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Outcome of Rodenticide Poisoning and Its Determinants Among Adult Patients in India: A Five-Year Retrospective Study (2020–2024)

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KEYWORDS

Rodenticide
Poisoning

ABSTRACT:

Background:

Rodenticide poisoning remains a major contributor to pesticide-related morbidity and mortality in India, particularly in the context of deliberate self-harm. Highly toxic compounds such as aluminum phosphide, zinc phosphide, and yellow phosphorus are widely accessible and associated with severe systemic toxicity and high case fatality rates.

Objectives:

To assess clinical outcomes and identify determinants of mortality among adult patients admitted with rodenticide poisoning in a tertiary care setting in India.

Methods:

A retrospective analytical study was conducted among 174 adult patients admitted with confirmed rodenticide poisoning between January 2020 and December 2024. Data were extracted from hospital records using a structured format. Descriptive statistics were used for baseline characteristics. Associations were assessed using Chi-square tests, and multivariable logistic regression was performed to identify independent predictors of mortality.

Results:

Most patients were aged 18–30 years (62.1%), with a slight male predominance (52.9%). Suicidal ingestion accounted for 86.2% of cases. The overall mortality rate was 37.9%. Independent predictors of mortality included suicidal poisoning (AOR=9.42), tachycardia (AOR=6.15), hypotension (AOR=5.82), and delayed hospital presentation (>2 hours) (AOR=4.21).

Conclusion:

Rodenticide poisoning continues to be associated with high mortality in India. Early recognition of high-risk clinical features and prompt management are essential to improve outcomes.

INTRODUCTION

Poisoning continues to be a major public health challenge globally, particularly in low- and middle-income countries, where it accounts for a significant proportion of preventable deaths. Among various toxic exposures, pesticide poisoning is a leading cause of morbidity and mortality, especially in regions with high agricultural activity[1]. India, being predominantly agrarian, experiences a high burden of pesticide-related poisoning, with rodenticides constituting an important subset[2].

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Rodenticides are chemical agents designed to eliminate rodents but are highly toxic to humans when ingested. Commonly used compounds in India include aluminum phosphide, zinc phosphide, and yellow phosphorus[3]. Aluminum phosphide, widely used as a fumigant, releases phosphine gas upon exposure to moisture, which disrupts mitochondrial oxidative phosphorylation and leads to cellular hypoxia and organ failure[4]. Phosphine-induced toxicity is characterized by severe oxidative stress, inhibition of cytochrome c oxidase, and direct myocardial depression, often resulting in refractory shock and multi-organ dysfunction[5].

Yellow phosphorus, another commonly used rodenticide, primarily exerts hepatotoxic effects. It causes acute liver injury progressing to acute liver failure, often requiring intensive care or liver transplantation[6]. Recent Indian data indicate that yellow phosphorus poisoning has emerged as a significant cause of toxic hepatitis, with substantial mortality and limited treatment options[6].

The epidemiology of rodenticide poisoning in India is closely linked to intentional self-harm. Socioeconomic stressors, interpersonal conflicts, and lack of access to mental health services contribute significantly to the high prevalence of suicidal ingestion[7]. The easy availability of highly toxic compounds without strict regulatory control further exacerbates this issue[8].

Despite advancements in critical care, the management of rodenticide poisoning remains largely supportive due to the absence of a specific antidote for most compounds. Mortality rates remain high, particularly in aluminum phosphide poisoning, where case fatality may exceed 50% in some settings[9]. Recent studies have identified several prognostic indicators, including hemodynamic instability, metabolic acidosis, and delayed presentation to healthcare facilities[10].

A 2022 study on rodenticide poisoning highlighted the severe clinical manifestations, including circulatory collapse, arrhythmias, and renal failure, with significant mortality despite intensive care[11]. Similarly, recent emergency department-based studies have emphasized the role of early clinical parameters such as shock index and vital signs in predicting outcomes[12].

Given the evolving trends in poisoning patterns and the continued high mortality associated with rodenticide ingestion, there is a need for updated evidence from Indian settings. This study aims to evaluate the clinical outcomes and identify predictors of mortality among adult patients with rodenticide poisoning over a five-year period.

METHODOLOGY

The present study was designed as a retrospective analytical study conducted in a tertiary care teaching hospital catering to both rural and urban populations. The study period extended from January 2020 to December 2024. The study population included adult patients aged 18 years and above with confirmed rodenticide poisoning, identified from hospital records.

Data were extracted from medical records using a structured proforma. The variables collected included socio-demographic characteristics, type and mode of poisoning, clinical parameters at admission (such as pulse rate and blood pressure), time interval between ingestion and hospital presentation, and treatment outcomes.

