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Demographic and clinical analysis of pediatric poisoning in intensive care

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Abstract

Aim: This study aims to improve the understanding of childhood poisoning by examining the demographic, clinical, and laboratory characteristics of critically ill patients admitted to the pediatric intensive care unit (PICU).

Materials and Methods: This retrospective study analyzed 209 pediatric poisoning cases admitted to the PICU, accounting for 4.2% of total admissions. Data on age, gender, exposure route, location, time to admission, symptoms, examination findings, treatments, and PICU stay duration were collected. Patients were categorized as survivors or non-survivors, and statistical analyses were conducted to identify predictors of mortality.

Results: Of the 209 cases, 62.2% were female, with a mean age of 8.75 years. Accidental poisoning was more common in children under five (56.5%), while suicide attempts (36.8%) and substance abuse (6.7%) were prevalent among adolescents. Girls had higher rates of accidental and suicidal poisoning, while boys were more involved in substance abuse. The majority of exposures were oral (90.9%) and occurred indoors (86.1%). Drug-related poisonings accounted for 53.6% of cases, with central nervous system drugs (12.4%) being the most common agents, followed by corrosive substances (7.9%). Mechanical ventilation was required in 25.4% of accidental, 9% of suicidal, and 14% of substance abuse cases. The overall mortality rate was 8.2%, with prolonged PICU stay and the absence of activated charcoal identified as significant predictors of mortality.

Conclusion: This study underscores the critical need for age- and gender-specific preventive measures to mitigate pediatric poisoning. Safe storage of hazardous substances and prompt medical intervention, such as timely administration of activated charcoal, are critical to reducing mortality. Prolonged PICU stays have been associated with increased mortality, often indicating more severe cases. Unintentional poisonings in younger children, largely due to inadequate supervision, highlight the importance of preventive strategies, while intentional poisonings in adolescents require closer monitoring and mental health interventions.

Introduction

Poisoning, a major public health problem, is the result of toxic substances entering the body through various routes, with consequences ranging from mild symptoms to life-threatening conditions [1].The problem is particularly acute in children, especially those under the age of 5, due to their exploratory behavior and physiological vulnerability. Accidental poisoning is particularly common in this age group and includes unintentional ingestion of household substances, medications, and other toxic materials [2]. In contrast, intentional poisoning, including suicide attempts and substance abuse, is more common in adolescents and is influenced by sociocultural and psychological factors. While poisoning accounts for 2% of childhood deaths in developed countries, this figure rises to over 5% in developing countries [3]. The diversity of poisoning agents reflects geographic, cultural, and socioeconomic differences, as well as the varying risk of exposure in different age groups, underscoring the need for nuanced prevention and treatment strategies [4].

Factors contributing to poisoning events range from accidental ingestion to deliberate harm and include environmental exposures, therapeutic errors, and adverse drug reactions. These incidents are a leading cause of pediatric emergency department visits and hospital admissions, highlighting the critical need for effective diagnostic and therapeutic approaches [5]. The problem of child-

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hood poisoning is compounded by socio-cultural and economic factors and a spectrum of risk exposures ranging from accidental to intentional. The significant variation in the causes and outcomes of poisoning between regions and populations highlights the urgent need for comprehensive epidemiologic studies. Such studies are essential to develop targeted interventions and improve health care responses to poisoning incidents, thereby reducing avoidable childhood morbidity and mortality [6].

The purpose of this study was to gain a better understanding of critical pediatric poisonings by analyzing the demographic, clinical, and laboratory characteristics of poisoning cases admitted to our pediatric intensive care unit (PICU). This research will compare its findings with existing literature, propose preventive strategies, and develop a comprehensive regional poisoning profile. Ultimately, the goal is to improve early diagnosis and treatment methods, inform public health policy, and refine clinical practices to reduce the incidence of preventable childhood poisonings.

Materials and Methods

Study design and population

This retrospective study analyzed pediatric poisoning cases admitted to the PICU between January 1, 2009 and December 31, 2022. Initially, 226 cases were reviewed, but after excluding 17 cases due to stays of less than 24 hours and insufficient PICU criteria, 209 cases remained eligible. Participants included patients aged 0-18 years who experienced various poisoning events. Those over 18 years of age were excluded to maintain a pediatric focus.

