The European Research Journal 2023;9(5):1105-1113 Original Article

DOI: 10.18621/eurj.1341860 *Pediatrics*

Acute poisonings requiring intensive care in childhood and a hidden threat, suicide attempts: a single-center experience

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ABSTRACT

Objectives: Very few studies have been conducted to identify the conditions that cause poisoning in pediatric patients needing intensive care, both by age group and toxic agent factor. This study will support the development of strategies for poisoning prevention measures by comparing the data in our region with other data in the world.

Methods: This study is a single-centered, retrospective study. The baseline status of acute poisoning was defined in pediatric patients aged one month to 18 years who required intensive care hospitalization between November 2017 and March 2022.

Results: There were 148 patient admissions due to acute poisonings (5.2% of all admissions, 69.6% females, median age: 13.6 months). Our study revealed that acute poisoning in children is caused mainly by pharmacological (88.5%), oral intake (97.3%) and at home (85.8%). It was observed that intoxication peaked at two different ages; the first peak was at preschool (33.1%), and the second peak was at adolescence (58.7%). In the univariate analysis, females (odds ratio [OR] = 4.1), adolescents (OR = 167.6), psychiatric drug users (OR = 55.5), and multiple drug intoxications (OR = 3.6) were associated with more suicides. Being adolescents and using psychiatric medication contributed significantly to suicide attempts in multivariate analysis (OR = 145.3 and OR = 37.9). None of our patients died.

Conclusions: Preventing both poisoning and suicide attempts is the most critical priority. However, we suggest prevention strategies should be strengthened even if mortality is not observed. Furthermore, our study shows that suicide attempts are very likely to be repeated, especially if an underlying psychiatric illness exists.

Keywords: Acute poisoning, children, pediatric intensive care unit, self-poisoning, suicide attempts

Poisonings are a predictable and preventable public health problem. Drug, chemical, or herb-related poisonings can cause multi-organ failure and even death in childhood. The World Health Organization (WHO) states that poisoning in children is one of the top five causes of death from unintentional injuries [1]. According to the 2020 data from the American Association of Poison Control Centers (AAPCC), pub-

Received: ***August 12, 2023;*** *Accepted:* ***August 19, 2023;*** *Published Online:* ***August 22, 2023***

How to cite this article: *Oto A, Kılıç S, Sahin M. Acute poisonings requiring intensive care in childhood and a hidden threat, suicide attempts: a single-center experience. Eur Res J 2023;9(5):1105-1113. DOI: 10.18621/eurj.1341860*

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e-ISSN: 2149-3189

lished annually, 58% of the over 3 million poisoning calls made to the poison center are made for children, with children under six years of age having the highest exposure [2]. Today's rising drug use rates in adults and children raise the risk of poisoning, particularly in pediatric patients. We discovered that the small number of patients and forensic cases were only mentioned in acute poisoning studies in Bursa province and that epidemiological data were not revealed in such a large study. The present research is the first study in Bursa province on acute poisoning cases requiring pediatric intensive care.

Suicide refers to a person's action to end their life willingly; it can be done by hanging, jumping from a height, poisoning, or injury with a firearm [3]. This study did not include only suicidal attempts with toxic substance intake. However, our data show that the probability of suicide is significantly higher if the poisoned person is a female and/or an adolescent if the poisoning is done with multiple drugs, and if there is a history of psychiatric drug use. Therefore, with this study, we wanted to raise awareness to reduce child deaths, hospitalizations, and acute poisoning-related costs and not waste precious life-saving intensive care beds with predictable and preventable acute poisonings.

METHODS

This is a retrospective study on acute poisoning patients admitted to the medical/surgical pediatric intensive care clinic at Bursa Yuksek Ihtisas Training and Research Hospital between November 2017 and March 2022. Following the approval from the local ethics committee (2011-KAEK-25 2022/08-01), data collection was initiated in accordance with the principles of the Helsinki Declaration.

Patients were admitted to the intensive care unit for respiratory failure, cardiovascular dysfunction, arrhythmia, seizures, or loss of consciousness. Alternatively, if the toxic substance they were exposed to was risky in terms of content or dose in relation to the conditions listed above, they were admitted to PICU.
Patients' demographic characteristics (sex, age, race, presence of concomitant disease), substance content and number (one or more), route of exposure (oral, inhaler, cutaneous), time of hospitalization in intensive care clinic, specific antidote treatment if used, supportive intensive care treatments, stay in intensive care and total hospitalization duration, and outcomes were recorded by scanning the files. Age groups were defined as follows: infant (1 month-12 month), preschool (1-5 years), school age (6-11 years), and adolescent (12-18 years). All patients are older than 1 month and younger than 19 years. The study excluded patients with drug side effects, anaphylaxis, burns, food poisoning, chronic poisoning, and data deficiency. A patient with multidrug poisoning was considered a single case.

