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Clinico-etiological Profile of Poisoning in Children and Impact of Counselling on Child Care and Safety Practices - A Prospective Study from North India

Çocuklarda Zehirlenmelerin Klinik-etiyolojik Profili ve Danışmanlığın Çocuk Bakımı ile Güvenlik Uygulamaları Üzerindeki Etkisi - Kuzey Hindistan'dan İleriye Yönelik Bir Çalışma

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Abstract

Introduction: Childhood poisoning, resulting from exposure to various substances through ingestion, inhalation, or contact, is a major global health concern. In India, the increased availability of household, agricultural, industrial, and pharmaceutical chemicals has led to an increased incidence of accidental poisonings among children aged 1-5 years. This study examines the prevalence, types, and outcomes of childhood poisoning in India, highlighting the role of sociodemographic factors and parental behaviors. Hospital data underscore the need for improved education and safety practices, including effective counseling and strategies to support behavioral change, to reduce incidents and improve long-term outcomes.

Methods: This prospective study was conducted in a tertiary-care hospital in North India from December 2022 to August 2023 to analyze the burden and types of childhood poisoning and to assess the influence of sociodemographic factors using the modified Kuppuswamy scale (2023). Secondary outcomes included clinical outcomes and post-counseling behavioral changes, assessed at the two-month follow-up. Follow-up, conducted through telephonic consultations, evaluated late sequelae, repeat poisonings, and changes in safety practices.

Results: One hundred and two pediatric poisoning cases were enrolled, representing 1.53% of all pediatric emergencies (n=6630). Most cases occurred in children aged 1-5 years (74.7%, n=76), predominantly male (66.7%, n=68), with higher incidence in metropolitan areas (62.7%, n=64) and in lower socioeconomic groups (81.4%, n=83). Household cleaning agents (40.2%, n=41) and hydrocarbons (23.5%, n=24) were the leading causes, reflecting

Öz

Giriş: Çocukluk çağı zehirlenmeleri; yutma, soluma veya temas yoluyla maddelere maruz kalma sonucu ortaya çıkan önemli bir küresel halk sağlığı sorunudur. Hindistan'da evsel, tarımsal, endüstriyel ve farmasötik kimyasalların artan erişilebilirliği, 1-5 yaş arası çocuklarda kazara zehirlenmeleri artırmıştır. Bu çalışma, Hindistan'da çocukluk çağı zehirlenmelerinin prevalansını, türlerini ve sonuçlarını inceleyerek sosyodemografik faktörler ve ebeveyn davranışlarının rolünü vurgulamaktadır. Hastane verileri, etkili danışmanlık ve davranış değişikliği yoluyla eğitim ve güvenlik uygulamalarının güçlendirilmesi gerekliliğini ortaya koymaktadır.

Yöntemler: Aralık 2022-Ağustos 2023 tarihleri arasında Kuzey Hindistan'da bir üçüncü basamak hastanede yürütülen bu ileriye yönelik çalışmada, çocukluk çağı zehirlenmelerinin yükü ve türleri ile sosyodemografik faktörlerin etkisi 2023 modifiye Kuppuswamy ölçeği kullanılarak değerlendirildi. İkincil sonuçlar; klinik seyir ve iki aylık takip sonrası danışmanlıkla oluşan davranış değişikliklerini içerdi. Takipte geç sekeller, tekrarlayan zehirlenmeler ve güvenlik uygulamalarındaki değişiklikler telefon görüşmeleriyle değerlendirildi.

Bulgular: Toplam 102 pediyatrik zehirlenme olgusu çalışmaya alındı ve tüm pediyatrik acil başvurularının %1,53'ünü (n=6630) oluşturdu. Vakaların çoğu 1-5 yaş grubunda (%74,7; n=76), erkeklerde (%66,7; n=68) ve metropoliten bölgelerde (%62,7; n=64) görüldü; düşük sosyoekonomik gruplarda daha yüksekti (%81,4; n=83). En sık nedenler evsel temizlik maddeleri (%40,2; n=41) ve hidrokarbonlardı (%23,5; n=24); bu durum kerosen zehirlenmesindeki azalmayı göstermektedir. Asit bazlı korozif temizleyiciler yaygındı. Beş yaş üzeri çocuklar, yaşı büyük kardeşi olanlar ve geniş ailede yaşayanlarda

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Abstract

a shift from the earlier predominance of kerosene. Corrosive cleaners-mainly acid-based-were common. Being older than five years, having older siblings, and living in a joint family were associated with a lower incidence of poisoning. Outcomes were favorable in most cases, with 84.3% successfully discharged; two deaths occurred due to corrosive poisoning. Follow-up showed no repeat incidents, and parental counseling significantly improved storage practices.