Data collection

Clinical and epidemiologic data were extracted from patient records and meticulously documented on specially designed follow-up forms. Variables collected included demographic details (sex, age), timing of poisoning (month, season of admission), location of the incident, and whether the poisoning was due to single or multiple drug ingestion or involved non-medication toxic substances. Clinical information such as symptoms at presentation, physical examination findings, length of stay in the PICU, treatments administered, and patient outcome (recovery or death) were also recorded. Patients were classified as survivors or non-survivors for comparative analysis of clinical outcomes. Additional data included route of exposure, time since exposure, and cause of poisoning (accidental, suicide attempt, or substance abuse).

Statistical analysis

Statistical analyses were performed using IBM SPSS Statistics version 22.0. The distribution of data was assessed using histograms, q-q plots, and the Shapiro-Wilk test to determine compliance with parametric or nonparametric distribution norms. Parametric data were presented as mean ± standard deviation, whereas nonparametric data were presented as median with interquartile ranges (25^{th} percentile-75^{th} percentile). Categorical data were analyzed using the chi-squared test or Fisher's exact test, as appropriate. Numerical variables were analyzed using the independent samples t-test or the Mann-Whitney U test when parametric test assumptions were not met.

Univariate and multivariate binary logistic regression analysis was performed to determine risk factors for mortality. Odds ratios (OR) and 95% confidence intervals (CI) were calculated for each factor. To identify independent determinants, variables significant in the univariate analysis were included in the multivariate model and backward elimination was performed using the Wald statistic at a stringency level of $P<0.05$. Statistical significance was established at a p-value of <0.05 for all analyses.

Results

Characteristics of pediatric poisoning cases

In this study, we investigated 209 cases of pediatric poisoning treated in the PICU. These cases constituted 4.2% of the 4,850 admissions to the PICU during the specified period. Of the cases studied, 62.2% (n=130) were female, and 37.8% (n=79) were male (Table 1).

The age of the patients ranged from 0 to 18 years, with a mean age of 8.75 ± 6.07 years. The age distribution was as follows: 13.4% (n=28) were between 0 and 2 years, 39.2% (n=82) between 3 and 5 years, 1.4% (n=3) between 6 and 11 years, and 45.9% (n=96) were 12 years or older. Seasonal distribution indicated a high number of admissions during winter, accounting for 78.5% (n=164) of the cases, followed by spring with 18.7% (n=39). Both summer and autumn had the lowest, with 1.4% (n=3) each (Table 1).

In terms of poisoning causes, 56.5% (n=118) were accidental, 36.8% (n=77) were suicidal (all older than 12 years), and 6.7% (n=14) were due to substance abuse. Statistical analysis showed that accidental poisoning was more prevalent among children under 5 years ($p<0.001$), while suicidal and substance abuse-related poisonings were more common in adolescents over 12 years (Table 1). Gender-based analysis revealed statistically significant differences: accidental and suicidal poisonings occurred more frequently in girls ($p=0.001$), whereas boys were more likely to be involved in substance abuse cases (Table 1).

Analysis of poisoning data

Upon examining the routes of exposure to toxic substances, it was observed that 190 cases (90.9%) involved oral intake, while 19 cases (9.1%) involved inhalation. Regarding the locations where the exposure occurred, 180 cases (86.1%) took place indoors, whereas 29 cases (13.9%) occurred outdoors.

In 112 cases (53.6%), the poisoning agent was a medication, while in 97 cases (46.4%), it was a non-medication substance (e.g., toxic plants, insecticides). Among accidental poisonings, 30 cases (25.4%) involved medications, whereas in poisonings due to suicide attempts, 75 cases (97.4%) involved medications. The incidence of medication intake was significantly higher in suicide attempts compared to accidental poisonings ($p<0.001$, Table 2).

Additionally, 51 cases (24.4%) involved multiple drug intake. The higher frequency of multiple drug intake in suicide-related poisonings (58.4%), compared to single drug intake in accidental poisonings (23.7%), was statistically significant ($p<0.001$, Table 2).

Table 1. Characteristics of pediatric poisoning cases.

Category	Details	Total Cases (n=209)	Percentage
Gender	Female	130	62.2%
	Male	79	37.8%
Age Group (mean age: 8.75 ± 6.07)	0-2 years	28	13.4%
	3-5 years	82	39.2%
	6-11 years	3	1.4%
	≥12 years	96	45.9%
Seasonal Admission	Winter: 164 (78.5%), Spring: 39 (18.7%) Summer: 3 (1.4%), Autumn: 3 (1.4%)		
Category	Accidental (n=118, %56.5)	Suicidal (n=77, %36.8)	Substance Abuse (n=14, %6.7)
Age			
0-2 years	28 (23.7%)	0 (0%)	0 (0%)
3-5 years	82 (69.5%)	0 (0%)	0 (0%)
6-11 years	3 (2.5%)	0 (0%)	0 (0%)
12-18 years	5 (4.2%)	77 (100%)	14 (100%)
	Accidental	Suicidal	Substance Abuse
Gender			
Male	54 (45.8%)	17 (22.1%)	8 (57.1%)
Female	64 (54.2%)	60 (77.9%)	6 (42.9%)
Gender Statistical Significance	p<0.001	p<0.001	p<0.001

Table 2. Analysis of poisoning data.