Statistical analysis was carried out using appropriate methods. Descriptive statistics were used to summarize baseline characteristics. The Chi-square test was applied to assess associations between categorical variables and mortality. Variables found to be significant in bivariate analysis were entered into a multivariable logistic regression model to identify independent predictors of mortality. Model performance and goodness of fit were evaluated using the Hosmer–Lemeshow test and Nagelkerke R^2. A p-value of <0.05 was considered statistically significant.

RESULTS

Socio-demographic Characteristics

A total of 174 patients with confirmed rodenticide poisoning were included in the study. The majority of patients belonged to the younger age group, with 62.1% aged between 18–30 years, followed by 25.8% in the 31–50-year group and 12.1% above 50 years. There was a slight male predominance (52.9%), while females constituted 47.1% of cases.

Most patients were from rural areas (72.4%), reflecting the higher exposure and accessibility to rodenticides in agrarian settings. In terms of marital status, 58.0% were married and 42.0% were unmarried.

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Table 1: Socio-demographic Characteristics of Study Participants (N = 174)

Variable	Category	Frequency (n)	Percentage (%)
Age group (years)	18–30	108	62.1
	31–50	45	25.8
	>50	21	12.1
Sex	Male	92	52.9
	Female	82	47.1
Residence	Rural	126	72.4
	Urban	48	27.6
Marital status	Married	101	58.0
	Single	73	42.0

These findings indicate that rodenticide poisoning predominantly affects young adults in rural populations, highlighting the role of socio-environmental determinants.

Exposure Characteristics

Intentional (suicidal) poisoning was the predominant mode of exposure, accounting for 86.2% of cases, whereas accidental exposure constituted only 13.8%.

Aluminum phosphide was the most commonly implicated rodenticide (56.3%), followed by zinc phosphide (24.1%) and yellow phosphorus (19.6%). More than half of the patients (58.6%) presented to the hospital after a delay of more than 2 hours following ingestion.

Table 2: Exposure Characteristics of Rodenticide Poisoning (N = 174)

Variable	Category	Frequency (n)	Percentage (%)
Mode of poisoning	Suicidal	150	86.2
	Accidental	24	13.8
Type of rodenticide*	Aluminum phosphide	98	56.3
	Zinc phosphide	42	24.1
	Yellow phosphorus	34	19.6
Time to hospital	≤2 hours	72	41.4
	>2 hours	102	58.6

The predominance of suicidal ingestion and aluminum phosphide use underscores the high lethality and easy accessibility of these compounds in the community. The high proportion of delayed presentation suggests gaps in early healthcare access and referral systems.

Clinical Presentation at Admission

At the time of admission, tachycardia was observed in 60.9% of patients, while 57.5% presented with

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hypotension, indicating significant hemodynamic instability in a large proportion of cases.

The most common presenting symptom was vomiting (75.9%), followed by abdominal pain (50.6%) and breathlessness (36.8%).

Table 3: Clinical Presentation at Admission (N = 174)

Variable	Category	Frequency (n)	Percentage (%)
Pulse rate	Normal	68	39.1
	Tachycardia	106	60.9
Blood pressure	Normal	74	42.5
	Hypotension	100	57.5
Common symptoms	Vomiting	132	75.9
	Abdominal pain	88	50.6
	Breathlessness	64	36.8

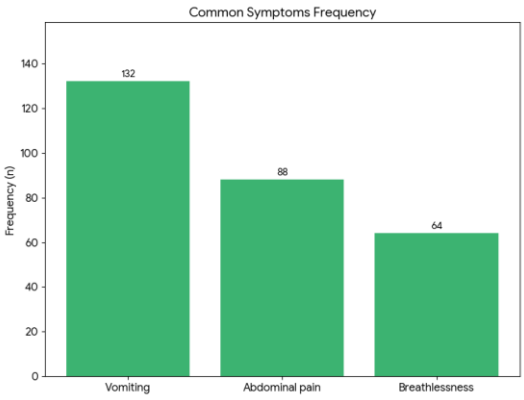

Figure 1 : Frequency of common symptoms

These findings reflect the typical clinical profile of rodenticide poisoning, characterized by early gastrointestinal symptoms followed by cardiovascular compromise, which is a key determinant of severity.

Treatment Outcomes

Among the 174 patients, 99 (56.9%) recovered completely, while 9 (5.2%) developed residual complications. A total of 66 patients died, resulting in an overall case fatality rate of 37.9%.