The forms of poisoning were divided into five: unsupervised intake, suicidal intake, recreational intake, therapeutic error, and others (snake bite, mushroom poisoning). The factors causing acute poisoning were classified as pharmaceutical and non-pharmaceutical factors. Pharmaceutic drugs consisted of analgesics (paracetamol, anti-inflammatory, myorelaxant), antimicrobials (antibiotics, antivirals, antifungals), neuroactive drugs (antidepressants, antipsychotics, antianxiety, antiepileptics), antihypertensives and antidiabetics. Non-pharmaceuticals included alcohol, stimulants, pesticides, corrosives, snake bites, inedible vegetable oils, and mushroom poisonings.

Statistical Analysis

The SPSS 15v Chicago IL program was used in data analysis. A p - value of $p < 0.05$ was considered significant. When presenting qualitative data, frequency and percentage values are given, mean and standard deviation when presenting quantitative data, and median and minimum-maximum values when the data is heterogeneously distributed. Normality tests (Kolmogorov-Smirnov and Shapiro-Wilk) were used to test the data distribution. Chi-square test and, if applicable, Fisher's Exact and post hoc Z test were used to compare qualitative data. In the second step, Multivariable analysis was used to analyze the patients' poisoning characteristics since the significant features at the 0.05 level in the Bivariate analysis were suitable for a Binary logistic regression model.

RESULTS

Between November 2017 and March 2022, 2820 patients aged one month to 18 were admitted to PICU,

with 148 (5.2%) patients due to acute poisoning. All patients were mostly female (69.6%), and the most common exposure was at home (85.8%). The exposures were frequent (97.3%) in the form of ingestion. None of our patients died. The factors were pharmacological in 131 (88.5%) patients.

In Table 1, the sociodemographic characteristics of the patients hospitalized due to intoxication are given in detail. There was no difference in terms of sex based on age groups ($p > 0.05$ for all groups). Separately for the male and female sex groups, the preschool group has a significantly higher number of cases than the infant group, and the adolescent group has a significantly higher number of cases than the other three groups ($p < 0.05$). There were no statistical differences between the infant group and school group, school group, and preschool group (Chi-square post hoc Z test, $p > 0.05$). Figs. 1a and 1b show the sex distribution by age group and the causes of poisoning.

The mean age of all cases was 10.4 ± 6.2; the median is 13.6 years. Unsupervised intakes are most common in the preschool group, accounting for 88.5% of all unsupervised intake cases ($p < 0.0001$; median: 2.6). Intentional recreational intakes were all in the adolescent group, limited in number; there were only 3 cases (100%), and it was not significant ($p > 0.05$). The adolescent group accounted for 96.3% (n = 78) of the suicide cases, and they were significantly higher ($p < 0.0001$; median: 15.4). The age group distribution of therapeutic error cases is balanced. 130 (87.8%) of the acute poisoning patients were caused by pharmacological agents. The poisoning factors of patients who were poisoned for pharmacological and non-pharmacological reasons are given in Table 2.

In Table 3, the data of the patients poisoned for suicide are given in detail. According to the univariate analysis in Table 3, females are more associated with suicide in cases of intoxication (odds ration [OR] = 4.1). Intoxications in adolescents are associated with suicide 167.6 times more than in other age groups. While cases in the morning are 3.3 times more likely to be a suicide, cases in the evening are less likely to be a suicide than all cases in the other parts of the day

Table 1. Sociodemographic variables of hospitalized children with acute poisoning