Category	Subcategory	n	%	Subcategory 2	n2	%2	p
Route of Exposure to Poison	Oral	190	90.9	Inhalation	19	9.1	-
Locations of Toxic Exposure	Indoors	18	86.1	Outdoors	29	13.9	-
Agent Causing Poisoning	Medication	112	53.6	Non-medication	97	46.4	<0.001
Ratio of Accidental Poisoning - Medication	Medication	30	25.4	Non-medication	88	74.6	<0.001
Ratio of Suicide-related Poisoning - Medication	Medication	75	97.4	Non-medication	2	2.6	<0.001
Accidental Poisonings: Single vs. Multiple Drug	Single Drug Intake	28	23.7	Multiple Drug Intake	2	1.7	<0.001
Suicide-related Poisonings: Single vs. Multiple	Single Drug Intake	30	39.0	Multiple Drug Intake	45	58.4	<0.001

Table 3. Causative agents, reasons for intensive care follow-up, and emergency treatments in poisoning cases.

Category	Subcategory	n	%
Single Drug Poisoning	Paracetamol	22	9.6
	Tricyclic Antidepressants	16	7
	Colchicine	53	12
Reason for PICU Admission	Consciousness Impairment	108	51.6
	Respiratory Failure	30	14.3
	Hypotension	28	13.3
	Metabolic Disorder	27	12.9
	Arrhythmia	16	7.9
Emergency Treatments	Activated Charcoal	134	64.1
	Gastric Lavage	89	42.6
	Antidote	27	12.9
	Supportive Treatment	87	41.6
PICU Stay Duration	Average (min-max) days	-	1.9 (1-65)

Table 4. Oxygen therapy, clinical outcomes, and emergency department admission times for poisoning cases.

Poisoning Cause	Room Air	Oxygen via Mask	High Flow	MV	Total	p value	Clinical Outcome	n	%
Accident	42	27	19	30	118		Transferred to Another Service	192	91.8
Suicide	16	47	7	7	77	p<0.001	Death	17	8.2
Substance Abuse	2	10	0	2	14		–	–	–
Total	60	84	26	39	209		–	–	–
Admission Time									
0-30 min: 2 (1%), 30 min-1 hour: 22 (10.5%), 1-2 hours: 50 (23.9%), 2-6 hours: 68 (32.5%), 6-12 hours: 23 (11%), 12-36 hours: 18 (8.6%), Unknown: 26 (12.4%).									

Table 5. Comparison of clinical outcomes between survivors and non-survivors in pediatric poisoning cases.

Parameters	Survivor (n=192)	Nonsurvivor (n=17)	p value
Age, year	6.1 ± 8.9	5.6 ± 6.1	0.11
Female/male, n(%)	120/72 (%63/%37)	10/7 (%59/%41)	0.76
PICU stay (days)	1.4 ± 0.9	16.6 ± 8.1	0.04
Place of poisoning	Indoor 166 (86%) Outdoor 26 (14%)	Indoor 14 (82%) Outdoor 3 (18%)	0.63
Emergency arrival time	3hour (1-6)	4hour (2-6)	0.30
Activated charcoal	Received 128 (67%) Not 64 (33%)	Received 6 (35%) Not 11 (65%)	0.01
Gastric lavage	Received 84 (44%) Not 108 (56%)	Received 5 (30%) Not 12 (70%)	0.25
Cause of poisoning	Accident 105 (54%) Suicide 73 (38%) Substance Abuse 14 (8%)	Accident 13 (76%) Suicide 4 (24%) Substance Abuse-	0.17

Table 6. Univariate and multiple binary logistic regression analyses for predictors of mortality in pediatric poisoning patients.

