ONLINE FIRST

ORIGINAL ARTICLE

A Prospective Cohort Study on Factors of Mortality Due to Acute Organophosphate Poisoning

Shaib Muhammad[1], Khalida Faryal Almani[1]*, Ubed-ur-Rehman Mughal[1], Muhammad Saleh Khaskheli[2], Rafia Tabassum[2], Rabbiya Ahmad[3], Narendar Kumar[4]

[1]*Department of Pharmaceutics, Faculty of Pharmacy, University of Sindh, Jamshoro, Sindh, Pakistan*
[2]*Department of Anesthesiology, SICU & Pain Center, Peoples University of Medical and Health Sciences for Women, Shaheed Benazirabad, Pakistan*
[3]*Discipline of Clinical Pharmacy, School of Pharmaceutical Sciences, Universiti Sains Malaysia, Pulau Pinang, Malaysia*
[4]*Department of Pharmacy Practice, Faculty of Pharmacy, University of Sindh, Jamshoro, Sindh, Pakistan*
Correspondence: *almanikhalidafaryal@gmail.com*
doi: 10.22442/jlumhs.2025.01230

ABSTRACT

OBJECTIVE: This study assessed the association of demographic characteristics, causes of poisoning, pre-hospital care, clinical manifestations, and treatment with outcomes of organophosphate poisoning.
METHODOLOGY: This prospective cohort study was conducted in the emergency department, medicine wards, and intensive care units of a tertiary care hospital in Sindh, Pakistan, and lasted one year (July 2023 to June 2024). The data were collected using the non-probability purposive sampling technique on a questionnaire designed by reviewing the literature. IBM SPSS version 29 was used for analysis using various statistical tools. The categorical variables were presented as frequencies and percentages. A Chi-squared test (Fisher's exact test where required) was used to determine the association between variables.
RESULT: During the study period, 605 patients were enrolled. Organophosphate poisoning (OPP) was prevalent in the males (57.2%). The majority of patients were uneducated (70.9%), belonging to rural areas (96.4%), and aged ≤30 years (82%). Poisoning was mainly intentional (92.2%) through oral route (96.9%). The most common clinical manifestation was emesis (55.9%), and circulatory support was provided to 99.3% of patients as a therapeutic intervention. The majority of patients were mildly affected (84.0%) due to OPP, and the death rate was 5.5%. The vital signs, clinical manifestations, interventions, and hospital management significantly impacted the mortality with $p<0.05$.
CONCLUSION: This study's findings emphasize the necessity for healthcare providers to prioritize rapid assessment and intervention of baseline vitals, typical OPP symptoms, intensive management, duration of stay in hospital, and poisoning severity for better outcomes in OPP patients.

KEYWORDS: Poisoning, organophosphates, clinical manifestations, interventions, outcomes, pre-hospital care

INTRODUCTION

Organophosphates (OP) are a diverse group of neurotoxic compounds extensively employed as pesticides and in developing biological warfare agents[1]. OP compounds irreversibly inhibit acetylcholinesterase and cause severe cholinergic toxicity[2,3] after exposure through dermal contact, inhalation, or ingestion[4]. This causes overstimulation of nicotinic and muscarinic receptors and manifests cholinergic crisis, which leads to clinical manifestations of lacrimation, bronchospasm, bronchorrhea, diarrhea, abdominal pain, vomiting, arrhythmia, fasciculation, and respiratory failure[2,3,5].

OPs can cause significant pesticide-related illnesses and mortality in underdeveloped nations. Literature shows that pesticide exposure has significant deteriorating effects on human well-being. Acute OP poisoning results in death or a variety of chronic health disorders in humans[1].

OP poisoning (OPP) is diagnosed through a history of poisoning, signs, symptoms, characteristic odor, and laboratory evaluation of plasma cholinesterase levels[4]. Studies show that early recovery of acetylcholinesterase in OPP is associated with decreased morbidity and mortality. Furthermore, patients with altered mental status need 100% oxygen support and instant endotracheal intubations. Atropine is the mainstay treatment in cases of cholinergic toxicity, while the use of oxime therapy remains arguable[3]. The initial management includes cardio-respiratory stabilization, decontamination by removing clothes and washing the skin and eyes, and passing a nasogastric tube for gastric lavage in ingesting large quantities of OPs within 1 to 2 hours of ingestion[4,6].

The World Health Organization (WHO) has categorized OPs as highly toxic pesticides; however, developing nations frequently use these harmful chemicals because of easy accessibility and low cost. Frequently used OPs in agriculture include parathion, chlorpyrifos, dichlorvos, diazinon, fenitrothion, tetrachlorvinphos, and azinphos-methyl[7]. OPs are one of the chief causes of emergency department admissions (8). In the past 30 years, research shows that pesticides, mainly OPs, have caused millions of admissions to hospitals because of intentional and unintentional poisoning (9), resulting in a death rate of 300,000 each year[2,3].

OP poisoning is one of the significant public health issues in Asian countries[3]. Pakistan is the second most populous country in Southeast Asia and the fifth most populous country globally[10,] with a population of 241.49 million[11]. OPs are also the substances significantly involved in the poisoning in Pakistan[12]. Pakistan follows the regional trend in choice of substance in suicides as OP pesticides are more predominant in agriculture-based rural populations[12]. The issue of pesticide poisoning is not well comprehended in Pakistan as national health statistics are not collected and are based on regional research studies[10,12].

