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Original article

Pattern, Severity and Outcome of Acute Pesticide Poisoning Among Patients Admitted to Alexandria Poison Center

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ABSTRACT

Background: Pesticide use to control pests is a common practice worldwide. Pesticide exposure can cause acute toxicity and account for substantial morbidity and mortality worldwide. Thus, this study investigated the pattern, severity, and outcome of acute pesticide poisoning. **Subject and Method:** The study enrolled all patients with acute pesticide poisoning admitted to Alexandria Poison Center (APC) and Intensive Care Unit (ICU) of Alexandria Main University Hospital from 1 January to 30 June 2019.**Results:** The present study was conducted on 678 patients (617 in APC group and 61 in ICU group). Accidental poisoning occurred in 64.9% of the patients and 55.2% of the patients were exposed to insecticides. In APC group, 25.1% of patients were exposed to carbamates, while in ICU group, 70.5% were exposed to aluminum phosphide. It was found that patients admitted to the ICU had a significantly longer time before receiving medical care compared to other patients (p=0.001). Regarding outcomes, 52.2% of the patients recovered, 34% did not complete their management, 0.1% developed complications and 6.5% died. A significant difference was found between the two studied groups regarding outcome, where $^{MC}P<0.001$. A significant relation between PSS and mortality was noticed, where $^{MC}P<0.001$.**Conclusion:** The current study examined acute pesticide poisoning in APC in depth. It highlighted the association between the need for ICU admission and various factors, including delayed medical care and poisoning with aluminum phosphide. It also pointed to the poisoning severity score as a predictor of acute pesticide poisoning outcome.

I. Introduction:

Pesticide is a general term describing diverse classes of insecticides, rodenticides, fumigants, fungicides, herbicides, insect repellents, and other household disinfectants. These pesticides vary from one class to another according to their physical and chemical characteristics (Yadav & Devi, 2017). Pesticide poisoning occurs when chemicals intended to regulate pests affect a human being. The effects of pesticides on human health vary considerably. Manifestations may develop immediately within minutes to hours after a single exposure (acute pesticide poisoning) or may occur due to repeated, small, non-lethal doses over a long over a long duration, which may take months or even years to manifest (chronic pesticide poisoning) (Damalas & Koutroubas, 2016). The consequences of pesticide poisoning depend on the type and amount of the pesticide involved. Moreover, the pattern and outcome vary in different geographic regions worldwide with diverse socio-cultural and environmental risk factors. The

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severity of pesticide poisoning may range from mild to severe or even fatal (Roberts *et al.*, 2010; Dayasiri *et al.*, 2018; Robb *et al.*, 2024). Careful evaluation and identification of the different cases of poisoning could enhance diagnostic measures and therapeutic decisions, which can then improve the patient's outcomes. The proper approach for managing the poisoned patient should be systematic. The initial management is always directed to stabilizing life-threatening situations and administering the specific antidote when available (Daly *et al.*, 2006; Chandran & Krishna, 2019).

Acute pesticide poisoning is recognized as an important and serious public health concern. However, the estimation of acute pesticide poisoning cases per year is not precise due to the lack of standardized case description, identification, and diagnosis (Boedeker *et al.*, 2020; World Health Organization (WHO), 2020). Therefore, the current study analyzed acute pesticide poisoning among patients admitted to the Alexandria Poison Center (APC) and Intensive Care Unit (ICU) of Alexandria Main University Hospital in Alexandria, Egypt.

II. Subjects and methods:

Study design: The current research is a cross-sectional prospective study.

Study setting:

The study enrolled all patients with acute pesticide poisoning admitted to APC, and ICU of Alexandria Main University Hospital for six months, starting on January 1st and ending on June 30th, 2019.

Inclusion and exclusion criteria:

The study included all patients poisoned with pesticides admitted to APC during the study period. The diagnosis of acute pesticide poisoning was based on the history of recent pesticide exposure. Attending clinical toxicologists requested the pesticide containers to confirm the diagnosis and categorize the pesticides. Furthermore, relevant clinical manifestations and laboratory findings coincided with acute pesticide poisoning. Patients with unconfirmed diagnoses and those with co-exposure to other poisons were excluded from the study. Also, the current research did not include patients with cardiac and pulmonary chronic diseases.

Data collection tools and techniques:

A detailed history of sociodemographic data and the history of the current poisoning was obtained from each patient or his/her relatives. The vital signs and Glasgow Coma Scale (GCS) were recorded, and a comprehensive clinical examination was conducted by attending clinical toxicologists. The results of routine laboratory investigations were registered. All patients received adequate medical care. Atropine and oximes were administered to patients poisoned with cholinesterase inhibitors pesticides whenever indicated. The patients were categorized according to the place of admission into Group (1), which included cases admitted to APC, and Group (2), which included cases admitted to ICU. The patients' outcome was recorded (survival or death). The data were extracted in a specially designed collection form.

