

**CORRELATION OF WHOLE BLOOD
ACETYLCHOLINESTERASE ACTIVITY WITH CLINICAL
SEVERITY SCORE AND THEIR ASSOCIATION WITH
IN-HOSPITAL OUTCOME IN ACUTE
ORGANOPHOSPHORUS COMPOUND POISONING**

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BACKGROUND

- World Health Organization (WHO) estimated 200,000 pesticide suicides each year.
- OPC poisoning is a common suicidal method in Bangladesh and more than 75% of acute poisoning emergencies and mortality rate is about 16%.
- It is a clinical diagnosis but confirmation based on the measurement of cholinesterase activity.

- Red blood cell (RBC) acetylcholinesterase (AChE) and plasma pseudocholinesterase (PChE) activity both can be used but RBC AChE correlates better with CNS AChE.
- Portable '**ChE check mobile**' measures AChE and PChE within 4 minutes.

- There is a clinical severity scoring system Peradeniya Organophosphorus Poisoning (POP) scale
- It uses six clinical parameters **miosis, fasciculation, respiratory rate, Pulse, level of consciousness** and **history of convulsion** to assess the severity of poisoning and graded as mild (score 0-3), moderate (score 4-7) and severe (score 8-11).

OBJECTIVES

➤ **A. General Objective:**

- To correlate POP score with whole blood AChE activity and to study the prognostic value of POP score and whole blood AChE activity in acute OPC poisoning, related to the identity of insecticide involved.

➤ **B. Specific Objective:**

- To observe in-hospital outcomes development of IMS, need for assisted ventilation, length of hospital stay, total dose of atropine and death.
- To evaluate whole blood AChE activity with standard reference RBC AChE and plasma PChE activity and clinical outcomes.
- To describe the clinico-epidemiological variations.

MATERIALS AND METHODS

- **Type of study:** Hospital based prospective observational study.
- **Place of Study:** Department of Medicine, Chittagong Medical College Hospital, Bangladesh.
- **Study period:** 1st July 2021 to 31st July 2022.
- **Study population:** acute OPC poisoning during the study period sample size (n=76).
- **Sample Technique:** Convenient sampling.

SELECTION CRITERIA

➤ Inclusion Criteria:

1. Patients with a relevant history and/or symptoms and signs of OPC poisoning.
2. Patients 16 years of age and above.

➤ Exclusion Criteria:

1. Patients with history of poisoning with undetermined substances without cholinergic features.
2. Patients who will die within few minutes of hospitalization even before the initial treatment.
3. Refusal to participate.

OPERATIONAL DEFINITIONS

- **‘ChE Check Mobile’**: Photometer used to quickly determine personal exposure to cholinesterase inhibitor at bed side by measuring the activity of AChE from human blood.



Figure 2.1: ChE check mobile assay kit
BSMCON '24, Dhaka

- **Laboratory Studies** : RBC AChE and Plasma PChE activity measured by spectrophotometer at BSMMU pharmacology laboratory.



TOOL AND PROCEDURE

- OPC poisoning was confirmed
- Initial resuscitation.
- Informed written consent.
- Severity of the poisoning was graded by **POP scaling**.
- A drop of blood was tested by “**ChE check mobile**” for **whole blood AChE activity** and sample of venous blood (approx. 3ml) was collected and preserved for the measurement of **RBC AChE and plasma PChE activity** prior to treatment with atropine and pralidoxime.

RESULTS

- Initially 147 patients were screened for the eligibility.
- 110 patients were found to be eligible for the study and enrolled.
- Data analysis could be done 76 patients due to time constraint.

Table I: Demographic characteristics of the participants (n=76)

Characteristics	Frequency (%) / Mean$\pm$SD
Age, years	
16-25	37 (48.7)
26-35	20 (26.3)
36-45	16 (21.1)
>45	3 (3.9)
Mean $\pm$ SD	28.7 $\pm$ 9.5
Gender	
Male	45 (59.2)
Female	31 (40.8)

Table II: Socioeconomic characteristics of the patients (n=76)

Characteristics	Frequency (%)
Religion	
Islam	64 (84.2)
Others	12 (15.8)
Residence	
Urban	19 (25.0)
Rural	57 (75.0)
Marital status	
Unmarried	28 (36.8)
Married	48 (63.2)
Socioeconomic class	
Upper middle	6 (7.9)
Lower middle	14 (18.4)
Upper lower	53 (69.7)
Lower	3 (3.9)

