



# The Epidemiological Study of the Children Committing Suicide with Toxic Substances Admitted to the Emergency and Pediatric Wards in Iran (2016-2013)

Farah Ashrafzadeh (MD)<sup>1</sup>, Farideh Sahebkar (MD)<sup>2</sup>, Anahita Alizadeh (MD)<sup>3</sup>, Majid Sezavar (MD)<sup>4</sup>, Babak Karimi (MD)<sup>5</sup>, Maryam Naseri (MD)<sup>5</sup>, Gholamreza Khademi\* (MD)<sup>6</sup>

<sup>1</sup>Department of Pediatric Neurology, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran.

<sup>2</sup>Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran.

<sup>3</sup>Medical Toxicology Research Center, Mashhad University of Medical Sciences, Mashhad, Iran.

<sup>4</sup>Pediatric Intensive Care Division, Department of Pediatrics, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran.

<sup>5</sup>Department of pediatrics, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran.

<sup>6</sup>Neonatal Research Center, Mashhad University of Medical Sciences, Mashhad, Iran.

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### ABSTRACT

**Introduction:** Poisoning is the most common method of non-fatal suicide. In recent years, poisoning caused by the use of medications and chemicals has increased. The present study aimed to investigate the rate of suicide using toxic compounds in Iranian children.

**Methods:** This retrospective study was conducted using the data of 83 children aged 5-16 years who attempted suicide using toxic substances and were admitted to the pediatric and toxicology departments of Imam Reza Hospital in Mashhad, Iran.

**Results:** Among 500 suicide cases, 83 committed suicide using toxic substances, and 8.4% of the suicides were committed by children aged 5-7 years. In addition, 60% of the suicide cases were aged 14-16 years. In total, 45.5% of the children committed suicide with prior planning (statistically significant). The peak time of referral to the emergency department was between 6-12 PM, and more than 90% of the patients were admitted with stable vital signs. The most commonly used toxic substance was organophosphate. During admission, psychiatric counseling was not provided to 36.1% of the patients, and the clinical outcomes also showed the use of non-lethal doses.

**Conclusion:** According to the results, it is of utmost importance to assess the underlying causes of suicide attempts in early childhood (e.g., prior planning and antisocial behaviors), especially with the increased age of children to 14-16 years in such incidents.

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### Introduction

Suicidal ideation and suicide attempts are serious public health concerns in children and adolescents (1). The term 'suicide attempt' often refers to the suicidal behaviors that could lead to the death of an individual (2). According to statistics, about one million cases commit suicide each year across the world. The rate of suicide (completed and non-fatal) in the world has been reported to be 1.5 times

higher than other deaths, and suicide is the 10th leading cause of death in the world (3). Nevertheless, studies have rarely been focused on the rate of suicide in particular age groups, and these rates are speculated to vary greatly across various age groups (4).

Youth suicide does not often lead to death, and the ratio of completed suicide to non-fatal suicide in

\*Corresponding author: Gholamreza Khademi.

Neonatal Research Center, Mashhad University of Medical Sciences, Mashhad, Iran.

E-mail: khademigh@mums.ac.ir

Tel: +985137275580

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these individuals is 1:10-20. However, the survivors of suicide frequently suffer from severe injuries, which may require long-term medical care (5). According to the Centers for Disease Control and Prevention, the suicide rate in children aged 5-11 years is 0.17 per 100,000, while the rate has been estimated at 5.18 per 100,000 in children aged 12-17 years (6).

Suicide attempts encompass specific purposes, planning, and availability of fatal tools, such as firearms, high-rise structures or lethal substances (1). According to the literature, poisoning is the most common method of non-fatal suicide (5, 7). In recent years, poisoning caused by the use of medications and chemicals has increased. According to a study regarding acute poisonings at Razi Hospital in Ghaemshahr (Iran), most of the poisonings cases were deliberate with suicidal intentions (8). In Iran, the rate of suicide has been on the rise within the past three decades (9). Previous findings have suggested that the rate of suicide in Iranian children is up to 93.4% through medication abuse (10). Some of the most significant risk factors for suicide in children and adolescents include mental illnesses, history of suicidal behavior, circumstances surrounding children, parental psychopathology, availability of lethal tools, and gender (11). Considering the scarcity of the data regarding the rate, underlying causes of suicide attempt and the predisposing factors in Iranian children who often have easy access to various toxins, the present study aimed to investigate the rate of suicide attempts with toxic substances and the contributing factors in hospitalized children.

