Review article

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Review on acute paediatric poisoning requiring admission in Hong Kong: A retrospective observational study

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Abstract

***Objective*: Acute paediatric poisoning is a global public health concern. This study aimed to describe the characteristics and clinical outcomes of acute paediatric intoxication in Hong Kong and to compare the features of intentional and unintentional intoxication.**

***Design, setting, patients, and participants*: All paediatric intoxications requiring admission to Queen Elizabeth Hospital in Hong Kong from 1 January 2019 to 31 December 2021 were retrospectively reviewed.**

***Measurements and results*: During the study period, 206 children were admitted for acute poisoning. The median age was 15.0 years. A bimodal distribution was observed, with an early peak at 1-2 years and a later peak at 14-16 years. Females were predominant. The vast majority of children were poisoned by ingestion. Therapeutic agents were the most frequent class of agents. The majority of cases were intended for deliberate self-harm, which was more prevalent in middle childhood and early adolescence. Analgesics were the most frequent agents.**

While the majority of patients were stable with close observation, 29 patients (14%) required antidote treatment for the intoxication. Thirty-seven patients (18%) were admitted to the Paediatric Intensive Care Unit (PICU). Four of them (1.9%) required intubation and mechanical ventilation, and one received kidney replacement therapy (continuous veno-venous haemodiafiltration).

Intentional poisoning was more common in female patients ($p<0.001$) and older patients ($p<0.001$). It was associated with therapeutic agents ($p=0.009$) and the necessity for antidote treatment ($p=0.01$). They had a higher mean Poisoning Severity Score (PSS) ($p<0.001$) and required significantly more extended hospital stays ($p<0.001$). They were also more commonly associated with preexisting psychiatric conditions or newly diagnosed psychiatric conditions ($p<0.001$).

***Conclusions*: The vast majority of acute paediatric poisoning was intentional for deliberate self-harm. Intentional poisoning was associated with female sex, increasing age, more severe disease, need for an antidote or invasive treatment, and longer length of hospitalisation. The significantly higher proportion of children in this group having preexisting or newly diagnosed psychiatric disorders raised concerns about addressing emotions in children.**

Key words: Poisoning, intoxication, intentional, unintentional, self-harm, accidental.

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Introduction

Acute paediatric poisoning is a global public health concern. (1) Hong Kong is no exception to the phenomenon. A 3-year local analysis by Yip et al. revealed 1002 cases of paediatric poisoning reported to the Hong Kong Poison Information Centre (HKPIC). (2) Many of these incidents are preventable. (3)

Previous studies have been performed to assess features of paediatric poisoning and the magnitude of

burden related to the incidents. Depending on the poisoning agent and presentation time, different management strategies, such as gastrointestinal decontamination and specific antidotes, were provided. (2,4-7) Though fatalities and long-term morbidity are relatively rare, intensive care and invasive treatment in paediatric intensive care units (PICU) were indicated in some patients. Acute intoxication constituted around 4-8% of all PICU admissions. (4,7) Jayashree et al. reported that 44% of patients required oxygen supplementation for respiratory distress, and nearly half of these patients progressed to respiratory failure necessitating mechanical ventilation. (7) A study in the United States (US) showed that 2 out of 273 patients required dialysis for detoxification. (4)

This study aimed to provide an updated insight into the characteristics of acute paediatric poisoning in Hong Kong.

Methods

Study design and setting

We conducted a retrospective observational study of children admitted to Queen Elizabeth Hospital in Hong Kong due to acute poisoning over 3 years from 1 January 2019 to 31 December 2021. We included all patients under 19 years of age admitted to the paediatric general ward and PICU. The criteria for PICU admissions included depressed mental status, seizures, respiratory failure or significant risk of respiratory failure, and cardiovascular dysfunction or significant risk of arrhythmia. In this study, we aimed to describe the characteristics and clinical outcomes of acute paediatric intoxication in Hong Kong and to compare the features of intentional and unintentional intoxication. The study was approved by the Research Ethics Committee (Kowloon Central/Kowloon East Cluster), Hospital Authority, Hong Kong (Reference: KC/KE-21-0081/ER-4).

Data collection

The cases were identified by the Clinical Data Analysis and Reporting System (CDARS) using the search terms 'overdose,' 'poisoning,' and 'intoxication.' Clinical data, including patient demographics, characteristics of intoxication, treatment, and outcome, were extracted from the medical records.

