

Retrospective study of poisoned patients admitted to a hospital's pediatric intensive care unit in Chile

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ABSTRACT

Introduction. Pediatric poisoning is a public health problem worldwide. The objective of this study was to establish the characteristics of pediatric cases of poisoning seen at the pediatric intensive care unit (PICU) of a hospital in Chile.

Population and methods. The medical records of patients diagnosed with poisoning and admitted to the PICU between 2013 and 2017 were reviewed.

Results. A total of 105 cases were identified, who account for 3% of all admissions recorded in the study period. Patients' median age was 10 years. In total, 73.3% of cases were female patients; 51% of cases were associated with intentional poisoning; and 83% were caused by drug exposure. The most common drugs identified were antidepressants (11.2%) and non-steroidal anti-inflammatory drugs (10.7%). Intake was the most frequent route of exposure (93%). The average length of stay in the PICU was 1.3 days. One patient required intubation and another required hemodialysis in the PICU. Statistically significant relationships were established between patient sex and the circumstance of exposure and between the patient's psychiatric condition and the number of toxic substances ingested.

Conclusion. Most poisoning cases seen at the PICU were intentional and occurred in female patients, who had a psychiatric condition. The most common drugs identified were antidepressants and non-steroidal anti-inflammatory drugs.

Key words: poisoning, toxicology, epidemiology, Chile.

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INTRODUCTION

Pediatric poisoning has been recognized as a public health problem worldwide.¹

Exposure to drugs in the pediatric population aged 1 to 5 years is the leading cause of calls to poison control centers in the United States. This is because of the characteristics typical of this age group, together with the regular hand-to-mouth activity, which increases their motor skills and the development of exploratory behavior.²

Worldwide, each year, thousands of pediatric patients are seen at the emergency department due to exposure to various chemicals (via intake, inhalation or dermal absorption).³

The toxicology information associated with pediatric cases of poisoning is scarce, even in developed countries.⁴ In the United States, approximately 1 000 000 pediatric cases of poisoning were associated with toxic exposure in 2015.⁵ In addition, self-harm (e.g., suicide attempt) and recreational exposure account for a large percentage of poisoning in the pediatric population.³

In general, poisoning is classified into accidental or non-intentional and intentional. Among intentional events, caused by the patients themselves –including suicide attempt– self-harm episodes or recreational substance use were identified, and they account for a large percentage of poisoning cases.³ When third parties are involved, abuse and homicide were reported.⁶

Poisoning associated with children younger than 6 years is considered exclusively accidental because children lack the judgment related

to potentially harmful substances.⁷ In most cases, adsorbed substances are minimally toxic; however, some cases may result in serious complications and require an immediate response from the health care team to prevent permanent damage, including death.¹

An updated epidemiological registry of poisoning in specific areas or regions is a useful tool that can be used to both predict and implement related prevention strategies and have health care teams available who are capable of adequately managing these clinical situations.¹

Unfortunately, this scenario is not common in Chile because only few reports have considered pediatric cases of poisoning related to drugs and cleaning products together with beauty products in recent decades.⁸⁻¹⁰

The objective of this study was to establish the characteristics of pediatric poisoned patients admitted to the pediatric intensive care unit (PICU) of a tertiary care hospital in Chile between 2013 and 2017.

POPULATION AND METHODS

This was a retrospective study carried out in a tertiary care hospital in the city of Concepción, Chile. This hospital caters for approximately 1 500 000 potential users; one third of them are pediatric patients.

The medical records of patients diagnosed with poisoning and admitted to the PICU were reviewed based on the following inclusion criteria: patient age (1 day to 14 years), admission to the PICU with a diagnosis of acute poisoning caused by drugs or other non-drug agents, including gases and industrial products that were identified, either alone or combined, for a single poisoning case.

Exclusion criteria were poisoning of unknown cause, poisoning related to alcohol or illegal drug use (e.g., cocaine, cannabis, ecstasy, etc.), adverse drug reactions or side effects, insect or snake bites, and foreign body ingestion. Such exclusions were based on the fact that 1) drugs are the leading cause of poisoning in the pediatric population in the Americas;¹¹ 2) the circumstance associated with ethanol (alcohol) poisoning involves, in most cases, a social component, so we decided to exclude it; and 3) no cases of snake bites have been registered in Chile. However, cases associated with recluse spider or scorpion bites have been registered, but they are uncommon and were not identified among the patients admitted to the PICU in the 2013-2017 period.