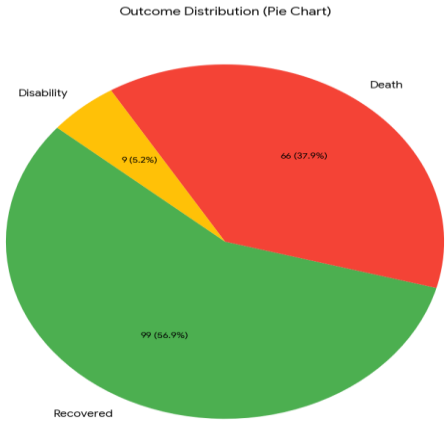

Figure 2 : Outcome distribution

The high mortality rate observed in this study highlights the severe toxicity associated with rodenticides, particularly phosphide compounds, and underscores the need for early and aggressive management.

Bivariate Analysis of Factors Associated with Mortality

On bivariate analysis, multiple clinical and exposure-related variables demonstrated a statistically significant association with mortality among patients with rodenticide poisoning. Mortality was markedly higher among patients with suicidal poisoning, with 42.0% of such cases resulting in death, compared to only 12.5% among those with accidental exposure; this difference was statistically significant ($p = 0.001$), indicating a strong association between intentional ingestion and adverse outcomes.

Similarly, pulse rate at admission showed a significant relationship with mortality. Patients presenting with tachycardia had a substantially higher mortality rate of 49.1%, in contrast to 20.6% among those with a normal pulse rate ($p < 0.001$), suggesting that tachycardia may serve as an early clinical indicator of severe toxicity.

Blood pressure status was also strongly associated with outcomes. Patients with hypotension at presentation exhibited a mortality rate of 51.0%, which was significantly higher than the 20.3% observed among normotensive patients ($p < 0.001$). This finding underscores the critical role of cardiovascular

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compromise in determining prognosis in rodenticide poisoning.

In addition, time to hospital presentation was found to be a significant determinant of mortality. Patients who presented more than 2 hours after ingestion had a mortality rate of 47.1%, compared to 25.0% among those who presented within 2 hours (p = 0.001). This highlights the importance of early medical intervention in improving survival outcomes.

Overall, these findings indicate that both clinical parameters at admission and delays in accessing care are key factors influencing mortality in rodenticide poisoning.

Table 4: Bivariate Analysis of Factors Associated with Mortality

Variable	Category	Death n (%)	Survived n (%)	Chi-square	p-value
Mode	Suicidal	63 (42.0)	87 (58.0)	10.21	0.001
	Accidental	3 (12.5)	21 (87.5)		
Pulse	Tachycardia	52 (49.1)	54 (50.9)	18.34	<0.001
	Normal	14 (20.6)	54 (79.4)		
Blood pressure	Hypotension	51 (51.0)	49 (49.0)	22.15	<0.001
	Normal	15 (20.3)	59 (79.7)		
Time to hospital	>2 hours	48 (47.1)	54 (52.9)	11.62	0.001
	≤2 hours	18 (25.0)	54 (75.0)		

These findings suggest that both clinical severity at presentation and delay in treatment play a crucial role in determining outcomes.

Multivariable Logistic Regression Analysis

Multivariable logistic regression analysis was performed to identify independent predictors of mortality after adjusting for potential confounders. The analysis demonstrated that several variables retained statistical significance, indicating their independent contribution to adverse outcomes.

Suicidal mode of poisoning emerged as the strongest predictor of mortality, with patients having a significantly higher likelihood of death compared to those with accidental exposure (AOR = 9.42; 95% CI: 2.10–42.50; p = 0.003). This suggests that intentional ingestion is associated with more severe exposure and poorer prognosis.

Tachycardia at admission was also found to be an independent predictor, with affected patients having over six times higher odds of mortality compared to those with normal pulse rates (AOR = 6.15; 95% CI: 1.80–20.40; p = 0.005). This reinforces its value as an early clinical marker of systemic toxicity and severity.

Similarly, hypotension was significantly associated with increased mortality risk, with patients exhibiting nearly six-fold higher odds of death (AOR = 5.82; 95% CI: 1.70–19.20; p = 0.007). This highlights the critical impact of hemodynamic instability in determining patient outcomes.

In addition, delayed hospital presentation, defined as more than 2 hours after ingestion, was independently associated with increased mortality (AOR = 4.21; 95% CI: 1.20–14.80; p = 0.012), emphasizing the importance of timely medical intervention in improving survival.

