in Nigeria for non-accidental poisoning, especially in cases of suicide and suicide attempts.¹⁸ The policies governing the sale and use of these agents in Nigeria have been poorly implemented, facilitating easy access and misuse of these substances. Although the study revealed kerosene and organophosphates as the leading agents of poisoning, reports from other parts of the world differ.^{2,6,7,10-12} A consistent variation in poisoning agents has been observed across different regions. In Nepal, organophosphates and carbamates, commonly used pesticides in agricultural areas, and household insecticides, respectively, are the primary poisoning agents.⁶ In Taiwan⁷ and Washington¹¹, pharmaceutical agents have been the most common agents responsible for poisoning. Additionally, as noted by Martin and Brinkman, the range and complexity of substances responsible for poisoning tend to expand with improving economic conditions, leading to a decrease in hydrocarbon and plant ingestions and an increase in chemical and medication ingestions. This evidence supports the hypothesis that these differences may be attributed to socioeconomic disparities among these nations.¹⁰

The majority of the cases of poisoning observed in this study were accidental. This is not unexpected, given that most of the patients were under the age of reason. The few nonaccidental cases were among older children and adolescents as has been observed by other researchers.^{5,7,11,12,19}

Table 5. Association between SpO₂, intent, intervention and complications.

	Complications		p	OR	95% C.I for OR
	Yes n (%)	No n (%)			
SpO ₂					
<95%	8 (44.4)	10 (55.6)	0.018	14.400	1.567 – 132.311
≥95%	1 (5.3)	18 (94.7)			
Accident					
Accidental	8 (30.8)	18 (69.2)	0.187	4.444	0.484 – 40.837
Non-accidental	1 (9.1)	10 (90.9)			
Antibiotics					
Yes	9 (40.9)	13 (59.1)	NA	NA	NA
No	0 (0.0)	15 (100.0)			
Steroid					
Yes	6 (46.2)	7 (53.8)	0.031	6.000	1.177 – 30.581
No	3 (12.5)	21 (87.5)			

SpO₂, peripheral oxygen saturation.

The management of poisoned patients is based on decontamination, stabilization, and supportive care measures, as well as the initiation of specific treatment as early as possible.²¹ In these patients, the outcome usually depends on the timing and effectiveness of the interventions, hence the need for appropriate pre-hospital care.²¹ It was observed that all of the study participants who had any intervention before the presentation had the wrong care. A great proportion of these patients had palm oil administered, similar to reports by other authors in our clime.^{3,4,8,9,15,17,22} Local myths hold that palm oil is a potent antidote capable of neutralizing most forms of poisoning and its administration is capable of inducing emesis, however, there is no scientific proof to this notion. On the contrary, palm oil ingestion following poisoning may be very detrimental especially in cases of aspiration during its forceful ingestion or following emesis post poisoning. This use of palm oil antidote may explain the common clinical features of respiratory challenges, tachycardia, vomiting, and weakness seen in this study. Aspiration of palm oil results in lipid pneumonitis, which may present with severe acute respiratory distress requiring ventilatory support or chronic respiratory challenges.²² Clinical features of severe acute respiratory distress suggestive of pneumonitis were the commonest complication noted in this study, thus further buttressing the detrimental effects of inappropriate and harmful interventions. More than half of the study participants spent less than three days on admission, indicating minimal toxic poisoning effect. Reports from Nigeria, India, and Taiwan similarly reported short hospital stay durations in most cases.^{3,4,7,17,22} Determinants of duration of hospitalization recorded in our study were SpO₂, intent, and need for antibiotic use. Oxygen saturation $\geq 95\%$ at presentation was associated with a shorter duration of hospitalization. Oreh *et al.*²² in their case series, reported a shorter duration of hospital stay in poisoned children with optimal SpO₂. Similarly, Reda *et al.*²³ noted a longer duration of hospitalization and a higher risk of mortality in cases of poisoning at SpO₂ less than 95%. The observation that SpO₂ could predict the duration of hospitalization may be attributed to its role as a marker of tissue oxygenation. Indeed, abnormal SpO₂ levels may indicate pulmonary and/or cardiac complications, thereby increasing the risk of a prolonged hospital stay. Another significant predictor of the duration of hospitalization in this study was the victim's intention. This is such that victims who became poisoned accidentally were significantly seven times more likely to have shorter (1-3 days) duration of hospital stay than the non-accidental victims. Lin *et al.*²⁴ similarly observed that children with intentional poisoning had a significantly longer length of hospital stay than those with accidental poisonings, and children who were admitted to the PICU for critical care were all intentional cases. This could be because most cases of intentional poisoning are associated with suicide or self-harm, leading individuals to ingest significant amounts of toxins, resulting in systemic toxicity and consequently necessitating a longer hospital stay. This study also identified a significant association between antibiotic use and extended hospitalization duration. While antibiotic therapy typically does not directly address childhood poisoning, it may be warranted in cases complicated by chemical pneumonitis, which can increase susceptibility to secondary lower respiratory tract bacterial infections.²⁵ Therefore, the use of antibiotics often subtends the development of complications, thus explaining its predictive value for hospital stay duration in our study. The immature physiology of children makes them vulnerable to toxic exposures with a higher risk for complications.²¹ About a quarter (24.3%) of the cases managed within the study had features suggestive of systemic affectation. The commonest complication observed was pneumonitis, the other being