Collected data were entered into Microsoft Excel[®] spreadsheets. The study variables were patient age and sex; drug or substance that caused the poisoning; circumstance of exposure (accidental or intentional); prior diagnosis of psychiatric condition, including previous episode of self-harm, suicide attempt, depression; route of exposure; and clinical outcome. In relation to the variable “prior psychiatric condition”, it is worth noting that there may be poisoned patients who may have an undiagnosed psychiatric condition which, if diagnosed, may be so over a longer period than that of a stay in the PICU.

Patients were grouped by age: 0 to 5, 6 to 10, and 11 to 14 years.

At the time of the study, patients up to 14 years old were considered pediatric patients, so they were admitted to the hospital’s PICU.

Statistical analysis

The statistical analysis was done using the IBM SPSS 22[®] (Statistical Package for the Social Sciences, United States) statistical software.

All cases who met the above-mentioned criteria were included. No data were lost.

Collected data are presented as frequency for categorical variables and as median for continuous variables.

One-sided proportion tests and Pearson’s χ^2 test were done for quantitative and qualitative variables, respectively. *P* values lower than 0.05 were considered statistically significant.

Ethical considerations

Approval was obtained from the ethics committee of the hospital where the study was conducted to access clinical records. Patients were identified using serial numbers, and information was kept confidential.

RESULTS

There were a total of 133 cases of poisoning associated with substance exposure; 28 were excluded. Of these, 23 corresponded to overdose, alone or combined with alcohol, cocaine, and cannabis. In addition, the cause of poisoning was not identified in 5 cases. Therefore, 105 poisoning cases were identified based on the inclusion criteria mentioned before. They accounted for 3% of all admission to the PICU in the 2013-2017 period. *Table 1* shows the annual distribution of poisoning cases registered.

The number of poisoning cases associated with female patients ranged from 16 to 20, whereas

that associated with male patients ranged from 1 to 9 in the study period, which evidences the higher variability of the latter.

The median age of poisoned patients was 10 years. Female patients had an older median age than males.

Table 2 shows the annual distribution of poisoning cases broken down into age, sex, and circumstance of exposure (accidental or intentional).

Of all poisoning cases, 51% were intentional and 49%, accidental. Pearson's χ^2 test showed a statistically significant relationship between sex and circumstance of exposure ($p < 0.0001$) during the study period. Specifically, female patients were associated with a higher frequency of intentional poisoning.

There were 51 accidental cases (female-male ratio $29/22 = 1.4$). Intentional cases were 54 (female-male ratio $48/6 = 8$).

The proportion of female patients was higher than that of male patients in the 0-5-year-old group ($p < 0.05$) and the 11-14-year-old group ($p < 0.0001$). Male patients prevailed in the 0-5-year-old group and were related to accidental poisoning.

According to Table 3, 83% of poisoning cases were caused by drug exposure, whereas 17% were caused by non-drug agents. In relation to drug-induced poisoning, 55% of cases were related to a single drug and 28% were associated with exposure to more than one drug.

In addition, we found a statistically significant relationship between the diagnosis of a psychiatric condition among female patients with intentional poisoning and the exposure to one or more drugs

(16.2% and 18.1%, respectively).

Table 4 shows the drug type involved in poisoning cases. They include antidepressants (amitriptyline, venlafaxine), non-steroidal anti-inflammatory drugs (NSAIDs) (ibuprofen, ketoprofen, metamizole sodium or dipyrone), antipsychotics (chlorpromazine), opioids (tramadol), benzodiazepines (chlordiazepoxide, clonazepam), antihypertensive drugs (losartan, propranolol, enalapril), antihistamines (chlorpheniramine), antiepileptic drugs (phenobarbital, carbamazepine), antibiotics (cloxacillin), muscle relaxants (cyclobenzaprine), antidiabetics, diuretics, corticosteroids, and oral contraceptives. In relation to non-drug agents, liquid silicon and carbon monoxide were identified. The information related to routes of exposure, treatment administered in the PICU, length of stay in the PICU, and clinical outcome was also recorded.

DISCUSSION

This study established the characteristics of poisoned patients admitted to the PICU in the 2013-2017 period. Only 2% of patients required complex management in the PICU (intubation, hemodialysis). The average length of stay in the PICU was 1.3 days. Seventy-one percent of hospitalized patients were transferred from the PICU to the pediatric ward of this hospital for observation, whereas 29% were discharged.

A feasible alternative, as long as they are available, are intermediate care units with monitoring devices and health care staff with experience in the management of critical poisoned patients.

