

The Use of Pesticides in Suicide Attempts in the Eastern Mediterranean Region of Turkey



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SUMMARY

Objective: In parallel with common usage areas, pesticide poisonings are encountered in the community due to reasons such as no wearing of protective clothing and masks during use, unintentional consumption and suicide-intended intake. In this study was aimed to examine the cases who applied to the emergency department with pesticide poisoning and share of suicide cases.

Method: This study is a retrospective record study based on the files of 234 patients who reported to the emergency department for pesticide and rodenticide poisoning between 2014 and 2018. The patients were compared in terms of sociodemographic, substance type, prognosis, and accident/suicide status. Chi-square test, Binary logistic regression analysis were used in the analysis of the data.

Results: Organophosphates was the most common substance recorded as a cause of poisoning, while rat poison placed second. 38% of the acute poisoning cases were suicide attempts. Poisoning among men was found to be prominently due to accident while among women suicidal poisoning was more prominent. While the mortality rate is 4.7% in all acute intoxication cases, the mortality rate in poisonings with suicidal purposes is 5.6%. Patients with psychiatric diseases have a 28-fold higher risk of intoxication of attempting suicide. The most common comorbid psychiatric disorders in acute pesticide poisoning are anxiety and depression.

Conclusion: A major proportion of pesticide poisoning cases is suicide attempts. Suicide attempt is at the forefront in women and death rates are higher in people with psychiatric illness. It may be advisable to avoid the easy accessibility of pesticides.

Keywords: Pesticides, rodenticides, suicide

INTRODUCTION

Pesticides are compounds that are used to prevent, reduce or control harmful organisms. Insecticides contained in this group of compounds which are used against insects are also called ‘agricultural pesticides’ in many places because they are globally known as products used to increase agricultural production. Pesticides have a very important place both as part of increasing agricultural production activities, home use and in public health. They are used at home and in many other areas. In parallel with common uses, pesticide poisonings are encountered in the society due to careless behavior such as not using protective equipment during application, packaging or other errors in storage, unconscious consumption and consumption with suicidal intent. Pesticide poisoning cases are frequently encountered in our country as well as all over the world (Özkaya et al. 2013). Pesticides ranked the 10th of

all the causes of poisoning in the 2009 report of the American Association of Poison Control Centers (Bronstein et al. 2010). Pesticides are among the 25 compounds with the highest rate of increasing cases of poisoning, 8th place on the list of the first 25 compounds in pediatric poisoning cases and 5th in the list of the top 25 substances in adult poisoning cases. It was seen that 8.8-10.3% of the consultations to the poison information centers in our country are pesticide poisonings, among which organophosphate poisoning is the first (Kalkan et al. 2003, Satoh and Hosokawa 2000). It is seen that the predominant causes of poisoning were accidental but among postmortem poisoning cases 51-100% were as a result of attempted suicide (Özkaya et al. 2013).

Self-poisoning with agricultural pesticides contributes significantly to the global suicide burden (World Health Organisation, 2014). Looking at the international literature

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from 1990 to 2007, it is seen that this method is used in about a third of the world's suicide attempts and is estimated to cause 260,000 deaths per year (Gunnell et al. 2007). When the global burden of pesticides and suicide is examined between 2006 and 2015, it is seen that pesticides contribute significantly to the global suicide incidence and account for 14-20% of deaths worldwide. This indicates that pesticide poisoning leads to significant morbidity and mortality (Mew et al. 2017). Suicide with pesticides is especially common in South Asia, Southeast Asia and China. China is the most populous country in the world where suicide rates are relatively high. A study showed that 62% of suicides in China were committed by insecticide poisoning (Phillips et al. 2002). Following the publication of this review, some countries have developed strategies to reduce the burden of pesticide suicides, and overall suicide rates have fallen by about 10% in China (Liu et al. 2015) and worldwide. Therefore, it is necessary to review the ongoing contribution of pesticide poisoning to the global suicide incidence (Cha et al. 2016, Pearson et al. 2015).