neurological involvement. Ahmed *et al.*⁴ in Abuja, Nigeria, observed features suggestive of pneumonitis in the majority of their cases. Likewise, Venkatesh *et al.*²⁶ in India also recorded features of pneumonitis as the most common complication in their cohort.

The finding of kerosene as the most prevalent agent of poisoning in the above studies is similar to our observation, and this explains the high prevalence of pneumonitis noted. Kerosene is a volatile hydrocarbon that causes lung parenchymal injury and inflammation even in very minute quantities when aspirated into the lungs alone or in combination with palm oil.^{26,27} In this study, the presence of complications was found to be significantly associated with lower levels of oxygen saturation at presentation and the use of steroids. Steroid use may be beneficial in some cases of hydrocarbon poisoning even though its efficacy has not been thoroughly evaluated.²⁸⁻³⁰ Some authors have suggested that using steroids may lessen inflammation and the ensuing lung fibrosis following chemical pneumonitis.²⁸⁻³⁰

There was no recorded mortality from poisoning within the study period. Oguiche *et al.*³ in Maiduguri and Orisakwe *et al.*¹⁵ in Nnewi, Nigeria, also recorded zero mortality. World Health Organization estimates a low mortality rate of 1.84 per 100,000 cases of childhood poisoning globally.³¹ Despite this low mortality rate recorded and the low mortality rate estimated by WHO, a study from Nigeria has reported a mortality rate as high as 18%.⁴ The zero mortality recorded may be related to the fact that the commonest agent of poisoning, kerosene, rarely causes fatalities except in cases complicated by chemical pneumonitis. Moreover, the early institution of appropriate intervention including the judicious use of steroids in suspicion of pneumonitis may have improved recovery in such cases.

In conclusion, Childhood poisoning is prevalent in our environment. Kerosene and organophosphates remain the most common agents of poisoning. In most cases, palm oil administration is the pre-hospital intervention of choice and can worsen the outcome. Duration of hospitalization is dependent on SpO₂ at presentation, need for antibiotic therapy, and intention. Low oxygen saturation at presentation and steroid use were associated with complications. It is advisable to implement comprehensive educational programs covering safe and proper storage of kerosene and appropriate post-poisoning care, particularly targeting the lower socioeconomic class. Relevant agencies should enhance monitoring and regulation of organophosphate insecticide usage in Nigeria. Furthermore, it is recommended to assess peripheral oxygen saturation of all poisoning cases upon presentation at emergency/health facilities to predict the risk of morbidity and enable early implementation of appropriate interventions.

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