	Univariate		Multiple	
Variables	OR (%95 CI)	P	OR (%95 CI)	P
Poisoning cause	0.37 (0.12-1.09)	0.06	–	–
Place of poisoning	1.36 (0.36-5.38)	0.64	–	–
Emergency arrival time	0.81 (0.56-1.15)	0.24	–	–
Drug category	1.55 (1.05-2.2)	0.02	–	–
Length of PICU stay	1.3 (1.1-1.7)	0.04	15.7 (4.36-56.7)	<0.001
Length of hospital stay	1.06 (0.96-1.14)	0.06	–	–
Not received activated charcoal	3.6 (1.2-10.3	0.01	6.35 (1.47-27)	0.01
Gastric lavage	1.8 (0.6-5.5)	0.25	–	–

OR (95% CI): Odds ratios and 95% confidence intervals.

Analysis of poisoning cases: Causative agents, reasons for intensive care follow-up, and emergency treatments

When examining the substances causing poisoning, central nervous system drugs, particularly tricyclic antidepressants, were found to be the most common. Paracetamol was identified as the leading individual drug, causing 96% (n=22) of the poisonings. This was followed by tricyclic antidepressants at 7% (n=16) and colchicine at 12% (n=53).

Among the patients who presented to the emergency department with poisoning, the most common reason for PICU admission was consciousness impairment. Other reasons are detailed in Table 3. Of the patients treated in the emergency department, 134 (64.1%) received only activated charcoal, 89 (42.6%) received only gastric lavage, and 73 (34.9%) received both gastric lavage and activated charcoal. Supportive treatment (fluids, oxygen, gastric protectors, etc.) was administered to 87 patients (41.6%) without any decontamination procedures, and antidotes were given to 27 patients (12.9%). The shortest PICU stay was 1 day, the longest was 65 days, with an average stay of 19 days (Table 3).

Admission times, oxygen therapy and clinical outcomes in poisoning cases

When examining the time from exposure to the agent to presentation at the emergency department, 1% (2) of the patients presented within the first 30 minutes, 10.5% (22) within 30 minutes to 1 hour, 23.9% (50) within 1-2 hours, 32.5% (68) within 2-6 hours, 11% (23) within 6-12 hours, 8.6% (18) within 12-36 hours, and for 12.4% (26) of the cases, the exposure time was unknown. There was no statistically significant difference in the admission times to the emergency department between accidental and suicidal cases (p=0.213).

The rate of mechanical ventilation was 25.4% (30/118) in cases of accidental poisoning, 9% (7/77) in cases of suicide attempts, and 14% (2/14) in cases of substance abuse poisoning. There was a statistically significant difference in the oxygen therapy received by patients between accidental, suicidal, and substance abuse poisonings (p<0.001, Table 4).

Clinical outcomes and mortality analysis

After treatment in the pediatric intensive care unit (PICU) for poisoning, 192 patients (91.8%) were successfully transferred to other services, while 17 patients (8.2%) unfortunately succumbed to their condition. Among those who died, 4 were adolescents who had attempted suicide. The causes of death were varied: 2 patients died from ammonium fluoride poisoning, 2 from carbon monoxide exposure, 2 from rodenticide ingestion, 3 from corrosive substance ingestion, 2 from organophosphate poisoning, 2 from cardiovascular drug ingestion, 2 from multiple drug ingestion, and 1 from mushroom poisoning.

A statistically significant difference in PICU length of stay was observed between survivors and non-survivors, with non-survivors having a significantly longer stay (p=0.04). In addition, the use of activated charcoal was significantly associated with survival, with a higher percentage of survivors receiving this treatment compared to non-survivors (p=0.01). No statistically significant differences were found between survivors and non-survivors in other variables, including age, sex, location of poisoning, time to emergency admission, gastric lavage, and cause of poisoning (p>0.05). These results, along with the complete statistical analysis, are detailed in Table 5.

Identification of predictors of mortality using binary logistic regression analysis

Both univariate and multivariate binary logistic regression analyses were performed to identify significant predictors of mortality. In the univariate analysis, factors such as suicide-related poisoning, drug category (poisoned substance), length of stay in the PICU, and administration of activated charcoal were found to be significant predictors of mortality (p=0.02, p=0.04, p=0.01, respectively). These factors were included in the multivariate analysis. In the final model, not receiving activated charcoal and longer PICU stay were independently associated with higher mortality. The odds ratios (OR) and 95% confidence intervals (CI) were as follows: 15.7 (4.36-56.7) for PICU length of stay and 6.35 (1.47-27) for not receiving activated charcoal. Detailed results are shown in Table 6.