Table III: OPC exposure related variables of the patients

Variables	Frequency	Percentage
Nature of poisoning		
Suicidal	76	100
Reason of poisoning		
Domestic issue	44	57.9
Financial loss	8	10.5
Marital issue	8	10.5
Educational failure	1	1.3
Unspecified	15	19.7
Route of poisoning		
Oral	76	100.0
Interval between exposure to admission		
Median (IQR), hours		2 (1-4)
Received prehospital treatment		
Yes	55	72.4
OPC types		
Unknown OPC	36	47.4
Mixed (Chlorpyrifos+Cypermethrin)	15	19.7
Single (Chlorpyrifos)	14	18.4
Single OPC (others)	11	14.5

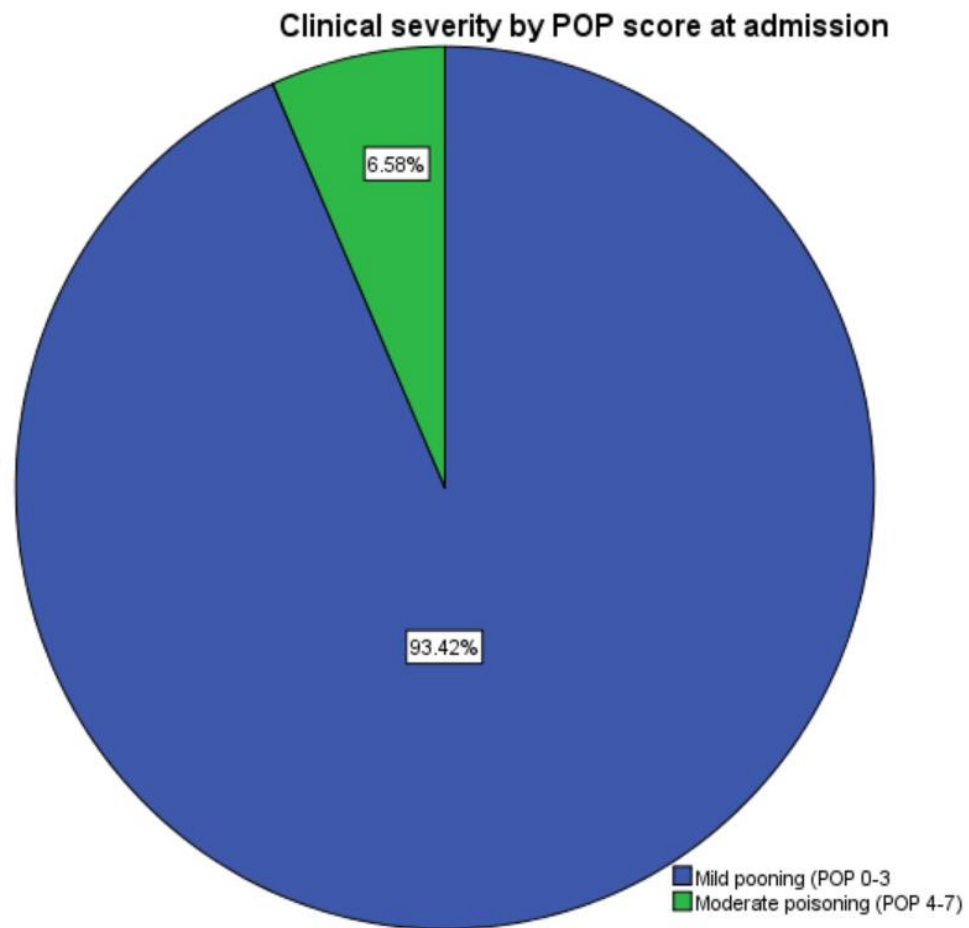


Figure 4.1: Distribution of the patients by their clinical severity by POP score at admission

Table IV: Summary measures of the baseline biochemical parameters of the patients

Paramters	Median (minimum -maximum)
Whole blood AChE, U/gHb	36.45 (0.0-53.80)
RBC AChE, activity/U/gHb	22.32 (0.0-39.02)
Plasma PChE, activity/mU/ml	2572.90 (528.60-6274.80)

Table V: Treatment and outcome summary of the patients (n=76).