Conclusion: The study demonstrates a changing pattern in childhood poisoning, with corrosive agents emerging as the most common cause and kerosene poisoning declining. Addressing household risks, strengthening parental education, and improving healthcare systems are essential, with counseling playing a pivotal preventive role.

Keywords: Toxicology, clinical profile, poisoning, pica, child safety practices

Öz

zehirlenme insidansı daha düşüktü. Olguların %84,3'ü başarıyla taburcu edildi; korozif zehirlenme nedeniyle iki ölüm görüldü. Takipte tekrarlayan zehirlenme saptanmadı ve ebeveyn danışmanlığı depolama uygulamalarını belirgin şekilde iyileştirdi.

Sonuç: Çalışma, çocukluk çağı zehirlenmelerinde korozif maddelerin öne çıktığını ve kerosen zehirlenmelerinin azaldığını göstermektedir. Ev içi risklerin azaltılması, ebeveyn eğitiminin güçlendirilmesi ve sağlık sistemlerinin geliştirilmesi kritik olup, danışmanlık önlemede kilit rol oynamaktadır.

Anahtar Kelimeler: Toksikoloji, klinik profil, zehirlenme, pika, çocuk güvenliği uygulamaları

Introduction

Poisoning refers to injury resulting from exposure to an exogenous substance that causes cellular damage or cell death. This exposure can occur through ingestion, inhalation, injection, or direct contact. The severity and outcome of poisoning in children depend on several interrelated factors, including the type, amount, and form of the poison, the route of exposure, the child's age and nutritional status, the presence of other toxins, and concurrent diseases or injuries.[1]

In India, a developing nation, the use of various household, agricultural, industrial, and pharmaceutical chemicals has surged. The presence of these in households and surrounding areas contributes to an increased incidence of accidental poisoning among children, who are naturally curious.[2] The vast majority of cases belong to children aged 1-5 years.[3,4] The common types of poisoning observed in them include kerosene (hydrocarbons), household cleaning agents (corrosives), turpentine, medications, insecticides, among others.

An analysis of data across multiple regions of India indicates that hydrocarbon poisoning, particularly kerosene, is the predominant type of poisoning in the country.[3,5] The incidence of hydrocarbon poisoning is notably higher in rural areas compared to urban areas. Additionally, rural regions experience higher rates of snake bites, ingestion of poisonous plants, and exposure to unknown substances. Over time, the nature of these available agents has changed because of lifestyle shifts and regional development, resulting in altered poisoning patterns.

Across the globe, thousands of children are brought to the hospital with cases of accidental poisoning that could have been avoided with better education and preparedness.[6-9] Parents' behavior regarding childcare and safety practices also plays an important role in determining the causes and incidence of accidental poisoning among children.

This study examined the prevalence and types of childhood poisoning and the influence of sociodemographic factors on these events. The study also assessed outcomes at presentation and at two months' follow-up, focusing on long-term effects, repeat incidents, and changes in parents' safety behaviors after counseling provided to all parents during hospital stays about safe storage practices for poisonous substances.