Definition

The children were classified with age groups according to the National Institute of Child Health and Human Development (NICHD) in the United States Paediatric Terminology, which were infancy and toddler, less than 2 years; early childhood, 2 to 5 years; middle childhood 6 to 11 years; early adolescence, 12 to 18 years. (8)

The poisonings were categorised as intentional or unintentional. Intentional poisonings included deliberate self-harm and recreational drug use. Unintentional poisonings included accidental poisoning, therapeutic error, and criminal poisoning. Each drug was counted separately in case of intoxication involving more than one agent.

Upon arrival at the hospital, the initial clinical assessment was conducted qualitatively using the Poisoning Severity Score (PSS), a standard tool for grading the severity of poisoning. The PSS used a 5-level grading system ranging from no symptoms (zero), mild, transient, and spontaneously resolving symptoms or signs (one), pronounced or prolonged symptoms or signs (two), severity or life-threatening symptoms or signs (three), and death (four). It assessed 12 organ systems, including the gastrointestinal tract, respiratory tract, nervous system, cardiovascular system, metabolic balance, liver, kidney, blood, muscular system, local effects on the skin, local effects on the eye, and local effect of bites and stings (Appendix 1). (9)

Statistical analysis

Categorical data were expressed as frequencies and percentages. Continuous variables were expressed as medians and interquartile ranges (IQR). Categorical data were analysed using a chi-square test or Fisher exact test where appropriate. Continuous data between groups were compared using the Mann-Whitney U test. All data were analysed using the Statistical Package for the Social Sciences (SPSS) version 29. A p-value of less than 0.05 was considered statistically significant.

Results

Demographics

During the study period, 206 children were admitted to our paediatric unit for acute poisoning. The median age was 15.0 years (IQR 13.0-16.6 years). A bimodal distribution was observed with an early peak at 1-2 years and a later peak at 14-16 years (**Figure 1**). Females were predominant (n=145, 70.4%), and 93.7% were Chinese (n=193) (**Table 1**).

Characteristics and types of poisoning

A total of 306 agents were identified. Poisoning by more than one agent was observed in 58 children (28.2%). The vast majority of children were poisoned by ingestion (n=202, 98.1%). Therapeutic agents were the most frequent class of agents (n=177, 83.5%), followed by recreational drugs (n=24, 11.3%) and household agents (n=11, 5.2%)

(**Table 1**). The intoxicating agents were classified and summarised in **Table 2**.

Intention of intoxication

Deliberate self-harm accounted for the majority of intoxication (n=139, 67.5%), followed by accidental poisoning (n=27, 13.1%), therapeutic error (n=19, 9.2%), recreational drug use (n=13, 6.3%), and criminal poisoning (n=8, 3.9%) (**Table 1**). Deliberate self-harm was more prevalent in middle childhood and early adolescence, while accidental poisoning mainly occurred in infancy, toddler, and early childhood. The distribution of intentions among different age groups was summarised in **Figure 2**.

Intentional poisoning

Intentional poisoning accounted for 152 cases (73.8%), including 139 cases (67.4%) of self-harm and 13 cases (6.3%) of recreational drug use.

- Deliberate self-harm
  Analgesics were the most frequent agents involved in deliberate self-harm (n=59, 42.4%). Other common agents included antidepressants (n=39, 28.1%), sedatives and hypnotics (n=36, 25.9%), anticholinergics and antihistamines (n=19, 13.7%), as well as antipsychotics (n=14, 10.1%). Around one-third (n=46, 33.1%) of patients had taken more than one agent. Around two-thirds (n=90, 64.7%) were suicidal at the time of intoxication, and 31.1% (n=28) of these had accompanying acts, predominantly wrist slashing.
- Recreational drug use
  Alcohol was the predominant agent among children intoxicated for recreational purposes (n=9, 69.2%). Other recreational drugs included cocaine (n=4, 30.8%), hallucinogens and lysergic acid diethylamide (LSD) (n=3, 23.1%), cannabis (n=3, 23.1%), methamphetamine (n=3, 23.1%), ketamine (n=2, 15.4%), 3,4-methylenedioxy-methamphetamine (MDMA) (n=1, 7.7%), and gamma-hydroxybutyric acid (GHB) (n=1, 7.7%).

Unintentional poisoning

Unintentional poisoning accounted for 54 cases (26.2%), including 27 cases (13.1%) of accidental poisoning, 19 cases (9.2%) of therapeutic errors, and 8 cases (3.9%) of criminal poisoning.