Characteristics	Median (Range)
Total amount of atropine used, mg	53.9 (6.0-358.8)
Duration of maintenance therapy, hours	95.0 (12.0-240.0)
Duration of pralidoxime use, hours	90.0 (12.0-259.0)
Length of hospital stay, days	5.0 (1.0-17.0)
Characteristics	Frequency (%)
Assisted ventilation needed	4 (5.3)
Assisted ventilation provided	1 (1.3)
Developed IMS	3 (3.9)
In-hospital mortality	4 (5.3)

Table VI: Distribution of whole blood AChE, RBC AChE, and plasma PChE activity according to the types of OPC compound .

Parameters	OPC types	Q1	Median	Q3
Whole blood AChE, U/gHb	Unknown OPC	34.20	39.35	43.13
	Mixed OPC*	3.40	5.20	37.40
	Single (Chlorpyrifos)	7.97	31.60	38.77
	Single OPC (others)	33.70	35.80	37.30
RBC AChE, activity/U/gHb	Unknown OPC	18.55	25.50	29.62
	Mixed OPC	4.03	7.47	27.25
	Single (Chlorpyrifos)	6.84	16.55	23.56
	Single OPC (others)	9.28	22.49	36.58
PlasmaPChE, activity/mU/ml	Unknown OPC	2182.80	3708.55	4454.72
	Mixed OPC	1168.80	1350.90	2917.20
	Single (Chlorpyrifos)	1348.75	1590.00	2779.12
	Single OPC (others)	1793.10	2366.30	4548.80

*Chlorpyrifos+Cypermethrin

Table VII: Correlation (Spearman's rho) between different parameters of OPC poisoned patients.

Paramters		Whole blood AChE	RBC AChE	Plasma PChE	Total atropine dose	Total POP score
RBC AChE	rho	0.665				
	P value	<0.001				
Plasma PChE	rho	0.547	0.560			
	P value	<0.001	<0.001			
Total atropine dose	rho	-0.529	-0.535	-0.442		
	P value	<0.001	<0.001	<0.001		
Total POP score	rho	-0.391	-0.335	-0.312	0.355	
	P value	<0.001	0.003	0.006	0.002	
Length of stay in hospital	rho	-0.298	-0.271	-0.252	0.704	0.281
	P value	0.009	0.018	0.028	<0.001	0.014