Variables*	Data
Age (year)	13.6 (9.9-11.1)
Gender (male/female), n (%)	45(30.4) / 103 (69.6)
Setting home/other, n (%)	127 (85.8) / 21 (14.2)
Intensive care duration (day)	1.0 (1.7- 2.0)
Outpatient clinic duration (day)	3.0 (3.5-4.7)
Exitus/ discharge, n (%)	0 (0) / 148 (100)
Substance pharmacological/ Non	131 (88.5) / 17 (11.5)
Season winter/ spring/ summer/ autumn, n (%)	27 (18.2) / 49 (33.1) / 38 (25.7) / 34 (23.0)
Route of intake (oral/ inhaler/ dermal), n (%)	144 (97.3) / 1 (0.7) / 3 (2.0)
Drug use in anamnesis (Yes/ No), n (%)	93 (62.8) / 55 (37.2)
Psychiatric drug in anamnesis (Yes/ No), n (%)	38 (25.7) / 110 (74.3)
Additional disease (Yes/ No), n (%)	59 (39.9) / 89 (60.1)
Psychiatric disease, n (%)	52 (35.1) /96 (64.9)
PICU (Level 2/ Level 3), n (%)	62 (41.9) / 86 (58.1)
Glasgow coma scale	13.0 (12.6-13.1)
Former suicidal attempt (Yes/ No), n (%)	20 (13.5) / 128 (86.5)
Race (Turkish/Refugee), n (%)	139 (93.9) / 9 (6.1)

Continuous data were expressed as median (25-75 percentile). PICU = pediatric intensive care unit

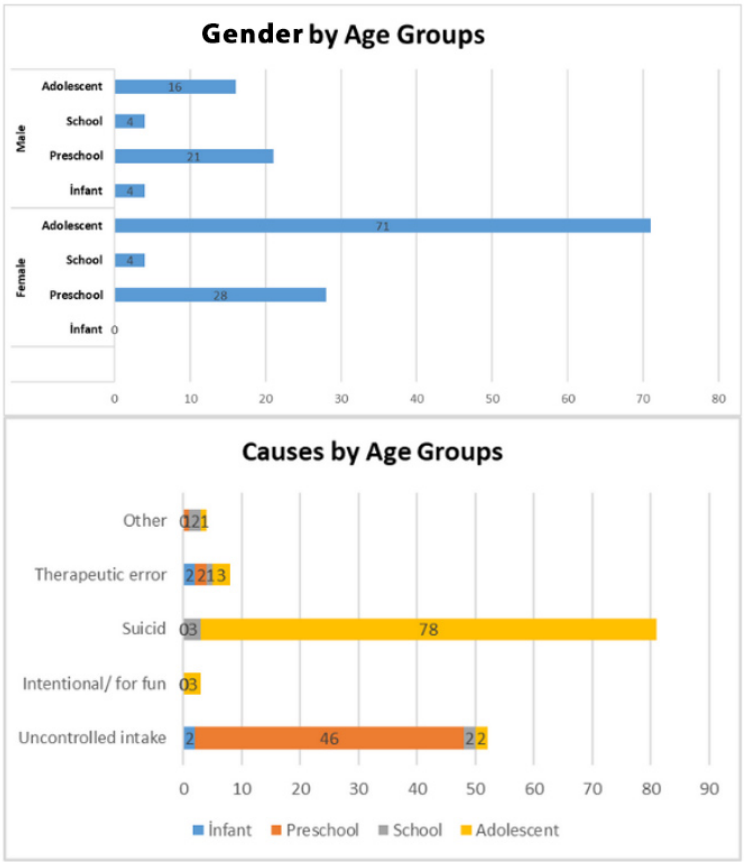

Fig. 1. **(A) Gender distribution by age groups. (B) Causes of poisoning by age groups**

(OR = 0.4). In cases that occurred on Fridays, the suicide rate was significantly lower than on other days (OR = 0.3). When psychiatric drug and non-drug users are compared, the probability of drug-using cases being suicidal is stronger (OR = 55.5). If multiple drugs cause the case of intoxication, the probability of suicide is 3.6 times higher compared to toxicity with only one drug. A local (Turkish) case is more likely to be a suicide than an immigrant case (OR = 5.2). In 20 of the suicide cases, there were previous histories of suicide attempts.

Since the findings in Table 3 were also appropriate for a binary logistic regression model, multivariate analysis was used in the second step, and the model was found to be significant. Again, being an adolescent and using psychiatric medication contributed significantly to the model (OR = 145.3 and OR = 37.9).

The most common drug used in drug poisoning was neuroactive drugs (n = 71). Analgesics were used with the second frequency (n = 48). Exposure to drug categories by age and sex is shown in Table 4. In 59 patients, multiple drug exposure was present.