The quality of global data on suicide methods is inadequate for many regions. Although there has been a significant decrease in recent years in the use of pesticides as a tool for suicide, the use of pesticides as a suicide tool remains an important public health problem. Globally, one in seven suicide attempts are with pesticides (Mew et al. 2017). In general, suicide rates vary between the sexes, while suicide methods vary by country. The most commonly used methods are self-hanging, self-poisoning with pesticides and the use of firearms. Most suicides worldwide are related to psychiatric disorders and have a higher risk of death from unnatural causes than in the general population. In particular, depression, substance use and psychosis are the most important risk factors. In general, there is probably significant underreporting of cases. However, suicides can be partially prevented by restricting access to suicidal agents. Suicide represents a major social problem, requiring prioritization in many aspects and diverse areas (Bachmann 2018). The use of pesticides as a suicide tool is especially greater in lower-middle income countries, and its use as a pesticide increases its availability. Under the light of all these factors, the possibility of suicide should be considered in acute pesticide poisonings that present to the emergency room. This study aims to evaluate the number of suicides, the extent of presence of psychiatric disease comorbidity and mortality rates in poisoning cases in people who present to Çukurova University adult ER with pesticide poisoning.

METHOD

This is a retrospective study focusing on the records of patients who presented to Çukurova University Faculty of Medicine Adult ER due to poisoning between 2014 and 2018. Patients from Adana, Hatay, Mersin, Kahramanmaraş, Osmaniye

provinces presented to the ER. Permission has been obtained from the ethics committee of the Çukurova University to carry out the study (Decision no:67). In the course of the study records of some 3699 patients who presented to the hospital's ER with cases of poisoning between 2014 and 2018 were analyzed. ICD 10 diagnostic codes given to patients who presented with poisoning; (World Health Organisation, 1992) are as follows:

F10.0-Mental and behavioural disorders due to use of alcohol: acute intoxication

F10.1-Mental and behavioural disorders due to use of alcohol: harmful use

T51.8-Other alcohols

T51.9-Nonorganic sleep disorder, unspecified

T51-Toxic effect of alcohol

T58-Toxic effect of carbon monoxide

T60.0-Toxic effect: Organophosphate and carbamate insecticides

X44-Accidental poisoning by and exposure to other and unspecified drugs, medicaments and biological substances

X64-Intentional self-poisoning by and exposure to other and unspecified drugs, medicaments and biological substances

Y19 Poisoning by and exposure to other and unspecified chemicals and noxious substances, undetermined intent

According to these this diagnostic codes 3699 patient files were screened and 234 cases of intoxication with insecticides, rodenticides and other pesticides were identified. All insecticide, rodenticide and other pesticide poisoning cases were included in the sampling. The records of the 234 patients were scrutinized retrospectively. In the standard working forms prepared, patients; age, gender, marital status, residence, occupation, social security, hospital admission time, hospital admission date, substance of exposure, form of exposure, suicide/accident status, underlying psychiatric disorders, complications during follow-up, intensive care hospitalization status, prognosis, department of hospitalization, department in which treatment was received and hospitalization period were recorded. Patients were assessed sociodemographically per type of poisonous substance, prognosis, and accident/suicide status.

Statistical Analysis

SPSS 22 program was used for data analysis. In the presentation of quantitative data, mean and standard deviations are provided, while qualitative data, has been presented with frequency and percentage values. Data was analyzed using Chi-square test and Binary logistic regression analysis. The value $p < 0.05$ was considered significant.

RESULTS

Sociodemographic characteristics and substance of exposure information of the 234 people who presented to the ER with pesticide poisoning between 2014 and 2018 are given in Table 1.

Organophosphates were the most frequently encountered of causal agents in poisonings, followed by rat poison. 53.4% of poisoning cases presented were men and 38% of the cases of poisoning were as a result of suicide attempts. The route of exposure to substances was peroral. The average hospital stay of the patients was 2.15 days. The distribution of the number of presented cases by years and months is given in Figure 1.

