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Drug self-poisoning in adolescents: A report of 267 cases

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ABSTRACT

Introduction: The current study aims at describing a sample of adolescents admitted to a tertiary referral pediatric hospital for drug self-poisoning and to identify variables that could explain and predict a higher severity of intoxication.

Methods: We retrospectively reviewed the cases of drug self-poisoning in adolescents admitted to the Bambino Gesù Children's Hospital between January 2014 and June 2022 requiring consultation by the local Pediatric Poison Control Center (PPCC). We reported the type and class of drug ingested and correlated the clinical characteristics of the patients with their Poison Severity Score.

Results: The data of 267 patients were reported. Most patients were female (85.8 %), with a median age of 15.8 years at presentation. Half of the patients were symptomatic at admission (44.2 %), and most had at least one psychiatric comorbidity (71.1 %). Most patients were hospitalized (79.6 %), 16.6 % of cases required antidote administration and a minority required intensive care. Most patients received a PSS score of 0 (59.6 %). The most frequently ingested drug was acetaminophen (28.1 %) followed by ibuprofen (10.1 %) and aripiprazole (10.1 %). Antipsychotics as a class were the most abused drugs (33.1 %). The correlation of clinical variables with the PSS showed that older and male patients were more prone to be severely intoxicated.

Conclusions: This single-center study identifies the most commonly ingested drugs in a large sample of adolescents with voluntary drug self-poisoning, also showing that older and male patients are more susceptible to severe intoxication.

1. Introduction

Suicide and self-harm are main health issues during adolescence. According to the World Health Organization (WHO), suicide is the second leading cause of death amongst subjects aged between 15 and 29 years worldwide. The annual account of the American Society of Poison Control Centers (AAPCC) reports that adolescents in the 10 to 19 years age group presenting to the hospital with intentional ingestions can be divided into 3 categories: voluntary abuse, intentional misuse, and suicide attempt [1]. According to the literature, 27.5 % to 57.7 % of all poisonings are caused by voluntary ingestion [2,3]. A Swiss study reported 578 cases of self-poisoning by drugs among the 920 cases of attempted suicide (62.8 %) that accessed the local emergency department between 2012 and 2016. Of these, 94 (16.3 %) were 20 years old or younger [4]. Intentional drug ingestion is the most common cause of poisoning among adolescents with a reported international average of 0.4 – 10.3 % [5]. The pandemic period has exacerbated this phenomenon among adolescents leading to an increase in suicide attempts by drug or substance poisoning (from 40.0 % to 66.7 %) compared to pre-COVID-19 years [6]. In Italy we observed an abrupt increase of neuropsychiatric disorders (from 0.67 % to 1.23 % of all ED admission, +83.1 %), with a parallel increase in suicidal ideation (from 0.76 % to

Abbreviations: ECMO, Extra-corporeal Membrane Oxygenation; ED, Emergency Department; EGD, Esophagogastroduodenoscopy; PICU, Pediatric Intensive Care Unit; PPCC, Pediatric Poison Control Center; PSS, Poison Severity Score.

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1.87 % of all neuropsychiatric disorders, +147 %) [7].

Health practitioners are nowadays increasingly involved in the management of voluntary drug ingestion in pediatrics and proper knowledge is needed to assess and treat this specific condition. Unfortunately, the literature is scarce regarding the clinical presentation and outcomes of this group of patients.

The signs and symptoms of acute intoxication can take different forms and aspects, especially when different classes of drugs are involved. A thorough medical history should be obtained whenever toxic exposure is suspected. This includes the type and amount of molecule ingested (if known), the possibility of multiple agents, the time of ingestion, the time of presentation, any history of vomiting, choking, coughing, altered mental status, and a description of interventions performed prior to presentation to the medical facility. If the suspected products or their containers are available, they should be brought to the hospital. In addition, past and current medical history should be ascertained and a profile of any medication taken regularly obtained.

Although most poisonings are managed primarily with monitoring, decontamination and appropriate supportive care, it is possible that some patients will be hospitalized or require intensive care treatment such as mechanical ventilation, extracorporeal treatments or administration of antidotes.