Ethical consideration:

The current study was approved by the Research Ethics Committee of the Faculty of Medicine, Alexandria University (No: 00012098, FWA No: 00018699, Serial Protocol No: 0105883). An informed consent was taken from all participants. The data was handled anonymously, and its confidentiality was strictly preserved.

Statistical analysis of the data

Data was fed to the computer and analyzed using IBM SPSS software package version 20.0. (Armonk, NY: IBM Corp). Qualitative data were described using numbers and percentages. The Kolmogorov-Smirnov test was used to verify the normality of distribution. Quantitative data were described using range (minimum and maximum), mean, standard deviation, median, and interquartile range (IQR). The significance of the results obtained was judged at the 5% level.

III. Results:

The present study was carried out on 678 patients with acute pesticide poisoning. 617 patients were admitted to APC, and 61 were admitted to the ICU of Alexandria Main University Hospital in Alexandria, Egypt.

1. Demographic data (Table 1):

Males constituted more than half of patients with acute pesticide poisoning admitted to APC and those admitted to ICU (51.2 % and 52.5%, respectively). Yet, the difference between the number of patients admitted to APC and ICU between both sexes was statistically insignificant, where p= 0.853

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Regarding the age of the patients, in APC admissions, 29.2% were in the age group 1 – <10 years. Nevertheless, in the ICU group, 42.6% of the admissions were in the age group 10 – <20 years. A significant difference was noticed between the two studied groups regarding age categories, where $^{MC}P = 0.002$.

Regarding the patients' residence, most patients admitted to APC were from Alexandria governorate (56.7%), whereas ICU patients were mostly from Beheira governorate (63.9%). A significant difference was observed between the two studied groups regarding residence, where $^{MC}P < 0.001$. It was observed that the highest incidence of acute pesticide poisoning was in June (29.2%), followed by May and April (15.9% and 15.6%, respectively), while the lowest incidence was observed in February (11.5%).

Considering the time between exposure to pesticides and admission, In the APC group, more than half of the patients (51.4%) were presented to our poison Centre within a couple of hours. In the ICU group, 34.4% of patients were admitted between 4-6 hours. A significant difference was observed between the two studied groups regarding the time passed before receiving medical care, where p=0.001.

Most patients (85.4%) were exposed to pesticides through ingestion as the main route of poisoning, followed by inhalational exposure, which occurred in 14.5% of the patients. Whereas dermal exposure represented 7.4% of the patients. Concerning the manner of exposure, accidental poisoning occurred in nearly two-thirds of patients (64.9%), while the rest of the patients had suicidal intent.

Regarding prehospital management, 23.8% of patients admitted to APC had received pre-hospital management. While in the ICU group. More than half of the patients (52.5%) were managed in a prehospital setting.

2. Types of pesticides: (Table 2)

Regarding the main pesticide category, 55.2% of the patients were exposed to insecticides, followed by rodenticides (28%), fumigants, and insect repellents (15.3% and 1.3%, respectively). Herbicides and fungicides represented the lowest fractions of pesticide-poisoned patients (0.9% and 0.4%, respectively).

In the APC group, more than half of the patients (57.9%) were exposed to insecticides, followed by rodenticides and fumigants (30.3% and 9.9%, respectively). In the ICU group, more than two-thirds of patients (70.5%) were exposed to fumigants, followed by insecticides and rodenticides (27.9% and 4.9%, respectively). A significant difference was noticed between the two studied groups regarding pesticide categories (p= 0.001).

Concerning the major chemical class, 23.2% of the patients were exposed to carbamates, followed by zinc phosphide (19.3%), then aluminum phosphide (14 %), and organophosphates (13.4%). In the APC group, 25.1% of patients were exposed to carbamates, then zinc phosphide and organophosphates (20.7% and 12.8%, respectively). In the ICU group, 70.5% of the patients were exposed to aluminum phosphide, followed by organophosphates (19.7%) and zinc phosphide (4.9%).

3. Clinical manifestations:

Table (3) shows that the patients admitted to APC had GCS scores ranging between 10-15, with a mean value of 14.96 ± 0.36, while in the patients admitted to ICU, the GCS score ranged between 3-15, with a mean value of 12.25 ± 3.65. A significant difference was observed between the two studied groups regarding the mean value of the GCS score, where p<0.001.

Concerning pupil size, 82.2% of the patients had normal pupil size, while 5.6% had constricted pupils. Pinpoint pupils were observed in 7.4% of the patients, whereas dilated pupils were found in 4.9% of the patients, who received atropine sulfate injections as part of the pre-hospital management.

In the APC group, more than three-quarters (78.6%) of the patients had normal sinus rhythm, while in the ICU group, more than half (57.4%) had sinus tachycardia. A significant difference was noticed between the two studied groups regarding electrocardiogram findings, where p<0.001.

