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Case-Control Study Of Risk Factors Associated With Acute Unintentional Poisoning In Children Aged 1-12 Years In A District Hospital, Puducherry, India

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Abstract



Unintentional poisoning, particularly among children under five, is a global concern. A case-control study conducted in a South Indian tertiary care institute aimed to identify socio-epidemiological risk factors for acute unintentional poisoning in children aged 1-12 years. Through caregiver interviews, 480 children were categorized as cases (with acute unintentional poisoning) or controls (with acute medical illnesses). Household poisons ingestion was prevalent, with inadequate storage and accessibility as significant contributors. Prompt hospital presentation correlated with better outcomes. Higher birth order, low maternal education, paternal substance abuse, and inadequate storage emerged as risk factors. Though developmental delays weren't prevalent, maternal education, paternal income, and substance abuse were linked to childhood poisoning. Targeted interventions promoting household safety, parental education, and supervision are crucial for prevention, along with health education campaigns on safe storage practices, labeling, and substance disposal. Timely medical intervention and improved healthcare access are essential to reduce childhood poisoning-related morbidity and mortality, especially in resource-limited settings like India.

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INTRODUCTION

Every year, approximately one million children globally succumb to injuries, with poisoning ranking as the fourth leading cause of death among them, following road accidents, burns, and drowning. Poisoning occurs when an individual is exposed to substances capable of causing organ dysfunction or even death. In children, acute poisoning constitutes a pediatric emergency, primarily stemming from unintentional exposure.

The gravity of toxic exposures in childhood is evident, with nearly 45,000 child fatalities annually worldwide, contributing significantly to the burden of disease. Children under five years old account for approximately 15% of unintentional poisoning-related deaths globally, resulting in about 23% of Disability-Adjusted Life Years (DALYs) lost.

In India, unintentional poisoning poses a substantial clinical challenge, contributing to 3-6% of pediatric admissions in tertiary care hospitals. Notably, a study from Delhi reported a high incidence of childhood poisoning, emphasizing its prevalence in the community. The patterns of poisoning vary across regions due to factors like age, type of exposure, nature of poisons, and sociodemographic influences. Often, children ingest poisonous substances unknowingly while exploring their surroundings, driven by natural curiosity and developmental milestones. Preschoolers are particularly vulnerable due to their exploratory behavior, gradually becoming more discerning as they age¹⁻².

This case-control study aims to identify socio-epidemiological risk factors contributing to unintentional poisoning in children. Such insights hold significant public health implications, potentially preventing a considerable proportion of poisoning cases by targeting household environments³. Addressing these factors can alleviate family anxiety and emotional burdens associated with perceived lapses in parental supervision.

The pressing need for this study arises from the preventable nature of acute pediatric poisoning, which presents a substantial burden on mortality and morbidity worldwide, especially in developing countries. Factors such as the easy accessibility of household chemicals, medicines, and pesticides exacerbate the risk. Despite the rising incidence, comprehensive socio-epidemiological studies on acute unintentional pediatric poisoning remain scarce in India, highlighting the urgency to investigate and develop effective intervention strategies for prevention.

MATERIALS AND METHODS

The study is a case control study done in a tertiary care institute of South India.

Participants:

Case: Children with history of acute unintentional poisoning, attending emergency department, fulfilling the inclusion criteria will be included in the study after obtaining the written, informed, valid consent from the caretaker.

Control: Children with acute medical illnesses and without any history of chronic medical illnesses or accidental or deliberate poisoning.

Inclusion Criteria:

Children aged 1-12 years with history of acute unintentional poisoning.

Exclusion Criteria:

Children below 1 and above 12 years of age.

Children with doubtful poisoning and with no clear etiology.

Children with food poisoning, snake envenomation, allergic reactions, and adverse drug reactions.

This study was conducted within the Pediatric department of Rajiv Gandhi Government Women and Children Hospital in Puducherry, following approval from the scientific and ethical committee of the Indira Gandhi Government General Hospital and Post-graduate Institute, also located in Puducherry. Children aged 1-12 years were randomly selected to participate in the study if they presented with acute unintentional poisoning, after obtaining written informed consent from their caregivers. These children were designated as "cases" upon confirmation of acute unintentional poisoning through thorough history-taking and clinical examination to exclude other potential diagnoses. The "control" group comprised children from the same pediatric wards during the same study period. These children presented with acute medical illnesses but had no history of chronic medical conditions or accidental or deliberate poisoning. Acute medical illnesses considered for the control group included upper respiratory tract infections, acute diarrheal diseases, and urticaria. Children with nonspecific symptoms lacking a definitive diagnosis were excluded. Controls were matched with cases based on age (within six months), gender, and admission within 48 hours on an individual patient basis.

