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Pediatric Poisonings and Risk Markers for Hospital Admission in a Major Emergency Department in Romania

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Abstract To identify the prevalence, characteristics, and risk markers for childhood poisonings treated in the emergency department of a large Romanian hospital. Trauma registry data using ICD-10 codes and case summaries were studied to identify poisonings among children aged 0–18. Multivariate logistic regression identified factors associated with hospital admission. Between 1999 and 2003, 1,173 pediatric trauma cases were seen in the emergency department; 437 (37.3%) were treated for poisoning, including medication (35%), alcohol (26%), chemical products (19%), and carbon monoxide (14%). Half of all poisonings were unintentional, primarily affecting children < 10 years. Half were intentional, mainly affecting children 10–18. Females were three times more likely than males to have documented suicidal intent ($P < .0001$). Over 30% of suicide attempts were among children ages 10–14 ($P < .0001$). We report significantly increased adjusted odds ratios ($P < .05$) of hospital admission for children 10–18, and for chemical substance poisoning, and suicidal intent. Pediatric poisoning is a serious public health issue in Romania, and we suggest these findings are relevant across other eastern European countries with limited resources. Poisonings result in morbidity and hospital admissions, yet there are few prevention resources available. Health education programs and consumer product safety policies are needed in Romania and eastern Europe.

Keywords Injury · Trauma · Pediatric care · Poisonings · Hospital admissions

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Introduction

Poisoning and intoxication are a common cause of emergency department (ED) visits throughout the world, particularly among children [1]. The incidence, prevalence, and characteristics of poisonings have been described for developed countries, but studies are scarce from low- and middle-income countries, particularly in central and eastern Europe.

Studies from high-income countries have identified patterns associated with children's unintentional ingestion of toxic substances. More than 50% of unintentional substance exposures in the United States (US) are due to prescription and over-the-counter medication, with the majority of these occurring among children under the age of 4 [2]. Other common exposures include pesticides and carbon monoxide [3].

Among young adults (15–19 years), intentional (self-harm) poisonings, including those with suicidal intent, are more frequent than unintentional poisoning worldwide.

The US literature indicates that self-harm poisoning is an important problem since there are 12–15 self-harm related ED visits for every suicide [4]. Overall, more than half of self-harm attempts by young adults involve toxic substances and may be associated with substance abuse [5–7].

Although it is known that death rates due to injuries in eastern Europe are 60% higher than in western Europe [8], injury prevention and control programs remain limited in eastern Europe due to lack of epidemiologic evidence and limited resources. Little is known about poisoning prevalence, demographic patterns, causes, and outcomes in pediatric populations in eastern Europe. We have reported on pediatric injury in Romania [9] and are aware of one other study describing childhood poisoning in Romania [10]. Research on pediatric poisoning in eastern Europe has come primarily from Poland, although a recent study examined hospital admissions for alcohol intoxication among children and adolescents in the Slovak Republic [11]. An improved understanding of the prevalence and risk factors associated with poisonings will support new prevention, treatment, and follow-up strategies.

The aim of this study was to develop epidemiologic data on the prevalence, demographic indicators, causes, and outcomes of poisoning among children in an eastern European urban center. The resulting epidemiologic data can be used to guide regional policy to prevent and reduce injuries among children.

Methods

Setting

The authors identified pediatric poisoning cases from the ED unit of the Children's Emergency Hospital in Cluj-Napoca, Romania [9]. Cluj-Napoca is the third largest city in Romania. It has a peri-urban area population of more than 400,000 residents. The ED unit of the Children's Emergency Hospital is the only one of its kind in Cluj County ($\sim$700,000 residents). While Romanian hospitals and EDs do not routinely collect electronic data related to poisonings, the authors worked with the hospital to develop and access a pilot trauma registry that included all injury cases seen in the ED between January 1999 and December 2003.