Regarding the patients' complaints, 296 patients (43.7%) experienced vomiting, 114 patients (16.8%) had abdominal colic, 22 patients (3.2%) had diarrhea, 11 patients (1.6%) had excessive salivation, and 10 patients (1.5%) complained of nausea.

4. The Interventions:

Table (4) shows that decontamination procedures were applied to 80.1% of the studied patients. In the APC group, the most common method of decontamination was activated charcoal, given to 332 patients (53.8%),

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whereas in the ICU group, the most common method of decontamination used was paraffin oil, given to 37 patients (60.7%).

It was found that 27.3% of the patients studied required emergency therapies. Endotracheal intubation was performed on 47 patients (77%) in the ICU group, whereas none of the APC group required endotracheal intubation. Oxygen therapy was administered to 126 patients (20.4%) in the APC group and 59 patients (96.7%) in the ICU group.

Antidotes were given to 15.3% of the studied patients. Atropine sulfate was administered to 79 patients (12.8%) in the APC group and 17 patients (27.9%) in the ICU group. Also, obidoxime chloride was given to 59 patients (9.6%) in the APC group and 16 patients (26.2%) in the ICU group. Furthermore, Vitamin K1 was given to one patient with anticoagulant rodenticide poisoning in the APC group.

In APC admissions, 47.5% of the patients were admitted for 6 – < 24 hours. However, in ICU admissions, most patients (32.8%) stayed for less than 6 hours. A significant difference was noticed between the two studied groups regarding the duration of hospital stay, where p<0.001.

5. Outcome

Table (5) reveals that more than half (52.2%) of the patients recovered, some patients did not complete their management because they were either discharged at the request of their relatives (33.2%) or escaped (8%). Concerning the complications, one patient (0.1%) with carbamate poisoning (Furadan) developed dyspnea, muscle weakness, and a drop in oxygen saturation after one day of admission to APC. The patient was referred to ICU, but unfortunately, he died on the same day. Unfortunately, 44 patients died, which represented 6.5% of studied cases.

In APC admissions, more than half of the patients recovered (54.6%), whereas in ICU admissions, most of the patients died (72.1%). A significant difference was noticed between the two studied groups regarding outcome, where $^{MC}P<0.001$.

6. Poisoning Severity Score (PSS)

Table (5) reveals that, considering PSS, more than half of the patients (51.3%) scored minor (1), followed by a score of none (0) and a score of moderate (2) (28.5% and 13%, respectively). The lowest percentage of patients (7.2%) had scored severe (3). In APC admissions, more than half of the patients (56.2%) scored minor (1), while in ICU admissions, most of the patients (80.3%) had scored severe (3). A significant difference was observed between the two studied groups regarding Poisoning Severity Score, where p<0.001.

7. Poisoning Severity Score (PSS) and types of pesticides

Table (6) illustrates that scores none (0) and minor (1) were found in all types of pesticides with different percentages. 43.2% of patients in the score moderate (2) group were due to carbamate exposure, followed by organophosphates, aluminum phosphide, and zinc phosphide exposures (23.9%, 13.6%, and 6.8%, respectively).

In score severe (3), most of the patients (76.3%) were due to aluminum phosphide exposure, followed by organophosphates and organochlorines (20.4% and 6.1%, respectively). The lowest percentages were in carbamates and zinc phosphide equally (4.1%).

8. Poisoning Severity Score and Outcome (Table 7)

Score none (0) was mostly observed in patients (64.8%) who recovered, while the rest percentages were either discharged against medical advice or escaped (25.9% and 9.3%, respectively). In score minor (1), most patients (49.1%) recovered. Moreover, the one patient who developed complications scored moderate (2). Death was recorded in three patients (3.4%) with a score of moderate (2) and 41 patients (83.7%) with a score of severe (7). A significant relation between PSS and outcome was noticed, where $^{MC}P<0.001$.

IV. Discussion:

Pesticides are chemical compounds used extensively in agriculture and industry. They increase agricultural productivity and income. Pesticides are also utilized in public health protection programs, as they help society fight disease outbreaks by controlling rodents and insect vectors (Nicolopoulou-Stamati *et al.*, 2016; Li & Jennings, 2017). In most developing countries, there is inadequate pesticide regulation, a shortage of surveillance systems, less protocol implementation, insufficiency of training, and easy access to a wide variety of chemicals; therefore, health-related issues associated with exposure to pesticides are increasing (Nguyen & Tsai, 2024).

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Although several studies had shown the significant adverse consequences of pesticide exposure, accurate data are still insufficient. (Mansour, 2004) Therefore, this work was conducted to study acute pesticide poisoning in terms of demographic data of cases with acute pesticide poisoning, pattern of exposure, whether accidental, suicidal, or homicidal, and severity and outcome of poisoning.