Data collection involved interviews with caregivers of children in both the case and control groups, primarily conducted with mothers. If mothers were unavailable, other caregivers such as

grandparents or relatives were interviewed. A multi-structured questionnaire was utilized, addressing demographic information, details of the poisoning incident, and potential risk factors for acute poisoning. Risk factors were categorized into four domains: environmental, psychosocial, family-related factors, and personal characteristics, tailored to fit Indian cultural contexts. Each risk factor was predefined before inclusion in the questionnaire.

Childhood personality abnormalities were determined subjectively by parents, encompassing traits such as shyness, aggression, or psychiatric illness-related personality disorders. Child behavioral abnormalities were defined by various aberrant behaviors like nightmares, nail-biting, hyperactivity, etc. Developmental delay referred to a delay of more than six months in achieving developmental milestones in one of four domains: gross motor skills, fine motor and vision, speech, language and hearing, and social and behavioral development. A young mother was defined as someone aged nineteen or younger at the time of assessment, while a parent with psychological illness was diagnosed with a psychiatric disorder. Unsafe storage of poisons (medicines, household chemicals, and pesticides) was identified when these substances were not stored securely, either in a lockable container or in an inaccessible location to the child. Caregivers' judgments were considered in determining economic and marital problems, inadequate housing space, and lack of family and social support. Harmful alcohol use and inadequate supervision were also noted. At the conclusion of the questionnaire, all mothers (both cases and controls) received counselling emphasizing the importance of enhanced vigilance and safe storage of poisonous substances, along with creating a safe environment for their children.

METHOD OF STATISTICAL ANALYSIS

Considering the prevalence of one of the risk factor (inadequate space in house) as 34% and 22.4% among cases and controls in a study* conducted in Indian subcontinent⁴ having similar sociodemographic profile the sample size has been calculated using OpenEpi** software as below (table 1)

Table 1 Sample Size Calculation for Case-Control Study

Two-sided confidence level(1-alpha)	95
Power(% chance of detecting)	80
Ratio of Controls to Cases	1
Hypothetical proportion of controls with exposure	22.4
Hypothetical proportion of cases with exposure:	34
Least extreme Odds Ratio to be detected:	1.78
Sample Size – Cases	240
Sample Size – Controls	240

Type of poison, symptoms of poison, outcome etc., were considered as primary outcome variables. Study group (Cases Vs Controls) was considered as primary explanatory variable.

Descriptive analysis was carried out by mean and standard deviation for quantitative variables, frequency and proportion for categorical variables. Non-normally distributed quantitative variables were summarized by median and interquartile range. (IQR). For normally distributed Quantitative parameters the mean values were compared between study groups using Independent sample t-test (2 groups). For non-normally distributed Quantitative parameters, Medians and Interquartile range (IQR) were compared between study groups using Mann Whitney u test (2 groups). P value < 0.05 was considered statistically significant. IBM SPSS version 22 was used for statistical analysis. IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.

RESULTS

A total of 480 children were included in the study divided into two groups of 240 each and all the patients completed the study. The median age was 2.5 years (IQR 1.5 to 3.5) in cases and it was 2 years (IQR 1.5 to 3.5) in controls. The difference in the age between study groups was statistically not significant (P value 0.629). Of the 240 cases, 138 (57.5%) were males and remaining 102 (42.5%) were females. Among the 240 controls, 138 (57.5%) were males and remaining 102 (42.5%) were females. The difference in the proportion of distribution of males and females among cases and controls was statistically not significant (P value 1.000).

Table 2 Showing different types of poisons consumed

Type of poison	Frequency	Percentages
Household poisons	155	62.92%
Medicines	56	23.33%
Poisonous plants	4	1.67%
Agrochemicals	1	0.42%
Miscellaneous	24	11.67%

Prevalence and Types of Household Poisons:

Among 155 cases of childhood poisoning, household poisons accounted for the highest proportion at 19.26%, followed by mosquito repellent (14.07%) and kerosene (13.33%). These findings are notable as they deviate from previous studies where hydrocarbons, particularly kerosene, were more prevalent. Additionally, the study underscores the importance of understanding the diverse range of household poisons and their potential risks to children.