Materials and Methods

A prospective observational study of poisoning among children under 12 years of age was conducted in the clinic of pediatrics at a tertiary-care hospital in North India from December 2022 to August 2023. The study commenced after obtaining approval from the Maulana Azad Medical College and Associated Hospital Institutional Ethics Committee (approval no: F.1/IEC/MAMC/MD/MS 92/04/2022 No.371, date: 29.08.2022). This study investigated the burden and types of childhood poisoning and examined the influence of sociodemographic factors. It addresses child-specific factors (e.g., pica), parental dynamics (e.g., educational status), family characteristics (e.g., family type, number of children, crowding, and urban or rural setting), and the use of home child-proofing measures. Details of the poison encompass type, quantity, accessibility, and packaging, whereas ingestion events are categorized according to how they were discovered. Post-ingestion symptoms and parents' actions, including initial steps taken and presentation to the hospital, were analyzed. Hospital outcomes, previous poisoning episodes, and nutritional status were also evaluated.

At discharge, the parents of the enrolled patients were counseled on child safety practices, child-proofing, and childcare, including adequate nutrition. A follow-up telephone call was conducted at two months to monitor for delayed effects, recurrent episodes, and behavioral changes in parents or family members. A single investigator collected daily data using a predesigned proforma; the data were then analyzed to characterize the spectrum of poisonings and their outcomes.

At discharge, all parents received a structured counselling session focused on preventing future poisoning episodes. The counselling was delivered in person by the investigator, a pediatric resident, and was supervised by a consultant pediatrician. Each session lasted approximately 15 minutes and followed a standardised checklist consisting of seven domains. Counseling was delivered verbally and supported by simple demonstrations, such as how to lock cabinets, when relevant. The parents were also encouraged to ask questions and seek clarification.

A telephone follow-up at two months after discharge was conducted to enquire about recurrent episodes, changes in the child's behaviour, improvement in pica (if present), and implementation of recommended safety practices at home.

Statistical Analysis

The data collected were entered into an MS Excel sheet and analyzed using descriptive statistics. The categorical responses are expressed as percentages. Continuous data were presented as mean (±2 standard deviation) for parametric variables and median (interquartile range) for non-parametric variables.

Results

This study spanned from December 2022 to August 2023. Notably, 1.53% (102) of all pediatric emergency admissions (n=6630) were due to poisoning. Most patients were 1-5 years old (74.7%, n=76); males predominated (66.7%, n=68). Urban areas accounted for 62.7% (n=64) of cases, and 84.3% (n=86) of cases were from within the city. Ninety-five incidents (93.2% of the total) occurred in and around the house. Only 6.8% (n=7) of cases were reported outdoors. Corrosive agents were the leading cause of poisoning (40.2%, n=41), followed by hydrocarbons (23.5%, n=24) and drugs (17.6%, n=18). Acid-based toilet cleaners were the most common corrosives, and turpentine was the most common hydrocarbon (Tables 1-3). Pallor was observed in 73.5% (n=75) of patients, while 61.8% (n=63) exhibited pica. Anemia was present in 85.3% (n=87) of the children. Among these, 68 (78.2%) also exhibited pallor, whereas 19 (21.8%) were anemic without pallor. Of the 75 children with pallor, 68 (90.7%) had anemia and 7 (9.3%) did not. The highest incidence of poisoning occurred during the summer (41.2%, n=42) and monsoon (30.4%, n=31) seasons. Corrosive and hydrocarbon poisonings peaked in summer and the monsoon (73%, n=30; 66.6%, n=16, respectively). Drug ingestion (Table 4) spiked in winter (61.1%, n=11), while insecticides (Table 5) and venomous animal bites surged during the monsoon (70%, n=7 and 60%, n=3 respectively).

Among parents, 30.4% (n=31) had only a primary-school education, 45.1% (n=46) had a high-school education, 23.5% (n=24) had graduate degrees, and 1% (n=1) had postgraduate qualifications. Regarding socioeconomic status, 51 (50%) belonged to the lower class, 32 (31.4%) to the upper lower class, and 19 (18.6%) fell into the lower middle class. Thirty-six children (35.3%) were second-born, 27 (26.5%) were first-born, and 25 (24.5%) were third-born. In the majority of cases, two children were at home (37.3%, n=38), followed by three (29.4%, n=30), four (12.7%, n=13), and one (12.7%, n=13). Of the children, 91.2% (n=89) were from nuclear families. Only 5.9% (n=6)