Table 1: Distribution of the patients exposed to acute pesticide poisoning and admitted to Alexandria Poison Center (APC) and Intensive Care Unit (ICU) of Alexandria Main University Hospital according to demographic data (n = 678)

	Total (n = 678)		APC (n = 617)		ICU (n = 61)		Test of Sig.	p
	No.	%	No.	%	No.	%		
Sex								
Male	348	51.3	316	51.2	32	52.5	χ^2= 0.034	0.853
Female	330	48.7	301	48.8	29	47.5		
Age (years)								
0 – <1y	12	1.8	12	1.9	0	0.0	χ^2= 22.496*	^{MC}p= 0.002*
1y – <10y	184	27.1	180	29.2	4	6.6		
10y – <20y	188	27.7	162	26.3	26	42.6		
20y – <30y	143	21.1	128	20.7	15	24.6		
30y – <40y	86	12.7	78	12.6	8	13.1		
40y – <50y	25	3.7	23	3.7	2	3.3		
50y – <60y	27	4.0	22	3.6	5	8.2		
≥60	13	1.9	12	1.9	1	1.6		
Residence governorate								
Alexandria	365	53.8	350	56.7	15	24.6	χ^2= 29.652*	^{MC}p <0.001*
Beheira	243	35.8	204	33.1	39	63.9		
Kafr El-Sheikh	41	6.0	39	6.3	2	3.3		
Matrouh	17	2.5	15	2.4	2	3.3		
Others	12	1.8	9	1.5	3	4.9		
Occupation								
Child	182	26.8	179	29.0	3	4.9	χ^2= 24.031*	^{MC}p <0.001*
Student	181	26.7	158	25.6	23	37.7		
Housewife	80	11.8	69	11.2	11	18.0		
Farmer	92	13.6	88	14.3	4	6.6		
Others	143	21.1	123	19.9	20	32.8		

χ^2: Chi square test MC: Monte Carlo

p: p value for comparing between the two studied groups

*: Statistically significant at $p \le 0.05$

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Table (2): Distribution of the patients exposed to acute pesticide poisoning and admitted to Alexandria Poison Center (APC) and Intensive Care Unit (ICU) of Alexandria Main University Hospital according to types of pesticides (n = 678)

Pesticide	Total (n = 678)		APC (n = 617)		ICU (n = 61)		χ^2	p
	No.	%	No.	%	No.	%		
Insecticides	374	55.2	357	57.9	17	27.9	20.188*	<0.001*
Organophosphate	91	13.4	79	12.8	12	19.7	2.253	0.133
Carbamate	157	23.2	155	25.1	2	3.3	14.884*	<0.001*
Organochlorine	30	4.4	27	4.4	3	4.9	0.039	^{FE}p=0.745
Pyrethroid/ pyrethrin	43	6.3	43	7.0	0	0.0	4.539*	^{FE}p=0.025*
Fipronil	5	0.7	5	0.8	0	0.0	0.498	^{FE}p=1.000
Boric acid	10	1.5	10	1.6	0	0.0	1.003	^{FE}p=0.612
Unknown	39	5.8	39	6.3	0	0.0	4.091*	^{FE}p=0.040*
Rodenticides	190	28.0	187	30.3	3	4.9	17.742*	<0.001*
Zinc phosphide	131	19.3	128	20.7	3	4.9	8.921*	0.003*
Short-acting anticoagulant	39	5.8	39	6.3	0	0.0	4.091*	^{FE}p=0.040*
Strychnine	1	0.1	1	0.2	0	0.0	0.099	^{FE}p=1.000
Unknown	18	2.7	18	2.9	0	0.0	1.828	^{FE}p=0.394
Fumigants	104	15.3	61	9.9	43	70.5	157.007*	<0.001*
Aluminum phosphide	101	14.9	58	9.4	43	70.5	163.421*	<0.001*
Naphthalene	3	0.4	3	0.5	0	0.0	0.298	^{FE}p=1.000
Fungicides	3	0.4	3	0.5	0	0.0	0.298	^{FE}p=1.000
Chlorothalonil	1	0.1	1	0.2	0	0.0	0.099	^{FE}p=1.000
Unknown	2	0.3	2	0.3	0	0.0	0.198	^{FE}p=1.000
Herbicides	6	0.9	6	1.0	0	0.0	0.598	^{FE}p=1.137
Glyphosate	2	0.3	2	0.3	0	0.0	0.198	^{FE}p=1.000
Unknown	4	0.6	4	0.6	0	0.0	0.398	^{FE}p=1.000
Insect repellent	9	1.3	9	1.5	0	0.0	0.902	^{FE}p=1.000
Unknown	9	1.3	9	1.5	0	0.0	0.902	^{FE}p=1.000

χ^2: Chi square test FE: Fisher Exact
p: p value for comparing between the two studied groups
*: Statistically significant at $p \leq 0.05$