- Accidental poisoning
  Two-thirds of children who had accidental poisoning involved therapeutic agents (n=18, 66.7%), and one-third involved household agents (n=9, 33.3%). Most therapeutic agents belonged to the children's family members (n=14, 77.8%), while the rest belonged to the children themselves (n=2, 11.1%) and unrecorded sources (n=2, 11.1%). The majority of these incidents were unwitnessed (n=19, 70.4%). The therapeutic agents were nutritional supplements (n=4, 14.8%), anticholinergics and antihistamines (n=2, 11.1%), analgesics (n=2, 11.1%), sedatives and hypnotics (n=2, 11.1%), and antithyroid medications (n=2, 11.1%). Among children who were intoxicated by household agents, cleansing products were the most common agents (n=3, 11.1%), followed by insecticides (n=2, 7.4%), mothballs (n=1, 3.7%), perfumes and cosmetics (n=1, 3.7%), and solid air fresheners (n=1, 3.7%).
- Therapeutic error
  Analgesics (n=5, 26.3%), sedatives, and hypnotics (n=5, 26.3%) constituted the majority of substances that were erroneously taken for therapeutic purposes leading to intoxication. Antidepressants (n=3, 11.1%), anticholinergics and antihistamines (n=2, 11.1%), and nutritional supplements (n=2, 11.1%) were also reported.
- Criminal poisoning
  Among children who were unintentionally poisoned by others in criminal cases, methamphetamine was the most common agent (n=2, 25%), followed by cocaine, ketamine, LSD, alcohol, zolpidem, clozapine, dexamethasone, and levothyroxine (n=1, 12.5% each).

Severity, treatment, and outcome

Activated charcoal was prescribed to 25 patients (12.1%) before ward admission, and one patient required gastric lavage in the emergency department for quetiapine and lorazepam overdose. While the majority of patients (70%) were stable with close observation, 29 patients (14%) required antidote treatment for the intoxication, including N-acetylcysteine (NAC) infusion for paracetamol overdose in 23 patients (11.1%) and cyproheptadine for serotonin syndrome in 2 patients (1%). One patient was given benztropine for the overdose of an atypical antipsychotic named paliperidone. Thirty-seven patients (18%) were admitted to the PICU. Four of them (1.9%) required intubation and mechanical ventilation, and one received kidney replacement therapy (continuous veno-venous haemodiafiltration) for hyperammonaemia secondary to intentional valproate overdose. The median length of stay in the PICU and hospital were 1.7 days (IQR 0.9-2.6 days) and 3.7 days (IQR 1.9-6.8 days), respectively. The Poisoning Severity Score (PSS) median was 1.0 (IQR 0.0-2.0). One patient had long-term

complications due to Cushing's syndrome after prolonged accidental exposure to corticosteroids. There was no mortality in this cohort.

Association between the intention of poisonings and other variables

Intentional poisoning was more common in female patients (81.6% vs 38.9%, p<0.001) and older patients (15.5 vs 3.7 years, p<0.001) (**Table 3**). It was associated with therapeutic agents (90.0% vs 75.9%, p=0.009) and the necessity for antidote treatment (19% vs 3.7%, p=0.01). On the other hand, unintentional poisoning was more related to household agents (0.7% vs 18.5%, p<0.001). All patients who required mechanical ventilation and kidney replacement therapy were intoxicated intentionally. They had a higher mean Poisoning Severity Score (PSS) (1.2±1.4 vs 0.5±1.1, p<0.001) and required significantly longer hospital stay (4.2 vs 1.8 days, p<0.001). They were also more commonly associated with preexisting psychiatric conditions or newly diagnosed psychiatric conditions (OR 6.71 and OR 17.1, p<0.001).

Discussion

This study summarised the characteristics and outcomes of acute paediatric intoxication requiring admission between the years 2019 and 2021 in Hong Kong. Concurring with the epidemiology in other cities, we demonstrated a bimodal distribution of age among acute paediatric intoxication in our locality with an early peak at 1-2 years and a later peak at 14-16 years. (10,11) Most studies found a male predominance in paediatric poisoning and a female predominance in the intentional poisoning subgroup. (9,12-22) Our data showed an overall preponderance of females, which was likely accounted for by intentional poisoning, constituting the majority of poisoning.