Table 1. Type of poisoning agent

	Poisoning agent	Number of patients	Percentage
A	Corrosives	41	40.2%
B	Hydrocarbons	24	23.5%
C	Drugs	18	17.64%
D	Insecticides	10	9.86%
E	Venomous animal bitesa	5	4.9%
F	Miscellaneousb	4	3.9%
	Total	102	100%

[a]: Three cases of snake bite by common krait, one snake bite by cobra, and one case of scorpion bite, [b]: One case each of ingestion of camphor, silica powder, clay and soap

Table 2. Type of corrosive agent

	Type of corrosive	Number	Percentage (out of total)
A	Toilet cleaner (hydrochloric acid)	27	26.47%
B	Bleach [sodium hypochlorite (alkali)], used for laundry	7	8.86%
C	Phenyl (carbolic acid, a weak acid)	4	3.92%
D	Caustic soda (sodium hydroxide)	2	1.96%
E	Vinegar [acetic acid (weak acid)]	1	0.98%

Table 3. Type of hydrocarbon

	Type of hydrocarbon	Number	Percentage (out of total)
A	Turpentine (paint thinner)	15	14.7%
B	Kerosene	7	8.86%
C	Machine oil	1	0.98%
D	Naphthalene (aromatic hydrocarbon)	1	0.98%

Table 4. Type of drugs

	Type of drugs	Number	Percentage (out of total)
A	Belonged to the patient and given in wrong dosage	10	9.86%
B	Paracetamol	3	2.94%
C	Dextromethorphan	3	2.94%
D	Thyroxine	2	1.96%
E	Phenytoin	2	1.96%
F	Belonged to other family members	8	7.84%
G	Other drugs: promethazine, cannabinoid, permethrin, propranolol, aripiprazole, olanzapine, hydrogen peroxide, salicylic acid	1 each	0.98%

Table 5. Type of insecticides and pesticides

	Type of insecticides and pesticides	Number	Percentage (out of total)
A	Pyrethroid (mosquito repellent liquid)	6	5.9%
B	Brodifacoum (anticoagulant rodenticide)	2	1.96%
C	Paraquat (weed killer)	1	0.98%
D	Organophosphate (insecticide)	1	0.98%

Table 6. Type of storage containers, appearance, availability and accessibility of agents

Characteristics Number		Percentage
Type of storage containers		
Transparent water bottle	47	48.5%
Attractive packaging	16	16.5%
Soft drink bottles	14	14.4%
Medicine bottles	10	10.3%
Hazardous marked containers	10	10.3%
Appearance		
Colored	70	72.10%
Transparent	27	27.90%
Availability		
Easy to acquire	63	64.9%
Difficult to acquire	34	35.1%
Accessibility		
Easy to access	95	98%
Out of reach	2	2%

of children had both parents working, whereas 94.1% (n=96) had one parent working.

The choice of storage containers for toxic agents is crucial to prevent accidental poisoning. Transparent water bottles were most commonly used (48.5%, n=47), followed by attractive packaging (16.5%, n=16), and empty soft drink bottles (14.4%, n=14). Fewer agents were stored in medicine bottles (10.3%, n=10) or in containers marked as hazardous (10.3%, n=10). The majority of toxic agents, 98% (n=99), were easily accessible to patients because they were within physical reach, clearly visible, and lacked child-resistant packaging, permitting easy opening (Table 6).

In our study, most ingestion events (89.2%, n=91) were promptly observed or otherwise detected by parents, particularly in cases involving corrosives and hydrocarbons, in which symptoms developed rapidly. In a small percentage (8.8%, n=8), children alerted parents to their distress, whereas in 2% (n=2) of cases, children kept the ingestion a secret, which eventually led parents to identify the cause of illness.

Notably, 97.1% (n=99) of events were accidental, while only 2.9% (n=3) were reported as homicidal. In one case, a mother attempted suicide by ingesting an agricultural-grade herbicide (paraquat) herself and by feeding it to her baby. In another case, a mother attempted suicide by ingesting bleach mixed with milk and by feeding it to both her children. After exposure, about half (47.5%, n=46) of the patients induced vomiting at home by parents/caregivers through digital stimulation of the throat, while 52.5% (n=51) took no home-based action. About 58.8% (n=57) arrived within 30 minutes, 20.6% (n=20) at 30 minutes to two hours, and 20.6% (n=20) after more than two hours. Vomiting was the predominant symptom at hospital presentation (67.6%, n=66).