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Table (3): Distribution of the patients exposed to acute pesticide poisoning and admitted to Alexandria Poison Center (APC) and Intensive Care Unit (ICU) of Alexandria Main University Hospital according to Systemic manifestations (n = 678)

Systemic manifestations	Total (n = 678)		APC (n = 617)		ICU (n = 61)		χ^2	p
	No.	%	No.	%	No.	%		
Neurological								
Agitation	8	1.2	6	1.0	2	3.3	2.532	$^{FE}p=0.157$
Anxiety	4	0.6	4	0.6	0	0.0	0.398	$^{FE}p=1.000$
Headache	100	14.7	77	12.5	23	37.7	28.092*	<0.001*
Delirium	15	2.2	5	0.8	10	16.4	62.308*	$^{FE}p<0.001^*$
Slurred speech	4	0.6	0	0.0	4	6.6	40.699*	$^{FE}p<0.001^*$
Convulsion	5	0.7	0	0.0	5	8.2	50.950*	$^{FE}p<0.001^*$
Coma	12	1.8	4	0.6	8	13.1	49.622*	$^{FE}p<0.001^*$
Cardiovascular								
Tachycardia	144	21.2	109	17.7	35	57.4	52.331*	<0.001*
Bradycardia	21	3.1	15	2.4	6	9.8	10.142*	$^{FE}p=0.008^*$
Hypertension	16	2.4	15	2.4	1	1.6	0.151	$^{FE}p=1.000$
Hypotension	43	6.3	9	1.5	34	55.7	275.338*	$^{FE}p<0.001^*$
Syncope	1	0.1	0	0.0	1	1.6	10.130	$^{FE}p=0.090$
Shock	28	4.1	0	0.0	28	45.9	295.413*	$^{FE}p<0.001^*$
Respiratory								
Dyspnea	8	1.2	5	0.8	3	4.9	8.033*	$^{FE}p=0.028^*$
Tachypnea	115	17.0	81	13.1	34	55.7	71.557*	<0.001*
Cough	15	2.2	15	2.4	0	0.0	1.517	$^{FE}p=0.384$
Wheezes	42	6.2	37	6.0	5	8.2	0.462	$^{FE}p=0.415$
Crepitation	32	4.7	18	2.9	14	23.0	49.542*	$^{FE}p<0.001^*$
Gastrointestinal								
Nausea	10	1.5	10	1.6	0	0.0	1.003	$^{FE}p=0.612$
Vomiting	296	43.7	273	44.2	23	37.7	0.966	0.326
Diarrhea	22	3.2	20	3.2	2	3.3	0.000	$^{FE}p=1.000$
Abdominal colic	114	16.8	114	18.5	0	0.0	13.549*	<0.001*
Excessive salivation	11	1.6	11	1.8	0	0.0	1.105	$^{FE}p=0.611$
Burning sensation in the mouth	4	0.6	4	0.6	0	0.0	0.398	$^{FE}p=1.000$
Dysphagia	1	0.1	1	0.2	0	0.0	0.099	$^{FE}p=1.000$
Lip edema	1	0.1	1	0.2	0	0.0	0.099	$^{FE}p=1.000$

χ^2: Chi square test FE: Fisher Exact
p: p value for comparing between the two studied groups
*: Statistically significant at $p \leq 0.05$

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Table (4): Distribution of the patients exposed to acute pesticide poisoning and admitted to Alexandria Poison Center (APC) and Intensive Care Unit (ICU) of Alexandria Main University Hospital according to interventions applied in acute pesticide poisoning (n = 678)