Timing of Hospital Presentation and Clinical Outcomes:

A significant proportion of poisoning cases (53.75%) presented to the hospital within 1-2 hours of ingestion, highlighting the importance of prompt medical attention. Early presentation correlated with better outcomes, as evidenced by the low mortality rate (0%) and successful discharge of all cases. This emphasizes the critical role of timely intervention in mitigating the severity of poisoning and improving prognosis. (table 3).

Table 3 Showing the time of presentation

Time of presentation after poisoning	Frequency	Percentages
<1 hr	64	26.67%
1 to 2 hrs	129	53.75%
2 to 4 hrs	40	16.67%
>4 hrs	7	2.92%

Birth Order and Developmental Factors:

Higher birth order was found to increase the risk of poisoning, possibly due to maternal preoccupation with elder children. However, developmental delays and behavioral disorders were not prevalent in either cases or controls, likely due to the young age of the subjects. Nonetheless, studies have shown that childhood hyperactivity can

predispose children (table 4) to ingest harmful substances.

Table 4 Showing the percentages of developmental delay

Development delay	Study group	
	Cases (N=240)	Controls (N=240)
Yes	2 (0.833%)	0 (0%)
No	238 (99.16%)	240 (100%)

Parental Characteristics and Socioeconomic Factors:

Low maternal education emerged as a significant risk factor, underscoring the importance of parental knowledge and awareness in preventing poisoning incidents. Additionally, low paternal income and substance abuse were identified as risk factors, highlighting the socioeconomic determinants of childhood poisoning. The mothers' income, social status, marital status were similar in both the groups. ($p > 0.05$)

Among cases, 3 (1.25%) fathers were illiterate, 21 (8.75%) fathers had middle school education, 71 (29.58%) fathers had high school education, 93 (38.75%) fathers had intermediate/Diploma education and 52 (21.66%) fathers were graduates/postgraduates. Among controls, 2 (0.833%) fathers were illiterate, 16 (6.666%) fathers had middle school education, 46 (19.16%) fathers had high school education, 118 (49.16%) fathers had intermediate/Diploma education and 58 (24.16%) fathers were graduates/postgraduates. The difference in the proportion of father's education between study groups was statistically significant (P value 0.05) regarding the substance abuse, the difference was significant.

Table 5

Substance abuse in father	Study group		Chi square	P-value
	Cases (N=240)	Controls (N=240)		
Yes	17 (7.083%)	4 (1.666%)	8.416	0.004
No	223 (92.91%)	236 (98.33%)		

Environmental Factors and Storage Practices:

Inadequate storage and accessibility of household products were identified as significant risk factors

for childhood poisoning. Factors such as inadequate space, supervision, and storage were more prevalent among cases compared to controls, emphasizing the need for proper storage practices and parental supervision to prevent accidental ingestions. The difference in storage and packing was different in the groups.

Table 6

Storage in original pack	Frequency	Percentages
Yes	306	73.91%
No	108	26.08%

Among cases, 56 (27.05%) children were exposed to poisons which were safely stored. Among controls, 158 (76.32%) children had taken poisons which were not safely stored. The difference in the proportion of children based on safe storage between study groups was statistically significant (P value <0.001).

Table 7

Safe storage	Study group		Chi square	p-value
	Cases* (N=207)	Controls (N=207)		
Yes	56 (27.05%)	158 (76.32%)	100.63	<0.001
No	151 (72.94%)	49 (24.63%)		

Among cases, 201 (97.1%) children had an easy access to poisons. Among controls 30 (14.49%) had an easy access to poisons. The difference in the proportion of children with easy accessibility to poisons between study groups was statistically significant (P value <0.001).

DISCUSSION

Age as a Risk Factor:

The mean age of children affected by poisoning in the study was 2.5 years, with a significant proportion falling below 5 years of age, consistent with previous research.⁽⁵⁻⁸⁾ Children in this age group are characterized by their curiosity and exploratory behavior, making them more vulnerable to unintentional poisoning incidents.

Table 8

Study	Age < 5 years (%)
Manas Pratim Roy et al	75
Rathore S et al	62

Suresh Kumar Gupta et al	64.75
Ram P et al	55.5
Present Study	94.5

Gender Distribution:

While previous studies have shown varying trends in gender distribution, this study found no statistically significant difference between male and female children in terms of poisoning incidence.⁹⁻¹⁰ However, boys have been predominantly affected in some studies, highlighting the need for gender-sensitive preventive strategies.

