



## PESTICIDES POISONING DEATHS IN NORTH OF JORDAN: AN 11-YEAR RETROSPECTIVE STUDY OF FORENSIC AUTOPSY CASES.

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Submitted on: 10.05.2024;

Revised on: 14.05.2024;

Accepted on: 17.05.2024

### ABSTRACT:

**Background:** Pesticide poisoning is a serious public health issue worldwide, especially in countries with lower and middle incomes (LMICs) such as Jordan.

**Objective:** To describe pesticide-related deaths in northern Jordan reported to the Forensic Medicine Teaching Center in Irbid (2011-2021).

**Methods:** This is an 11-year retrospective study, based on investigating 4098 autopsy reports and selecting 62 pesticide-related fatalities received at the Forensic Medicine Teaching Center of North Jordan (2011- 2021).

**Result:** It has been found that 62 deaths, with the majority of cases being male (69.4%) and the most frequent age interval being 20-29 years (38.7%). The cases started declining from 2014 to 2020, with a sharp increase in 2021 (12.9%). Carbamate was the most common pesticide used (59.7%), and suicides predominated (83.9%). The most frequent signs found during autopsies were multiorgan congestion in (91.9%), pulmonary edema in (87.1%) and signs of resuscitation in (71%) of the cases. Autopsy results revealed various findings associated with manner of death and hospital stay.

**Conclusion:** pesticide poisoning is still a serious problem in Jordan, causing many preventable deaths. Regulation is crucial due to the lethality and accessibility of pesticides. The pandemic caused a spike in cases in 2021, highlighting the need for continued efforts.

**KEYWORDS:** pesticides, carbamate, organophosphate, death, poisoning,

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Indian Research Journal of Pharmacy and Science; 38(2024)2986-2998;

Journal Home Page: <https://www.irjps.in>

## INTRODUCTION

The Environmental Protection Agency (EPA) of the United States defines a pesticide as any compound or mixture of substances that is designed to prevent, eliminate, repel, or minimize the effects of any pest or disease or use as a plant regulator, defoliant, or desiccant or use as a nitrogen stabilizer (1).

Even if the potential benefits of pesticides are significant, several studies have raised concerns about the potential risks that pesticides represent to both the health of humans and the health of the environment (2). However, exposure can also be acquired indirectly through the consumption of food that has been tainted with pesticides. Direct contact with pesticides can result from their use in the workplace, on farms, or in homes (2).

The World Health Organization (WHO) has arranged pesticides into distinct classes based on their varying degrees of toxicity, with Class 1a (very hazardous) being the most dangerous and Class 3 being the least deadly (3).

Around 11,000 individuals are died each year as a direct result of the approximately 385 million cases of acute unintentional pesticide poisoning that are recorded each year around the world (4).

Between the years 2010 and 2014 each year there were around 110,000 people who took their own lives by poisoning themselves with pesticides. This accounted for 13.7% of all suicides that took place all over the world(5).

It is noteworthy that the number of people who die from self-poisoning is fewer in high-income countries (HIC), which are places where highly dangerous pesticides are either prohibited, restricted, or used only by trained professionals who employ mechanized methods (6). On the other hand, more than 95% of pesticide poisonings take place in countries with lower and middle incomes (LMICs), where high-hazard pesticides (HHPs) are to blame for a high proportion of incidents and many farmers are unable to achieve safety standards for high-hazard pesticides HHPs (7).

There is a lack of capacity for pesticide management in the region, which contributes to the **continuation**

**of the negative effects that are associated with the use of HHPs in Near East and North Africa(NENA)** countries, where they are still widely used even though they pose serious risks to human health and the environment(8).

By the year 2020, Jordan had a total of 1902 pesticides that have been registered, and of those, 190 will be used to protect public health. Furthermore, 1190.50 tons were transported into the country in the year 2017 (9).

The Jordan National Drug and Poison Information Center (JNDPIC) received 857 cases of poisoning in the three years between 2006 and 2008; 53 of these cases, or 6.18 percent of the total, involved poisoning from pesticides (10).