Interventions	Total (n = 678)		APC (n = 617)		ICU (n = 61)		χ^2	p
	No.	%	No.	%	No.	%		
A. Decontamination	543	80.1	500	81.0	43	70.5	3.871*	0.049*
Gastric Lavage	120	17.7	115	18.6	5	8.2	4.155*	0.042*
Activated charcoal	338	49.9	332	53.8	6	9.8	42.935*	<0.001*
Paraffin oil	193	28.5	156	25.3	37	60.7	34.109*	<0.001*
Skin wash	49	7.2	48	7.8	1	1.6	3.122	^{FE}p=0.114
Eye wash	1	0.1	1	0.2	0	0.0	0.099	^{FE}p=1.000
B. Emergency Treatment	185	27.3	126	20.4	59	96.7	162.882*	<0.001*
Endotracheal intubation	47	6.9	0	0.0	47	77.0	510.803*	^{FE}p<0.001*
Oxygen therapy	185	27.3	126	20.4	59	96.7	162.882*	<0.001*
C. Antidote	104	15.3	87	14.1	17	27.9	8.103*	0.004*
Atropine sulphate	96	14.2	79	12.8	17	27.9	10.365*	0.001*
Obidoxime chloride	75	11.1	59	9.6	16	26.2	15.674*	<0.001*
Phytomenadione	1	0.1	1	0.2	0	0.0	0.099	^{FE}p=1.000
D. Supportive treatment	677	99.9	616	99.8	61	100.0	0.099	^{FE}p=1.000
Mechanical Ventilation	43	6.3	0	0.0	43	70.5	464.387*	^{FE}p<0.001*
Nebulizer therapy	75	11.1	68	11.0	7	11.5	0.012	0.914
IVF and Electrolytes	674	99.4	613	99.4	61	100.0	0.398	^{FE}p=1.000
H2-Receptor blocker	604	89.1	590	95.6	14	23.0	301.526*	<0.001*
Proton pump inhibitors	107	15.8	58	9.4	49	80.3	210.114	<0.001*
Antiemetic	345	50.9	309	50.1	36	59.0	1.773	0.183
Antispasmodic	156	23.0	152	24.6	4	6.6	10.241*	0.001*
Antibiotics	19	2.8	7	1.1	12	19.7	70.035*	^{FE}p<0.001*
Antifungal	4	0.6	2	0.3	2	3.3	8.262*	^{FE}p=0.042*
Antipyretic	15	2.2	8	1.3	7	11.5	26.585*	^{FE}p<0.001*
Anticoagulant	25	3.7	0	0.0	25	41.0	262.550*	<0.001*
Sodium bicarbonate	74	10.9	23	3.7	51	83.6	364.284*	<0.001*
N-acetylcysteine	5	0.7	0	0.0	5	8.2	50.950*	^{FE}p<0.001*
Noradrenaline	47	6.9	3	0.5	44	72.1	441.660*	^{FE}p<0.001*
Dopamine	6	0.9	0	0.0	6	9.8	61.230*	^{FE}p<0.001*
Steroids	22	3.2	10	1.6	12	19.7	57.615*	^{FE}p<0.001*
Sedative hypnotics	45	6.6	0	0.0	45	73.8	487.522*	^{FE}p<0.001*
Diuretic	3	0.4	0	0.0	3	4.9	30.479*	^{FE}p=0.001*
Laxative	2	0.3	0	0.0	2	3.3	20.289*	^{FE}p=0.008*
Levocarnitine supplement	14	2.1	0	0.0	14	23.0	144.592*	^{FE}p<0.001*
Coenzyme Q10 supplement	19	2.8	5	0.8	14	23.0	99.903*	^{FE}p<0.001*
Antihistaminic	4	0.6	4	0.6	0	0.0	0.398	^{FE}p=1.000
Anticonvulsant	6	0.9	1	0.2	5	8.2	40.856*	^{FE}p<0.001*
Antihypertensive	1	0.1	1	0.2	0	0.0	0.099	^{FE}p=1.000
Anti Protozoal	3	0.4	2	0.3	1	1.6	2.180	^{FE}p=0.247
B12 vitamin	9	1.3	0	0.0	9	14.8	92.257*	^{FE}p<0.001*
Anti Arrythmic	1	0.1	0	0.0	1	1.6	10.130	^{FE}p=0.090

χ^2: Chi square test FE: Fisher Exact
p: p value for comparing between the two studied groups
*: Statistically significant at $p \le 0.05$

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Table (5): Distribution of patients exposed to acute pesticide poisoning and admitted to Alexandria Poison Center (APC) and Intensive Care Unit (ICU) of Alexandria Main University Hospital studied groups according to Outcome and poisoning severity score (n = 678)

	Total (n = 678)		APC (n = 617)		ICU (n = 61)		p
	No.	%	No.	%	No.	%	
Outcome							
Recovered	354	52.2	337	54.6	17	27.9	^{MC}p <0.001*
Complication (ICU admission)	1	0.1	1	0.2	0	0.0	
Discharge against medical advice	225	33.2	225	36.5	0	0.0	
Escaped	54	8.0	54	8.8	0	0.0	
Death	44	6.5	0	0.0	44	72.1	
Poisoning severity score							
None (0)	193	28.5	193	31.3	0	0.0	<0.001*
Minor (1)	348	51.3	347	56.2	1	1.6	
Moderate (2)	88	13.0	77	12.5	11	18.0	
Severe (3)	49	7.2	0	0.0	49	80.3	

MC: Monte Carlo
*: Statistically significant at $p \le 0.05$

Table (6): Relation between poisoning severity score and pesticide in patients exposed to acute pesticide poisoning and admitted to Alexandria Poison Center (APC) and Intensive Care Unit (ICU) of Alexandria Main University Hospital (n = 678)