Most patients had a 1-3-day hospital stay (59.8%, n=58), 15.6% (n=15) stayed for 4-7 days, and 11.8% (n=11) were required to stay over seven days while 12.8% (n=12) got discharged on the same day. Pediatric intensive care unit (PICU) stay was required for 11.8% (n=11) of patients. Out of 41 patients with corrosive ingestion, 61% (n=25) underwent upper gastrointestinal endoscopy. Two patients died during treatment, representing a mortality rate of 1.96% (n=2). In both fatal cases, the offending agent was a corrosive toilet cleaner that had been stored in water bottles.

At discharge, parents of enrolled patients were counselled, according to the standardised checklist (Table 7), about child safety practices, child-proofing, and childcare, including proper nourishment. Two months after discharge, 82 of 86 patients were successfully reached by telephone, with only four (4.66%) lost to follow-up. Parents exhibited significant behavioral changes regarding the storage of potentially poisonous agents, with 96.3% (n=94) making efforts to prevent accidental ingestion. No repeated accidental ingestions occurred (Table 8).

Table 7. Standardised counselling checklist		
1.	Secure medications	- Keep meds locked up and out of reach. - Use child-resistant packaging.
2.	Chemical safety	- Store household chemicals in locked cabinets. - Restrict access to cleaning products and agents. - Follow guidelines for disposal.
3.	Child-proofing	- Install safety locks on cabinets. - Secure personal care items.
4.	Education	- Teach children about the dangers of ingesting substances and about their safe handling. - Emphasize that products are not toys.
5.	Emergency information	- Keep poison control number accessible. - Take the child immediately to the nearest hospital. - Do not try to induce vomiting at home.
6.	Supervision	- Keep a close eye on young children. - Be cautious in unfamiliar environments, and monitor during outdoor play.
7.	Proper food storage	- Store food items securely, away from harmful substances.

Table 8. Attitude changes in parents after counselling		
Attitude changes in parents	**Number of cases**	**Percentage**
Yes	79	96.3%
No	3	3.7%

Discussion

In our study, accidental poisonings accounted for 1.53% of all pediatric emergency admissions, which is similar to the 1.05% reported at our centre in 2009[3] and consistent with studies by Jadhav et al.[10], Koh et al.[6], and other studies across India.[2,4,9] Most affected children (76.4%) were aged 1-5 years, a trend widely reported in the literature.[2,5,6,9-11] This age group is more prone to accidental ingestion due to exploratory behaviour and limited awareness. A male predominance (66.7%) was also noted in line with the findings of Brata Ghosh et al.[2] and Tarvadi et al.[12]

A higher proportion of cases were from metropolitan areas (62.7%) and from lower socioeconomic strata (81.4%), according to the modified Kuppuswamy scale (2023). The World Health Organization World report on child injury prevention reports similar observations, highlighting increased poisoning risks among lower-income groups.[1]

Corrosive household cleaners were the most common agents (40.2%), followed by hydrocarbons (Tables 1-3). This represents a shift from earlier studies, including Parekh and Gupta[13] and our 2009 data, where kerosene dominated. More recent work by Suting et al.[9] also reports a decline in kerosene ingestion comparable to our findings (6.8%). Turpentine has now replaced kerosene as the predominant hydrocarbon (Table 3). The rise in ingestion of corrosive cleaners may reflect reduced kerosene use and changes in household practices. Acid-based toilet cleaners accounted for the majority of corrosive ingestions (65.8%), whereas bleach accounted for 17.3% (Table 2). Western studies also report a rise in ingestions of household cleaners, although alkaline agents predominate.[5,6,11,14]

Hydrocarbons ranked second, with turpentine accounting 62.5% of cases and often linked to painting activities. Pharmaceuticals ranked third among substances involved in unintentional ingestions (17.64%). Paracetamol and dextromethorphan were the most prevalent medications (16.5% each) and were often administered incorrectly. Other drugs (mainly thyroid medication and anti-epileptic drugs) belonging to family members were accidentally ingested (Table 4). These patterns resemble findings from North India and Western countries.[2,9,13,15,16]

Venomous bites accounted for 4.9% of cases, predominantly snake bites (80%) and scorpion bites (20%), consistent with the species commonly found in Northern India (Table 1). A seasonal rise in poisonings was observed during summer (41.2%) and the monsoon (30.4%), emphasizing the role of environmental factors.