Study Design

In this descriptive study, the authors examined injury cases treated between January 1999 and December 2003 in the Cluj-Napoca ED. Injury cases were recorded in an electronic trauma registry created using the EpiInfo Software, version 3.3.2 (CDC, Atlanta, Georgia, USA). Injury diagnoses and causes of injury were coded based on the International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10) [12]. Additional information on the trauma registry is presented elsewhere [9]. The authors chose to further study case summaries of ED admissions for poisoning because primary analysis indicated that poisonings were a major cause of pediatric injury. The analytic data set contained de-identified cases, and the study was approved by the Institutional Review Board for Biomedical Research (IRB-01) at the University of Iowa and the Children's Emergency Hospital.

Study Variables/Measures

Study variables included gender, age, ICD-10 injury diagnosis, source of poisoning, cause of injury, injury intent, and disposition. Age was categorized into four groups (<5, 5–9, 10–14, and 15–18 years) for descriptive analysis and into two groups for logistic regression (0–9, 10–18). Poisonings were classified based on the toxic substance and included carbon monoxide, alcohol, chemical substances (e.g., household chemicals, agricultural pesticides), medication (e.g., prescription, over-the-counter medication), wild mushrooms, and other/unknown toxins. Poisonings were classified by intent as unintentional (accidental) and intentional (self-harm) based on ICD-10 codes. Intentional poisonings were further classified as self-harm without suicidal intent (e.g., alcohol intoxication) or self-harm with suicidal intent. Suicidal intent was identified based on clinical notes, such as medication overdose with suicidal intent or a combination of substances with known lethal effects. Unintentional poisoning included carbon monoxide, medication, chemical substances, mushrooms, or other substances without recorded notes indicating suicidal intent. Disposition was classified as home or hospital admission. Disposition was used as an outcome measure indicative of severity of outcome, extent of treatment, and cost to the healthcare system.

Statistical Analyses

SAS software (V9.1.3) was used to conduct statistical analyses. Bivariate analyses were conducted and assessed for statistical significance using chi-square tests. A multivariate logistic regression analysis was performed to identify factors predictive of hospital admission.

Results

During the 5-year study period, 1,173 children between the ages of 0–18 were treated at the Cluj Children's

Emergency Hospital's ED injuries [9]. Poisonings comprised 37.3% (437) of these visits (Table 1). More male children (228; 52.2%) than female children (209; 47.8%) were represented among poisoning visits. Children aged 15–18 comprised 38.8% (160) of all poisoning visits. Children < 5 years had the second highest proportion of poisoning visits (27.2%), followed by children between the ages of 10–14 (26.9%). Children ages 5–9 were the least likely to be seen for poisoning (7.0%).

Prescription and over-the-counter medications were the most common type of poisoning substance and accounted for over one-third of all poisoning visits (151; 34.6%). These medications were significantly more likely to poison female children (105; 69.5%) than male children (46; 30.5%) ($P < .0001$). Children ages 15–18 comprised 45.4% (65) of medication poisonings, but this type of poisoning was also common among younger children and early adolescents.

Alcohol (115; 26.3%) was the next most common poisoning substance. Male children were significantly more likely (88; 76.5%) than female children to present with alcohol intoxication (27; 23.5%) ($P < .0001$). Overall, children between the ages of 10–18 represented over 98% of acute alcohol intoxication; however, young adolescents (ages 10–14) comprised 38.0% (41) of ED visits for acute alcohol intoxication. Chemical products, which accounted for 18.5% (81) of visits, were more common among young children between the ages of 0–4 (56; 70.9%) and were more frequent among males (53; 65.4%) than females (28; 34.6%). Females were more likely to be admitted to the ED for carbon monoxide and mushroom poisoning, and the prevalence of those two toxins increased with age. There were no reported cases of recreational/illicit drug overdose.