## Methods

This cross-sectional, retrospective study was conducted using the medical records of children aged 5-16 years who committed suicide with toxic substances during March 2013-March 2016 and were admitted to the pediatric and toxicology departments of Imam Reza Hospital in Mashhad, Iran. Data of the children hospitalized due to intoxication and suicide attempts and those who were hospitalized more than twice due to pharmaceutical intoxication were collected and analyzed. The data of the patients were extracted from the archived medical records based on the final diagnosis, ICD10 codes recorded in the files or other information in the records in the cases where the cause of admission was not suicide attempt. If needed, the remaining data were obtained through follow-up via phone call or interviews with the individual or their family members. Trained investigators collected the required data on the personal information, suicide motives, method of suicide, past suicides, chronic physical

illnesses, mental illnesses, and recent life stressors. Notably, no intervention was performed in the study.

Ethical considerations were in accordance with the Stockholm Convention, and the study protocol was approved by the Ethics Committee of the School of Medicine at Mashhad University of Medical Sciences. The subjects were anonymous in the checklists, and the information obtained from the sample population remained confidential.

Data analysis was performed in SPSS after coding, and Chi-square was used for the analysis. In addition, t-test and the analysis of variance (ANOVA) were used for the normal quantitative variables, and non-parametric tests were applied for the non-normal variables.

## Results

In total, 500 suicide cases within the age range of 5-16 years were investigated, 83 (16.6%) of which were unsuccessful suicides with toxic substances. According to the findings, 55 cases (66.3%) of the unsuccessful suicides with toxic substances occurred in females. Among the studied patients, 27.7% were from rural areas, 26.5% were city dwellers, 25.3% lived in the suburbs, 20.5% lived in small towns ( $P=0.149$  according to Chi-square). The highest rate of suicide ( $n=60$ ; 72.3%) was observed in the age group of 14-16 years. In addition, 13 suicide cases were in the age group of 11-13 years, three cases were in the age range of 8-10 years, and seven cases were in the age group of 5-7 years ( $P=0.295$  according to Chi-square).

In terms of marital status, 64 subjects (77.1%) were single, and the others were married and all female ( $P=0.103$  according to Chi-square). The length of hospital stay was within the range of 1-16 days, and 44.64% of the patients were hospitalized for two nights, while 21.79% were hospitalized for three nights, and 19.3% were hospitalized for one night ( $P=0.582$  according to Chi-square). The time of referral to the emergency department or pediatric ward was recorded in hours. Accordingly, 30.1% of the patients referred at 18-24 o'clock, 28.9% referred at 12-18 o'clock, 25.3% referred at 0-6 o'clock, and 15.7% referred at 6-12 o'clock ( $P=0.606$  according to Chi-square).

Table 1 shows the data on the vital signs of the patients, used toxins, history of suicide, psychiatric counseling, serum urea levels, and acidosis upon admission and their glucose concentrations. Accordingly, the vital signs were stable in the majority of the children, organophosphorus pesticides were used by more than half of the children, and less than half of the patients had a history of suicide. In addition, the pH of blood was normal

in 77% of the children, and 64% of the children sought psychologists' advice.

According to the information in Table 1, the serum urea levels were abnormal in approximately 93% of the children, and the serum glucose levels showed inequalities in the values; mean serum glucose level was  $122.6 \pm 56.8$  mg% (minimum: 53, maximum: 433). The distribution of the glucose levels varied in different age groups (Table 2). The assessment of planning to commit suicide in the subjects indicated that a significant number of the patients (45.8%) attempted suicide with prior planning ( $P=0.025$  according to Chi-square). The records of some patients also indicated demonstrations of antisocial behavior, which were considered statistically significant ( $P=0.001$  according to Chi-square).