Patterns of poisoning vary from one region of the world to another and in different locations in the same country, affecting the outcomes[8]. Predicting outcomes in OPP is crucial for guiding clinical management and reducing mortality rates[13]. Knowledge of OP poisoning in a specific geographical area is beneficial for early diagnosis, treatment, and promising outcomes in resource-limited rural settings. Though some studies have been conducted in Pakistan, these studies are more urban-centred and cover only certain geographical areas. Moreover, the earlier studies were based on limited variables, and statistical associations were not evaluated. There have been no previous detailed studies in the current geographical location where the study has been conducted. So, there was a dire need to carry out a study to cover the research gaps. The objective of this study was to assess the association of demographic characteristics, causes of poisoning, pre-hospital care, clinical manifestations, and treatment with the outcomes of OP poisoning in rural population-dominated geographical areas.

METHODOLOGY

Design of study
This was a prospective cohort study conducted at a tertiary care hospital.

Study setting
This single-centre study was conducted in Peoples Medical College Hospital (PMCH) Shaheed Benazirabad, Sindh, Pakistan. It is a tertiary healthcare facility that provides 24-hour services for various illnesses. It works as a referral hospital and has direct admissions of patients from a large catchment area. The data regarding the poisoning patients was collected from the emergency department, medicine wards, and intensive care units (ICU). The study lasted one year, starting on 1 July 2023 and ending on 30 June 2024.

Study participants
The data were collected using the non-probability purposive sampling technique. During the data collection period, all consecutive patients suffering from acute OP poisoning (exposure within 24 hours) and coming through the emergency department were enrolled in the study. Patients who were not willing to participate in the survey were dead on arrival and left against medical advice, and had comorbidities were not included in the study. The consent for participation in the study was received from the patients or attendants (in cases where the patient was unconscious or a child).

Variables
The variables in the study included demographics and poisoning characteristics, pre-hospital care, clinical manifestations, treatment, poisoning severity, and outcomes. The investigator personally filled out the questionnaire to avoid problems in understating questions, anomalies, and missing data.

Outcomes
The outcomes of poisoning were determined after 30 days of discharge from the diagnosis. If the death occurred during the admission to the hospital, the duty doctor confirmed the death and was recorded in the patient's medical records. However, if the death occurred after discharge, the attendant confirmed the death on a phone call.

Survived: Patients who may have had specific toxic effects of OPP but were alive after 30 days of discharge from the hospital.

Died: Patients who could not survive during the treatment in the hospital or after 30 days of discharge from the hospital.

The Peradeniya Organophosphorus Poisoning Scale (POPS)
The severity of OP poisoning was determined through POPS[14]. This scale determines the severity of OP poisoning based on six parameters on a score of 0, 1, and 2. The six parameters include pupil size, respiratory rate, heart rate, fasciculations, level of consciousness, and seizures. To determine the severity, the scores are added up. On a scale of 0-11, 0-3 indicates mild poisoning, 4-7 moderate poisoning, and 8-11 severe poisoning.

Data sources
The data was collected using a predesigned questionnaire adapted after reviewing the relevant literature[1,9,15]. The necessary changes were made to the study instrument based on the socio-economic and local policies after validation by three academic experts and by conducting a pretest on 50 patients. The results of the pretest were excluded from the final data. The variables in the final study instrument included demographic characteristics (gender, marital status, education, residential area, age, and employment), poisoning characteristics (cause of poisoning, route and site of exposure,) pre-hospital care (type of admission, exposure to reporting time, local remedies, mode of arrival), baseline vitals and clinical manifestations,

and clinical management (emergency management, decontamination procedures, therapeutic interventions, services used, duration of stay in hospital, poisoning severity and medical outcome).

When the patient arrived at the emergency department, the physician diagnosed the patient, and if the OPP was confirmed, the patient was shifted to the medical ward after the first aid. If the patient was stabilized in 24 hours, the patient was discharged. However, in critical conditions, the patient was admitted to the medical ward or shifted to the ICU for extended periods. The follow-up to the patients was made through phone calls after discharge. The questionnaire was administered at all these stages by interviewing the patient and/or attendant (if the patient was unconscious or a child), the physician, and the nursing staff, and by reviewing the patient's medical records. The follow-up to the patient was done through phone calls.

Sample size calculation

The sample size was calculated through Cochrane's formula considering significance level 95% (z)=1.96 and sampling error (e) =0.05 (16).

$$n = \frac{z^2}{4e^2} = \frac{(1.96)^2}{4(0.05)^2} = 384.16$$

After acquiring the minimum sample size, the final sample size was calculated as 461, with a 20% dropout rate.

Statistical analysis

The data was coded and tabulated in IBM SPSS version 29 for analysis using various statistical tools. The categorical variables were presented as frequencies and percentages. A chi-squared test (Fisher's exact test where required) was used to determine the association between independent and dependent variables. To determine the associations with treatment outcomes (survived or died), a $p<0.05$ was considered statistically significant.