According to an updated version of Jordan's Draft National Implementation Plan, the handling and storage of pesticides were the cause of between 27 - 69% of cases of poisoning that happened indoors. These incidents all occurred in Jordan (9).

The use of pesticides in Jordan is a major concern even unintentional exposure to low quantities of the toxin can result in serious health problems and even death (10).

There were two previous studies had been done concerned about pesticides poisoning mortality in Jordan the first study covered 13-year period of 1973-1985 and the second study during 4-year period 1999-2002. These studies showed the number of fatal pesticides poisoning cases in Jordan has increased over 20 years from 23.5 to 35 cases per year(11, 12).

**Study objectives:** The main objectives of the present study were to describe, over a period of 11 years, the forensic deaths caused by pesticides that were claimed to have occurred at the north of Jordan and received in Forensic Medicine Teaching Centre in Irbid, Jordan (2011-2021).

**Subjects and methods:** This section included the basic steps that were followed in conducting the present study. It included the following points:

**Study design and setting:** A retrospective study was conducted to collect data from files of cases. The study was carried out in the Department of Legal Medicine, Toxicology and Forensic science, Jordan,

Jordan University of Science and Technology, Irbid, Jordan and the ministry of health Forensic Medicine Teaching Center for 11years period (January 2011 - December 2021).

**Study sample:** Approximately, 4098 files were selected for reviewing. A total of 62 cases were appropriate to be included.

**Study procedure:** Procedure of the present study involved the following steps:

- 1- Obtaining the ethical approval of IRB from ethical committee at Jordan university of science and technology.
- 2- Reviewing medical files to select represented cases.
- 3- Creating working excel sheet for cases.
- 4- Study variables: demographic variables such as age and gender, autopsy variables such as stomach content including color, smell, respiratory tract secretions, manner of death, and type of pesticides.
- 5- Data was analyzed using SPSS software; the results were presented in table and graphic form.

**RESULTS**

**General characteristics of participants**

As shown in table (1), the data represents the cases of pesticides exposure since 2011 to 2021. The

majority of cases were in 2012 (19.4%). The cases started declining from 2014 to 2019 and 2020 in which the minimal level of cases reached 3.2%. A sharp increase occurred in 2021 (12.9%). When cases were given per month, most cases occurred in March and August (11.3%). This was followed by 9.7% in each of January, May, October and December. The least cases were seen in February and November, 3.2% for each. The remaining cases were in the range between these cases. The most frequent age was in the age interval (20-29 years) in which approximately 39% of cases occurred. This was followed by the age interval (30-39 years) in which about 24% of cases were taken place. The least occurrence of cases was in the age interval  $\geq 60$ , in which approximately 3% of cases were taken place (table 1).

More than two thirds of cases were males (69.4%). Regarding hospital stay, the data of the present study showed that slightly more than half of the cases (53.2%) did not stay in the hospital, about 10% of cases stayed a hospital for hours, about one quarter of cases (25.8%) stayed at hospital for  $\leq 1$  w, and about 11% of cases stayed at hospital for more than 1 w. Pesticide types were: carbamate (methomyl) (59.7%), organophosphate (11.3%), rodenticide (1.6%), and unspecified (27.4%). Manner of death was classified to be accidental (8.1%), suicidal (83.9%), and unspecified (8.1%) (table 1).