The evaluation of the correlation between the used toxins and various factors indicated no significant associations between the serum glucose levels and used toxins ( $P=0.143$  according to Chi-square). Additionally, no significant correlation was observed between the presence of acidosis and used toxins ( $P=0.532$  according to chi-square). On the other hand, the time of admission to the emergency department was significantly correlated with the toxic substances ( $P=0.337$  according to Chi-square). The toxic substances had no significant associations with gender ( $P=0.289$  according to Chi-square), marital status ( $P=0.223$  according to Chi-square), and history of suicide attempt ( $P=0.487$  according to Chi-square). However, the associations of acidosis ( $P>0.05$  according to Chi-square) and serum glucose levels ( $P>0.05$  according to Chi-square) with the age of the patients was not considered significant.

## Discussion

To date, several studies have investigated suicide from different aspects. According to statistics of the Youth Risk Behavior Surveillance System (YRBSS), there was a remarkable increase in the number of the children attempting suicide during 2009-2015 (12). The depth of the catastrophe becomes more apparent when the chemical toxins that are readily available are used more frequently than other methods to commit suicide in this age group. Since the majority of suicide cases in Iranian children have been due to medicinal abuse (10), studies must identify the underlying causes of suicide attempts and the contributing factors in this population. According to the results of the present study, 66.6% of the suicide attempts were in female patients. In a study conducted in Tehran (Iran) on 60 children who attempted suicide, 62% of the cases were reported in males, and 38% were reported in females (10). Furthermore, the

**Table 1.** Data on Symptoms, Toxins, Concentrations of Compounds, and Records of Children Who Attempted Suicide

Variable	N	%	P-value	
Vital Signs Status	Fixed	75	90.4	0.548
	Out of Normal Range	7	8.4	
	Missing Data	1	1.2	
Toxins	Organophosphorus	47	56.6	0.894
	Insecticides	27	32.5	
	Rodent Poisons	9	10.9	
History of Suicide	Yes	12	14.5	0.846
	No	34	41	
	Missing Data	37	44.5	
pH	Acidosis	18	21.7	0.846
	Natural	64	77.1	
	Missing Data	1	1.2	
Psychiatric Consultation during Hospitalization	Yes	53	63.9	0.743
	No	30	36.1	
Urea Level	Normal	4	4.8	0.403
	Abnormal	77	92.8	
	Missing Data	2	2.4	
Glucose Level (%mg)	60-150	65	78.3	0.350
	60>	2	2.4	
	150<	13	15.7	
Planned Suicide	Yes	38	45.8	0.025
	No	44	53	
	Missing Data	1	1.2	
History of Antisocial Behavior	Yes	24	28.9	0.001
	No	15	18.1	
	Missing Data	44	53	

**Table 2.** Distribution of Glucose in Different Age Groups

Serum Glucose mg (%)	5	6	7	9	10	11	12	13	14	15	16	Total
60-150	1	2	2	1	0	4	1	6	18	29	1	65
60>	0	0	0	0	0	0	0	1	0	1	0	2
150<	0	0	2	0	2	0	0	1	2	6	0	13
Total	1	2	4	1	2	4	1	8	20	36	1	80

study by Oh *et al.* (13) indicated the higher incidence of suicide attempts in females. Considering that the married subjects in the present study were all female, if the number of married individuals was subtracted from the total number of the female population, the number of the female and male subjects in the project would be approximately equal. On the other hand, the issue of marriage at an early age, which is more likely to occur in the rural areas in Khorasan province compared to the metropolis of Tehran, may play a key role in the higher incidence of suicide among children in this province. Another issue that should not be overlooked is that despite the high rate of suicide among females, none of the cases were fatal in the current research, which could represent a pre-tentious attempt to commit suicide without a definite decision. According to the study by Zakharov *et al.* (5), the use of non-toxic doses in the females attempting suicide was more frequent compared to males.

In the present study, no significant difference was observed in the number of the suicide attempts between the children living in small and large communities, which indicated that the rate of suicide in urban communities is not necessarily higher than rural areas or vice versa; this finding could be attributed to the similar content on various media in urban and rural areas (14). According to the study by Recuperero *et al.* (15), the tools used in mass communication and the Internet could disseminate information about suicide in the community by presenting various methods of suicide. Consequently, the demonstration of suicide methods on the Internet may spread the popularity of the action.