Table 9

Study	Male (%)	Female (%)
Radhika Raman et al	52.9	47.1
Manas Pratim Roy et al	63	37
Suresh Kumar G et al	63.11	36.88
Ram P et al	50.6	49.4
Ramesh Polasa et al	54.26	42.5
Present Study	57.5	42.5

Route and Pattern of Poisoning:

Ingestion emerged as the primary route of poisoning, with household substances being the most common culprits, followed by drugs. Household poisons like ala, mosquito repellents, and kerosene were identified as significant contributors to poisoning incidents¹¹. Adequate storage and careful handling of these substances are crucial for preventing such incidents, emphasizing the importance of health education and awareness campaigns.

Table 10

Study	Route of Poisoning – Ingestion (%)
Manas Pratim Roy et al	100
Utkarsh Kohli et al	96.9
Suresh Kumar Gupta et al	96.8
Present Study	98.75

Location and Time of Presentation:

Home was identified as the most common location for poisoning incidents, emphasizing the

importance of household safety measures. Prompt presentation to the hospital within hours of poisoning significantly reduced complications and improved prognosis,¹²⁻¹⁴ highlighting the critical role of timely medical intervention.

Table 11

Study	Home (%)	Outdoors (%)
Ramesh Polasa et al	86.58	13.4
Tigist Bacha et al	74.2	6.3
Ghaniya SM et al	66.67	33.33
Izuora GI et al	80	20
Present Study	92.1	7.9

Personal Characteristics and Family Related Factors:

Higher birth order was associated with an increased risk of poisoning, possibly due to decreased parental supervision. Developmental delay and behavioral disorders were identified as potential risk factors, necessitating early intervention and support services. Maternal education, occupation, and marital status, along with paternal education, income, and substance abuse, were all found to influence the risk of childhood poisoning, underscoring the multifactorial nature of this issue.¹⁵⁻¹⁷ In our study, among cases, 2 (0.83%) had developmental delay with no subjects in the controls because of which statistical test could not be applied. However, M.B.K.C Dayasiri et al showed that developmental delay is a significant risk factor of childhood poisoning.

Table 12

Study	Substance Abuse in Father (p value)
M.B.K.C Dayasiri et al	0.014
Mansori K et al	< 0.001
Feiz Disfani H et al	< 0.03
Eleni Petridou et al	0.01
Aggelos Tsalkidis et al	-
Orton E et al	-
Present Study	0.004

Environmental Factors and Health Education:

Inadequate space, supervision, and storage practices were identified as significant environmental risk factors for childhood poisoning which goes along with earlier¹⁸⁻²⁰ studies.

Table 13

Study	Adequacy of Storage (original pack) (p value)
M.B.K.C Dayasiri et al	< 0.05
Margonato FB et al	< 0.001
Hamid Soori et al	-
Sonya M.S. Azab et al	-
Present Study	< 0.001

Health education interventions focusing on safe storage practices, proper labeling, and disposal of toxic substances are essential for raising awareness and promoting preventive behaviors among caregivers.

CONCLUSION

In conclusion, this study identified several significant risk factors associated with acute unintentional poisoning in children. Higher birth order ($p < 0.001$), low parental educational status (mothers: $p = 0.01$, fathers: $p = 0.05$), paternal substance abuse ($p = 0.004$), low paternal income ($p < 0.001$), and low socio-economic status ($p < 0.001$) were all found to increase the risk of childhood poisoning. Inadequate space for living ($p < 0.001$) was identified as a significant risk factor, while adequate supervision and safe storage practices ($p < 0.001$) were protective factors against unintentional poisoning. These findings underscore the importance of targeted interventions focusing on parental education, substance abuse prevention, and improving living conditions to mitigate the risk of childhood poisoning. Implementing strategies to enhance supervision and promote safe storage practices can further contribute to preventing unintentional poisoning incidents among children, thus emphasizing the need for comprehensive public health initiatives in this regard.

Ethical Approval

This research was conducted in accordance with guidelines established by the Institutional Animal Ethic Committee (IAEC). Approval number: GHIEC/2018 dated 10.08.2018 was obtained from the IAEC prior to the commencement of the study.

All procedures involving animals were carried out with care and consideration for their welfare, in compliance with ethical standards and regulations.

Author Contribution

All authors made substantial contributions to the conception, design, acquisition, analysis, or interpretation of data for the work. They were involved in drafting the manuscript or revising it critically for important intellectual content. All authors gave final approval of the version to be published and agreed to be accountable for all aspects of the work, ensuring its accuracy and integrity.

Conflict of Interest

The authors declare no conflict of interest, financial or otherwise.

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