Compared to a previous local study conducted in the year 2005, which showed that the majority of acute paediatric poisoning was unintentional, our study showed a predominance of intentional poisoning. (5) Poisoning used to be more prevalent among young children (most commonly at two years of age) due to accidental exposure to household agents. (12) In recent years, poisoning occurred more frequently in teenagers (median age 15 years old) intending for self-harm or suicide. Younger boys tended to have accidental exposure, while adolescent girls were more likely to ingest medications for self-harm. (2) While analgesics were consistently shown to be the commonest agents used for self-harm, the incidence of antidepressant poisoning had increased from 4.9% in the past decade to 24.3%. (2) Furthermore, one-third of these incidents were accompanied by physical acts of self-harm, such as wrist-slashing. A significantly higher proportion of children in the intentional poisoning subgroup had preexisting mental conditions or newly diagnosed psychiatric disorders. This phenomenon could be attributed to the heightened emotional stress experienced by teenagers in Hong Kong. A local survey conducted in 2021 showed that nearly half of secondary school students had high levels of stress, and 52% of students had emotional symptoms of depression. (13) As children receive antidepressants for treating their psychiatric conditions, they may have access to relatively large amounts of antidepressants at times of emotional disturbance and self-harm.

There was a high variability in the intention and pattern of intoxication among children worldwide. This could be related to social, economic, and educational background differences. In general, developed countries had a higher proportion of intoxication due to self-harm (23% to 47%) as compared to developing countries (13% to 31%). (14-17)

Deliberate self-harm was the most common intention for acute intoxication among teenagers in Hong Kong and Australia. (18,19) The drug profile of intoxication was similar, namely paracetamol, antidepressants, and antipsychotics. Consistent with our study, the analysis of Australian paediatric poisoning found associations between intentional poisoning and female sex and increasing age. In addition, it showed a statistically significant association between intentional poisoning and the initial coronavirus disease 2019 (COVID-19) lockdown. Australian adolescent females were found to have more persistent psychological distress levels over the first year of the pandemic. Although there was to date no review that focused on the relationship between acute paediatric poisoning and the COVID-19 pandemic in our locality, the growing prevalence of drug intoxication for self-harm raised concerns about addressing emotions in teenagers and developing strategies to mitigate their psychological distress.

Regarding recreational drug use leading to intoxication, our study concurred with data in the U.S. that alcohol remained the most prevalent agent. (23) Along with methamphetamine and hallucinogens, cocaine and cannabis were the popular illicit drugs of choice for adolescents. However, they were much less abused than alcohol in our locality. This may be related to the banning of these illicit drugs and the comparatively more easily accessible alcohol among teens in Hong Kong.

Contrary to studies conducted in India and Africa, where accidental poisoning constituted up to 97%

of paediatric poisoning, it only accounted for 13.1% of poisoning in our study. (22,24) Accidental poisoning was shown to mainly occur in young children (mean age 4.3 to 7.8 years old) in India and Africa. They were frequently poisoned by accidental exposure to hydrocarbons like kerosene oil and organophosphate-containing insecticides. Poisoning due to animal and insect bites was also reported, but this was rare in our locality. (17,20-22,25-27) Our study demonstrated that the majority of children accidentally ingested pharmaceuticals, most commonly nutritional supplements, which belonged to their family members. Cleansing products and insecticides were the typical household agents when involved. Accidental intoxication predominantly occurred in children younger than five years old. Children of this age group are particularly prone to accidental intoxication due to their curiosity, exploration by mouth, and mistaking drugs as candies. Though the severity of accidental intoxication was usually relatively mild, mortality had been reported in some studies. (21,28) Inadequate supervision, unsafe storage, and environment are some strong risk factors. (29) This highlights the importance of parental education on household safety with safe storage and enhanced vigilance.

Overall, intentional poisoning tended to be more severe than unintentional poisoning. It was associated with a higher Poisoning Severity Score (PSS), need for antidote treatment, and longer duration of hospitalisation, which may be explained by the higher proportion of paracetamol or antidepressant overdose in which antidotes are readily available and higher dosage of drugs taken in these patients. Though not statistically significant due to the small number, four patients required ventilation, and one patient required kidney replacement therapy, all being in the group of intentional intoxication. On the other hand, a higher proportion of patients (up to 20%) in developing countries needed ventilatory support, possibly because of the high prevalence of poisoning due to organophosphate-containing insecticides, which could lead to severe respiratory depression. (22,25-30) Other invasive procedures, such as extracorporeal membrane oxygenation (ECMO), have been reported in some cases. (31,32)

There were some limitations in this study. First, owing to the retrospective nature, there could be missing data regarding the features of intoxication. Second, since the study focused on patients who were admitted to the hospital, those who had only a mild clinical course without hospitalisation were not captured. Third, the data in this single-centre analysis may not reflect the overall picture of paediatric poisoning in the city. A further multi-centre analysis will be helpful for a better understanding of the epidemiology of paediatric poisoning in Hong Kong.