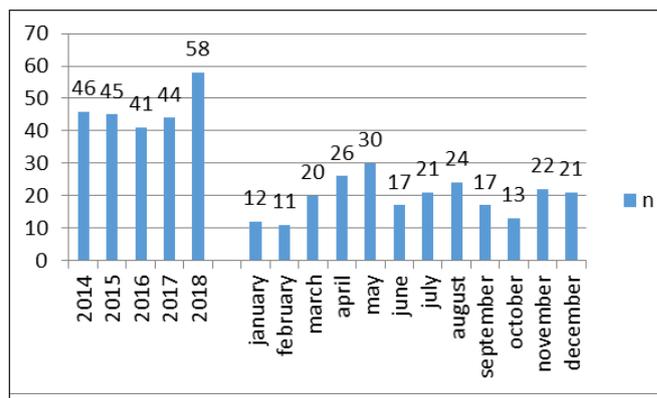


Figure 1. Distribution of the number of cases by years and months

Table 1. Sociodemographic characteristics

Characteristics	
Age (years) (min-max, X±S.S.)	19-92, 43.09±15.17
Gender male /female n/ (%)	125 (53.4) / 109 (46.6)
Place of residence Adana/other n/(%)	181 (77.4) / 40 (17.1)
Psychiatric disorder (present/absent) n/(%)	213 (91.0) / 21 (9.0)
Hospitalization Period (days) (min-max, X±S.S.)	0-37, 2.15±4.61
Reason for admission accident/suicide n/(%)	145 (62.0) / 89 (38.0)
Substance type organophosphate / rat poison / other n/(%)	108 (46.2) / 68 (29.1) / 58 (24.8)
Mode of exposure oral/inhalation/IV/other/ unidentified/ (%)	165 (70.5)/21(9.0)/2(0.9)/13(5.6)/33(14.1)
Complication present/absent n/(%)	192 (82.1) / 42 (17.9)
ICU admission yes/no n/(%)	222 (94.9) / 12 (5.1)
Prognosis deceased/discharged n/(%)	11 (4.7) / 223 (95.3)

Table 2. Comparisons by mode of substance exposure

Gender	Reason for Admission n (%)		p
	Accident	Suicide	
Female	60 (55.0)	49 (45.0)	0.042
Male	85 (68.0)	40 (32.0)	
Age			
40 and younger	60 (55.6)	48 (44.4)	0.061
41 and older	85 (67.5)	41 (32.5)	
Comorbid psychiatric disorders			
None	140 (65.7)	73/34.3	0.001
Anxiety disorder	1 (12.5)	7 (87.5)	
Depression	2 (33.3)	4 (66.7)	
Anxiety / Depression	1 (25.0)	3 (75.0)	
Psychosis	1 (33.3)	2 (66.7)	
Mode of exposure			
Oral	79 (47.9)	86 (52.1)	<0.001
Inhalation	21 (100.0)	0 (0.0)	
IV/IM	1 (50.0)	1 (50.0)	
Other	13 (100.0)	0 (0.0)	
Unidentified	31 (93.9)	2 (6.1)	
Substance			
Organophosphates	82 (75.9)	26 (24.1)	<0.001
Rat poison / other	63 (50.0)	63 (50.0)	
Psychiatric disorders			
Absent	140 (65.7)	73 (34.3)	<0.001
Present	5 (23.8)	16 (76.2)	
Total	145 (62.0)	89 (38.0)	

Looking into year-on-year distribution of cases, it was seen that it was seen that the number of cases in 2018 was higher than in other years and the number of cases in all years was highest in months of April and May. When the types of poisoning were evaluated per months, it was found that the intoxication by rat poison and other substances was significantly higher in November and December ($p=0.006$). Still on a monthly basis, there was no significant difference in the number of presented cases resulting either from accidental causes or as a suicidal attempt. ($p=0.270$). It is seen that men (68%) mostly present with accidental poisonings, whilst 45% of all cases involving women were due to a suicidal attempt ($p=0.042$). 58.4% of organophosphate poisonings were seen in men, and 67.9% of intoxication by rat poison and other substances was seen in women ($p<0.001$). It was found that, while intoxication by rat poison and other substances were mostly due to attempted suicide, organophosphate poisonings were mostly the result of accidents. No significant difference was found among suicide rates by age group. 76.2% of cases presented involving individuals with psychiatric disorders were attempted suicides. While the rate of psychiatric illness

was 5% among people who presented with cases of accidental poisoning, it was 18% among individuals who presented with cases of attempted suicide ($p<0.001$). Anxiety and depression were the most common comorbid psychiatric disorders in persons who attempted suicide. The rate of those who attempted suicide was found to be significantly higher in people who were exposed to the substance orally (Table 2). The relationship among the cause of hospital admission, gender, age, presence of psychiatric disorder and the mode of exposure to the substance is given in Table 2.