RESULTS

During the study period, 690 OPP patients arrived at the emergency department. Among them, 35 did not consent to participate in the study, eight had comorbidities, 11 left against medical advice, and follow-up could not be done to 31 patients. The final statistical analysis was done on 605 patients (Supplement Figure). Among the study participants, OPP was more prevalent in the male gender (57.2%) than in females (42.8%). Furthermore, it was found that there was not much difference in marital status, as 51.4% of patients were single and 48.6% were married. Most people exposed to the OPs were uneducated (70.9%), and only 29.1% were educated. The residential area of the majority of the patients participating in the study was rural (96.4%), and only 3.6% belonged to the urban. Moreover, most of the younger population under the age of 30 years was involved in the poisoning (82.0%). Furthermore, most individuals were employed (59.3%) and 40.7% were unemployed.

It was found during the study that 92.2% of the poisoning cases were intentional, and only 7.8% were unintentional. The route of exposure in poisoning incidences was mainly ingestion (96.9%). It was found that most of the poisonings occurred at the home of the patient (91.4%) and remaining at the workplace (6.6%) and public area (2.0%). Most patients arriving at the hospital were direct admissions (53.4%) to the study centre, while 46.6% were referred. Additionally, it was found that about two-thirds of patients (64.3%) arrived in the hospital after one hour of exposure to the poison, while only 35.7% arrived within one hour. It was further found that 11.4% of the patients were given local remedies at the exposure site. Most of the patients' mode of arrival was non-ambulance (79.2%), and only in 20.8% of cases was ambulance service provided to the patient.

Table I gives information regarding demographics, poisoning, and pre-hospital care.

Table I: Demographics, poisoning, and pre-hospital care

Variable		N	%
Gender	Female	259	42.8
	Male	346	57.2
Marital status	Married	294	48.6
	Single	311	51.4
Education	Educated	176	29.1
	Uneducated	429	70.9
Residential area	Rural	583	96.4
	Urban	22	3.6
Age (years)	>30	109	18.0
	≤30	496	82.0
Employment	Employed	359	59.3
	Unemployed	246	40.7
Cause of poisoning	Intentional	558	92.2
	Unintentional	47	7.8
Route of exposure	Combination	7	1.2
	Ingestion	586	96.9
	Inhalation	12	2.0
Site of Exposure	Home	553	91.4
	Public area	12	2.0
	Workplace	40	6.6

Type of admission	Direct Admission	323	53.4
	Referral	282	46.6
Exposure to reporting time	>1 hour	389	64.3
	≤1 hour	216	35.7
Local remedies	No	536	88.6
	Yes	69	11.4
Mode of arrival	Non-ambulance	479	79.2
	Ambulance	126	20.8

Table II shows the baseline vitals and clinical manifestations of OPP patients. During the study period, the most common clinical manifestations among the OPP patients were due to typical OPP symptoms (diarrhea, urination, miosis, bradycardia, emesis, and lacrimation) and variations in baseline vitals. Emesis (55.9%) was the most common clinical manifestation, followed by abnormal respiratory rate (46.3%) and others.

Table II: Baseline vitals and Clinical manifestations in the OPP patients

Variable	N	%
Emesis	338	55.9
Abnormal respiratory rate	280	46.3
Abnormal pulse rate	219	36.2
Abnormal pupil size	217	35.9
Abnormal blood pressure	202	33.4
Epigastric pain	192	31.7
Salivation	133	22.0
Abnormal consciousness	118	19.5
Bronchorrhea	117	19.3
Lacrimation	103	17.0
Abnormal temperature	93	15.4
Fasciculations	80	13.2
Diarrhea	63	10.4
Urination	57	9.4
Lethargy	43	7.1
Dyspnea	40	6.6
Irritable	36	6
Frothing	30	5
Pale color	27	4.5
Diaphoresis	26	4.3
Bronchospasm	26	4.3
Abdominal pain	21	3.5
Vertigo	20	3.3
Drowsy	19	3.1
Nausea	19	3.1
Seizure	18	3
Headache	16	2.6
Dehydration	10	1.7
Other*	23	3.8

*Edema, pain, itching, cyanosis, blurred vision, dizziness, confusion, laryngeal edema, cough, hematemesis

Table III: Patient handling and medical management in the hospital

Variable		N	%
Emergency management	Circulatory support	601	99.3
	Airway support	114	18.8
	Catheterization	120	19.8
Decontamination procedure	Gastric lavage	580	95.9
	Skin and eye decontamination	92	15.2
	Single-dose activated charcoal	4	0.7
Therapeutic interventions	Symptomatic treatment	594	98.2
	Antidote administration	587	97.0
	Ventilator support	36	6.0
	Tracheostomy	4	0.6
	Suctioning	38	6.3
Services used	Emergency department	605	100.0
	Ward	600	99.2
	Intensive care unit	116	19.2
	Observation unit	5	0.8
Duration of stay in hospital	>1 days	150	24.8
	1 day	455	75.2
Poisoning severity	Mild	508	84.0
	Moderate	94	15.5
	Severe	3	0.5
Medical outcome	Died	33	5.5
	Survived	572	94.5