In this study, we described the growing phenomenon of voluntary drug self-poisoning in adolescents, and compared the variables between patients with a different severity of symptoms.

2. Methods

We retrospectively reviewed the cases of drug self-poisoing with suicidal intent in adolescents admitted to the pediatric Emergency Department (ED) of the Bambino Gesù Children's Hospital between January 2014 and June 2022, requiring consultation by the local Pediatric Poison Control Center (PPCC), a national reference point for the management of pediatric intoxications. After specific management for intoxication, all patients received neuropsychiatric evaluation with submission of the Columbia-Suicide Severity Rating Scale (C-SSRS) for suicide risk upon which either hospitalization or discharge was decided [8].

The following clinical variables were reported for each patient: age, sex, type of ingestion (domestic or not), presence of symptoms at admission, presence of a psychiatric disorder, ingestion of more than one molecule, time from assumption to referral, hospitalization (to PICU or pediatric ward), discharge (directly from the ED), length of hospitalization, administration of an antidote (when available), other treatments, Poison Severity Score (PSS). We also reported the type of drug ingested when the weight-adjusted dosage was toxic. We described the drugs ingested by the patients in terms of molecule and agent class and reported the pediatric toxicity threshold of the former when available from the existing literature. When available, an antidote was administered if deemed appropriate by the treating paediatric toxicologist based on the clinical presentation. This approach included cases of ingestion of a toxic or suspected toxic dose, which is also potentially dangerous since patients with self-poisoning from drugs (and their parents, often not present at the time of ingestion) may not be fully able to provide information on the amount and type of drugs ingested, leading to an underestimation of actual intoxication.

The clinical characteristics of the patients were reported and compared according to the PSS grading system [9]. The PSS is a grading system that aims to provide a simple but reliable system for describing intoxications in qualitative terms and to define their severity [10]. The score is assigned according to the most severe sign or symptom observed during poisoning. The following score from 0 (no severity) to 4 (fatal) is attributed to the following events: *absence* of any sign or symptom of poisoning; *mild*, transient, and spontaneously regressing symptoms; *pronounced* or prolonged symptoms; *severe* or life-threatening symptoms; *death*. The complete PSS with the association between affected organs, signs/symptoms and severity is available at the online link indicated in the references. Finally, we performed an ordinal logistic regression adopting the PSS as the dependent variable and age, gender, presence of psychiatric comorbidities, ingestion of more than one molecule and toxic dosage of the ingested molecule as independent variables.

2.1. Statistical analysis

All continuous variables were expressed as means and standard deviations (if normally distributed) or as medians and ranges (if non-normally distributed). All categorical variables were expressed as proportions and percentages. The patients were divided in four groups, according to their PSS score. Subgroup analysis was performed with the Kruskal-Wallis test for non-normally distributed continuous variables and the Chi-squared test for categorical variables. Multivariate analysis was performed via ordinal logistic regression, adopting the PSS score (0, 1 or >1) as the dependent variable and age, sex, psychiatric comorbidity, time from ingestion and molecule co-ingestion as independent variables. A p-value less than 0.05 was considered statistically significant.

3. Results

We retrospectively reviewed the medical records of 275 patients admitted for self-poisoning by drugs during the study period (0.6 every 1000 admissions to the ED, considering 420,699 total admissions in the same period). Data about intoxication (assumed dose, ingestion time, type of molecule) was incomplete for 5 patients, one of whom refused admission. Other 3 patients had taken high doses of supplements and no pharmacologic agent. Therefore, the data of 267 patients were found suitable for the report and analysis.

The characteristics of the study sample are outlined in Table 1.

The median age at presentation was 15.8 years (5–95° 13.0 - 17.7). Most patients were female (85.8 %), with a ratio of 1:6.0 between males and females. All medications were mainly taken at home (95.9 %). Almost half of the patients complained of some symptom associated with

Table 1
Characteristics of study sample.