TABLE 1. Annual distribution of poisoning cases admitted to the pediatric intensive care unit by patient sex. N: 105

Year	Female			Male		
	Number (%)	Range years old	Median years old	Number (%)	Range years old	Median years old
2013	18 (17)	1-14	11	9 (8.6)	0.2-14	5
2014	16 (15.2)	3-14	12.5	3 (2.9)	2-5	3
2015	10 (9.5)	2-14	12	8 (7.6)	2-14	2.5
2016	20 (19.0)	0.3-14	13	7 (6.7)	1-14	5
2017	13 (12.4)	0.5-14	12	1 (1.0)	NA ^a	NA ^a
Total	77 (73.3)	0.3-14	12	28 (26.7)	0.2-14	3

NA^a = Not applicable, only 1 case of poisoning.

Female patient/male patient ratio = 2.7.

One-sided proportion test $p < 0.0001$.

Poisoning cases recorded in this study showed similarities with those published in the articles by Mintegi,³ Gonzalez-Urdiales,¹¹ and Lee² in terms of the number of events by patient sex and age and the circumstance of exposure. Such scenario may be explained by the fact that, during adolescence, self-harm episodes account for the most common type of poisoning in association

with female patients.^{3,11}

Adolescent patients face many stressful situations that may trigger self-harm actions, including suicide attempts, especially associated with the intake of drugs or other substances commonly found at home. In addition, a risky behavior and the feeling of invincibility may lead to illegal substance use.²

TABLE 2. Annual distribution of poisoning cases broken down into patient sex, age, and circumstance of exposure; n (%)

Year	Age (years old)				
	0 to 5		6 to 10		11 to 14
Female	Accidental	Accidental	Intentional	Accidental	Intentional
2013	7 (6.7)	0 (0)	2 (1.9)	0 (0)	9 (8.6)
2014	6 (5.7)	1 (1)	0 (0)	0 (0)	9 (8.6)
2015	4 (3.8)	0 (0)	0 (0)	0 (0)	6 (5.7)
2016	6 (5.7)	0 (0)	0 (0)	1 (1)	13 (12.4)
2017	4 (3.8)	0 (0)	0 (0)	0 (0)	9 (8.6)
Total	27 (25.7) ^a	1 (1)	2 (1.9)	1 (1)	46 (43.8) ^a
Male	Accidental	Accidental	Intentional	Accidental	Intentional
2013	5 (4.8)	1 (1)	1 (1)	1 (1)	1 (1)
2014	3 (2.9)	0 (0)	0 (0)	0 (0)	0 (0)
2015	7 (6.7)	0 (0)	0 (0)	0 (0)	1 (1)
2016	4 (3.8)	0 (0)	1 (1)	0 (0)	2 (1.9)
2017	1 (1)	0 (0)	0 (0)	0 (0)	0 (0)
Total	20 (19) ^a	1 (1)	2 (1.9)	1 (1)	4 (3.8) ^a

^a: One-sided proportion test.

TABLE 3. Number of poisoning cases broken down into patient sex, age, and psychiatric condition, and type and number of substances involved. N: 105

2013-2017 period	Female, accidental (%)			Female, intentional, with psychiatric conditions ^b (%)			Female, intentional, without psychiatric conditions (%)		
	1 drug	>1 drug	Non-drug	1 drug	>1 drug	Non-drug	1 drug	>1 drug	Non-drug
Age (years old)									
0 to 5	18 (17.1)	1 (1)	8 (7.6)	0	0	0	0	0	0
6 to 10	0	0	2 (2)	1 (1)	0	0	2 (2)	0	0
11 to 14	0	0	0	16 (15.2)	19 (18.1)	0	5 (4.8)	5 (4.8)	0
Total	18 (17.1)	1 (1)	10 (9.5)	17 (16.2) ^a	19 (18.1) ^a	0	7 (6.7)	5 (4.8)	0
	Male, accidental (%)			Male, intentional with psychiatric conditions ^b (%)					
Age (years old)									
0 to 5	14 (13.3)	1 (1)	5 (4.8)	0	0	0			
6 to 10	0	0	1 (1)	1 (1)	1 (1)	0			
11 to 14	0	0	1 (1)	1 (1)	2 (2)	1 (1)			
Total	14 (13.3)	1 (1)	7 (6.7)	2 (2)	3 (2.8)	1 (1)			

Non-drug: non-drug agent, alone or combined.

^a: Pearson's χ^2 test $p < 0.0001$.

^b: Previously diagnosed psychiatric conditions: prior self-harm episode, suicide attempt, depression.

A prior diagnosis of psychiatric conditions plays a key role in the increasing number of intentional poisoning, especially among female adolescents.⁸ However, there may be poisoned patients who may have an undiagnosed psychiatric condition which, if diagnosed, may be so over a longer period than that of a stay in the PICU.