The logistic regression analysis established to predict the risk of suicide in people who presented to the ER with acute poisoning was found significant. Presence of a psychiatric illness in poisoning cases reported to the ER increases the risk of suicide 28.4 times, and oral ingestion of the substance increases the risk of suicide attempt 33.6 times (Table 3).

The overall mortality rate is 4.7% in acute poisoning cases, and 5.6% in suicidal poisonings. No statistically significant difference was found between mortality rates and gender or presence of comorbid psychiatric diseases (Table 4).

Table 3. Suicide risk logistic regression analysis

	B	p	O.R.	%95 G.A. (O.R.)	
				Lower limit	Upper limit
Gender	-0.06	0.835	0.93	0.48	1.79
Psychiatric disorder	3.34	<0.001	28.47	4.47	181.34
Place of residence	0.58	0.175	1.79	0.77	4.20
Substance type	0.31	0.378	1.37	0.67	2.79
Mode of intake	3.51	<0.001	33.69	7.12	159.46

Table 4. Mortality rates

	Prognosis		p
	Discharged	Deceased	
Reason for admission			
Accident	139 (95.9)	6 (4.1)	0.752
Suicide	84 (94.4)	5 (5.6)	
Gender			
Female	104 (95.4)	5 (4.6)	1.000
Male	119 (95.2)	6 (4.8)	
Comorbid psychiatric disorders			
None	204 (95.8)	9 (4.2)	0.162
Anxiety disorder	7 (87.5)	1 (12.5)	
Depression	6 (100.0)	0 (0.0)	
Anxiety / Depression	4 (100.0)	0 (0.0)	
Psychosis	2 (66.7)	1 (33.3)	
ICU admission			
Yes	215 (96.8)	7 (3.2)	0.001
No	8 (66.7)	4 (33.3)	

DISCUSSION

The frequency of organophosphate poisoning and poisoning with other substances is seen similar in almost every country in the world. However, the use of pesticides for suicide is mostly the case in lower-middle income countries which is a significant burden on the health system (Pedersen et al. 2017). A study by Gunnell and his colleagues shows that a third of suicides globally involve pesticides (Gunnell et al. 2007). The most likely explanation for the high number of pesticide suicides in developing countries is the high mortality rates associated with pesticide intake compared to the relatively low mortality rates in developed countries. For example, in England and Wales, the case mortality rate among people hospitalized for treatment in cases of self-poisoning is <0.5%, compared to 7% in rural Sri Lanka. Suicide attempts with some commonly used pesticides (paraquat and aluminum phosphide) are particularly fatal, with over 70% fatality rate of all cases (Gunnell et al. 2007).

In our study, acute pesticide poisoning cases reported to the ER for a period of 5 years were examined. Attempted suicide rate in acute poisoning cases was 38%, and it was found that females (45%) were more likely to present with suicide-related poisoning. 76.2% of acute pesticide poisoning cases among people with psychiatric illness were due to attempted suicide. The rate of presence of comorbid psychiatric disorders in individuals presenting with attempted suicide was 18% with anxiety and depression as the most common accompanying disorders. Acute pesticide intoxication in persons with psychiatric disorders is approximately 28 times more likely to result from attempted suicide. It was seen that rat poison is more preferred in attempted suicides and the most common mode of exposure is peroral. In acute poisoning, oral ingestion of the substance increases the risk of suicide by 33 times. Poisonings caused by pesticides between 1993 and 2002 were examined by Hacettepe Pharmaceutical and Poison Information Unit in Turkey. According to this data, pesticides are second only to drug poisoning with a proportion of 10.3% of all poisoning cases. The incidence of cases increases in summer and so with a majority of cases involving women. The rate of exposure to toxic substances by way of suicidal ingestion was 34% and the mortality rate in all pesticide poisoning cases was 0.6% (Çeliker et al. 2003). In a study conducted at Dokuz Eylül University Drug and Poison Information Center in 1993-2001 in which only pesticide poisonings were analyzed, it was found that the number of poisonings were higher in the summer season when spraying was intense (38.9%), with 80.9% of exposures being peroral and with a concentration of cases of attempted suicides in the 19-29 age group. (39.8%) (Kalkan et al. 2003). The 2008 report of the National Poison Advisory Center analyzed poisonings with both pesticides and animal health products separately and found that the rate of attempted suicide was 27.7% and the 20-29 years age group was found to