Most patients (n = 119, 80.5%) were followed up with supportive care. Patients were given N-acetyl cysteine (n = 6), NaHCO3 (n = 6), invasive mechanical ventilation (n = 7), vasoactive drug (n = 7), and snake antiserum (n = 1) based on their needs. In addi-

Table 2. **Distribution of poisoning causes**

	Frequency	Percent
Pharmaceutical	130	87,8
Substance use	5	3,3
Muriatic acid	4	2,7
Pesticide	3	2,0
Snakebite	2	1,4
Alcohol	2	1,4
Thinner	1	0,7
Mushroom poisoning	1	0,7
Total	**148**	**100**

Table 3. Univariable and multivariable analysis of suicide

Suicid	Yes n (%)	Total	Univariable analysis OR	Univariable analysis 95% CI	Multivariable logistic analysis OR	Multivariable logistic analysis 95% CI
Gender						
Male	14 (31.1)	45	1			
Female	67 (65.0)	103	4.1*	1.9-8.7	2.7	0.6-11.9
Age category						
Infant	0 (0.0)	4	0.4*	0.4-0.5		
Preschool	0 (0.0)	49	0.2*	0.1-2.8		
School	3 (37.5)	8	0.5	0.1-2.1		
Adolescent	78 (89.7)	87	167.6*	43.4-646.4	145.3*	28.0- 753.8
Location						
Own Home	67 (54.0)	124	1			
Other	14(58.3)	24	1.2	0.5-2.8		
Time of exposure						
Morning	8 (61.5)	13	3.3*	1.0-10.5	1.3	0.2-11.2
Afternoon	27(69.2)	39	0.9	0.5-1.9		
Evening	20 (38.5)	52	0.4*	0.2-0.7		
Night	26 (59.1)	44	1.2	0.6-2.4		
Days						
Monday	13 (59.1)	22	1.2	0.5-3.1		
Tuesday	15 (65.2)	23	1.7	0.7-4.2		
Wednesday	11 (61.1)	18	1.3	0.5-3.7		
Thursday	13 (54.2)	24	1.0	0.4-2.3		
Friday	7 (30.4)	23	0.3*	0.1-0.8		
Saturday	7 (43.8)	16	0.6	0.2-1.7		
Sunday	15 (68.2)	22	1.9	0.7-5.1		
Pandemic Measures	14 (63.6)	22	1.5	0.6-3.9		
Psychiatric History	37 (97.4)	38	55.5*	7.3-419.5	37.9*	2.1- 686.5
Substance						
Pharmaceutical	73 (55.7)	131	0.7	0.3-1.9		
Multi drug	43 (72.9)	59	3.6*	1.8-7.3	1.3	0.3-5.6
Race						
Refugee	1 (11.1)	9	1			
Turkish	80 (57.6)	139	5.2*	0.8- 33.0	13.7	0.9- 200.1
Total	**81 (54.7)**	**148**				

*Asterisk indicates $p < 0.05$

Table 4. Distribution of pharmacological drugs by age groups and gender

	Age n (%)				Gender n (%)		Total
	Infant	Preschool	School	Adolescest	Male	Female	
Neuroactive	1 (1.4)	17 (23.9)	4 (5.6)	49 (69.0)	22 (31.0)	49 (69.0)	71
Analgesic	0 (0.0)	11 (22.9)	2 (4.2)	35 (72.9)	11 (22.9)	37 (77.1)	48
Cardioactive	0 (0.0)	10 (50.0)	0 (0.0)	10 (50.0)	2 (10.0)	18 (90.0)	20
Hormones	0 (0.0)	3 (33.3)	0 (0.0)	6 (66.7)	3 (33.3)	6 (66.7)	9
Antimicrobial	0 (0.0)	0 (0.0)	1 (12.5)	7 (87.5)	3 (37.5)	5 (62.5)	8
Gastrointestinal	1 (20.0)	2 (40.0)	0 (0.0)	2 (40.0)	2 (40.0)	3 (60.0)	5

tion, renal replacement therapy was applied to two patients with isoniazid and metformin intoxication. Since our hospital did not have a pediatric psychiatry inpatient service, the patients were transferred to the pediatric service.

DISCUSSION

Acute poisoning in pediatric patients is still a significant public health problem. An international study of pediatric poisonings from 20 countries and eight different global regions discovered significant epidemiological differences by region [4]. Therefore, we wanted to raise awareness about acute poisoning in critically ill patients in Bursa province to reduce child deaths, hospitalizations, and costs, as well as not waste precious life-saving intensive care beds with predictable and preventable acute poisonings.

This study is a special report on acute childhood poisoning requiring intensive care. During the study period, acute poisonings accounted for 5.2% of total patient admissions in the PICU, where medical/surgical patients were followed. This is approximately half the rate determined by some studies [5]. The majority of our cohort consisted of females (n =103, 69.6%). However, with age, not only females but also males increased in number (Fig. 1b). In the childhood age group, poisoning cases peak at two different ages [5-7]. The first peak was during the preschool period between the ages of 1-6, and the second peak was during the adolescence period between the ages of 12-18 (Fig. 1b).