In addition, the greater access to prescription and over-the-counter drugs contributes to increasing the number of cases in which such substances are used for self-harm purposes.^{1,12}

In relation to drugs and non-drug agents identified in poisoning cases, they are consistent with the information reported in other published studies. Drugs acting upon the central nervous system were the most common ones in poisoning cases among pediatric patients.¹³⁻¹⁶ In our study, the oral route was the most common route of exposure. Several published studies agree with

our findings.¹⁷⁻¹⁹

We believe that reporting poisoning cases seen at hospitals is not enough. It is necessary to achieve an effective communication of risks to the general population, including education programs and healthy lifestyles, besides a support network at the level of both public and private institutions.

This study has limitations. First of all, its retrospective nature. For this reason, authors collected available relevant data from the medical records of the patients and cases that met the inclusion criteria. Therefore, it was not possible to conduct any intervention, such as interviews with patients or health care staff to obtain additional information.

This is an important aspect for cases in which patients have a prior diagnosis of a psychiatric condition and the subsequent classification of the episode as accidental or intentional.

TABLE 4. Toxicology information about poisoning cases recorded in the 2013-2017 period. N: 105

Route of exposure	Frequency	Percentage (%)
Intake	98	93.3
Inhalation	7	6.7
Drug		
Antidepressant	20	11.2
NSAIDs	19	10.7
Antipsychotic	18	10.1
Acetaminophen	14	7.9
Opioid	13	7.3
Benzodiazepine	12	6.7
Antihypertensive drug	10	5.6
Antihistamine	9	5.1
Antiepileptic drug	8	4.5
Antibiotic	6	3.4
Muscle relaxant	4	2.2
Other	45	25.3
Management at PICU		
Intubation	1	1.0
Hemodialysis	1	1.0
Length of stay in PICU	1.3 ^a	1 to 8 ^b
Clinical outcome		
Discharge from PICU	30	29.0
Transfer to pediatric ward	75	71.0
Death	0	0

PICU: pediatric intensive care unit.

N of drugs and non-drug agent = 178

^a Average length of stay in PICU in days.

^b Range of length of stay in PICU in days.

Another limitation is that no medical record indicated the dose or amount of drug to which patients may have been exposed. In addition, the toxicology determinations used to identify the substances involved were not recorded either. However, the clinical management of acute poisoning cases is mostly symptomatic and lab tests pose their own limitations.²⁰

The cases of poisoning reported in this study were seen at a hospital in the city of Concepción; therefore, our findings may not be representative of a national trend in terms of poisoned patients admitted to the PICU. A sample selection bias may be present.

In relation to the exclusion criterion related to unidentified poisoning cases, they corresponded to 5 episodes in which it was not possible to establish the substance that caused the clinical condition and which may have been severe. This type of episodes should be included in future studies. Likewise, the inclusion of episodes associated with alcohol (ethanol) intake should be taken into consideration because the prevalence of alcohol consumption in the Chilean school population is 76.2% and the age at initiation is 13.7 years.²¹

The information gathered in this study will help to promote preventive strategies and programs targeted at the pediatric population, one of the groups that is most susceptible to suffer poisoning.

At the same time, our results may be used to update clinical guidelines for the management of poisoning cases based on the trends associated with the drugs most commonly identified as causative of poisoning. Lastly, further studies are required to establish justified criteria for the admission of patients to the PICU in developing countries, where resources are limited, especially when a public health threat, such as the COVID-19 pandemic, may last longer than expected.

CONCLUSION

The main findings of this study indicate that 73% of poisoning cases seen at the PICU corresponded to female patients, who had a psychiatric condition, and which were intentional. The most common drugs identified in poisoning cases were antidepressants, NSAIDs, and benzodiazepines. Most patients admitted to the PICU were under observation for an average of 1 day and then discharged. ■