rho: Spearman's correlation coefficient

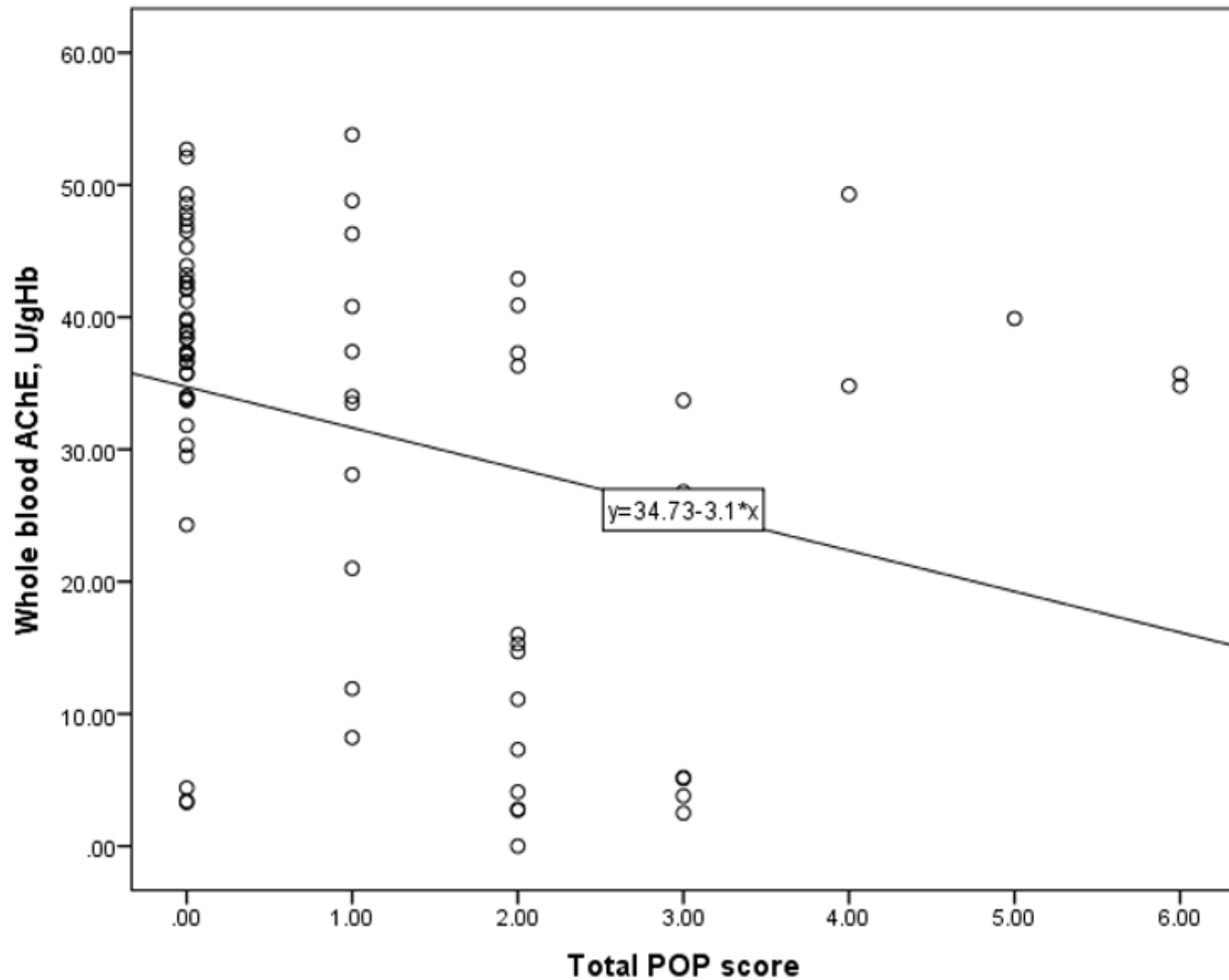


Figure 4.2: Scatter dot plot showing correlation between total POP score and whole blood AChE activity at admission.