Most incidents (93%) occurred at home, consistent with previous reports.[1,2,5] Children older than five years experienced fewer episodes, possibly owing to greater awareness. Family dynamics may also play a role, with larger families providing increased supervision.

Anemia was present in 87 children: 68 (78.2%) had pallor and 19 (21.8%) did not. Among 75 children with pallor, 7 (9.3%) were not anemic. Therefore, pallor detected anemia reasonably well but was unreliable in excluding it. Similar patterns are described in populations with mild anemia. The high rates of pica and pallor suggest underlying nutritional deficiencies that may contribute to both anemia and behavioral tendencies. Previous studies have also reported an association between anemia and pica.[17,18]

Parents with higher levels of education were more likely to adopt child-proofing measures (24.5% of parents), suggesting a association between education and safety awareness.[8] Storage practices played a major role, with toxic agents commonly stored in transparent bottles (48.5%) or in attractive containers (16.5%). Improper storage occurred in 79.4% of cases, and nearly all agents (98%) were easily accessible. Availability in the community was also high (64.9%). These findings highlight the need to address unsafe storage and accessibility.[1,2,16]

Nearly half of caregivers attempted to induce vomiting, usually through digital stimulation, indicating persistent knowledge gaps regarding appropriate first aid.

The study assessed patients' treatment and recovery. The PICU admission rate was 11.8%, while mortality was low (2%). A similar study conducted by Brata Ghosh et al.[2] showed a PICU admission rate of 11.7%, with a mortality rate of 2.7%. A fall in mortality rates has been observed over the last few decades. A mortality rate of 8.9% was reported in a study conducted by Jayashree and Singhi[19] over the period from 1993 to 2008. A mortality rate of 4.4% was reported in a study by Aggarwal et al.[20] during 2010-13. At discharge, detailed discussions with parents led to significant behavioral changes. Parents have become more cautious about children's access to household cleaning agents and have switched to safer alternatives, ensuring that hazardous substances are kept out of reach and are not stored in improper containers. The study implies that sources like the mass media can spread important information to a larger population and can help people learn safe storage practices, thereby reducing childhood poisoning. This collective effort can substantially decrease poisoning incidents, creating a safer environment for children.

Study Limitations

This study was conducted in a single tertiary-care hospital with a small sample size, which may limit the generalizability of the findings. Although the hospital receives children from many states and has a varied case mix referral bias is likely because more severe cases are typically referred to tertiary centers. The results may therefore differ from those seen in primary or district-level facilities. Larger multicenter studies in the future would help confirm and strengthen these findings.

Conclusion

This study examines childhood poisoning incidents, identifying accidental poisoning as the cause in the majority of cases. Household substances, most commonly toilet cleaners, are frequent agents of poisoning, and hydrocarbon poisonings have shifted from kerosene to substances such as turpentine oil. Seasonal patterns and family dynamics significantly influence poisoning incidents. Educational initiatives demonstrate positive outcomes, emphasizing the importance of targeted interventions and improved storage practices, thereby creating a safer environment for children.

Ethics

Ethics Committee Approval: The study commenced after obtaining approval from the Maulana Azad Medical College and Associated Hospital Institutional Ethics Committee (approval no: F.1/IEC/MAMC/MD/MS 92/04/2022/No.371, date: 29.08.2022).

Informed Consent: A prospective observational study.

Footnotes

Authorship Contributions

Concept: S.G., U.J., P.P., Design: S.G., U.J., P.P., Data Collection or Processing: S.G., D.K., Analysis or Interpretation: U.J., D.K., P.P., Literature Search: S.G., D.K., Writing: S.G., U.J., D.K., P.P.

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