The pattern of poisoning in children varies according to age and sex. According to the American Association of Poison Control Centers (AAPCC) annual National Poison Data System (NPDS), while the majority of poisonings in infants are caused by unintentional intakes or therapeutic errors[8], in adolescents, they are caused by deliberate intakes [2]. However, 64% of poisonings occur in girls between the ages of 13-19, and 64% are due to deliberate intake [2]. In many studies, the preschool age group is thought to be the most frequently poisoned age group due to a desire to explore the environment and imitate adults [9-11]. In our study, exposures in the preschool age group are primarily unintentional, with 88.5% being unsupervised intakes and suicide attempts occurring in the adolescent period (Figs. 1a and 1b). The most common place of exposure was home (85.8%) and was consistent with the available literature [2, 8]. Although many studies emphasize that the poisoning is often caused by unintentional exposure in the preschool period, it is thought-provoking that our study is also compatible with the literature. Unfortunately, this result shows that the public is still not sufficiently aware of poisonings.

It is known that in our country, it is easy to access health services and medicines since health expenditures, particularly for those under the age of 18, are completely under the guarantee of the state. Therefore, we believe that medicines are stocked at every home, and enough sensitivity is not shown in terms of properly storing them at home. 131 (88.5%) of acute poisoning patients were caused by pharmacological agents. The most common drug used in drug poisoning was neuroactive drugs (n = 71). Analgesics were used

with the second frequency (n = 48).

The poisoning factors for 18 patients who were poisoned due to non-pharmacological reasons are given in the Table 2. In our region, where agriculture is an essential source of income, only three patients were hospitalized with pesticide poisoning during these 3.5 years. Intentional recreational purchases, although not statistically significant, were all in the adolescent group, limited in number. There were only 3 cases. Unfortunately, some acute poisonings are also caused by a therapeutic error or incorrect application [12]. In our study, the distribution of therapeutic error cases according to age groups was balanced. Eight of our cases were poisoned due to therapeutic error.

No specific treatment was applied to 80.4% of the patients admitted to the PICU. All patients were given symptomatic treatment, and monitored their vital signs. Even if the patients were asymptomatic, the hospitalization decision was made considering the toxic factor and the amount they were exposed to. When the published literature on this subject is reviewed, it can be seen that death is usually an undesirable outcome [2, 5, 13, 14]. As far as we are aware, our study is one of the few in which no deaths were reported. Health measures were taken for four patients. 2 patients were in the child welfare institution and were followed up. All patients were transferred to the ward after they were examined and followed up by a child psychiatrist.

Suicide refers to a person's action to end their life willingly; it can be done by hanging, jumping from a height, poisoning, or injury with a firearm [3]. Suicide is the second most common cause of adolescent death [15]. As emphasized by WHO, unfortunately, suicidal ideations and attempt rates in adolescents have increased worldwide over the years [15]. In this study, most of the suicide cases were composed of adolescents and females. In our study, 96.3% (n = 78, median age: 15.4) of the suicide attempt cases were in the adolescent group. Today, the incidence of depressive moods in adolescents is increasing. Antidepressant intake is known to encourage suicide [16]. Suicide attempts, in our opinion, are facilitated by patients' easy access to antidepressant drugs prescribed to them. In our cohort, almost all of our patients were using psychiatric drugs. Every patient admitted to our clinic with a suicidal attempt necessarily receives a child psychiatry expert opinion.

At least one psychiatric disorder exists in adolescents who have attempted suicide [18]. In the case series of 11 children who died by suicide in Zambia, nine died by hanging, and two died by organophosphate poisoning [17]. None of these cases were prone to behavioral disorder, anxiety, or depression [17]. These cases, in our opinion, did not have psychiatric diagnoses because their families neglected them. So they wanted to die, and they died. In a study on 6483 adolescents aged 13 to 18 conducted in 2013, the suicidal ideation rate was 12.1%, and the suicide attempt rate was 4.1% [17]. Moreover, at least 80% of suicidal adolescents received psychiatric treatment [18]. In our study, when the cases using psychiatric drugs were compared with the cases not using psychiatric drugs, the probability of suicide was 55.5 times stronger for the case using it.