Overall, these findings indicate that both clinical parameters at admission and delays in treatment play a crucial role in predicting mortality. The relatively high adjusted odds ratios and statistically significant associations underscore the robustness of these predictors even after controlling for confounding variables. Together, the model highlights key areas for

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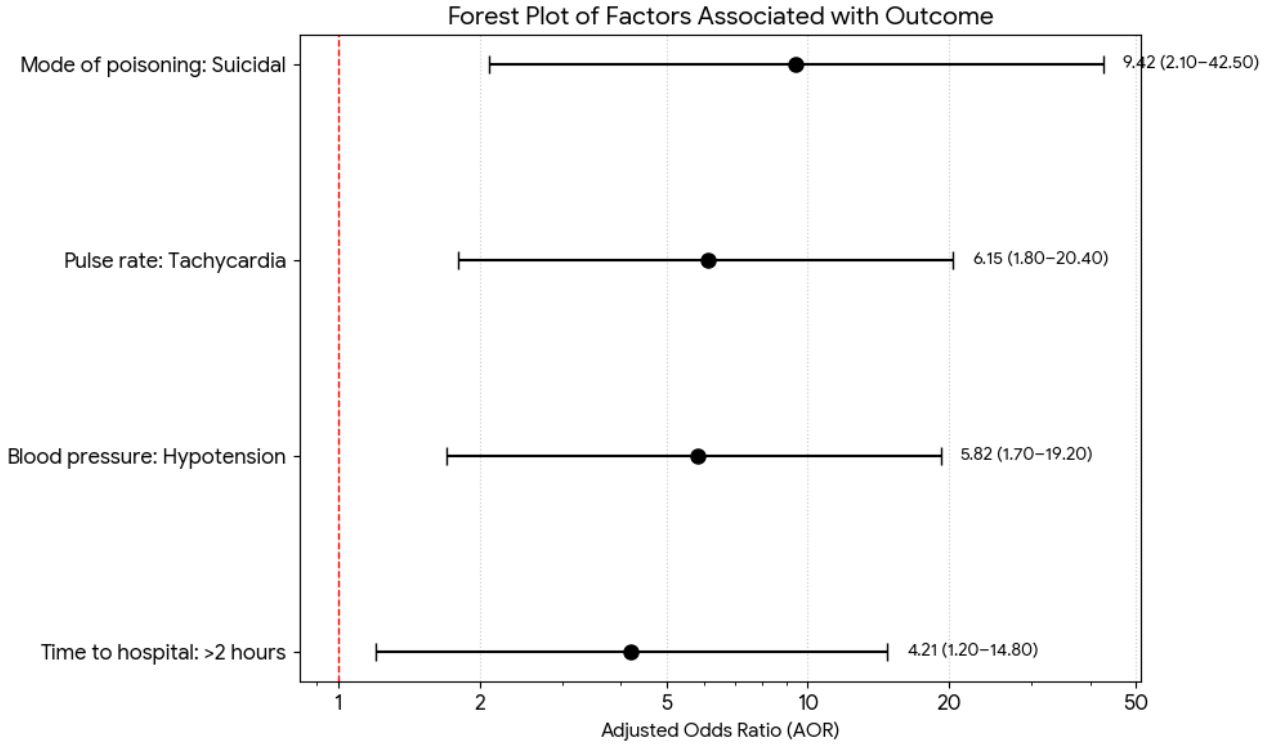
early risk stratification and targeted clinical management in patients with rodenticide poisoning.

Table 5: Multivariable Logistic Regression Analysis of Predictors of Mortality

Variable	Category	Adjusted Odds Ratio (AOR)	95% Confidence Interval	p-value
Mode of poisoning	Suicidal	9.42	2.10 – 42.50	0.003
Pulse rate	Tachycardia	6.15	1.80 – 20.40	0.005
Blood pressure	Hypotension	5.82	1.70 – 19.20	0.007
Time to hospital	>2 hours	4.21	1.20 – 14.80	0.012



These results indicate that both exposure-related factors (intent, delay) and physiological derangements (hemodynamic instability) independently influence mortality risk.

The performance of the logistic regression model indicated good calibration and acceptable explanatory power in predicting mortality among patients with rodenticide poisoning. The Nagelkerke R^2 value of 0.42 suggests that the model explains approximately 42% of the variability in mortality outcomes, reflecting a moderate level of explanatory strength in a clinical context.

The Hosmer–Lemeshow goodness-of-fit test was non-significant ($p = 0.61$), indicating that there is no significant difference between observed and predicted outcomes, and thereby confirming that the model fits the data well.

Furthermore, the overall model accuracy was 78.2%, demonstrating that the model correctly classified a substantial proportion of cases with respect to survival and mortality outcomes.

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Collectively, these indicators confirm that the regression model possesses adequate predictive capability and is statistically reliable for identifying key determinants of mortality in rodenticide poisoning.