Total	267
Age (years) - median ± IQR (range)	15.8 ± 2.0 (13.0 - 17.7)
Females - no. (%)	229 (85.8)
Male to female ratio	1:6.0
Domestic ingestion - no. (%)	256 (95.9)
Symptoms on admission - no. (%)	118 (44.2)
Psychiatric comorbidity - no. (%)	190 (71.2)
More than one molecule ingested - no. (%)	95 (35.6)
Alcohol co-ingestion	7 (2.6)
Toxic dose of ingested molecule	102 (43.2)
Time from assumption to referral (hours) - median ± IQR (5–95°)	3 ± 6 (1 - 42)
Hospitalized - no. (%)	214 (80.1)
PICU - no. (%)	21 (7.9)
Ward - no. (%)	193 (72.3)
Discharged - no. (%)	53 (19.9)
Hospitalization (days) - median ± IQR (5°−95°)	3 ± 4 (0 - 15)
Administration of antidote - no. (%)	46 (17.2)
Treatment - no. (%)	
Activated charcoal	92 (34.5)
Gastric lavage	47 (17.6)
EGD	12 (4.5)
Mechanical ventilation	5 (1.9)
Hemodialysis	2 (0.7)
ECMO	1 (0.4)
PSS - no. (%)	
Score 0	159 (59.6)
Score 1	74 (27.5)
Score 2	29 (10.8)
Score 3	5 (1.9)

drug poisoning at the time of admission (44.2 %). Most of the study sample had at least one psychiatric comorbidity (71.1 %). More than one molecule was ingested in a third of cases (35.6 %). The median time from assumption to referral was 3 days (5–95°, 1 - 42). The majority of patients were hospitalized (79.6 %). Most were admitted to a pediatric ward (71.7 %), but some required intensive care (7.1 %). The median time of hospitalization was 3 days (5–95°, 1 - 21). In 46 cases (17.2 %) an antidote to the ingested drug was administered. Some patients were treated with administration of decontaminating treatments, such as activated charcoal (34.5 %) and gastric lavage (17.6 %). Esophagogastroduodenoscopy (EGD) was performed in 12 patients (4.5 %). The types of drug ingested by these patients are reported in Supplementary Table 1. Only a minority required intensive care treatments, such as mechanical ventilation, hemodialysis and ECMO. Most patients were given a PSS score of 0 (59.6 %), 27.5 % of patients had a score of 1 % and 10.8 % had a score of 2, while only 5 patients had a score of 3 (1.9 %).

The list of ingested drug molecules (in order of frequency) and the relative number of patients who ingested a toxic dose of the drug are shown in Table 2.

The most frequently ingested molecule was acetaminophen (28.1 %) followed by ibuprofen (10.5 %) and aripiprazole (10.1 %). Lithium was the fourth most frequently used xenobiotic (9.7 %). Other less commonly employed drugs are listed in Table 2.

Regarding toxic doses, most patients ingesting aripiprazole, quetiapine, risperidone, diazepam, oxcarbazepine, gabapentin, and scopolamine took a toxic amount of these molecules (see Table 2 for more details). More precisely, 43 % of patients who took acetaminophen, 52 % of patients who took aripiprazole, and none of the patients who took ibuprofen ingested a toxic amount.

The list of ingested drugs grouped into classes (in order of frequency) is given in Table 3.

Antipsychotics were most abused (33.3 %), followed by acetaminophen (28.2 %) and non-steroidal anti-inflammatory drugs (13.1 %), respectively. Most drug classes showed a decreasing frequency of PSS from the lowest (PSS = 0) to the highest value (PSS >1), with the exception of antiepileptics, antidepressants and antibiotics (see Table 3).

The comparison of clinical characteristics of patients with PSS of 0, 1 or greater than 1 is shown in Table 4.

Comparing the patients according to PSS score, we found that patients with a higher PSS had ingested a toxic amount of drugs more frequently, had been admitted to a PICU more often, and remained in hospital for a significantly longer period than patients with a lower PSS. They also more frequently underwent intensive care treatments, such as EGD, ventilatory support, hemodialysis and ECMO.

When adopting the PSS score as the dependent variable and age, sex,

Table 2
List of ingested drugs (molecule) and relative antidote (when available).