According to the findings of the current research, the frequency of suicide increased after the age of 13 years, and the estimated rate was higher in the age range of 16-14 years, with a statistically significant difference in this regard. According to Gould *et al.* (16), childhood suicide occurs rarely, while suicide rates increase with growing into adolescence. In the present study, suicide attempts were observed at the age of five years in some of the admitted patients. According to Bridge *et al.* (17), although the incidence of suicide among school-aged children is rather low, it is considered to be the 11th leading cause of death in the children aged 5-11 years.

The patients in the present study had a low length of hospital bed occupation, and the number of the hospitalized patients with unstable vital signs was also relatively low, which may indicate the low intensity of the used suicide methods in the subjects. In current research, it was not possible to obtain the data regarding the time when the

suicides occurred, and only the data on the time of admission and hospitalization after the suicide attempt were recorded. As the effects of toxins on the body occur over a specific period, it was not possible to determine the exact time of the suicide attempt.

In the present study, the lowest rate of referral time due to suicide attempts was during the day (6-12 AM). In a similar study, the time of suicide attempts was reported to be 6-12 PM (18). The results of the present study indicated that psychiatric counseling was provided to approximately 64% of the children hospitalized due to suicide attempt. In another study by Nock *et al.* (19), the majority of the children who attempted suicide had one or two types of psychiatric disorders. According to a review conducted by Cash *et al.* (20), 80-90% of the children who attempted suicide (both victims and survivors) had a psychiatric disorder, the most common of which were associated with mood, anxiety, conduct, and substance abuse (alcohol/drugs).

In the current research, antisocial behaviors were observed in approximately 29% of the children, and the validity of 61.5% shows the statistical significance compared to the children without antisocial behaviors. In this regard, Martonen *et al.* (21) surveyed 53 survivors of suicide, reporting that antisocial behaviors were particularly effective in committing suicide, especially following alcohol consumption. In the present study, a history of suicide was observed in 14.5% of the patients although the data in this regard were missing in 44% of the cases. In another research, Molero *et al.* (22) evaluated 50 patients with depression for two and a half years, reporting the rate of repeated suicide attempts to be 25% in these individuals. In a study conducted by the CDC on 13,000 high school students, the likelihood of suicide attempt among the students with a history of suicide was 15 times higher compared to those without such a history (23).

The majority of the patients in the present study had elevated serum urea levels, and acidosis was also observed in 18 cases (21.7%), and the mean serum glucose level was estimated at  $122.6 \pm 56.8$  mg% (minimum: 53, maximum: 433). Meanwhile, elevated fasting serum glucose levels were observed in 13 cases (15.7% without considering the missing data). In addition, the serum glucose levels of lower than 60 mg% were observed in only two cases aged 13 and 15 years. Another notable finding was the instability of the vital signs in only seven patients (8.4%). Regardless of the fact that acidosis may occur following poisoning, the associations between the rate of acidosis, hypoglycemia, and unstable vital signs were not in-

vestigated in our study. Whether decreased blood glucose could lead to suicidal behaviors is a question that must be addressed in the further investigations in this regard.

In the current research, organophosphorus had the highest frequency of use compared to other toxins for suicide. In a similar study, organophosphorus was reported to be the most commonly used toxin for suicide (24). According to Nock et al. (19), planned suicide leads to committing suicide within at least one year. On the other hand, planned suicide has been reported to be within the same age range as suicide attempts although with higher frequency. According to the present study, 45.8% of the cases who attempted suicide had prior planning, and considering the mean age of the patients, our findings regarding both attempted suicide and planned suicide are consistent with the study by Nock et al. (19).

## Conclusion

The results showed no significant differences in the clinical outcomes of the children who attempted suicide. In addition, the survival of the patients indicated the use of non-lethal doses. Among the predisposing factors to suicide, two indicators of planned suicide and antisocial behaviors were considered significant, and considering the difference in the number of the suicide attempts within the age range of 14-16 years compared to younger individuals, further investigations are recommended to explore the possible associations between these factors and suicide attempts.

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## Conflict of Interest

The authors declare no conflict of interest.

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