When the patients arrived at the hospital, as emergency management, most patients were provided with circulatory support (99.3%). In decontamination procedures, most patients went through a gastric lavage (95.9%), followed by skin and eye wash (15.2%) and single-dose charcoal administration (0.7%). Furthermore, it was observed that the symptomatic treatment (98.2%) was the most common therapeutic intervention. After the initial management at the emergency department, 99.2% of patients were shifted to the ward, and 19.2% were also moved to the ICUs. Moreover, most patients (75.2%) stayed at the hospital for just one day while remaining (24.8%) for more than one day. Furthermore, while determining the severity of OP poisoning through POPS, it was found that the majority (84.0%) were mildly affected, and only 0.5% were severely affected. The study found that 5.5% (n=33) of patients died because of exposure to the Ops. The majority of these deaths occurred during the stay at the hospital (n=30), and only three at home **(Table III)**. **Table IV** provides detailed insight into hospital patient handling and medical management.

Statistical association

While analyzing the association of medical outcomes with demographics, poisoning characteristics, and pre-hospital care, no significant association was found among variables. However, a significant association was found with vital signs such as abnormal blood pressure, abnormal pulse rate, abnormal respiratory rate, and consciousness and clinical manifestations such as emesis, abnormal pupil size, salivation, bronchorrhea, lacrimation, diarrhea, urination, dyspnea, irritability, frothing, bronchospasm, and seizure with $p<0.05$. Moreover, while analyzing the association of medical outcome with the treatment provided

and medical management, a significant relationship was found with airway support, catheterization, skin and eye decontamination, ventilator support, tracheostomy, suctioning, ICU admission, duration of stay at the hospital, and poisoning severity with $p<0.05$.

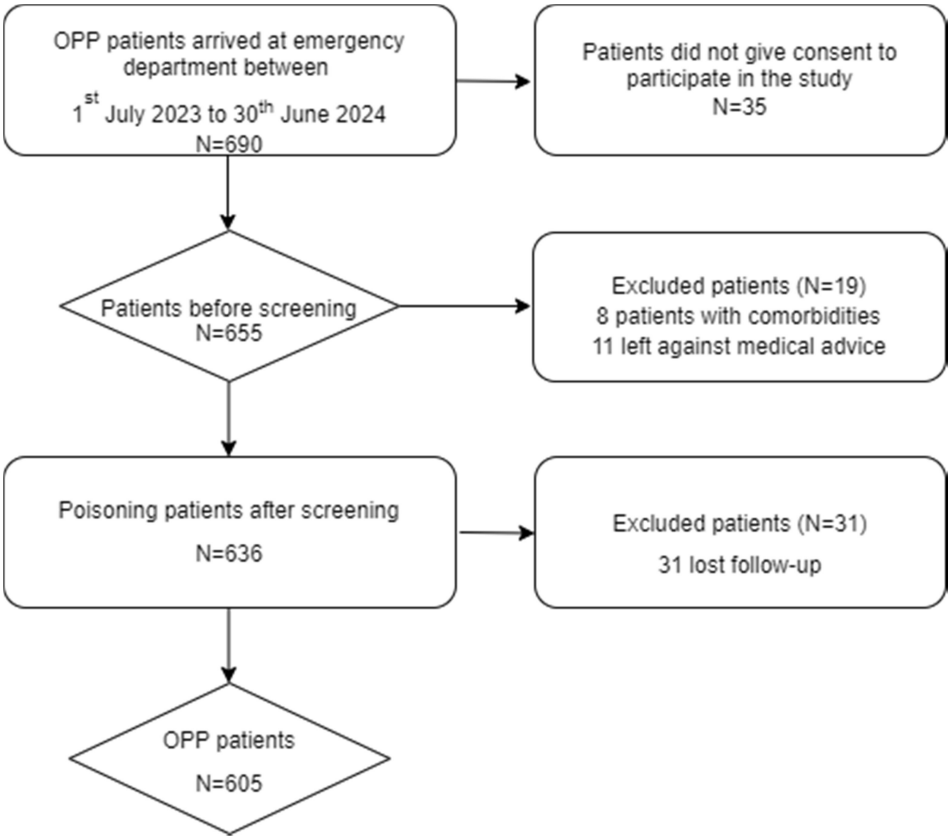
Table IV: Association of demographics, poisoning characteristics, pre-hospital care, baseline vitals, clinical manifestations, patient handling, and medical management with medical outcome

Variable		Died	Survived	P-value
Demographics, poisoning characteristics, and pre-hospital care				
Gender	Female	18	241	0.161
	Male	15	331	
Marital status	Married	16	278	0.990
	Single	17	294	
Education	Educated	11	165	0.581
	Uneducated	22	407	
Residential area	Rural	32	551	1.000*
	Urban	1	21	
Age (years)	>30	8	101	0.339
	≤30	25	471	
Employment	Employed	16	343	0.192
	Unemployed	17	229	
Cause of poisoning	Intentional	32	526	0.502*
	Unintentional	1	46	
Route of exposure	Combination	0	7	0.568
	Ingestion	33	553	
	Inhalation	0	12	
Site of Exposure	Home	31	522	0.639
	Public area	1	11	
	Workplace	1	39	
Type of admission	Direct Admission	17	306	0.824
	Referral	16	266	
Exposure to reporting time	>1	22	367	0.770
	≤1	11	205	
Local remedies	No	27	509	0.208
	Yes	6	63	
Mode of arrival	Non-ambulance	23	456	0.168
	Ambulance	10	116	
Baseline vitals and clinical manifestations				
Emesis		26	312	**0.006**
Abnormal respiratory rate		21	259	**0.040**
Abnormal pulse rate		18	201	**0.024**
Abnormal pupil size		20	197	**0.002**
Abnormal blood pressure		18	184	**0.008**
Epigastric pain		6	186	0.085
Salivation		16	117	**<0.001**
Abnormal consciousness		9	478	**<0.001**