**Table 1: General characteristics of participants**

Variable	Description
<b>Years: (N, %)</b>	
- 2011	11 (17.7%)
- 2012	12 (19.4%)
- 2013	11 (17.1%)
- 2014	6 (9.7%)
- 2015	3 (4.8%)
- 2016	2 (3.2%)
- 2017	2 (3.2%)
- 2018	3 (4.8%)
- 2019	2 (3.2%)
- 2020	2 (3.2%)
- 2021	8 (12.9%)
<b>Month (N, %):</b>	
- January	6 (9.7%)

- February	2 (3.2%)
- March	7 (11.3%)
- April	5 (8.1%)
- May	6 (9.7%)
- June	5 (8.1%)
- July	5 (8.1%)
- August	7 (11.3%)
- September	5 (8.1%)
- October	6 (9.7%)
- November	2 (3.2%)
- December	6 (9.7%)
<b>Age (years) (N, %):</b>	
- 10-19	9 (14.5%)
- 20-29	24 (38.7%)
- 30-39	15 (24.2%)
- 40-49	7 (11.3%)
- 50-59	5 (8.1%)
- ≥60	2 (3.2%)
<b>Gender (N, %):</b>	
- Male	43 (69.4%)
- Female	19 (30.6%)
<b>Hospital stay:</b>	
- None	33 (53.2)
- Hrs	6 (9.7%)
- ≤ 1 w	16 (25.8%)
- > 1 w	7 (11.3%)
<b>Pesticide type:</b>	
- Carbamate (methomyl)	37 (59.7%)
- Organophosphate	7 (11.3%)
- Rodenticide	1 (1.6%)
- Unspecified	17 (27.4%)
<b>Manner of death:</b>	
- Accidental	5 (8.1%)
- Suicidal	52 (83.9%)
- Unspecified	5 (8.1%)

### Signs of autopsy:

As shown in table (2), secretions from (mouth/nose) were shown by 45.2% of cases, 53.2% of cases did not show secretions, and 1.6% of cases were not known. Vomiting was shown in 11.3% of cases, not shown by 87.1% cases, and unknown by 1.6% of cases. Respiratory(trachea/bronchi) secretions were shown by 51.6% of cases, negative in 41.9% of cases, and unknown by 6.4% of cases. Lung edema was reported in 87.1% of cases. Unusual color of stomach

content was found in about 42% of cases, negative in 50% of cases, and not identified in about 8% of cases. Unusual smell of stomach content was identified in about 60% of cases, not found in 35.7%, and unknown in 4.8% of cases. Organs congestion was found in about 92%, no found in about 2%, and unknown in 6.5%. Signs of resuscitation were observed in 71% of cases and lacked in 29% of cases. External remnants of pesticides material were positive in 11.3% of cases.

Table 2: Signs of autopsy

Variable	Frequency (N)	Percentages (%)
<b>Secretion (mouth/nose):</b>		
- Unknown	1	1.6%
- Negative	33	53.2%
- Positive	28	45.2%
<b>Vomiting:</b>		
- Unknown	1	1.6%
- Negative	54	87.1%
- Positive	7	11.3%
<b>Respiratory secretion:</b>		
- Unknown	4	6.4%
- Negative	26	41.9%
- Positive	32	51.6%
<b>Lung edema:</b>		
- Unknown	4	6.5%
- Negative	4	6.5%
- Positive	54	87.1%
<b>Unusual color of stomach:</b>		
- Unknown	5	8.1%
- Negative	31	50%
- Positive	26	41.9%
<b>Unusual smell of stomach:</b>		
- Unknown	3	4.8%
- Negative	22	35.5%
- Positive	37	59.7%
<b>Organs congestion:</b>		
- Unknown	4	6.5%
- Negative	1	1.6%
- Positive	57	91.9%
<b>Signs of Resuscitation:</b>		
- Negative	18	29%
- Positive	44	71%
<b>External remnants:</b>		
- Negative	55	88.7%
- Positive	7	11.3%

### The relationship between manner of death and study variables

As shown in table (3), manner of death was significantly associated with gender ( $p=0.035$ ). Males were more likely to commit suicidal death compared with females. Secretions was significantly associated with manner of death ( $p=0.020$ ). A general trend can be observed that in cases of suicidal death, positive

secretions(mouth/nose) were more likely to occur. Vomiting was significantly associated with the manner of death ( $p=0.012$ ). One hundred percent of vomiting positive cases were suicidal. Age was significantly associated with the manner of death ( $p=0.010$ ).as age increases, cases are likely to be suicidal.