be the highest-risk group (Sato and Hosokawa 2000). Both assessments reported that suicides were higher in women. In our study, it was seen that poisoning cases in women mostly resulted from attempted suicide, but no difference was found as regards age groups. The rate of pesticide use in attempted suicides is reported to be 30% on average worldwide. Following a regional distribution, it is reported that the usage rates are 3.7% in Europe, 4.9% in North and South America, and 56% in the Western Pacific (Gunnell et al. 2007). In the same study, European countries were reported to handle 29% of global pesticide sales, in contrast to accounting for 2% of pesticide suicides globally. On the other hand, a mere 25% of pesticides sold worldwide were consumed in Asian countries which but accounted for 91% of pesticide suicides worldwide. These rates indicate that although accidental or suicidal pesticide exposure is decreasing in developed countries, they are still high in developing and under-developed countries (Gunnell et al. 2007). In a study examining the global burden of pesticide poisonings between 2006 and 2015, which included data from 108 countries, it was found that pesticide poisonings accounted for 13.7% of all global suicides. The rate of suicides due to pesticide poisoning varies considerably between regions. While it is 0.9% in low and middle-income countries in the European region, it increases up to 48.3% in low and middle-income countries in the Western Pacific region (Mew et al. 2017). In the study conducted by Razwiedani et al., it was found that 51% of organophosphate exposures were due to suicide attempts (Razwiedani et al. 2017). In the study conducted by Çolak et al., 67% of organophosphate poisonings were found to be a result of suicide attempts (Çolak et al. 2014). In the study of Lin et al., it was observed that 64% of organophosphate poisonings were motivated by suicidal intent and the remaining poisoning cases either had accidental or environmental backgrounds (Lin et al. 2008). In our study, it was seen that organophosphate poisoning was more common in men, and 32% of male cases and 45% of female cases were a result of attempted suicides. Women were found to prefer rat poison etc. for suicide. It is seen that the majority of organophosphate exposure in men were related to either environmental or occupational reasons. When studies in Asian countries are examined, it is seen that men are predominant in terms of exposure to organophosphate with mortality rates varying between 10-20% (Eddleston and Phillips 2004, Munidasa et al. 2004, Eddleston 2000). In the study conducted by Göksu et al., it was found that 6.2% of acute poisoning cases presenting to the ER and 20.8% of the admissions to ICUs were due to pesticide poisoning (Göksu et al. 2002). The study conducted by Cengiz et al., it was observed that 37.2% of acute poisoning cases reporting to the ER were due to ingestion of pesticides, half of which was due to exposure to organophosphates (Cengiz et al. 2006). In the study of Mert et al., it was found that organophosphates and rat poison were the second most-commonly used substances in

attempted suicide cases. In the same study, 23.1% of poisoning cases and 41% of attempted suicides were found to have a history of a psychiatric disorder (Mert and Bilgin 2006).