Total	267	Toxic dose (N, %)*	Antidote†
Acetaminophen - no. (%)	75 (28.1)	32 (43)	38 (51)**
Intravenous			
Oral			
Ibuprofen - no. (%)	28 (10.5)	0 (0)	-
Aripiprazole - no. (%)	27 (10.1)	14 (52)	-
Litio - no. (%)	26 (9.7)	-	-
Litio solfato	18 (6.7)	-	
Litio carbonato	8 (3.0)		
Alprazolam - no. (%)	23 (8.6)	2 (9)	1 (4)***
Lorazepam - no. (%)	16 (6.0)	-	-
Olanzapina - no. (%)	10 (3.7)	0 (0)	-
Quetiapine - no. (%)	10 (3.7)	10 (100)	-
Risperidone - no. (%)	10 (3.7)	7 (70)	-
Sertralina - no. (%)	10 (3.7)	-	-
Diazepam - no. (%)	8 (2.9)	5 (63)	1 (13)***
Clonazepam - no. (%)	7 (2.6)	2 (25)	-
Topiramate - no. (%)	6 (2.2)	0 (0)	-
Zolpidem - no. (%)	6 (2.2)	0 (0)	2 (33)***
Aspirin - no. (%)	5 (1.9)	2 (40)	-
Furosemide - no. (%)	5 (1.9)	-	-
Oxcarbazepine - no. (%)	5 (1.9)	4 (80)	-
Valproic acid - no. (%)	5 (1.9)	1 (20)	1 (20)****

*Percentages were calculated accounting for missing doses
**N-acetylcystein was administered in case of acetaminophen intoxication. In 6 cases the antidote was administered when the dose ingested was not specified by the non-collaborating or unconscious patient.
***Flumazenil was administered in case of benzodiazepine intoxication. It was also administered in two patients who ingested toxic amounts of bromazepam and fluorazepam respectively (not shown in the table).
****L-carnitine was administered in this case
†Another antidote administered was bicarbonate in one case of propafenone ingestion treated with ECMO (not shown in this table).

Table 3
List of ingested drugs (class).

Total	267	PSS = 0	PSS = 1	PSS > 1
Antipsychotics - no. (%)	89 (33.3)	49 (55)	27 (30)	13 (15)
Acetaminophen - no. (%)	75 (28.2)	53 (71)	17 (23)	5 (7)
Benzodiazepines - no. (%)	66 (24.7)	30 (46)	26 (39)	10 (15)
NSAIDs - no. (%)	35 (13.1)	28 (80)	5 (14)	2 (6)
Antiepileptics - no. (%)	26 (9.7)	12 (46)	12 (46)	2 (8)
Antidepressants - no. (%)	21 (7.9)	9 (43)	4 (19)	8 (38)
Antihypertensives - no. (%)	13 (4.9)	12 (92)	1 (8)	0 (0)
Anticholinergics - no. (%)	7 (2.6)	4 (57)	2 (29)	1 (14)
Diuretics - no. (%)	7 (2.6)	4 (57)	3 (43)	0 (0)
Antibiotics - no. (%)	6 (2.2)	5 (83)	0 (0)	3 (17)
Opioids - no. (%)	5 (1.9)	3 (60)	2 (40)	0 (0)
Antihistamines - no. (%)	3 (1.1)	2 (67)	1 (33)	0 (0)
Other. - no. (%)	21 (8.2)	13 (62)	6 (29)	2 (9)

Table 4
Comparison of patients according to the PSS.