Conclusion

Our study demonstrated that the vast majority of acute paediatric poisoning was intentional for deliberate self-harm, compared to the predominance of unintentional poisoning in the previous local study. Intentional poisoning was associated with female sex, increasing age, more severe disease, need for an antidote or invasive treatment, and longer length of hospitalisation. The significantly higher proportion of children in this group having preexisting or newly diagnosed psychiatric disorders raised concerns about addressing emotions in children.

Conflict of interest

There were no conflicts of interest associated with this publication, and there has been no significant financial support for this work that could have influenced its outcome.

Table 1. The characteristics of acute paediatric intoxication (n=206)

Variable	Frequency (%) or median (IQR)
Age (years)	15.0 (13.0-16.6)
Gender (female)	145 (70.4%)
Ethnicity (Chinese)	193 (93.7%)
Number of agents - 1 - 2 - ≥3	 148 (71.8%) 31 (15.0%) 27 (13.1%)
Route of poisoning* - Ingestion - Inhalation	 202 (98.1%) 4 (2.4%)
Poisoning agents** - Therapeutic agents - Recreational drugs - Household agents	 177 (85.9%) 24 (11.7%) 11 (5.3%)
Intention of poisoning - Deliberate self-harm - Accidental poisoning - Therapeutic error - Recreational drug use - Criminal poisoning	 139 (67.5%) 27 (13.1%) 19 (9.2%) 13 (6.3%) 8 (3.9%)

Legend: IQR=interquartile range.
*One patient was intoxicated by both ingestion and inhalation.
**Six patients were intoxicated by more than one class of agents.
The vast majority occurred in Chinese females who were poisoned by ingestion of therapeutic agents for deliberate self-harm.

Table 2. The agents involved in acute paediatric poisoning

Classification	Intoxicating agent	Frequency (%)
Therapeutic agents	Analgesics	67 (37.9%)
	Sedatives and hypnotics	45 (25.4%)
	Antidepressants	43 (24.3%)
	Anticholinergics and antihistamines	22 (12.4%)
	Other medications	18 (10.2%)
	Antipsychotics	15 (8.5%)
	Gastrointestinal drugs	8 (4.5%)
	Nutritional supplements	8 (4.5%)
	Stimulants	6 (3.4%)
	Traditional Chinese medicines	5 (2.8%)
	Cardiovascular drugs	5 (2.8%)
	Antimicrobials	3 (1.7%)
	Anticonvulsants	1 (0.6%)
Recreational drugs	Alcohol	14 (58.3%)
	Cocaine	5 (20.8%)
	Cannabis	4 (16.7%)
	Methamphetamine	4 (16.7%)
	Hallucinogens/LSD	4 (16.7%)
	Ketamine	3 (12.5%)
	MDMA	1 (4.2%)
	GHB	1 (4.2%)
Household agents	Cleansing agents	4 (36.3%)
	Insecticides	3 (27.3%)
	Mothballs	1 (9.1%)
	Soap sanitisers	1 (9.1%)
	Perfumes/cosmetics	1 (9.1%)
	Other agents	1 (9.1%)

Legend: LSD=lysergic acid diethylamide; MDMA=3,4-methylenedioxy-methamphetamine; GHB=gamma-hydroxybutyric acid.
Analgesics were the most common therapeutic agents. Alcohol accounted for the majority of recreational drugs. Cleansing agents were the most frequent household agents.

Table 3. The characteristics and outcomes of intentional and unintentional intoxication

	Intentional (n=152)	Unintentional (n=54)	p-value
	Frequency (%) or median (IQR)		
Demographic			
- Female	124 (81.6%)	21 (38.9%)	<0.001
- Median age (years)	15.5 (14.2-16.9)	3.7 (2.0-14.8)	<0.001
Age group			
- Infancy and toddler (<2 years)	0 (0%)	13 (24.1%)	<0.001
- Early childhood (2-5 years)	1 (0.7%)	20 (37%)	
- Middle childhood (6-11 years)	6 (3.9%)	4 (7.4%)	
- Early adolescence (12-18 years)	145 (95.4%)	17 (31.5%)	
Chinese	144 (94.7%)	49 (90.7%)	0.33
Preexisting psychiatric disorders	87 (57.2%)	9 (16.7%)	<0.001
Treatment			
- Gastric lavage	1 (0.7%)	0 (0%)	0.99
- Activated charcoal	21 (13.8%)	4 (7.4%)	0.33
- Antidote	27 (19%)	2 (3.7%)	0.01
- Mechanical ventilation	4 (2.6%)	0 (0%)	0.58
- CVVH	1 (0.7%)	0 (0%)	0.99
- Require PICU admission	30 (19.7%)	7 (13%)	0.27
Outcome			
- Median PICU LOS (days)	2.0 (0.9-2.9)	1.2 (0.9-1.5)	0.11
- Median total LOS (days)	4.2 (2.4-7.2)	1.8 (0.9-3.8)	<0.001
- Newly diagnosed psychiatric disorders	37 (23.7%)	1 (1.9%)	0.001
- Mean of total PSS scores±SD	1.2±1.4	0.5±1.1	<0.001
- Long term outcome	0 (0%)	1 (1.9%)	0.09
- Mortality	0 (0%)	0 (0%)	/