Half of all poisoning visits to the ED were cited as unintentional (Table 2). These poisonings were equally distributed by gender, but were more common among children < 5. All carbon monoxide poisonings were documented as unintentional, while only three acute alcohol intoxication/self-poisonings were documented as unintentional. Over one-quarter of poisoning visits were coded as self-harm without suicidal intent (i.e., the ingestion of a substance known by the patient to be harmful but ingested with no known suicidal intent). These cases were more frequent among males than females, and increased with age. Alcohol was the most common substance for self-harm poisonings. Intentional alcohol poisonings stated as suicide attempts or involving the use of a combination of substances with potential lethal effect comprised 23.2% of poisoning visits to the ED. Females were more likely than males to attempt suicide through poisoning. Nearly one-third of suicide attempts were among children ages 10–14. Medication overdoses were the predominant cause recorded in suicide attempts.

Approximately half of patients were sent home and the other half admitted to the hospital (Table 3). Females and males were equally likely to be admitted, and a slightly higher proportion of younger children than older children were admitted. All of the patients poisoned by wild mushrooms were admitted due to the potential severity of outcomes. Admission rates were also high for poisoning by

Table 1 Source of childhood poisonings treated in the ED by gender, age, intent, and disposition (Cluj-Napoca, Romania; 1999–2003)

	Medication N (%)	Alcohol N (%)	Chemical products N (%)	Carbon monoxide N (%)	Other/unknown[a] N (%)	Total N (%)	*P*-value
Total	151 (34.6)	115 (26.3)	81 (18.5)	59 (13.5)	31 (7.1)	437 (100.0)	
Gender							<0.0001
Male	46 (30.5)	88 (76.5)	53 (65.4)	23 (39.0)	18 (58.1)	228 (52.2)	
Female	105 (69.5)	27 (23.5)	28 (34.6)	36 (61.0)	13 (41.9)	209 (47.8)	
Age							<0.0001
0–4	38 (26.6)	1 (0.9)	56 (70.9)	8 (15.1)	9 (31.0)	112 (27.2)	
5–9	4 (2.8)	1 (0.9)	8 (10.1)	13 (24.5)	3 (10.3)	29 (7.0)	
10–14	36 (25.2)	41 (38.0)	8 (10.1)	17 (32.1)	9 (31.0)	111 (26.9)	
15–18	65 (45.4)	65 (60.2)	7 (8.9)	15 (28.3)	8 (27.6)	160 (38.8)	
Intent							<0.0001
Unintentional	55 (37.4)	3 (2.6)	75 (92.6)	57 (98.3)	26 (83.9)	216 (50.0)	
Self-Harm	4 (2.7)	107 (93.0)	3 (3.7)	0 (0.0)	2 (6.5)	116 (26.9)	
Suicide	88 (59.9)	5 (4.4)	3 (3.7)	1 (1.7)	3 (9.7)	100 (23.1)	
Disposition							<0.0001
Admission to hospital	90 (68.7)	19 (18.8)	40 (60.6)	24 (46.1)	18 (66.7)	191 (50.7)	
Home	41 (31.3)	82 (81.2)	26 (39.4)	28 (53.9)	9 (33.3)	186 (49.3)	

[a] Combined mushrooms with 'other/unknown' group

Table 2 Intent of childhood poisonings treated in the ED by gender, age, source/substance, and disposition (Cluj-Napoca, Romania; 1999–2003)