**Table 3: The relationship between manner of death and study variables**

Variable	Manner of death						P value
	Accidental		Suicidal		Unspecified		
	N	%	N	%	N	%	
<b>Gender:</b>							0.035
- Female	4	2.1%	13	68.4%	2	10.5%	
- Male	1	2.3	39	90.7%	3	7%	
<b>Secretion:</b>							0.020
- Unspecified	0	0%	0	0%	1	100%	
- Negative	3	9.1%	28	84.8%	2	6.1%	
- Positive	2	7.1%	24	85.7%	2	7.1%	
<b>Vomiting:</b>							0.012
- Unspecified	0	0%	0	0%	1	100%	
- Negative	5	9.3%	45	83.3%	4	7.4%	
- Positive	0	0%	7	100%	0	0%	
<b>Respiratory secretion:</b>							0.244
- Unspecified	0	0%	2	66.7%	1	33.3%	
- Negative	1	3.8%	25	96.2%	0	0%	
- Positive	4	12.5%	24	75%	4	12.5%	
<b>Lung edema:</b>							0.720
- Unspecified	0	0%	2	66.7%	1	33.3%	
- Negative	0	0%	4	100%	0	0%	
- Positive	5	9.3%	45	83.3%	4	7.4%	
<b>Unusual color of stomach:</b>							0.312
- Unspecified	0	0%	4	80%	1	20%	
- Negative	3	9.7%	24	77.4%	4	12.9%	
- Positive	2	7.7%	24	92.3%	0	0%	
<b>Unusual smell of stomach:</b>							0.370
- Unspecified	0	0%	2	66.7%	1	33.3%	
- Negative	3	13.6%	18	81.8%	1	4.5%	
- Positive	2	5.4%	32	86.5%	3	8.1%	
<b>Organ congestion:</b>							0.719
- Unspecified	0	0%	3	75%	1	25%	
- Negative	0	0%	1	100%	0	0%	
- Positive	5	8.8%	48	84.2%	4	7%	
<b>Resuscitation:</b>							0.299
- Negative	0	0%	16	88.9%	2	11.1%	
- Positive	5	8.1%	36	81.8%	3	6.8%	
<b>Hospital stay:</b>							0.206
- No	1	3%	29	87.9%	3	9.1%	
- Hrs	0	0%	5	83.3%	1	16.7%	
- ≤ 1w	2	12.5%	14	87.5%	0	0%	
- > 1 w	2	28.6%	4	57.1%	1	14.3%	
<b>Type of pesticides:</b>							0.762
- Carbamate	2	5.4%	31	83.8%	4	10.8%	

- Organophosphate	1	14.3%	5	71.4%	1	14.3%	
- Rodenticides	0	0%	1	100%	0	0%	
- Unspecified	2	11.8%	15	88.2%	0	0%	
<b>External remnants:</b>							<b>0.468</b>
- Negative	5	9.1%	45	81.8%	5	9.1%	
- Positive	0	0%	7	100%	0	0%	
<b>Age:</b>							<b>0.010</b>
- 10-19	4	44.4%	5	55.6%	0	0%	
- 20-29	0	0%	22	91.7%	2	8.3%	
- 30-39	0	0%	14	93.3%	1	6.7%	
- 40-49	0	0%	6	85.7%	1	14.3%	
- 50-59	1	20%	3	60%	1	20%	
- ≥60	0	0%	2	100%	0	0%	

**The relationship between hospital stay and study variables**

As shown in table (4), resuscitation was significantly associated with hospital stay (p=0.000). Cases with

positive resuscitation were more likely to stay at hospital irrespective to the staying length. Unusual smell of stomach was significantly associated with hospital stay (p=0.000). As stomach smell was positive, staying at hospital decreased.