DISCUSSION

The present study demonstrates a high mortality rate (37.9%) among patients with rodenticide poisoning, consistent with contemporary Indian and global literature. Recent studies have reported mortality rates ranging from 30% to over 70%, particularly in aluminum phosphide poisoning, highlighting its extreme toxicity[9–11].

The predominance of young adults observed in this study reflects a vulnerable demographic group frequently exposed to psychosocial stressors. Similar findings have been reported in recent Indian hospital-based studies, where individuals in the economically productive age group represent the majority of poisoning cases[13]. This has significant socioeconomic implications, as it affects workforce productivity and family stability.

Intentional self-poisoning was the predominant mode of exposure in this study (86.2%), consistent with national and regional data. A recent analysis of poisoning patterns in India emphasized that pesticide ingestion remains one of the most common methods of suicide due to its accessibility and lethality[13]. The widespread availability of rodenticides without stringent regulatory controls continues to facilitate their use in self-harm[14].

Suicidal ingestion emerged as the strongest predictor of mortality in this study (AOR=9.42). This is likely attributable to larger quantities of poison ingestion and delays in seeking medical care. Similar observations have been reported in recent studies, where intentional poisoning was associated with significantly worse outcomes[15].

Hemodynamic instability at presentation, particularly tachycardia and hypotension, was significantly associated with mortality. These findings align with the known pathophysiology of phosphine toxicity, which leads to myocardial depression, vasodilation, and circulatory collapse[10]. Recent emergency-based studies have demonstrated that parameters such as shock index, mean arterial pressure, and lactate levels are strong predictors of mortality in aluminum phosphide poisoning[12].

Delayed hospital presentation was another critical determinant of mortality. Patients presenting more than two hours after ingestion had significantly higher mortality rates. This finding is consistent with recent literature emphasizing the importance of early intervention in poisoning cases[15]. Delays in accessing healthcare, particularly in rural areas, remain a major challenge in India.

The absence of a specific antidote for phosphide poisoning continues to complicate management. Treatment is primarily supportive, focusing on hemodynamic stabilization, correction of metabolic acidosis, and management of complications. Although therapies such as magnesium sulfate and antioxidants have been explored, their efficacy remains variable[16].

Yellow phosphorus poisoning presents a distinct clinical challenge due to its hepatotoxic effects. Recent Indian studies have reported increasing incidence of yellow phosphorus-induced acute liver failure, with significant mortality rates despite supportive care[6]. Advanced therapies such as plasma exchange and liver transplantation are not widely accessible, further contributing to poor outcomes.

From a public health perspective, the findings of this study underscore the urgent need for:

- Regulation of toxic pesticide sales
- Strengthening mental health services
- Improving emergency response systems

Evidence from global studies suggests that restricting access to highly lethal means can significantly reduce suicide rates[17].

CONCLUSION

Rodenticide poisoning continues to be associated with high mortality in India, particularly in cases of intentional ingestion. Clinical indicators such as tachycardia, hypotension, and delayed presentation are strong predictors of poor outcomes. Early identification and aggressive supportive management are essential to improve survival.

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REFERENCES

1. WHO. Preventing suicide: a global imperative. Geneva; 2014.
2. Gunnell D, Eddleston M. Int J Epidemiol. 2003;32:902–909. doi:10.1093/ije/dyg307
3. D'Silva C. Indian J Crit Care Med. 2019;23:S257–S262.
4. Proudfoot AT. Clin Toxicol. 2009;47:89–100. doi:10.1080/15563650802520675
5. Mathai A, Bhanu MS. Indian J Anaesth. 2010;54:302–307. doi:10.4103/0019-5049.68372
6. Eapen CE, Venkataraman J. J Clin Exp Hepatol. 2021;11:414–417. doi:10.1016/j.jceh.2021.04.011
7. Patel V, et al. Lancet. 2012;379:2343–2351. doi:10.1016/S0140-6736(12)60606-0
8. Eddleston M. BMJ. 2004;328:42–44. doi:10.1136/bmj.328.7430.42
9. Ravichandran R. 2024 study on rodenticide outcomes
10. Rahmani AH. Toxicological profile study 2026
11. Abhilash KPP. 2022 rodenticide trends. doi:10.1016/j.forc.2020.200344
12. Emergency predictors study (ED-based) 2024
13. Western India poisoning study 2025
14. Rodenticide epidemiology India 2024
15. Recent mortality predictor studies (India & LMICs)
16. Karimani A, et al. Toxicol Rep. 2018;5:1053–1059. doi:10.1016/j.toxrep.2018.10.009
17. Hawton K. Lancet. 2001;357:1212–1213. doi:10.1016/S0140-6736(00)04459-1