	Unintentional N (%)	Self-harm w/o suicidal intent N (%)	Self-harm w/suicidal intent N (%)	Total N (%)	*P*-value
Total	216 (50.0)	116 (26.9)	100 (23.1)	432 (100.0)	
Gender					<0.0001
Male	112 (51.9)	87 (75.0)	25 (25.0)	224 (51.9)	
Female	104 (48.1)	29 (25.0)	75 (75.0)	208 (48.1)	
Age					<0.0001
0–4	111 (53.9)	0 (0.0)	1 (1.1)	112 (27.4)	
5–9	27 (13.1)	1 (0.9)	0(0.0)	28 (6.9)	
10–14	36 (17.5)	45 (41.3)	29 (31.2)	110 (27.0)	
15–18	32 (15.5)	63 (57.8)	63 (67.7)	158 (38.7)	
Substance					<0.0001
Medication	55 (25.5)	4 (3.4)	88 (88.0)	147 (34.0)	
Alcohol	3 (1.4)	107 (92.2)	5 (5.0)	115 (26.6)	
Chemical substances	75 (34.7)	3 (2.6)	3 (3.0)	81 (18.8)	
Carbon monoxide	57 (26.4)	0 (0.0)	1 (1.0)	58 (13.4)	
Other/unknown[a]	26 (12.0)	2 (1.7)	3 (3.0)	31 (7.2)	
Disposition					<0.0001
Admission to hospital	92 (50.6)	18 (17.7)	79 (89.8)	189 (50.8)	
Home	90 (49.4)	84 (82.3)	9 (10.2)	183 (49.2)	

[a] Combined mushrooms with 'other/unknown' group

Table 3 Crude and adjusted ORs for hospital admission among children treated for poisoning in the ED (Cluj-Napoca, Romania; 1999–2003)

	Discharged home	Admitted	Crude		Adjusted (full model)	
	N(%)	N(%)	OR	95% CI	OR	95% CI
Gender						
Male	110 (57.6)	81(42.4)	0.5[a]	0.34–0.77	1.1	0.63–2.01
Female	76 (40.9)	110 (59.1)	Ref	–	Ref	–
Age						
0–9	68 (59.6)	46 (40.4)	Ref	–	Ref	–
10–18	108 (45.2)	131 (54.8)	1.8	1.14–2.82	4.5[a]	1.96–10.43
Substance						
Medication	41 (31.3)	90 (68.7)	9.5[a]	5.09–17.62	1.7	0.38–7.66
Alcohol	82 (81.2)	19 (18.8)	Ref	–	Ref	–
Chemical	26 (39.4)	40 (60.6)	6.6	3.29–13.40	4.4	0.93–21.25
Carbon monoxide	28 (53.9)	24 (46.2)	3.7	1.77–7.75	1.3	0.25–6.43
Other/unknown[b]	9 (33.3)	18 (66.7)	8.6	3.36–22.16	NA	–
Intent						
Unintentional	90 (49.5)	92 (50.6)	4.8	2.66–8.57	6.8[a]	1.43–32.24
Self-Harm	84 (82.4)	18 (17.7)	Ref	–	Ref	–
Suicide	9 (10.2)	79 (89.8)	41.0[a]	17.38–96.52	37.1[a]	7.18–192.28
Total	186 (49.3)	191 (50.7)				

[a] Significant at the $P < 0.05$ level

[b] Combined mushrooms with 'other/unknown' group in multivariate logistic regression model due to 0 discharged to home, excluded from all adjusted models in this table

medication (68.5%) and chemical products (60%). About 20% of patients intoxicated with alcohol were also admitted. Controlled for gender, age, substance, and intent, children 10–18 were 4.5 times more likely to be admitted (95% CI: 1.96–10.43) than children < 9. Although confidence intervals did not indicate significance, we observed an increase.

Odds of poisoning by medication, chemical substances, and carbon monoxide had an increased odds for hospital admission; unintentional injuries were also more likely to result in admission. Compared with self-harm poisonings, unintentional poisonings were 6.8 times (95% CI: 1.4–32.24) more likely to be admitted and suicide attempts were 37 times more likely to be admitted (95% CI: 7.18–192.28). Due to the small sample size, confidence intervals were very wide. However, nearly 10% of patients documented as having attempted suicide were discharged home.