**Table 4: The relationship between hospital stay and study variables**

Variable	Hospital stay								P value
	No		Hrs		≤ 1 w		> 1 w		
	N	%	N	%	N	%	N	%	
<b>Resuscitation:</b>									<b>0.000</b>
- Negative	18	100%	0	0%	0	0%	0	0%	
- Positive	15	34.1%	6	13.6%	16	36.4%	7	15.9%	
<b>Unusual smell of stomach:</b>									<b>0.000</b>
- Unspecified	1	33.3%	0	0%	1	33.3%	1	33.3%	
- Negative	3	13.6%	2	9.1%	11	50%	6	27.3%	
- Positive	29	78.4%	4	10.8%	4	10.8	0	0%	
<b>Pesticide type:</b>									<b>0.019</b>
- Carbamate	21	56.8%	5	13.5%	9	24.3%	2	5.4%	
- Organophosphate	2	28.6%	0	0%	4	57.1%	1	14.3%	
- Rodenticides	0	0%	1	100%	0	0%	0	0%	
- Unspecified	10	58.8%	0	0%	3	17.6%	4	23.5%	

**DISCUSSION:**

The main objectives of this study were to describe, over a period of 11 years, the forensic deaths caused by pesticides that were claimed to have occurred at

the north of Jordan and received inForensic Medicine Teaching Centre in Irbid, Jordan (2011-2021).

Irrespective to the consideration that pesticides have great benefits, concerns of the hazards of pesticides

towards the environment and human health have been raised by many studies (Kim et al., 2017). Exposure to pesticides can occur directly from occupational, agricultural, and household use, while they can also be transferred indirectly through diet (2).

The data of this study showed that the majority of cases were in 2012 (19.4%). The cases started declining from 2014 to 2019 and 2020 in which the minimal level of cases reached 3.2%. A sharp increase occurred in 2021 (12.9%). The data of this study is consistent with previous studies that showed a declining trend of pesticide cases in period (2015-2020) (13-15). The reasons for this declining trend could be attributable to the regulation and precautions from the entity's government especially the Ministry of Agriculture for example instructions no Z/18 for the year 2016 on registration, manufacturing, preparation, importing, handling, and trade, issued by Article 21 of the Agriculture Law No. (13) of 2015 (16). Over 66 pesticides were banned in Jordan based on research from the US EPA and EU. Examples include methomyl 90% in 2011 and Paraquat in 2013(9). The sharp increase of pesticide in 2021 may be attributed to the existence of COVID-19. In their study, Pathirathna et al (2017) reported similar findings in which COVID-19 led to an increased prevalence of suicidal cases.

When cases were given per month, most cases occurred in March and August (11.3%). This was followed by 9.7% in each of January, May, October and December. The least cases were seen in February and November, 3.2% for each. It is possible to refer the explanation to the availability of pesticides during certain times of the year. (e.g., planting or harvesting season). This could lead to an increase in pesticide-related suicides during those months (18, 19). Trending of pesticide poisoning deaths cases in our study confirms the results of previous studies(20).

The most frequent age was in the age interval (20-29 years) in which approximately 39% of cases occurred. This was followed by the age interval (30-39 years) in which about 24% of cases were taken place. The least occurrence of cases was in the age interval  $\geq 60$ , in which approximately 3% of cases were taken place. It is plausible to explain this finding in which most pesticide poisoning occurs in the range of 20-39 years by taking into consideration

that people at this age interval are more likely to use pesticides and to be subjected for suicidal trials. Other previous studies almost reached similar findings including the study of Abdullat et al (12, 20, 21). However, a previous study in Jordan conducted by Abu Al-Ragheb et al (11) reported that the most prevalent age interval was 12-19 years.

More than two-thirds of cases were males (69.4%). It has been shown across the literature that pesticide poisoning is more common in male farmers and farmworkers which could have roots in culture, and availability of pesticides, and mental health issues (22, 23). Several studies have reported a male predominance in poisoning cases using pesticides (11, 12).

Regarding hospital stay, the data of the present study showed that slightly more than half of the cases (53.2%) did not stay in the hospital, about 10% of cases stayed at hospital for hours, about one quarter of cases (25.8%) stayed at hospital for  $\leq 1$  w, and about 11% of cases stayed at hospital for more than 1 week. The majority of cases either found dead or dead on hospital arrival. This is in line with various studies (11, 21).