In the study conducted by Li et al. in Tavyan, 157 of the people who presented with pesticide poisoning between 2000 and 2010 were found suicidal. While the cause of suicide in 29.3% of the patients was a mental illness, dysthymic disorder (26.7%) and major depressive disorders (24.7%), were found to be the most common comorbid psychiatric disorders, respectively (Li et al. 2014). In the study by Huang et al., focusing on 151 people who had recurrently attempted suicide between 2000 and 2015, the most commonly used substance was organophosphates (80.8%), where 40% of the cohort had a history of accompanying depression and 72% had a history of previous admission to the psychiatry service (Huang et al. 2020). In another study conducted in Taiwan, depressive disorder, schizophrenia and other psychotic disorders were found to be the most common of psychiatric disorders accompanying suicide attempts with pesticides. (Lin et al. 2018). In a study conducted by Paholpak, it was determined that pesticides were used in 89% of suicidal poisonings, and that 33.8% of the cases had a comorbid psychiatric disease, with anxiety disorder being the most common (Paholpak et al. 2012). In a study conducted by Aghanwa, pesticides were found to be the most used substance in attempted suicides and 60% of the patients had a psychiatric comorbid condition or a social problem (Aghanwa 2000). In a study conducted in India, 44% of people presenting with pesticide poisoning were found to have a comorbid psychiatric disease, with depression and dysthymia as the most common of such disorders (Vishnuvardhan and Sahoo 2012). In a meta-analysis study conducted by Knipe et al., the rate of completed suicide in psychiatric disorders was reported as 30% to 80%, and the rate of non-fatal suicide was reported between 3% and 86%. Mood disorders were reported to be the most common of disorders in both fatal and non-fatal suicidal behavior (25% and 21%, respectively). Schizophrenia and similar disorders were detected in 8% of those who died as a result of suicide and 7% of those who had non-fatal suicidal behavior. Anxiety disorders and substance abuse in non-fatal suicidal behavior were detected in 19% and 11% of individuals, respectively (Knipe et al. 2019). In our study, the frequency of comorbid psychiatric disorders in acute poisoning cases was found to be 38%, the risk of being suicidal from poisoning was 28 times higher in individuals with a psychiatric disorder and completed suicide rates in patients were 12.5% and 33.3% in anxiety and psychotic disorders, respectively, and 4.2% in patients without comorbid psychiatric disorders. Psychiatric comorbid conditions are common in acute poisonings, pesticides are used as an important agent for suicide, and mortality rates are higher in psychiatric patients.

The reason for the widespread use of organophosphates and other pesticides and insecticides in acute poisoning cases, especially in attempted suicides, is that these substances are easily accessible. In a systematic review of the effect of bans and restrictions on pesticide on suicide rates including 16 countries, suicide attempts and deaths were found decreased in all but one country following such regulations (Gunnell et al. 2017). Mortality rate in organophosphate poisoning is between 3-25% (Özkaya et al. 2013). In the study of Avşaroğlu et al., it was found that pesticide poisoning had the highest mortality rate in acute poisoning hospitalizations at the ER (Avşaroğulları et al. 2012). Epidemiological and toxicological data show that most deaths from suicide can be prevented if the use of pesticides that are toxic to humans is restricted, pesticides are stored safely in rural communities, their accessibility is reduced, and the quality of care is improved (Gunnell et al. 2007).

Limitations

The fact that the study was conducted on retrospective data covering only one geographical region and a single center and only in a tertiary hospital can be considered as limitations to the study.

CONCLUSION

A significant proportion of pesticide poisonings are caused by organophosphate compounds and rat poison. It has been found that a significant proportion of acute pesticide poisonings are the result of attempted suicide and the likelihood of suicide increases in the presence of comorbid psychiatric disorders. The most common comorbid psychiatric disorders in pesticide poisoning are depression and anxiety disorder. It was observed that there was a difference between the causes of poisoning according in terms of gender, and that cases of pesticide suicide were more prevalent among women. It was also observed that mortality rates are higher in suicidal poisoning cases. Cases of completed suicide are higher in patients with psychosis. The sale of pesticides, which are easily accessible and can be used for suicidal purposes, should be regulated or banned, the use of less toxic pesticides should be popularized, and social awareness regarding the use of these substances should be increased as well as laws should be enacted in order to prevent their use in suicide attempts. Furthermore, the possibility of suicide should be considered in patients presenting to the emergency services with pesticide poisoning and psychiatric consultation should be requested.

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