REFERENCES

1. Lee J, Fan N-C, Yao T-C, Hsia S-H, et al. Clinical spectrum of acute poisoning in children admitted to the pediatric emergency department. *Pediatr Neonatol*. 2019; 60(1):59-67.
2. Lee VR, Connolly M, Calello DP. Pediatric poisoning by ingestion: developmental overview and synopsis of national trends. *Pediatr Ann*. 2017; 46(12):e443-8.
3. Mintegi S, Azkunaga B, Prego J, Qureshi N, et al. International Epidemiological Differences in Acute Poisonings in Pediatric Emergency Departments. *Pediatr Emerg Care*. 2019; 35(1):50-7.
4. Ahmad I, Ahmad S, Iqbal W, Nazir M, et al. Spectrum, Complications and Outcome of Acute Pediatric Poisoning. *Toxicol Int*. 2017; 24(1):128-31.
5. Mowry JB, Spyker DA, Brooks DE, Zimmerman A, Schauben JL. 2015 Annual Report of the American Association of Poison Control Centers' National Poison Data System (NPDS): 33rd Annual Report. *Clin Toxicol (Pila)*. 2016; 54(10):924-1109.
6. Repetto Jiménez M, Repetto Khun G. Conceptos y definiciones: Toxicología, Toxicidad. In Repetto Jiménez M, Repetto Khun G. *Toxicología fundamental*. 4.^a ed. Madrid: Diaz de Santos; 2009, p.45-9.
7. Mintegi S. Manejo general, epidemiología de las intoxicaciones en pediatría. In Mintegi S. *Manual de intoxicaciones en pediatría*. 3.^a ed. Madrid: Ergon; 2012, p.3-8.
8. Von Dessauer B, Ortiz P, Hinojosa T, Bataszew VDA, et al. Intento de suicidio vía ingesta de fármacos en niños. *Rev Chil Pediatr*. 2011; 82(1):42-8.
9. González F, Retamal C, Silva L, Cerda P, et al. Caracterización de las consultas realizadas a un Centro de Información Toxicológica por productos de aseo y productos cosméticos en niños. *Rev Chil Pediatr*. 2019; 90(5):500-7.
10. Mena HC, Bettini SM, Cerda JP, Concha SF, Paris ME. Epidemiología de las intoxicaciones en Chile: una década de registros. *Rev Med Chile*. 2004; 132(4):493-9.
11. Gonzalez-Urdiales P, Kuppermann N, Dalziel SR, Prego J, et al. Pediatric Intentional Self-poisoning Evaluated in the Emergency Department: An International Study. *Pediatr Emerg Care*. 2021; 37(12):e1631-6.
12. Lowry JA, Burns M, Calello DP. Pediatric Pharmaceutical Ingestions. *Pediatr Ann*. 2017; 46(12):e459-65.
13. Alizadeh A, Asoudeh MZ, Abdi F, Moshiri M, et al. Epidemiological pattern of acute pediatric poisoning in Mashhad, Iran during 2011-2013. *Int J High Risk Behav Addict*. 2017; 6(2):e33707.
14. Farag AA, Said E, Fakhher HM. Pattern of Acute Pediatric Poisoning at Banha Poisoning Control Center, Egypt: One-Year Prospective Study. *Asia Pac J Med Toxicol*. 2020; 9(2):44-51.
15. Sobeeh FGA, Abd El-Hay NSE-D, Draz EE, Saad KM. Pattern of acute pediatric poisoning in middle delta poison control centers. *Tanta Med J*. 2018; 46(3):215-24.
16. Moon J, Chun B, Cho Y, Lee S, Jung E. Characteristics of emergency department presentations of pediatric poisoning between 2011 and 2016: a retrospective observational study in South Korea. *Pediatr Emerg Care*. 2021; 37(5):e261-8.
17. Pérez Medina Y, Fernández Villalón M, Urgellés Díaz D, Leyva Peguero Y, Fernández Villalón M. Morbilidad por intoxicaciones exógenas en un hospital pediátrico de Santiago de Cuba. *Medisan*. 2020; 24(6):1200-12.
18. Beauchamp GA, Carey JL, Cook MD, Cannon RD, et al. Sex Differences in Pediatric Poisonings by Age Group: a Toxicology Investigators' Consortium (ToxIC) Analysis

- (2010–2016). *J Med Toxicol*. 2020; 16(4):423-43.
19. Kline JN, Badolato GM, Goyal MK. Trends in Pediatric Poisoning-Related Emergency Department Visits: 2001–2011. *Pediatr Emerg Care*. 2021; 37(1):e7-12.
 20. Heyerdahl F, Hovda K, Bjornaas M, Brørs O, et al. Clinical assessment compared to laboratory screening in acutely poisoned patients. *Hum Exp Toxicol*. 2008; 27(1):73-9.
 21. Chile. Servicio Nacional para la Prevención y Rehabilitación del Consumo de Drogas y Alcohol. Decimotercer estudio de consumo de drogas en población escolar 2019. Santiago: Ministerio del Interior y Seguridad Pública. 2020. [Accessed on: December 13th, 2021]. Available at: <https://www.senda.gob.cl/observatorio/que-es-el-observatorio/>