Pesticide types were carbamate (methomyl) (59.7%), organophosphate (11.3%), rodenticide (1.6%), and unspecified (27.4%). Across the literature, studies reported different prevalent pesticides as the major sources of poisoning. As an example, Abu Al-Ragheb et al (11) reported that organophosphate was the most prevalent pesticide. On the other hand, Abdullat et al (12) reported that carbamate as the main pesticide involved in poisoning cases. In India, Karunarathneet al (24) reported that organophosphorus insecticides were important throughout the period from 2009-2018.

Manner of death was classified to be accidental (8.1%), suicidal (83.9%), and unspecified (8.1%). In general terms, suicidal cases are more frequent than accidental cases. This is in line with previous studies (11, 12, 25). This can be explained by having the intention to commit suicide, and pesticides are the most common type of suicidal committing approach. Several points make pesticides more involved such as the availability of pesticides in agriculture and



homes. Furthermore, they are highly toxic in small amounts (26).

As shown Secretions (mouth/nose) were shown by 45.2% of cases, 53.2% of cases did not show secretions, and 1.6% of cases were not known. The presence of secretions depends on various factors including the nervous system (27). Overstimulation of glands and respiratory failure are also important factors for the presence of secretion (28). However, other studies reported similar patterns of secretions (29, 30).

Vomiting was shown in 11.3% of cases, not shown by 87.1% cases, and unknown by 1.6% of cases. However, vomiting may indicate the involvement of nervous system and potential irritation of the epithelium lining of stomach and intestine (31).

Respiratory secretions (trachea/bronchi) were shown by 51.6% of cases, negative in 41.9% of cases, and unknown by 6.4% of cases. Some pesticides can also cause the lungs to produce excess mucus, leading to respiratory secretions (31).

Lung edema was reported in 87.1% of cases. Lung edema is a common feature of pesticide poisoning. One study published in the Journal of Emergency Medicine found that lung edema was a common complication among patients who had ingested pesticides. The study looked at 108 cases of pesticide poisoning and found that 23% of the patients developed lung edema. The authors concluded that "lung edema is a serious complication of pesticide poisoning and should be carefully monitored in these patients (32).

Unusual color of stomach content was found in about 42% of cases, negative in 50% of cases, and not identified in about 8% of cases. The color may reflect the type of pesticide (33).

Unusual smell of stomach content was identified in about 60% of cases, not found in 35.7%, and unknown in 4.8% of cases. Some pesticides have recognizable odors (34), while the odor of stomach contents can vary depending on factors like pesticide type, exposure duration, and the presence of other substances (35).

Organs congestion was found in about 92%, no found in about 2%, and unknown in 6.5%. organ congestion is a common finding in cases of acute pesticide poisoning and can contribute to death.

Signs of resuscitation were observed in 71% of cases and lacked in 29% of cases. This indicates that the majority of cases received medical intervention either before or after arriving at the hospital, suggesting that many deaths could have been preventable with prompt and effective treatment. One study conducted in Sri Lanka found that early proper medical intervention, including administration of antidotes and supportive care, significantly reduced mortality rates (37). In severe cases, medical intervention alone may not be enough to prevent deaths as per Sarkar et al. (36).

External remnants were positive in 11.3% of cases. External residues of pesticides refer to traces of pesticides that are found on a victim's clothing, skin, or hair, which suggests that the individuals likely came into direct contact with pesticides before their death. Studies have shown that the presence of external residues is associated with a higher likelihood of severe poisoning and death (38, 39).

Manner of death was significantly associated with gender ( $p=0.035$ ). Males were more likely to commit suicidal death compared with females. One possible explanation for the association between gender and the manner of pesticide poisoning death is the difference in cultural norms and attitudes towards suicide between males and females. In many societies, including some in Asia where pesticide poisoning is a common method of suicide, males may feel a greater pressure to conform to traditional masculine ideals of self-reliance and control, and may therefore be more likely to choose a more violent or dramatic method of suicide, such as pesticide ingestion (40, 41).