Bronchorrhea		21	96	**<0.001**
Lacrimation		12	91	**0.002**
Abnormal temperature		9	84	**0.051**
Fasciculations		8	72	0.055
Diarrhea		9	54	**0.001**
Urination		12	45	**<0.001**
Lethargy		0	43	0.158*
Dyspnea		11	29	**<0.001**
Irritability		10	26	**<0.001**
Frothing		6	24	**<0.001**
Pale color		1	26	1.000*
Diaphoresis		3	23	0.163*
Bronchospasm		6	20	**<0.001**
Abdominal pain		1	20	1.000*
Vertigo		0	20	0.618*
Drowsy		0	19	0.617*
Nausea		0	19	0.617*
Seizure		4	14	**0.013***
Headache		0	16	1.000
Dehydration		1	9	0.432*
Other**		1	22	1.000*
Patient handling and medical management in the hospital				
Emergency management	Circulatory support	33	568	1.000*
	Airway support	22	92	**<0.001**
	Catheterization	21	99	**<0.001**
Decontamination procedure	Gastric lavage	31	549	0.640*
	Skin and eye decontamination	10	82	**0.013**
	Singe-dose activated charcoal	0	4	1.000*
Therapeutic interventions	Symptomatic treatment	33	561	1.000*
	Antidote administration	33	554	0.616
	Ventilator support	12	24	**<0.001**
	Tracheostomy	2	2	**0.016***
	Suctioning	12	26	**<0.001**
Services used	Emergency department	33	572	--------***
	Ward	33	567	1.000
	Intensive care unit	22	94	**<0.001**
	Observation unit	0	5	1.000
Duration of stay in hospital	>1 days	16	134	**0.001**
	1 day	17	438	
Poisoning severity	Mild	12	496	**<0.001**
	Moderate	18	76	
	Severe	3	0	

*Fisher's exact test, **Edema, pain, itching, cyanosis, blurred vision, dizziness, confusion, laryngeal edema, cough, hematemesis, *** Does not meet test assumption

Figure 1: Screening of the patients



DISCUSSION

This study provides valuable insights into poisoning cases' sociodemographic and clinical characteristics, revealing critical patterns and their implications for prevention and management. A male predominance (57.2%) was observed, consistent with prior studies. These higher poisoning rates among males may be due to occupational hazards and risk-taking behaviors[17,18]. The nearly balanced marital status distribution, with 48.6% married and 51.4% single, suggests that poisoning affects individuals across these groups. This is due to different types of pressures on both groups. Previous research similarly highlights marital discord and socio-economic pressures as significant contributors to intentional poisoning, especially among single and unemployed individuals[19-21].

Additionally, the high proportion of uneducated participants (70.9%) and those residing in rural areas (96.4%) underscores the role of education and accessibility in poisoning prevention. Education plays a vital role in controlling a person's behavior and gives knowledge about the safe use and storage of pesticides. This lack of knowledge significantly increases the rate of poisoning cases[1,22,23]. Most cases involved young adults aged ≤30 years (82.0%), consistent with other studies[24,25]. This may be because of the stress of adulthood, including difficulties maintaining a relationship, joblessness, and economic pressures[26]. Though the majority of patients were uneducated, a significant proportion were employed individuals (59.3%) as they are mostly farmers by profession in rural areas. This increases vulnerability among these groups due to easy accessibility to pesticides[27,29].

Furthermore, it was found that the poisoning was mainly intentional (92.2%), consistent with the studies carried out in other parts of the world[30.31]. As discussed earlier, this may be due to the inability to handle stressful situations in both genders, especially in the young population. The route of exposure in most cases was ingestion (96.9%), which is consistent with other studies as well[30,32]. This is because the majority of poisoning cases are intentional, and they tend to ingest poisons. It was found that most of the poisonings occurred at the home of the patient (91.4%), and this is consistent with other studies[31,33]. This may be because the majority of the poisoning cases are intentional and are influenced by family disharmony and marital and financial issues[30]. Timely arrival in the healthcare facility has proven to have better healthcare outcomes. However, most patients in this study had arrived after one hour of exposure, contrary to a study conducted in Saudi Arabia (15). Furthermore, though this study reported that only 20.8% of patients were transported to the study centre by ambulance, the percentage is higher than that of a multicenter study conducted in 2010-11 in Pakistan and reported that only 7.0% of patients[34].