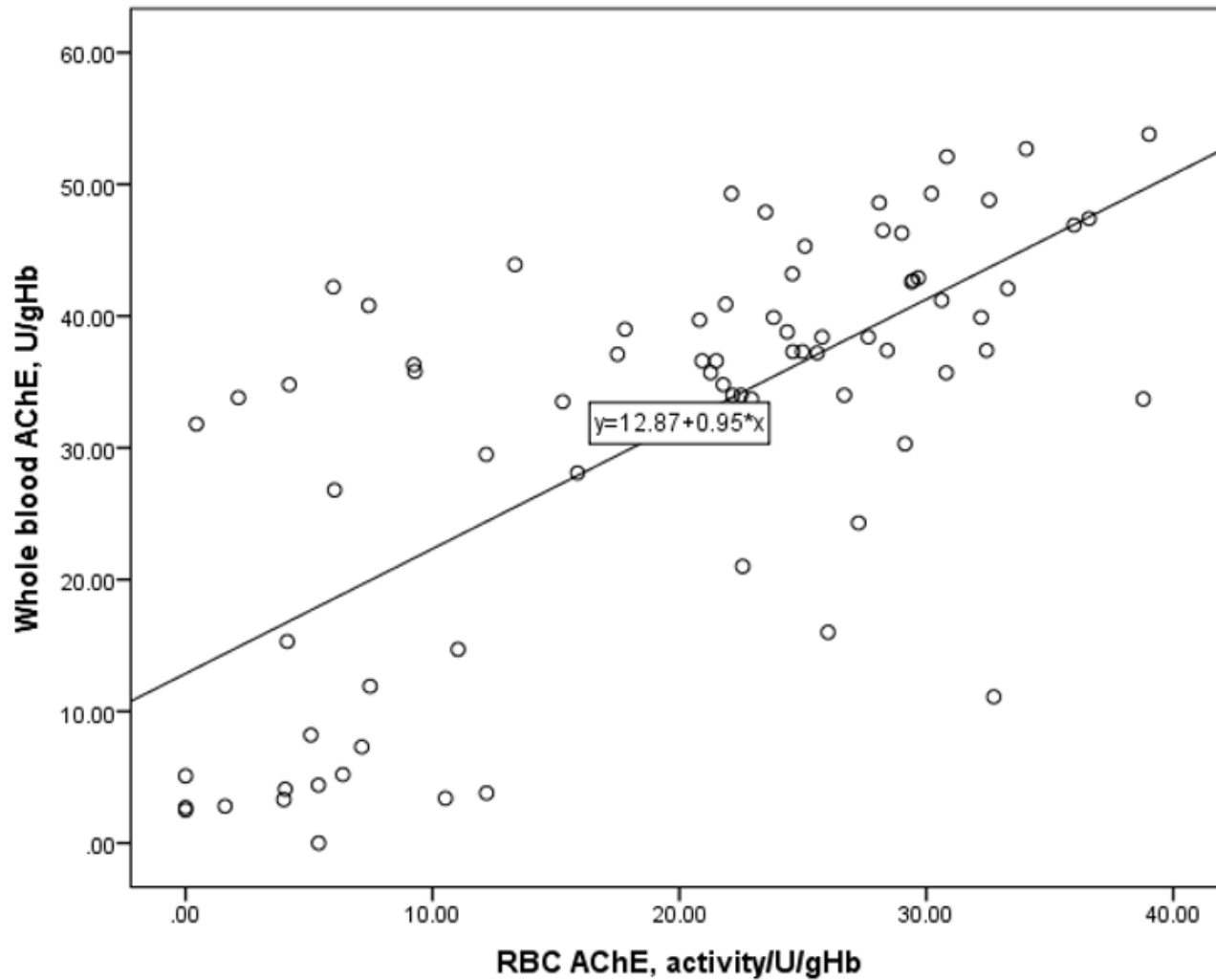


Figure 4.3: Scatter dot plot showing correlation between RBC AChE activity and whole blood AChE activity at admission.