	PSS = 0 159	PSS = 1 74	PSS > 1 34	*p-value*
Age (years) - median ± IQR (5–95°)	15.8 ± 2.4 (12.8 - 17.7)	16.3 ± 1.9 (13.5 - 17.8)	15.7 ± 1.6 (13.2 - 17.9)	0.139
Females - no. (%)	139 (87.4)	61 (82.4)	29 (85.3)	0.595
Male to female ratio	1:7.0	1:4.7	1:5.8	
Domestic ingestion - no. (%)	155 (97.5)	67 (90.5)	34 (100)	**0.020**
Symptoms on admission - no. (%)	25 (15.7)	62 (83.8)	31 (91.2)	**<0.001**
Psychiatric comorbidity- no. (%)	113 (71.1)	50 (67.6)	27 (79.4)	0.451
More than one molecule ingested - no. (%)	58 (36.5)	25 (33.8)	12 (35.3)	0.923
Alcohol co-ingestion	2 (1.3)	4 (5.4)	1 (2.9)	0.181
Toxic dose of ingested molecule	53 (37.9)	30 (45.5)	19 (63.3)	**0.035**
Time from assumption to referral (hours) - median ± IQR (5–95°)	3 ± 6 (1 - 24)	3 ± 9 (1 - 56)	4 ± 5 (1 - 85)	0.883
Hospitalized - no. (%)	116 (73.0)	64 (86.5)	34 (100)	**<0.001**
PICU - no. (%)	12 (7.6)	10 (13.5)	12 (35.3)	**<0.001**
Ward - no. (%)	104 (65.4)	54 (73.0)	22 (64.7)	0.115
Discharged - no. (%)	43 (27.0)	10 (13.5)	0 (0)	**<0.001**
Hospitalization (days) - median ± IQR (5°–95°)	3 ± 4 (0 - 11)	4 ± 6 (0 - 15)	7 ± 11 (0 - 64)	**<0.001**
Administration of antidote - no. (%)	26 (16.5)	12 (16.2)	8 (24.2)	0.536
Treatment - no. (%)	47 (29.6)	30 (40.5)	15 (44.1)	0.116
Activated charcoal	27 (17.0)	13 (17.6)	7 (20.6)	0.882
Gastric lavage	2 (1.3)	5 (6.8)	5 (14.7)	**0.001**
EGD	0 (0)	0 (0)	2 (5.9)	**<0.001**
Ventilatory support	0 (0)	0 (0)	1 (2.9)	**0.001**
Hemodialysis	0 (0)	0 (0)	0 (0)	**0.032**
ECMO				

psychiatric comorbidity, time since ingestion, and co-ingestion of molecules as independent variables in the ordinal logistic regression model, we found a significant correlation with age (p = 0.047), male sex (p = 0.023), and a longer hospitalization (p < 0.001).

These results are outlined in Table 5.

To further investigate the relationship between age and gender with the toxic dosage, we grouped and compared the former according to the latter but found no significant association between older age and male sex with toxic dosage.

This comparison is shown in Figs. 1 and 2.

Furthermore, we compared the classes of drugs according to sex, to evaluate if the ingestion of a specific class could be associated with a higher likelihood of intoxication but again, no significant differences were found (see Supplementary Table 2 for more detail).

4. Discussion

Suicide and self-harm are a public health problem in adolescents. Of all the modes of suicide, drug poisoning is clearly the most common in this population. Gender is an important aspect in this population. Studies conducted in the United States and Western Europe describe female adolescents as the most involved in voluntary drug intoxication [11]. An analysis conducted in Sri Lanka during the COVID-19 pandemic suggested that more than half of the patients (54.3 %) who presented to hospital for self-poisoning were female [12]. Another study confirmed these findings, with the occurrence of poisoning more common in female patients (67.7 %) than males [13]. Our data are in line with most of the previously cited studies, with girls accounting for 85.8 % of our sample and a male-to-female ratio of 1:6.0. However, we found that males were more likely to have a higher PSS than females, confirming data published by Oh SH et al., 2015 that male gender is a greater risk factor for death in cases of deliberate self-poisoning [14].

If gender is critical, age is certainly the other critical risk factor for pediatric voluntary drug intoxication. According to Lamireau et al. the mean age is higher in adolescents with intentional intoxication than in those with accidental poisoning [5]. These findings are similar to those of some previous studies that found a bimodal age distribution of poisonings, with children making up the majority (mainly accidental poisonings, with a male preponderance) and a second peak in adolescence (with an increase in intentional poisonings and a female preponderance) [2,15]. Interestingly, a multicenter study of 12,021 pediatric patients with acute intoxication (78 % intentional) found that male adolescents older than 13 years were more likely to require PICU intervention, confirming our findings [16].