Legend: IQR=interquartile range; CVVH=continuous veno-venous haemodiafiltration; PICU=paediatric intensive care unit; LOS=length of stay; PSS=Poisoning Severity Score; SD=standard deviation.
Intentional poisoning was associated with female and older patients, therapeutic agents, the necessity of antidote treatment, and a higher mean PSS. This group of patients was also more commonly associated with preexisting or newly diagnosed psychiatric conditions.

Figure 1. A graph illustrating a bimodal distribution of intoxication with an early peak at 1-2 years and a later peak at 14-16 years

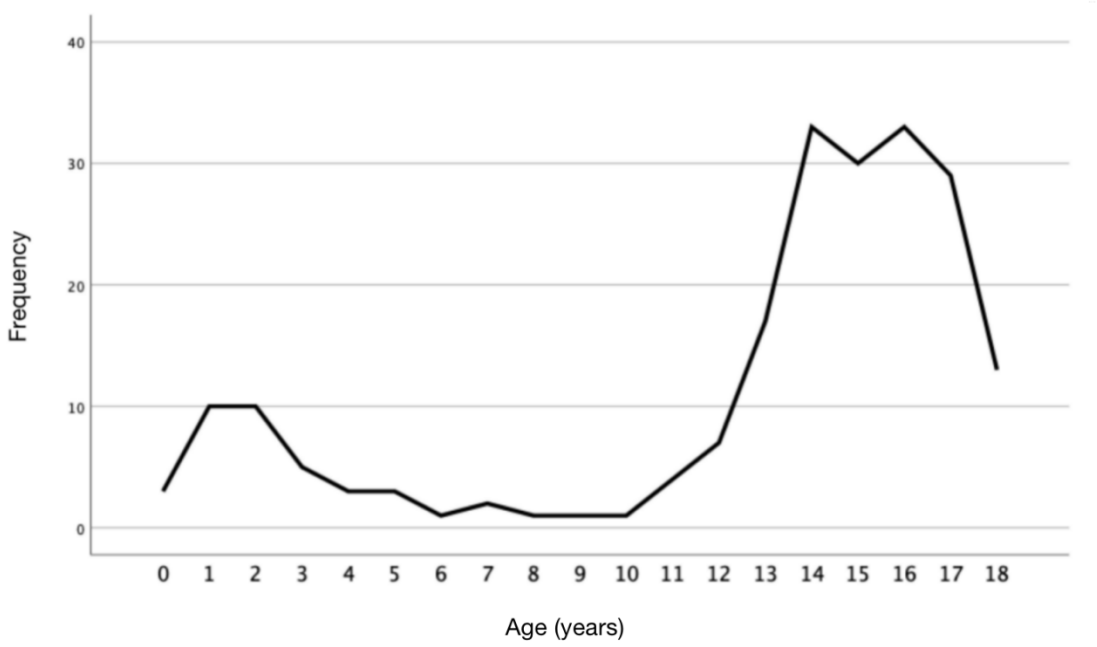
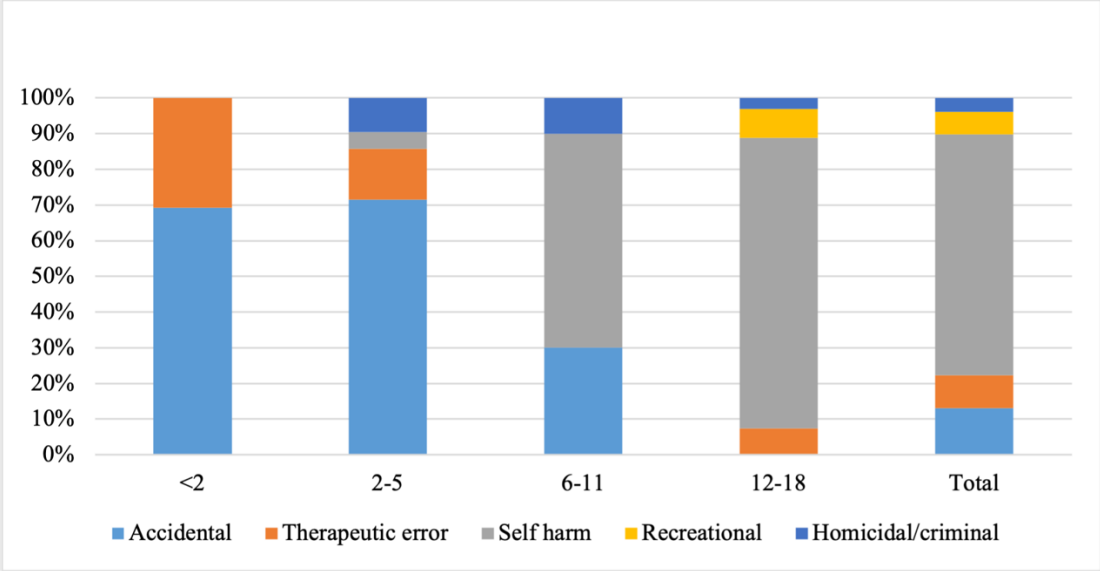