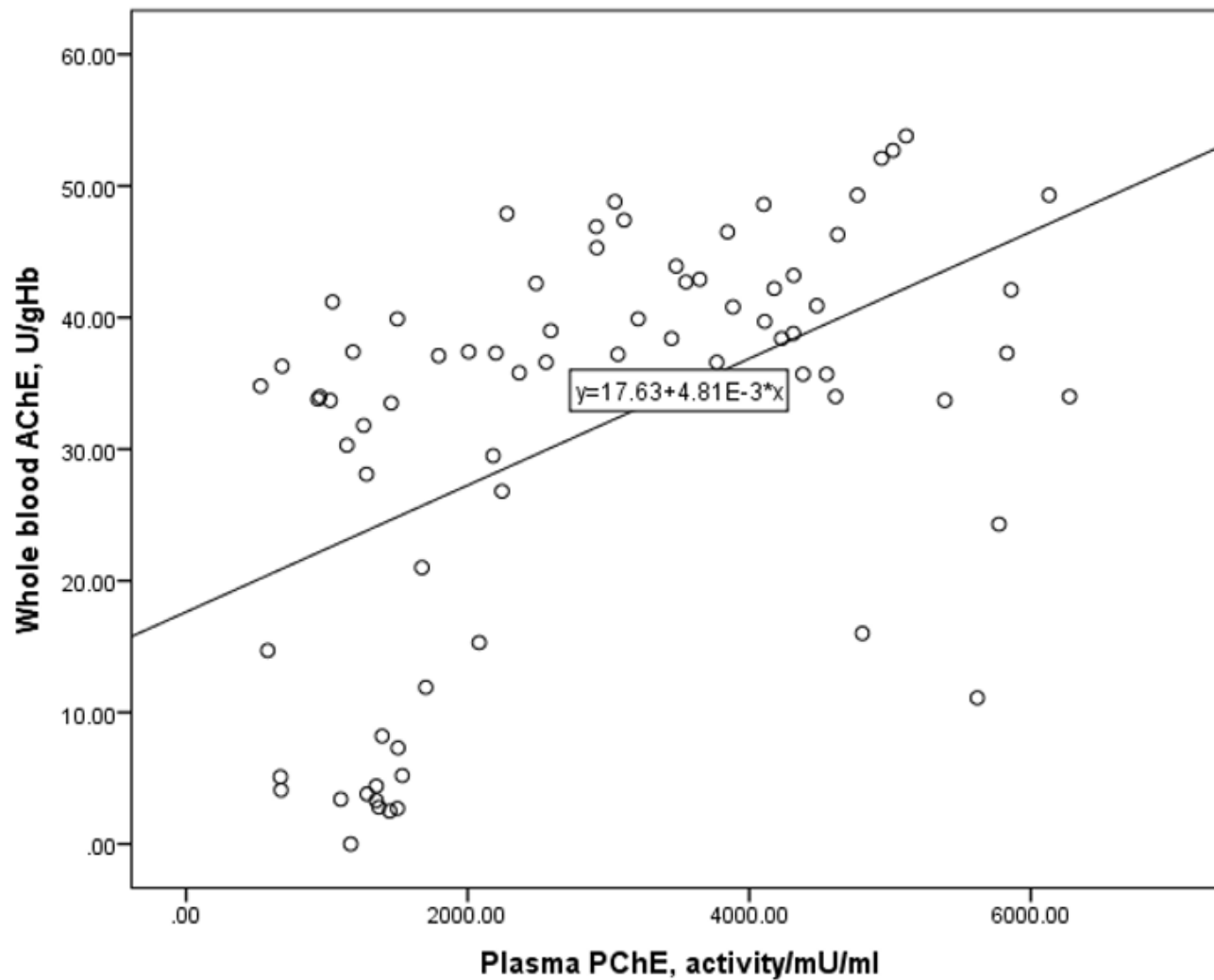


Figure 4.4: Scatter dot plot showing correlation between Plasma PChE activity and whole blood AChE activity at admission.