Our study, with a mean population age of 15.8 years (5–95° 13.0 – 17.7), also clearly shows the prevalence of adolescents practicing acute self-poisoning. As a result of ordinal logistic regression, age was significantly associated with a higher PSS, implying worse clinical presentation after exposure. However, the reasons for this are not clearly understood from the literature. Older studies have shown that males may be more at risk of drug self-poisoning than females, who should arguably be more prone to parasuicidal than suicidal behavior, namely tending towards self-destruction, without being actively so [14,17–19]. Consistent with this, females should take a less toxic dose of the drug than males. However, we were unable to demonstrate this difference in toxic dose between males and females, as shown in Fig. 2. Rather, this gender discrepancy may be explained by the individual response to medication, perhaps more severe in older males, based on their psychiatric comorbidities, suicidal behaviour and pharmacokinetics. To this regard, it is interesting to note that the liver expression of CYP3A4 and CYP2B6, two of the cytochromes mostly involved in drug metabolism, is respectively twofold and fourfold higher in females than males [20,21]. Such reasoning could also explain the role of age, which correlates with the induction of cytochromes by sex hormones produced at puberty [22].

Children might be protected from suicide because of the lack of

Table 5
Ordinal Logistic Regression (dependent variable: PSS).

Independent variables	OR	95 % C.I.	p-value
Age (years)	1.195	0.994 - 1.436	**0.047**
Sex (male)	2.682	1.155 - 6.225	**0.023**
Psychiatric comorbidity (yes)	0.788	0.425 - 1.461	0.451
More than one molecule ingested (yes)	0.882	0.472 - 1.652	0.696
Toxic dose of ingested molecule (yes)	1.492	0.831 - 2.679	0.180
Time from assumption to referral (hours)	0.991	0.991 - 1.015	0.604
Hospitalization (days)	1.124	1.059 - 1.193	**<0.001**

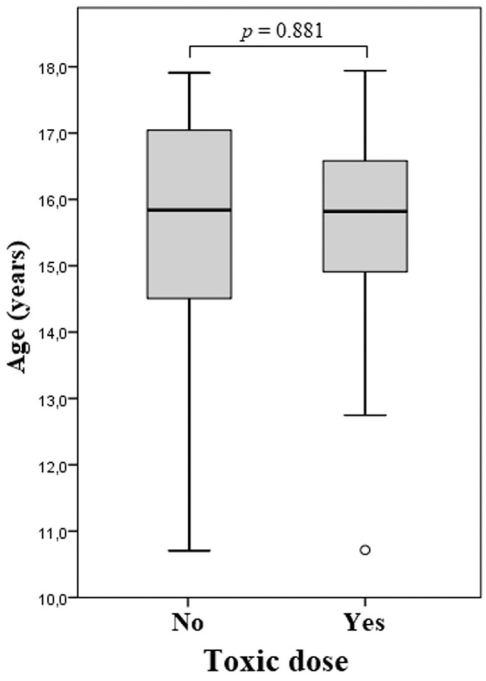

Fig. 1. Box plots of age grouped by toxic dosage.