Pesticide	Poisoning severity score: None (0) (n = 193)		Minor (1) (n = 348)		Moderate (2) (n = 88)		Severe (3) (n = 49)		χ^2	p
	No.	%	No.	%	No.	%	No.	%		
Insecticides	86	44.6	208	59.8	65	73.9	15	30.6	36.143*	<0.001*
Organophosphate	12	6.2	48	13.8	21	23.9	10	20.4	18.976*	<0.001*
Carbamate	34	17.6	83	23.9	38	43.2	2	4.1	33.274*	<0.001*
Organochlorine	6	3.1	16	4.6	5	5.7	3	6.1	1.868	^{MC}p=0.592
Pyrethroid/ pyrethrin	12	6.2	31	8.9	0	0.0	0	0.0	13.139*	0.004*
Fipronil	4	2.1	1	0.3	0	0.0	0	0.0	4.472	^{MC}p=0.116
Boric acid	6	1.3	4	1.1	0	0.0	0	0.0	3.993	^{MC}p=0.175
Unknown	13	6.7	21	6.0	5	5.7	0	0.0	3.387	0.336
Rodenticides	84	43.5	94	27.0	10	11.4	2	4.1	49.199*	<0.001*
Zinc phosphide	44	22.8	79	22.7	6	6.8	2	4.1	20.172*	<0.001*
Short-acting anticoagulant	32	16.6	5	1.4	2	2.3	0	0.0	58.650*	<0.001*
Strychnine	0	0.0	1	0.3	0	0.0	0	0.0	2.417	^{MC}p=1.000
Unknown	7	3.6	11	3.2	0	0.0	0	0.0	4.100	^{MC}p=0.204
Fumigants	21	10.9	36	10.3	12	13.6	33	67.3	113.644*	<0.001*
Aluminum phosphide	21	10.9	35	10.1	13	13.6	33	67.3	115.323*	<0.001*
Naphthalene	2	1.0	1	0.3	0	0.0	0	0.0	1.960	^{MC}p=0.637
Fungicides	1	0.5	1	0.3	1	1.1	0	0.0	2.134	^{MC}p=0.515
Chlorothalonil	0	0.0	0	0.0	1	1.1	0	0.0	5.167	^{MC}p=0.197
Unknown	1	0.5	1	0.3	0	0.0	0	0.0	1.466	^{MC}p=1.000
Herbicides	0	0.0	5	1.4	1	1.1	0	0.0	2.913	^{MC}p=0.335
Glyphosate	0	0.0	1	0.3	1	1.1	0	0.0	3.037	^{MC}p=0.441
Unknown	0	0.0	3	0.9	1	1.1	0	0.0	2.250	^{MC}p=0.598
Insect repellent	3	1.6	6	1.7	0	0.0	0	0.0	1.219	^{MC}p=0.747
Unknown	3	1.6	6	1.7	0	0.0	0	0.0	1.219	^{MC}p=0.747

χ^2: Chi square test MC: Monte Carlo

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p: p value for association between Poisoning Severity Score and Pesticide
*: Statistically significant at $p \leq 0.05$

Table (7): Relation between poisoning severity score and outcome in patients exposed to acute pesticide poisoning and admitted to Alexandria Poison Center (APC) and Intensive Care Unit (ICU) of Alexandria Main University Hospital (n = 678)

Outcome	Poisoning severity score								^{MC}p
	None (0) (n = 193)		Minor (1) (n = 348)		Moderate (2) (n = 88)		Severe (3) (n = 49)		
	No.	%	No.	%	No.	%	No.	%	
Recovered	125	64.8	171	49.1	50	56.8	8	16.3	<0.001*
Complication (ICU admission)	0	0.0	0	0.0	1	1.1	0	0.0	
Discharge against medical advice	50	25.9	146	42.0	29	33.0	0	0.0	
Escaped	18	9.3	31	8.9	5	5.7	0	0.0	
Death	0	0.0	0	0.0	3	3.4	41	83.7	

MC: Monte Carlo; p: p value for association between poisoning severity score and outcome
*: Statistically significant at $p \leq 0.05$

The current study revealed that the number of males exceeded that of females (51.3% compared to 48.7%). This may be explained by the fact that men work in agriculture more than women. This result supports a study by Ssemugabo *et al.* (2017)) in Uganda, in which the males outnumbered the females (62.7% compared to 37.3%). In addition, they found that the highest percentage of the cases was in the age group 20 – <30 years, in contrast to the findings in the present study, which showed that most of the patients were in the age group 10 – <20 years (27.7%).

In the relation between sex and age in the current study, the boys outnumbered the girls in the age group 0 – <1 and 1 – <10. This may be explained by the fact that boys at these young ages are more energetic and exhibit a curious behavior of exploring the surrounding environment than girls (Gurholt & Sanderud, 2016).

Moreover, in the older ages above 30 years, the higher numbers of male patients compared to female patients is attributed to the agricultural and industrial exposures in male workers and farmers. However, the females' percentages were higher in the age groups 10 – <20 and 20 –<30, which could be related to the increased incidence rates of suicide attempts at these ages among females (Lekei *et al.*, 2020). The residence data in the present study showed that most of the patients were from Alexandria (53.8%), followed by Beheira and Kafr El-Sheikh (35.8% and 6%, respectively). This finding is explained by the proximity of these governorates to APC. Similarly, Seif *et al.* (2016) conducted a study in APC, where most of the cases (66.5%) came from Alexandria governorate.