Figure 2. The distribution of intentions for intoxication among different age groups



Legend: Deliberate self-harm was more prevalent in middle childhood and early adolescence, while accidental poisoning occurred mostly in infancy, toddlerhood, and early childhood.

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Appendix 1. Poisoning Severity Score (PSS), a 5-level grading system to assess the severity of poisoning in 12 organ systems

ORGAN	NONE	MINOR	MODERATE	SEVERE	FATAL
	0	1	2	3	4
	No symptoms or signs	Mild, transient and spontaneously resolving symptoms or signs	Pronounced or prolonged symptoms or signs	Severe or life-threatening symptoms or signs	Death
GI-tract		• Vomiting, diarrhoea, pain • Irritation, 1st degree burns, minimal ulcerations in the mouth • Endoscopy: erythema, oedema	• Pronounced or prolonged vomiting, diarrhoea, pain, ileus • 1st degree burns of critical localization or 2nd and 3rd degree burns in restricted areas • Dysphagia • Endoscopy: ulcerative transmucosal lesions	• Massive haemorrhage, perforation • More widespread 2nd and 3rd degree burns • Severe dysphagia • Endoscopy: ulcerative transmural lesions, circumferential lesions, perforation	
Respiratory system		• Irritation, coughing, breathlessness, mild dyspnoea, mild bronchospasm • Chest X-ray: abnormal with minor or no symptoms	• Prolonged coughing, bronchospasm, dyspnoea, stridor, hypoxemia requiring extra oxygen • Chest X-ray: abnormal with moderate symptoms	• Manifest respiratory insufficiency (due to e.g. severe bronchospasm, airway obstruction, glottal oedema, pulmonary oedema, ARDS, pneumonitis, pneumonia, pneumothorax) • Chest X-ray: abnormal with severe symptoms	
Nervous system		• Drowsiness, vertigo, tinnitus, ataxia • Restlessness • Mild extrapyramidal symptoms • Mild cholinergic/anticholinergic symptoms • Paraesthesia • Mild visual or auditory disturbances	• Unconsciousness with appropriate response to pain • Brief apnoea, bradypnoea • Confusion, agitation, hallucinations, delirium • Infrequent, generalized or local seizures • Pronounced extrapyramidal symptoms • Pronounced cholinergic/anticholinergic symptoms • Localized paralysis not affecting vital functions • Visual and auditory disturbances	• Deep coma with inappropriate response to pain or unresponsive to pain • Respiratory depression with insufficiency • Extreme agitation • Frequent, generalized seizures, status epilepticus, opisthotonus • Generalized paralysis or paralysis affecting vital functions • Blindness, deafness	