Among the physiological variables, most patients were normotensive (66.6%). These findings align with prior research indicating that most poisoning cases present with stable blood pressure, though specific toxins can induce hypertensive or hypotensive states depending on their cardiovascular effects[35]. Respiratory parameters showed that 53.7% of patients had normal respiratory rates, while abnormal respiratory rates (46.3%) were also common, reflecting the respiratory distress often associated with poisoning. This is consistent with earlier findings where the abnormal respiratory rate was frequently linked to OPP due to cholinergic stimulation. Similarly, 84.6% of patients were normothermic, suggesting that significant temperature deviations occur only in specific poisoning types, such as salicylates or alcohol[36]. The vital signs also demonstrated significant associations with medical outcomes. Abnormal blood pressure, pulse rate, respiratory rate, and consciousness exhibited associations with the mortality rates with $p<0.05$, emphasizing the prognostic importance of baseline vital parameters. These findings align with studies that identify hemodynamic instability and altered mental states as indicators of severe toxicity and poor prognosis[37-39].

During the study period, the most common clinical manifestation among the OPP patients was emesis (55.9%). This is consistent with the other studies[33,40] and is due to the cholinergic symptoms of Ops[2]. Clinical manifestations were also strongly associated with mortality. Symptoms such as emesis, miosis, salivation, bronchorrhea, and dyspnea were significantly linked to higher mortality with $p<0.05$. This aligns with literature emphasizing the role of OPP symptoms and respiratory complications in predicting adverse outcomes[41,42].

The most common pharmacological treatment in the study was circulatory support (99.3%), consistent with other studies[26,30], while in decontamination procedures, most patients went through a gastric lavage (95.9%). The gastric lavage was performed excessively, as most patients (64.3%) arrived at the hospital after one hour. The guidelines suggest that gastric lavage should be done an hour after exposure to the poison and/or in large quantities of intake situations or if an antidote is unavailable[32]. Moreover, most patients (75.2%) stayed at the hospital for just one day, contrary to studies conducted in other parts of the world[4,30]. While determining the severity of OP poisoning through POPS, it was found that the majority (84.0%) were mildly affected, which is concordant with another study in Karachi, Pakistan[14]. Though the majority of the patients in this study were mildly affected, the mortality was much higher as 33 deaths at a rate of 5.5% occurred. However, this death rate is much lower than that of a study conducted in Ethiopia[9] and another study in Pakistan[43].

This study found that the interventions and hospital management significantly impacted outcomes. Procedures such as airway support, catheterization, and ventilator support with $p<0.05$ were associated with mortality, likely reflecting the severity of poisoning in these patients. ICU admission and extended hospital stays ($p=0.001$) with $p<0.05$ were also linked to higher mortality, supporting findings that critical care requirements often indicate severe poisoning. Notably, the severity of poisoning was significantly associated with outcomes ($p<0.001$), corroborating evidence that clinical grading of poisoning severity is a reliable predictor of prognosis[4,44].

This study identifies various factors associated with the mortality due to OPP. The regulatory authorities should take concrete measures to control the easy accessibility of the poison to the public. People should be educated about the safe use and storage of poisons and pre-hospital care at sites of exposure. Further research should be carried out on the prevalence of intentional pesticide poisoning and associated factors to decrease these incidences. Future research should focus on strengthening emergency response protocols, enhancing critical care capacities, and raising awareness about effective poisoning management to reduce mortality and improve patient outcomes.

The strengths of this study include its prospective nature, which avoids the chances of missing or incorrect data associated with retrospective studies. The study centre had manual patient records linked with missing patient files, which was also a problem with retrospective studies. A large sample size was achieved during the study by registering consecutive poisoning patients.

This study has some limitations. This study was conducted in a single centre, and the results cannot be generalized to other regions of Pakistan or the world. Poisoning cases from both children and adults were registered in the study. However, adults and children may have different effects and outcomes of poisoning.

CONCLUSION

This study highlights the critical role of clinical parameters, patient management, and hospital interventions in determining the medical outcomes of poisoning cases. It did not find any association between demographic and poisoning characteristics and pre-hospital care. However, baseline vitals, typical OPP symptoms, intensive management, duration of stay in hospital, and poisoning severity were significantly associated with survival. These findings emphasize that healthcare providers must prioritize rapid assessment and intervention of these variables for better outcomes in OPP patients.

ACKNOWLEDGMENT

The authors are highly grateful to the administrative and medical staff for their support during the study.

Ethical approval: University of Sindh, Jamshoro, Pakistan, IRB letter No. ORIC/SU/1484.
Conflict of interest: There is no conflict of interest between the authors.
Financial Disclosure / Grant Approval: No Funding agency was involved in the research
Data Sharing Statement: The corresponding author can provide the data proving the findings of this study on request. Privacy or ethical restrictions bound us from sharing the data publicly.