Secretion was significantly associated with manner of death ( $p=0.020$ ). A general trend can be observed that in cases of suicidal death, positive secretions were more likely to occur (42).

Vomiting was significantly associated with the manner of death ( $p=0.012$ ). One hundred percent of vomiting positive cases were suicidal. In general, studies examining the relationship between vomiting and pesticide poisoning have found that vomiting is a

common symptom of acute pesticide poisoning and may be associated with a higher risk of mortality. For example, a study by Velmurugan and colleagues found that vomiting was a significant predictor of mortality in cases of organophosphate pesticide poisoning (43).

Age was significantly associated with the manner of death ( $p=0.010$ ). As age increases, cases are likely to be suicidal. The association between age and suicide in pesticide poisoning cases may be related to a number of factors, such as changes in mental health, social support, and life circumstances that occur as people age. However, in general, studies examining the relationship between age and suicide risk have found that older adults may be at increased risk of suicide compared to younger adults, particularly in cases of self-poisoning (44). The data of this study agrees with previous studies (12, 20, 21).

Although external remnants of pesticides on clothing was not significantly associated with the manner of death ( $p=0.468$ ), it has been found that one hundred percent of External remnants positive cases were suicidal. The presence of external remnants of pesticides on the clothing, skin, or hair of a victim can provide valuable information about the circumstances surrounding their death. Studies indicate that external pesticide residues are linked with intentional poisoning, while their absence is associated with accidental poisoning (39, 45, 46).

Resuscitation was significantly associated with hospital stay ( $p=0.000$ ). Cases with positive resuscitation were more likely to stay at hospital irrespective to the staying length. A previous study by Gupta et al (47) found that patients who received resuscitation for acute organophosphate pesticide poisoning had a longer hospital stay compared to those who did not receive resuscitation.

Unusual smell of stomach was significantly associated with hospital stay ( $p=0.000$ ). As stomach smell was positive, staying at hospital decreased. It is possible that the unusual smell of the stomach in cases of pesticide poisoning is a sign of more severe

poisoning and therefore may be associated with worse outcomes and a higher risk of mortality. In this case, patients with a positive stomach smell (indicating more severe poisoning) may be more likely to die early, and therefore have a shorter hospital stay compared to patients with a negative stomach smell (indicating less severe poisoning) (33). Type of pesticide was significantly associated with hospital stay ( $p=0.019$ ). Death cases in case of carbamate pesticide were more likely to stay less in hospital as compared with organophosphate pesticide, it may imply that carbamate is more dangerous than organophosphate pesticide. This is plausible explained by taking into account that carbamate induces acute poisoning death. This is in line with a previous study that reported individuals who were exposed to carbamate pesticides were more likely to die from acute poisoning than those exposed to organophosphate pesticides (48).

#### CONCLUSIONS:

The study concludes that pesticide poisoning remains a significant issue in the country and a large number of deaths related to pesticide poisoning are preventable. The widespread use of pesticides in both agricultural and household settings means that they have the potential to be lethal due to their ready availability and accessibility. The government's efforts to regulate and restrict access to highly toxic pesticides have been successful in reducing cases between 2014 and 2020, but the COVID-19 pandemic caused a sharp increase in cases in 2021. The study emphasizes the need for continued efforts to prevent pesticide poisoning through education, awareness, advocating for alternative methods of pest control and enforcement of regulations to restrict access to highly toxic pesticides, particularly during times of crisis.

#### ACKNOWLEDGEMENT:

The authors would like to acknowledge the Deanship of Research in Jordan University of Science and Technology for funding this study, Grant No: 2023/0511.

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CONFLICT OF INTEREST REPORTED: NIL;  
SOURCE OF FUNDING: JORDAN UNIVERSITY OF SCIENCE AND TECHNOLOGY