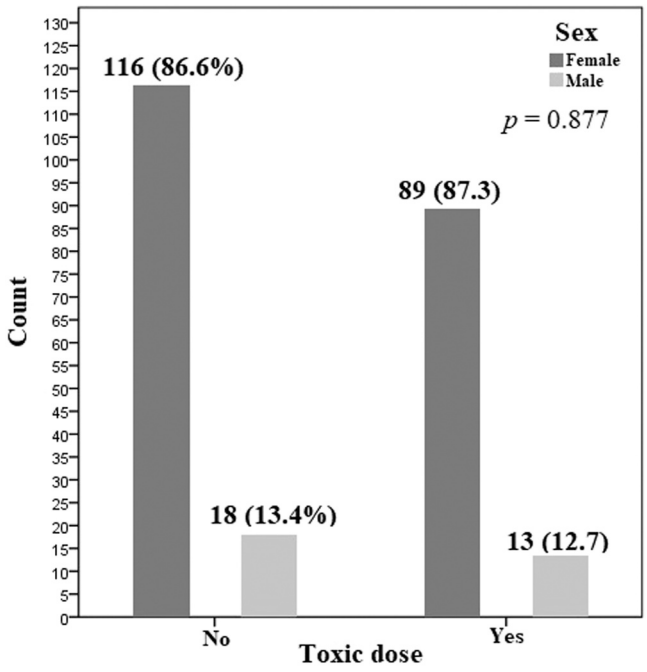

Fig. 2. Bar charts of sex grouped by toxic dosage.

cognitive maturity required to plan a successful suicidal act and to develop feelings of hopelessness [23]. Conversely, adolescents' growing self-awareness and drive for individuation may weaken the support of family, school and other support systems [24]. Developmental factors, such as rapid psychological, biological and social changes, can make adolescents vulnerable to environmental stress [25] and contribute to psychopathology [26]. Recent longitudinal studies have shown that emotional and behavioral disorders, such as exposure to adverse life events during adolescence, have a predictive impact for subsequent psychiatric disorders, psychosocial impairment, suicidal ideation, suicide attempts, and suicides [27]. Thus, psychiatric comorbidity is typical in this population. A recent review [28] reported that risk factors for anxiety include lack of routine activities, female gender, adolescence, repeated exposure to COVID-19 information, and having previously undergone psychiatric treatment.

Seventy-one percent of our cohort had associated psychiatric disorders. Similar data are found in other studies in which 60 % of patients hospitalized for opioid overdose in the United States had co-occurring psychiatric disorders [29]. Most of our patients received neuropsychiatric counseling and support after intoxication treatment. Interestingly, in our study, the presence of a psychiatric disorder was not statistically correlated with higher PSS.

Co-ingestion of multiple molecules was a common behavior in our cohort. Analgesics, antipyretics, sedative-hypnotics, antidepressants, and antipsychotics were the most commonly co-administered xenobiotics. Our population showed a rather high rate of co-ingestion (35.6 %) compared to literature data (6.4 %) [30]. However, this variable was not significantly associated with worse clinical presentation or higher PSS. In our sample, co-ingestion of alcohol was documented in 7 cases (2.6 %).

At the time of presentation to our emergency department, most patients were asymptomatic (55.8 %). This is consistent with other experiences in the literature, such as that of Chang Gung Memorial Hospital in Linko, Taiwan. In this case, most patients who presented to the emergency department for voluntary drug intoxication were asymptomatic (48.3 %); among symptomatic patients, most had gastrointestinal symptoms [31].

Upon arrival at the emergency department, all patients received prompt care with or without decontamination techniques. A third of patients were administered activated charcoal (34.5 %) and in some cases whole bowel irrigation was performed (17.6 %). In 12 patients, the ingested drug was removed by EGD. This was required depending on the quantity and quality of the ingested drug, whenever one or the other could justify the formation of gastric bezoars in the opinion of the clinicians. Indeed, in cases of ingestion of potentially life-threatening doses of single or multiple drugs, a decontaminating gastroscopy is preferred and should be carried out as soon as possible, as gastric lavage alone may be ineffective in reducing drug absorption, especially if delayed for an hour after ingestion or if a large amount of the drug is ingested. Although the risk/benefit ratio of gastric lavage is still a matter of debate [32], in a recent case, EGD successfully removed twenty foreign bodies consisting of a mixture of bupropion, fluoxetine and cyproheptadine adhered to the gastric fundus of a 14-year-old boy on the fourth day of hospitalization [33]. One case required ECMO because of propafenone exposure. In this case, the clinical presentation was immediately severe and required an intensive treatment confirming the higher risk profile of cardioactive drugs [34]; in 2 cases hemodialysis was used for lithium intoxication. An antidote was administered in 46 cases (17.2). Appropriate management influenced the overall outcome of intoxication. Decontamination, improved elimination, and antidotes limited the action of the drugs and reduced their spread in the blood and tissues, even when lethal doses were taken. This may be why no patients in our cohort died (PSS 4) and no permanent organic damage resulting from poisoning was documented after discharge.