AUTHOR CONTRIBUTION

Muhammad S:	Study concept, literature review, methodology, data collection, and drafting
Almani KF:	Critical analysis, expert opinion, final reviews
Mughal UR:	Revisions of the initial idea
Khaskheli MS:	Data collection logistics
Tabassum R:	Data collections and methodology
Ahmad R:	Drafting and revising the work for important intellectual content
Kumar N:	Statistical analysis

REFERENCES

1. Sinha SN, Kumpati RK, Ramavath PN, Sangaraju R, Gouda B, Chougule P. Investigation of acute organophosphate poisoning in humans based on sociodemographic and role of neurotransmitters with survival study in South India. Scientific Reports. 2022; 12(1): 16513.
2. Orzeł AK, Flieger W, Szlichta D, Terpiłowska B, Terpiłowski M, Orzeł Z et al. Assessment of hospitalizations of patients after intoxication with organophosphates used in agriculture. Ann Agri Environ Med. 2022; 29(1): 143-8.
3. Reddy BS, Skaria TG, Polepalli S, Vidyasagar S, Rao M, Kunhikatta V et al. Factors associated with outcomes in organophosphate and carbamate poisoning: a retrospective study. Toxicol Res. 2020; 36: 257-66.
4. Abdel Baseer KA, Gad EF, Abdel Raheem YF. Clinical profile and outcome of acute organophosphate poisoning in children of Upper Egypt: a cross-sectional study. BMC Pediatr. 2021; 21: 1-8.
5. Shah R, Pokhrel A, Shrestha A, Shrestha S, Sah A, Shah R. Precipitate, preterm labor in acute organophosphate poisoning in pregnancy: a case report. Ann Med Surg. 2024; 86(12).
6. Balali-Mood M, Saber H. Recent advances in the treatment of organophosphorous poisonings. Iran J Med Sci. 2012; 37(2): 74.
7. Adeyinka A ME, Regina AC. Organophosphates: StatPearls; 2025 [Available from: https://www.ncbi.nlm.nih.gov/books/NBK499860/.
8. Alva J, Devi ES, Chandrababu R, Abraham J, Balakrishnan JM. Epidemiologic characteristics, the length of hospital stay, and mortality of patients with organophosphate poisoning: A systematic review. Clin Epidemiol Glob Health. 2025; 32: 101932.
9. Tadesse B, Kibret H, Heluf H, Mesfin S, Alemu Y. Pattern and outcome of acute organophosphate poisoning at health facilities of Harari Region, Eastern Ethiopia. SAGE Open Med. 2023; 11: 20503121231216603.
10. Naveed S, Tahir SM, Imran N, Rafiq B, Ayub M, Haider II et al. Sociodemographic characteristics and patterns of suicide in Pakistan: an analysis of current trends. Comm Mental Health J. 2023; 59(6): 1064-70.
11. Statistics PBo. 7th Population and Housing Census-2023: Pakistan Bureau of Statistics; 2024 [Available from: https://www.pbs.gov.pk/content/announcement-results-7th-population-and-housing-census-2023-digital-census.
12. Safdar M, Afzal KI, Smith Z, Ali F, Zarif P, Baig ZF. Suicide by poisoning in Pakistan: review of regional trends, toxicity and management of commonly used agents in the past three decades. BJPsych Open. 2021; 7(4): e114.
13. Sobeeh FG, Eldayem YBA, Khalifa HK. Validity of different scoring systems in prediction of intensive care unit admission and mortality in acute organophosphate poisoning. Toxicol Res. 2024; 13(4).
14. Amir A, Raza A, Qureshi T, Mahesar GB, Jafferi S, Haleem F et al. Organophosphate poisoning: demographics, severity scores and outcomes from National Poisoning Control Centre, Karachi. Cureus. 2020; 12(5).
15. Yousef A, Albuali W, AlOmari M, AlMutairi A, Albuali HW, AlQurashi FO et al. Organophosphate poisoning in a paediatric intensive care unit: a retrospective analysis based on ten years of experience. Int J General Med. 2022; 15: 6269.
16. Chaokromthong K, Sintao N. Sample size estimation using Yamane and Cochran and Krejcie and Morgan and green formulas and Cohen statistical power analysis by G* Power and comparisons. APHEIT Int J Interdiscipl Soc Sci Technol. 2021; 10(2): 76-86.