In the present work, accidental poisoning exceeded suicidal poisoning with no incidents of homicidal poisoning. This result is concordant with that of Caldas (2016), who stated that accidental poisoning with pesticides was more than suicidal poisoning.

The frequent types of pesticides encountered in the current study were carbamates (23.2%), followed by zinc phosphide (19.3%), then aluminum phosphide, and organophosphates (14.9% and 13.4%, respectively). A previous study in APC reported that acetylcholinesterase inhibitor insecticides were the third common agent implicated in acute poisoning (Seif *et al.*, 2016). In the Tanta Poison Control Center, most pesticide poisoning cases were exposed to organophosphates, followed by zinc phosphide, carbamates, and aluminum phosphide (Abo El-Noor, 2013). Furthermore, at Menoufia Poison Control Center, the highest pesticide poisoning rates were due to organophosphates, carbamates, and zinc phosphide sequentially (Kandeel & El-Farouny, 2017).

Another study in Alexandria Poison Center by (Sheta & El-Banna, 2019), found that the majority of the cases (86.7%) with aluminum phosphide poisoning were due to suicidal exposure. In Egypt, the season of rice planting starts in summer (Elmoghazy & Elshenawy, 2019). Therefore, in the relation between types of pesticides and months of the year in the current study, carbamates (mainly Furadan) recorded the highest percentage in June (30.3%); most of the exposed cases were among farmers engaged in spraying procedures for rice cultivation. The lack of self-protection contributes to the high number of exposures.

The present results demonstrated that the GCS ranged from 3-15 on admission with a mean value of 14.71 ± 1.38. In another study by Prashar and Ramesh (2018), they found that the mean GCS value of pesticide poisoning was 12.22 ± 3.86; besides, 15.2% of the cases

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had unconscious status upon arrival to the emergency department, their score ranged from 3-8.

Relating to the level of consciousness in patients with aluminum phosphide poisoning in the current findings, GCS showed that most of the patients were conscious at the time of admission and remained mentally clear despite the severity of some conditions. Later on, the progression of the state of shock and cerebral anoxia resulted in drowsiness, delirium, coma, and even death. This finding corresponds to that of Darwish *et al.* (2020).

The present study showed that the most frequent clinical manifestations of acute pesticide poisoning were vomiting (43.7%), followed by tachycardia (21.2%), then tachypnea, abdominal colic, and headache (17%, 16.8%, and 14.7%, respectively). According to a study based on the major signs and symptoms of pesticide poisoning in a tertiary care hospital in India found that most of the patients suffered from gastrointestinal symptoms (48.2%), followed by symptoms affecting the central nervous and respiratory systems (19.2% and 18.4%, respectively). The study also revealed that the variation in the clinical manifestations following acute pesticide poisoning depends on the type and quantity of the poison ingested (Prashar & Ramesh, 2018).

Duration of hospital stay ranged between 6 hours – <24 hours for most patients (45.4%) in the present study. This is even more than the length observed by Halawa *et al.* (2013), which stated that the majority of the acute poisoning cases (84.1%) presented to Ain Shams Poison Control Center were observed for six hours only.

Regarding the PSS, more than half (51.3%) of the patients had scored minor (1), followed by scored none (0) and scored moderate (2) (28.5% and 13%, respectively). The lowest percentage of the patients (7.2%) scored severe (3). The current results concord with the study by Prashar and Ramesh (2018) (264), who concluded that the majority of the patients with pesticide poisoning recovered (80.3%), 24 patients died, and the rest were lost to follow-up because they were discharged against the medical advice (DAMA).

Furthermore, in the same study, the PSS was minor (1) in 40.3% of patients. Similarly, Mashali et al (2020) reported that 47.3% of patients with zinc phosphide toxicity recorded a score of none (0) in PSS.

A significant relation between PSS and outcome was noticed in the present study, where MCP<0.001. PSS was able to anticipate the clinical assessment of the severity and outcome of acute pesticide poisoning in the current research. Chandrasekhar *et al.* (2017), Peter *et al.* (2013), and Davies *et al.* (2008) stated that the PSS is an effective clinical system for predicting the severity and outcome of organophosphorus poisoning.

V. Conclusion and Recommendations:

The study concludes that aluminum phosphide was the most common pesticide poisoning requiring ICU admission. More than half of the patients (55.2%) were exposed to insecticides. The PSS is a useful clinical scale to assess the severity and outcome of acute pesticide poisoning. The study underlines the need to implement restriction rules on selling and handling highly toxic pesticides and to encourage individuals to seek medical advice immediately after poison exposure.

Conflicts of Interest:

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