The time from exposure to referral to our emergency department averaged 3 h (5–95° 1 – 42). This did not significantly correlate with the PSS. Patient age, sex, number of agents, and intensity of symptoms all influenced length of stay. Our sample had a mean length of stay of 3 days (5–95° 0 – 15). All of our patients attempted suicide and then received neuropsychiatric counseling after intoxication. In some cases, this ended with admission to the psychiatric ward for further evaluation, lengthening the overall length of hospitalization. Most of our patients were admitted (80.1 %), while others were discharged after a short-stay observation of 12 to 24 h (19.9%) and evaluation by the neuropsychiatrist. A minority of patients (7.9 %) required intensive observation or management and were therefore admitted to a pediatric intensive care unit (PICU). This percentage is slightly higher than those reported in Sweden (6.0 %) [35] and Turkey (4 %) [36]. This could be explained by the fact that the cited studies refer to both voluntary and involuntary exposures in a non-exclusively pediatric population.

In addition to patient characteristics, exposure characteristics were also described. Acetaminophen is the most abused drug in our population (28.1%), followed by ibuprofen. The wide distribution and accessibility of these molecules in Italy makes them easily available to adolescents. However, if we consider the pharmacological class, antipsychotics are in first place (33.3 %). Most drugs belonging to this class (e.g., aripiprazole, lithium) constitute the therapeutic strategy used for many of our patients with psychiatric comorbidity, thus making them available for abuse. Acetaminophen and NSAIDs ranked second (28.2 %) and third (13.1 %) as a class. Our data are in line with the experiences of other countries. In a study conducted in Taiwan, drugs acting on the neurological system were the dominant agents (29.6 %), while analgesics (16.1 %) were the most ingested drugs [37]. Another article claims that neurological system agents (52.2 %) were the most common pharmaceutical poisons, followed by analgesics (17.9 %), respiratory system agents (7.5 %), and cardiovascular drugs (6 %). In addition, neuroactive agents and analgesics were the two most common drugs associated with intentional exposure to poisons in a pediatric population [31]. Assessment of the toxic amount ingested was done for the most abused molecules. Lithium has a variable tissue distribution from patient to patient, so assessment of the amount ingested is not significant for toxicity. Lorazepam, on the other hand, has no threshold value for toxicity.

Our study is flawed by the retrospective design and the heterogeneity of the described sample, including both intoxicated and non-intoxicated patients with a variety of drugs. However, we believe that the added value of our study is the large sample of different patients included itself, resembling the reality of any pediatric emergency department where a child with a suspected self-intoxication is admitted.

5. Conclusion

This is the first study to investigate the clinical features of voluntary drug self-poisoning in a large sample of adolescents. Our results show that older male patients are more likely to be severely intoxicated than younger females. This could prove a useful indicator for healthcare professionals and intensive care specialists working in pediatric emergency departments to improve the management of young patients with drug self-poisoning.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work no AI and AI-assisted technologies were used.

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CRediT authorship contribution statement

Marco Roversi: Conceptualization, Methodology, Formal analysis, Writing – original draft, Writing – review & editing. **Matteo Martini:** Conceptualization, Data curation, Writing – original draft. **Antonio Musolino, Mara Pisani, Giorgio Zampini, Leonardo Genuini:** Conceptualization, Data curation, Resources. **Gabriella Bottari, Matteo Di Nardo, Francesca Stoppa:** Conceptualization, Supervision, Validation. **Marco Marano:** Conceptualization, Supervision, Writing – review & editing, Project administration, Funding acquisition. All authors approved the final manuscript as submitted and agreed to be accountable for all aspects of the work.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Deidentified individual participant data will be made available, in addition to study protocols, the statistical analysis plan, and the informed consent form. The data will be made available upon publication to researchers who provide a methodologically sound proposal for use in achieving the goals of the approved proposal. Proposals should be submitted to marco.marano@opbg.net.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.toxrep.2023.05.012.

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