ORGAN	NONE	MINOR	MODERATE	SEVERE	FATAL
	0	1	2	3	4
	No symptoms or signs	Mild, transient and spontaneously resolving symptoms or signs	Pronounced or prolonged symptoms or signs	Severe or life-threatening symptoms or signs	Death
Cardio-vascular system		• Isolated extrasystoles • Mild and transient hypo/hypertension	• Sinus bradycardia (HR ~40-50 in adults, 60-80 in infants and children, 80-90 in neonates) • Sinus tachycardia (HR ~140-180 in adults, 160-190 in infants and children, 160-200 in neonates) • Frequent extrasystoles, atrial fibrillation/flutter, AV-block I-II, prolonged QRS and QTc-time, repolarization abnormalities • Myocardial ischaemia • More pronounced hypo/hypertension	• Severe sinus bradycardia (HR ~<40 in adults, <60 in infants and children, <80 in neonates) • Severe sinus tachycardia (HR ~>180 in adults, >190 in infants and children, >200 in neonates) • Life-threatening ventricular dysrythmias, AV block III, asystole • Myocardial infarction • Shock, hypertensive crisis	
Metabolic balance		• Mild acid-base disturbances (HCO_3 ~15-20 or 30-40 mmol/l; pH~7.25-7.32 or 7.50-7.59) • Mild electrolyte and fluid disturbances (K^+ 3.0-3.4 or 5.2-5.9 mmol/l) • Mild hypoglycaemia (~50-70 mg/dl or 2.8-3.9 mmol/l in adults) • Hyperthermia of short duration	• More pronounced acid-base disturbances (HCO_3 ~10-14 or >40 mmol/l; pH ~7.15-7.24 or 7.60-7.69) • More pronounced electrolyte and fluid disturbances (K^+ 2.5-2.9 or 6.0-6.9 mmol/l) • More pronounced hypoglycaemia (~30-50 mg/dl or 1.7-2.8 mmol/l in adults) • Hyperthermia of longer duration	• Severe acid-base disturbances (HCO_3 ~<10 mmol/l; pH ~<7.15 or >7.7) • Severe electrolyte and fluid disturbances (K^+ <2.5 or >7.0 mmol/l) • Severe hypoglycaemia (~<30 mg/dl or 1.7 mmol/l in adults) • Dangerous hypo- or hyperthermia	
Liver		• Minimal rise in serum enzymes (ASAT, ALAT ~2-5 x normal)	• Rise in serum enzymes (ASAT, ALAT ~5-50 x normal) but no diagnostic biochemical (e.g. ammonia, clotting factors) or clinical evidence of liver dysfunction	• Rise in serum enzymes (~>50 x normal) or biochemical (e.g. ammonia, clotting factors) or clinical evidence of liver failure	
Kidney		• Minimal proteinuria/haematuria	• Massive proteinuria/haematuria • Renal dysfunction (e.g. oliguria, polyuria, serum creatinine of ~200-500 µmol/l)	• Renal failure (e.g. anuria, serum creatinine of >500 µmol/l)	

ORGAN	NONE	MINOR	MODERATE	SEVERE	FATAL
	0	1	2	3	4
	No symptoms or signs	Mild, transient and spontaneously resolving symptoms or signs	Pronounced or prolonged symptoms or signs	Severe or life-threatening symptoms or signs	Death
Blood		• Mild haemolysis • Mild methaemoglobinemia (metHb ~10-30%)	• Haemolysis • More pronounced methaemoglobinemia (metHb ~30-50%) • Coagulation disturbances without bleeding • Anaemia, leukopenia, thrombocytopenia	• Massive haemolysis • Severe methaemoglobinemia (metHb >50%) • Coagulation disturbances with bleeding • Severe anaemia, leukopenia, thrombocytopenia	
Muscular system		• Mild pain, tenderness • CPK ~250-1,500 iu/l	• Pain, rigidity, cramping and fasciculation • Rhabdomyolysis, CPK ~1,500-10,000 iu/l	• Intense pain, extreme rigidity, extensive cramping and fasciculation • Rhabdomyolysis with complications, CPK ~>10,000 iu/l • Compartment syndrome	
Local effects on skin		• Irritation, 1st degree burns (reddening) or 2nd degree burns in <10% of body surface area	• 2nd degree burns in 10-50% of body surface (children: 10-30%) or 3rd degree burns in <2% of body surface area	• 2nd degree burns in >50% of body surface (children: >30%) or 3rd degree burns in >2% of body surface area	
Local effects on eye		• Irritation, redness, lacrimation, mild palpebral oedema	• Intense irritation, corneal abrasion • Minor (punctate) corneal ulcers	• Corneal ulcers (other than punctate), perforation • Permanent damage	
Local effects from bites and stings		• Local swelling, itching • Mild pain	• Swelling involving the whole extremity, local necrosis • Moderate pain	• Swelling involving the whole extremity and significant parts of adjacent area, more extensive necrosis • Critical localization of swelling threatening the airways • Extreme pain	

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