Discussion

The most common poisoning substances in this study were prescription and over-the-counter medication, alcohol, chemical products (i.e., household, automotive, and farm chemicals), and carbon monoxide. Children between the ages of 0–4 and 10–18 comprised the most hospital admissions for poisoning. Older children were treated most frequently for acute intoxications with medication and alcohol. Suicide attempts were very high among female patients, while male patients showed self-harming behavior without stated intent for self-harm. High rates of stated suicide attempts and self-harm were observed among young adolescents (ages 10–14), especially by using medication and alcohol. Evidence-based guidelines for assessment and treatment of teenagers suspected of substance abuse include comprehensive assessments of alcohol use history, psychosocial risk factors, and treatment history. Combinations of alcohol abuse, previous self-harm, history of physical abuse, and a family history of mental health and substance use indicates an increased risk of completed suicide. Thus, implementation of evidence-based guidelines for adolescents seen in emergency units need to be explored in future research.

More than 80% of youth treated for acute alcohol intoxication were discharged home from the emergency department, which usually does not include preventive treatment or follow-up with psychological services. Just over 10% of youth treated for a suicide attempt were discharged home. Emergency department screening and intervention programs would be helpful to ensure that children are receiving appropriate follow-up care for conditions that may have psychological or mental health components.

Potential community interventions for the 10–18 age group could include: limiting access to both alcohol and certain medications to adults only; health education programs aimed at parents, youth, and teachers; improved access to psychiatric and/or psychological support services for individuals prone to risky behavior or self-harm; and clear guidelines for risk screening and parent education during routine physician visits. Furthermore, children < 5 are of particular importance for prevention because they are naturally curious, they cannot read labels, and are biologically more susceptible to the toxic effects of most poisons. A combination of policy and educational approaches can play a major role in reducing exposure of children to toxic substances, yet few organized efforts have been introduced in Romania or elsewhere in eastern Europe due to lack of resources.

A quarter of the medication poisonings were in the 0–4 age group, most likely because of lack of childproof medication containers, and limited parental knowledge regarding child safety. Prevention approaches to reducing exposure to medications include: child-resistant tampering containers; proper labeling (including illustrations recognizable by children); adding ill-smelling or tasting components; and parental education. Carbon monoxide poisoning was reported in all age groups and represented 13% of all poisonings. Carbon monoxide poisoning should be completely preventable [13], yet few, if any, programs have addressed carbon monoxide safety. Better safety standards for heating units, consumer education, and availability of carbon monoxide alarms are potential preventive steps.

This study has several limitations. Subject identification relies on correct coding of medical records. Coding errors due to incomplete information may have resulted in an underreporting of the number of children affected by poisonings. Furthermore, the availability of data in medical records does not allow for a comprehensive evaluation of psychosocial factors (i.e., family history) and long-term patient outcomes. Finally, our data suggest that poisoning patterns are very different by age and gender. Future larger studies should examine these as effect modifiers as our sample was not large enough to stratify.

Poisonings comprised a very high percentage (37%) of injury-related ED visits in this large children's hospital. This study identifies the major risk factors for poisonings as well as the age groups that are most susceptible to poisonings. These trends clearly identify childhood poisoning prevention as an important priority. Prevention efforts in high-income countries have shown success in reducing childhood poisonings, and duplicating these

methods in low and middle-income countries is critical [14].

There is a clear need for broader approaches, in addition to the interventions focused on individual substances described above. For example, EDs may not have adequate resources for mental health assessments for children treated for self-harm and suicide attempts. However, referral for active follow-up after self-poisoning is associated with reduced risk of repetition [15], and methods are needed to integrate these practices into emergency care in eastern Europe. Consumer product safety interventions, especially in regard to medication and chemicals containers, require more attention and research. Poison control centers represent a cost-effective alternative to address the burden of poisonings because they can support the activity of EDs through improved risk assessment documentation and protocols. In addition, poison control centers can provide lists of chemicals and antidotes that need to be assessed and reassessed at national level.

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Conflict of Interest None to declare.

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