In 2004, the U.S. Food and Drug Administration (FDA) requested that a warning be included in antidepressant drug product catalogs that may increase the risk of suicidal ideation and behavior, particularly during dose changes [19]. However, it is known that the risk of suicide attempts increases in those who have a psychiatric illness [20]. In 2008, the FDA requested that the drug catalogs be updated again, emphasizing that mood disorders and severe psychiatric disorders are major causes of suicide [21].

In a survey that investigated suicidal behavior in adolescents with the participation of 41 schools and 6020 students in the United Kingdom, 7% of the participants emphasized that they had intentionally harmed themselves in the previous year [22]. A Canadian study compared 20471 adolescents aged 10 to 19 who had their first self-poisoning episode within the previous 12 years to a control group of over 1 million people with no such history [23]. Suicide risk was 30 times higher within the first year after the first self-poisoning episode than in the control group [23]. Children who had attempted suicide had a high risk of repeating the attempt. Unfortunately, in our study cohort with 81 suicide attempts, 20 patients had attempted suicide before.

Our study aimed to draw attention to all acute poisoning cases in patients between 1 month and 18 years old. However, since the number of suicides is increasing in the childhood age group, especially in adoles-

cents, it was concluded that stricter child psychiatry controls for patients with comorbidities and especially psychiatric diagnoses, as well as increased interventions to take health measures by contacting social services, should be implemented.

According to the American Association of Poison Control Centers (AAPCC) National Poison Data System (NPDS) annual report, at least 80% of children younger than 13 were managed by phone outside of a health facility where the exposure occurred [2]. According to the 2020 data from the National Poison Information Center published by the Republic of Turkey Ministry of Health, 9.14% of phone calls were made by family members and 5.09% by the exposed person. As a result, increasing the frequency with which families in Turkey use poison control centers will reduce unnecessary health expenditures. In Turkey, families should be educated on how to avoid poisoning, and if there is a suspicion of poisoning, the telephone information system should be used more actively. Thus, by reducing unnecessary emergency applications, better quality emergency services will be provided, and unnecessary health expenditures will be eliminated, thereby contributing to Turkiye's economy.

According to a study in Sweden that compared suicide attempts among refugees and Swedes by forming groups of approximately 5 million people each, suicide attempts among refugees were significantly lower than among Swedes [24]. In our study, which lasted approximately 3.5 years, the total number of patients hospitalized in our unit was 2820, with 658 (23.3%) of these patients being Syrians. However, regarding exposure to intoxication, while our cohort consisted of 148 patients, 9 (6%) were Syrian. Only one patient's poisoning in this group was caused by a suicide attempt. Suicidal intoxication was rarely observed in Syrian patients; we believe it is a survival instinct in war societies that have fled their homeland.

Limitations

Our study has some limitations. Only patients with acute poisoning who required intensive care were included in the study. It excludes patients discharged and sent home from the emergency department, admitted to the wards, or died before being taken to the hospital. It is a single-center study, and multi-center studies are needed.

CONCLUSION

It would be beneficial to increase the number of studies aimed primarily at preventing acute poisonings, which are a major cause of morbidity and mortality in children. Increased drug use in adults and children raises the risk of poisoning, particularly in pediatric patients. We recommend that families in Turkey be educated on poisoning prevention methods regularly through public health campaigns and that the ways of protection from poisoning be explained. The phone information system should be used more frequently if poisoning is suspected. Of course, focusing on the psychological safety of children, especially adolescents, will significantly reduce suicide attempts.

Authors' Contribution

Study Conception: AO; Study Design: AO, SK; Supervision: SK; Funding: N/A; Materials: N/A; Data Collection and/or Processing: AO; Statistical Analysis and/or Data Interpretation: MS; Literature Review: AO; Manuscript Preparation: AO and Critical Review: AO, SK, MS.

Conflict of interest

The authors disclosed no conflict of interest during the preparation or publication of this manuscript.

Financing

The authors disclosed that they did not receive any grant during conduction or writing of this study.

Availability of Data and Material

The datasets utilized and analyzed during the present study are not publicly available but from the corresponding author on reasonable request; however, restrictions apply to the availability of the data due to privacy protection laws.

Ethics Approval and Consent to Participate

We initiated the study after the approval of the local ethics committee. The study received ethical approval (protocol number 2011-KAEK-25 2022/08-01) by Bursa Yüksek İhtisas Training and Research Hospital Clinical Research Ethics Committe. Informed consent was not applicable due to study design (retrospective). All methods were performed in accordance

with the ethical standards in the Declaration of Helsinki and its later amendments or comparable ethical standards.

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