Discussion

This study sought to elucidate the patterns of pediatric poisoning by analyzing the demographic, clinical, and laboratory characteristics of cases presenting to our hospital. The analysis revealed significant age-related differences in both the causes and outcomes of poisoning, highlighting the importance of targeted preventive measures. Accidental poisoning was found to be most common in children under five years of age, whereas suicidal and substance abuse-related poisonings were more common in adolescents over twelve years of age. These findings highlight the need for age-specific interventions to reduce the risks associated with different types of poisoning. A notable strength of this study is its extensive dataset of more than a decade of pediatric poisoning cases, which provides a comprehensive epidemiologic perspective. The thorough documentation of demographic, clinical, and laboratory data not only enriches the existing literature, but also provides critical insights for the development of more effective prevention and treatment strategies. In addition, this study identified charcoal administration and PICU length of stay as independent predictors of mortality, further emphasizing the critical importance of timely medical intervention and decontamination.

The findings of this study, which identify not receiving activated charcoal and prolonged PICU stays as independent predictors of mortality, align with previous research in the field. Activated charcoal has been shown to reduce mortality in poisoning cases, especially when administered promptly, as it decreases toxin absorption and thus mitigates poisoning severity [7]. Similarly, prolonged PICU stays are often associated with worse outcomes, as they tend to indicate more severe poisonings or complications such as organ failure [8]. These factors reinforce the importance of early intervention and the use of decontamination measures to improve outcomes in pediatric poisoning cases.

The high mortality rate associated with certain poisons, such as corrosives, organophosphates, and rodenticides, highlights the need for stricter regulation and increased public awareness. Our study found a higher mortality rate compared to other research, which underscores the urgent need for preventive strategies and timely intervention [9,10]. In the univariate regression analysis, drug type and toxic agent were significant predictors of mortality, with fatal cases linked to cardiovascular drugs, mushrooms, organophosphates, and rodenticides. These findings emphasize the importance of rapid treatment for these high-risk substances [11,12].

The higher incidence of accidental poisoning among young children compared to adolescents aligns with existing literature, highlighting the vulnerability of younger age groups due to their exploratory behaviors and limited awareness of danger [13,14]. Our findings indicate that interventions tailored to the specific risks of younger children, such as enhanced parental supervision and secure storage of hazardous substances, are essential. Gender differences in poisoning incidents were also notable, with accidental and suicidal poisonings being more common in females, while substance abuse was more prevalent in males. This is consistent with previous studies suggesting that girls are more

likely to engage in self-harm, whereas boys are more likely to engage in substance misuse [15]. These findings highlight the importance of gender-specific prevention strategies and mental health support.

The analysis of the routes of exposure revealed that oral intake was the most common, followed by inhalation. This pattern is in line with other studies and highlights the need for preventive strategies that address these common routes of exposure [16]. Public education on the dangers of both ingestion and inhalation of toxic substances is vital for prevention. Seasonal variation in poisoning incidents was observed, with a higher incidence during the winter months. This contrasts with some studies reporting higher rates in the summer [17]. The winter peak in our study may be attributed to indoor confinement and increased use of household chemicals. Further research is needed to explore these seasonal patterns. The study found that early presentation to the hospital following exposure was associated with better outcomes. This finding supports the literature that timely medical intervention significantly reduces morbidity and mortality in poisoning cases [18].

The retrospective design and single-center focus of this study limit the generalizability of the findings. The demographic and clinical characteristics observed in this study may not reflect broader populations, particularly in different geographical, cultural, or socioeconomic contexts. In addition, although changes in treatment protocols and community awareness during the study period were not formally accounted for, the consistency of the medical team and pediatric intensivist over 13 years suggests that significant protocol changes were unlikely. Future research should include multicenter, prospective studies to improve generalizability and track the impact of evolving treatment protocols and prevention efforts. Addressing these limitations will help refine our understanding and management of pediatric poisonings.

Conclusion

In conclusion, this study highlights the critical role of activated charcoal in reducing mortality by minimizing toxin absorption in pediatric poisoning. The results also emphasize that prolonged PICU stays, often associated with severe poisoning or complications, significantly increase the risk of mortality. In addition, unintentional poisonings in younger children, often due to inadequate supervision and easy access to toxic substances, underscore the need for enhanced preventive measures. Caregiver education and implementation of stricter safety protocols are essential to reduce the incidence of childhood poisonings, while intentional poisonings in adolescents should be addressed through close monitoring and mental health interventions.

Ethical approval

Ethical approval for this study was obtained from the Erciyes University Ethics Committee dated 26.04.2023 and with the decision number 2023/310.

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