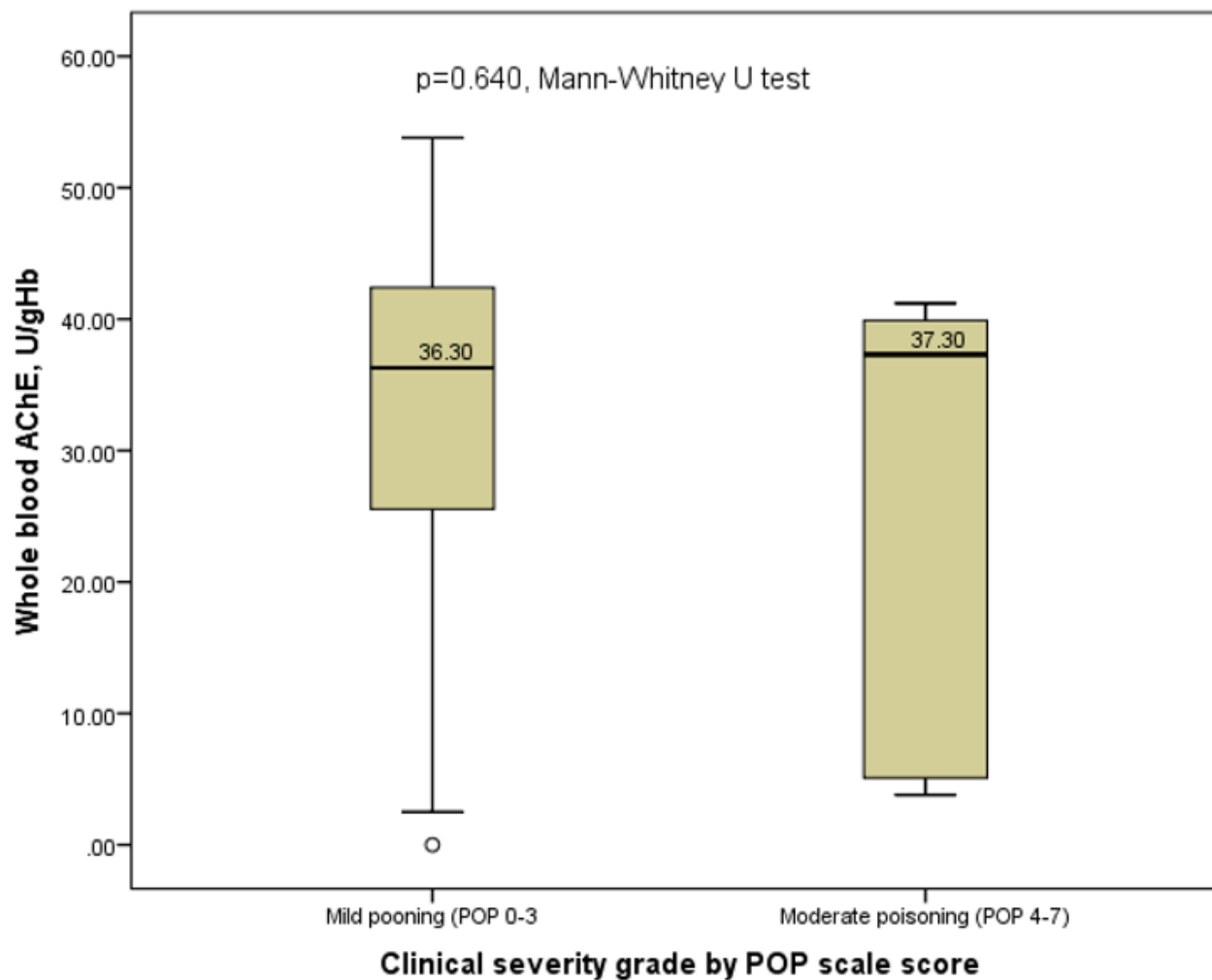


Figure 4.5: Box and whisker plot showing distribution of the whole blood AChE activity in each grade of severity.

Table VIII: Association of demographic characteristics with outcome of the participants (n=76).

Characteristics	Survived (n=72)	Expired (n=4)	P value
Age, years, Mean±SD	28.5±9.1	31.5±16.8	0.543 [†]
Gender			
Male	43 (59.7)	2 (50.0)	0.700 [*]
Female	29 (40.3)	2 (50.0)	

Data were expressed as frequency (%). [†]Independent sample t test. ^{*}Fisher's exact test.

Table IX: Association of POP score and outcome of patients in each grade of severity (n=76).

Clinical severity	Outcome		P value
	Survived (n=72)	Expired(n=4)	
Mild poisoning (POP 0-3)	71 (98.6)	0 (0)	<0.001*
Moderate poisoning (POP 4-7)	1 (1.4)	4 (100.0)	
Data were expressed as frequency (%);*Fisher's exact test.			

Table X: Association with baseline biochemical parameters and outcome of the patients (n=76).

Paramters	Survived (n=72)	Expired (n=4)	P value*
Whole blood AChE, U/gHb	36.45 (0.0-53.80)	21.20 (3.00-41.00)	0.398
RBC AChE, activity/U/gHb	22.32 (0.0-39.02)	18.59 (0.0-30.62)	0.728
Plasma PChE, activity/mU/ml	2751.55 (528.6-6274.8)	1162.6 (669.9-5829.8)	0.232
Data were expressed as median (minimum-maximum); *Mann-Whitney U test			

Table XI: Association with treatment and outcome of the patients (n=76).

Characteristics	Survived (n=72)	Expired (n=4)	P value
Total amount of atropine used	53.9 (6.0-358.8)	113.7 (49.0-231.6)	0.281*
Duration of maintenance therapy	96.0 (12.0-235.0)	56 (24.0-240.0)	0.385*
Duration of pralidoxime use	90.0 (12.0-259.0)	52.0 (24.0-80.0)	0.041*
Assisted ventilation needed	0 (0)	4 (100.0)	<0.001**
Assisted ventilation provided	0 (0)	1 (25.0)	0.053**

Data were expressed as median (minimum-maximum) or frequency (%); *Mann-Whitney U test; **Fisher's exact test.

LIMITATIONS

- Amount of toxins, ageing of toxins could not be assessed.
- Study may not represent the total population of the country as sample size is small.

CONCLUSION

- POP score applied at admission was able to predict the outcome in terms of mortality.
- Present study revealed significant correlation between POP score with whole blood AChE activity.
- Thus, it helps prediction of outcomes among patients with acute OPC poisoning at index visit.

RECOMMENDATION

- Use of POP score and 'ChE check mobile assay kit' as rapid bedside test for OPC poisoning detection and severity grading will greatly aid early assessment and prediction of poor outcomes.
- However, considering the limitations of the present study, further research is necessary to determine the validity of these results.

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