17. Conley K, Rao AL. Risk-Taking Behaviors Among Athletes. Mental Health in the Athlete: Modern Perspectives and Novel Challenges for the Sports Medicine Provider. 2020: 85-93.
18. Muhammad S, Kumar N, Qureshi Y, Tabassum R, Kumari G, Abbas J et al. Gravity of Poisoning Cases in Shaheed Benazirabad Sindh, Pakistan: A Prospective Study. J Pharmaceut Res Int. 2020; 10.
19. Govender R, van Niekerk A, Hector TJ, van Tonder W. Self-inflicted ingestion of harmful chemicals in adolescents and adults: risk factors and characteristics. BMC Public Health. 2024; 24(1): 1648.
20. Yibrie D, Wassie H. Socio-economic problems of Ethiopian young adults as reflected in three selected Ethiopian young adult novels in English. 2020.
21. Muhammad S, Ahmad R, Rajpoot PL, Tabassum R, Khaskheli MS, Abbas J et al. Threads of Vulnerability: A Cross-sectional Study on Factors Associated with Suicide and Self-harm in Pakistan. Sudan J Med Sci. 2024; 19(2): 173-87.
22. Alshalati LMJ. Limited knowledge and unsafe practices in usage of pesticides and the associated toxicity symptoms among farmers in Tullo and Finchawa rural kebeles, Hawassa City, Sidama Regional State, Southern Ethiopia. Emerging Contaminants: Intech Open; 2021.
23. Frazzoli C. Toxicological Risk Analysis in Data-Poor Countries: A Narrative Approach to Feed an "Awareness Raising-Community Empowerment" Vortex. Medicina. 2020; 56(11): 629.
24. Imran S, Awan EA, Memon MIS, Memon A. Frequency and outcomes of organophosphate poisoning at tertiary care hospital in Nawabshah. Age (years). 2017; 90(134): 23.3.
25. Al-Mahbashi HM, Howilah AA. A cross-sectional study examining the pattern of acute poisoning among patients admitted to a governmental hospitals in Sana'a City, Yemen. Toxicology Reports. 2024; 13: 101704.
26. Tefera GM, Teferi LG. Prevalence, predictors and treatment outcome of acute poisoning in Western Ethiopia. Open Access Emergency Med. 2020: 365-75.
27. Amaro H, Sanchez M, Bautista T, Cox R. Social vulnerabilities for substance use: Stressors, socially toxic environments, and discrimination and racism. Neuropharmacology. 2021; 188: 108518.
28. Spiller HA, Ackerman JP, Smith GA, Kistamgari S, Funk AR, McDermott MR, et al. Suicide attempts by self-poisoning in the United States among 10–25 year olds from 2000 to 2018: substances used, temporal changes and demographics. Clin Toxicol. 2020; 58(7): 676-87.
29. Gummin DD, Mowry JB, Beuhler MC, Spyker DA, Brooks DE, Dibert KW et al. 2019 annual report of the American association of poison control centers' national poison data system (NPDS): 37th annual report. Clin Toxicol. 2020; 58(12): 1360-541.
30. Nigussie S, Demeke F, Getachew M, Amare F. Treatment outcome and associated factors among patients admitted with acute poisoning in a tertiary hospital in Eastern Ethiopia: a cross-sectional study. SAGE Open Med. 2022; 10: 20503121221078155.
31. Liu S, Ling L, Ma J, Yuan H, Guo Z, Feng Q et al. Trends and profiles of acute poisoning cases: a retrospective analysis. Front Public Health. 2023; 11: 1235304.
32. Ng F. Ten-year profile of acute poisoning patients presenting to an Accident and Emergency Department requiring intensive care in a regional hospital of Hong Kong. Hong Kong J Emergency Med. 2019; 26(1): 3-14.
33. Eizadi-Mood N, Mahvari R, Akafzadeh Savari M, Mohammadbeigi E, Feizi A, Mirmoghtadaei P et al. Acute pesticide poisoning in the central part of Iran: A 4-year cross-sectional study. SAGE Open Med. 2023; 11: 20503121221147352.

34. Khan NU, Pérez-Núñez R, Shamim N, Khan UR, Naseer N, Feroze A et al. Intentional and unintentional poisoning in Pakistan: a pilot study using the Emergency Departments surveillance project. BMC Emergency Med. 2015; 15: 1-7.
35. Kumar A, Pappachan JM, Fernandez CJ. Catecholamine-induced cardiomyopathy: an endocrinologist's perspective. Rev Cardiovasc Med. 2021; 22(4): 1215-28.
36. Espinoza L, da Silva J. 31 Acetylcholine Overload: Organophosphate and Carbamate Exposures. Medical Toxicology. 2024: 352.
37. Albin CS, Cunha CB, Glaser TP, Schachter M, Snow JW, Oto B, editors. The Approach to Altered Mental Status in the Intensive Care Unit. Seminars in Neurology; 2024: Thieme Medical Publishers, Inc.
38. de la Torre JC. Hemodynamic instability in heart failure intensifies age-dependent cognitive decline. J Alzheimer's Disease. 2020; 76(1): 63-84.
39. Yu J-R, Hou Y-C, Fu J-F, Wang I-K, Chan MJ, Chen C-Y et al. Outcomes of elderly patients with organophosphate intoxication. Scientific Reports. 2021; 11(1): 11615.
40. Krishnasamy N, Narmadhalakshmi R, Prahalad P, Jayalakshmi R, Lokesh R, Ramesh J et al. Determinants of poison-related mortality in tertiary care hospital, South India. Indian Journal of Critical Care Medicine: Peer-reviewed, Indian Soc Crit Care Med. 2024; 28(4): 329.
41. Thakur DK, Mahaseth R, Jha S. Predictors of Morbidities in Organophosphate Poisoning. IJISRT. 2022; 7(3): 878.
42. Ramadori GP. Organophosphorus poisoning: Acute respiratory distress syndrome (ARDS) and cardiac failure as cause of death in hospitalized patients. Int J Molecular Sci. 2023; 24(7): 6658.
43. Ishfaq S, Nazir M, Bukhari S, Ahmed N, Ubaid M, Farooq H. Frequency of organophosphate poisoning and its outcome in SKBZ AK CMH Muzaffarabad. Pak J Med Health Sci. 2023.
44. El-Gharbawy D, Wahdan A. Predictors of major outcome in acute organophosphorus poisoned cases. Egypt J Forensic Sci Appl Toxicol. 2022; 22(4): 99-114.