Toxicology International, *31(3) : 351-360; 2024. DOI: 10.18311/ti/2024/v31i3/42001*

Online ISSN : 0976-5131; Print ISSN : 0971-6580

Toxicology International

Contents available at: www.informaticsjournals.com/index.php/toxi



Poisoning Patterns, Causes, and Implications for Hospital-Centric Interventions- A Retrospective Single-Centre Observational Study from India

Jnanaprakash B. Karanth[1*], Kiran Maribashetti[2], Dharmesh Soneji[3] and Gangapooja J. Karanth[1]

[1]Department of General Medicine, Shripad Hegde Kadave Institute of Medical Sciences, Sirsi - 581204, Karnataka, India; jbkaranth@gmail.com
[2]Department of General Medicine, 155 Base Hospital, Tezpur - 784501, Assam, India
[3]Office of DGAFMS, New Delhi - 110023, India

Abstract

Poisoning poses a significant public health concern in India, with rising trends observed over recent years. The study aims to observe patterns of demographic characteristics, presentation modes, outcomes, and associated factors among poisoning cases in India. A retrospective observational study was conducted on data of individuals admitted for poisoning from 2019 to 2023. Demographics, mode of presentation, type of poisoning, poisonous substances, presenting complaints, ICU admission, outcomes, time of ingestion, time of hospital admission, time delay in treatment initiation, and duration of hospital stay were analysed. Among the 357 individuals, the majority resided in rural areas and had up to a high school education. The majority of the admitted cases were self-poisoning (77.1%) followed by accidental poisoning (22.5%) and one homicide. Most of the self-poisoning cases (42.1%) were young adults (20-29 years), and accidental poisoning (32.9%) were individuals in their forties. Pesticides (67.9%), especially organophosphate and snake bites (100%) were the most common poisoning agents of self-poisoning and accidental poisoning, respectively. Mortality was 5.2% in self-poisoning, and 1.2% in accidental poisoning cases. Most patients who succumbed to the poisoning were in their thirties, with 78.6% requiring ICU admission. These events mostly occurred in autumn, during the daytime. Most patients were unconscious at admission. Self-poisoning using pesticides was the most common reason for admission. Seasons, poisoning agents, time of admission, presenting complaints and treatment delay contributed to the morbidity and mortality. Establishing poison information centres and toxicological units in hospitals is essential for improved management strategies.

Keywords: Healthcare Burden, Intentional Poisoning, Pesticides, Poisoning, Public Health

1. Background

India has observed a significant rise in harm-related deaths (10.6%) from 2007 to 2017[1], with 42% of all poisoning cases being pesticide poisoning[2]. A survey revealed a rate of 7.9 per 100,000/year for fatal poison-related suicides, and the World Health Organization (WHO) estimates an annual death toll of 100,000 due to envenomation, particularly in countries like India with venomous species of animals[3,4]. Pesticides, extensively used in agriculture and households, significantly contribute to self-poisoning cases in India despite efforts to restrict the availability of these poisoning agents. Intentional poisoning using pesticides poses a significant burden on emergency

**Author for correspondence*

Article Received on: 10.03.2024 Revised on: 08.04.2024 Accepted on: 14.04.2024

centres, with poisoning ranking among the main causes of hospital emergency attendance in many countries[5]. Observational studies based in healthcare settings have reported most of the pesticide poisoning to be deliberate rather than accidental exposure, with case fatality rates varying from 5% to over 70%[2,6].

Factors such as financial stress (debt or debt stress, financial hardship, or difficulties)[7,8], psychiatric illnesses (mental health disorders, such as depression, anxiety, and mood disorders)[8], and sociocultural practices, including the patriarchal system (a system of society controlled by men), play pivotal roles in emerging countries like India[5]. These factors contribute not only to the prevalence of suicides but also create a substantial burden on healthcare systems such as demand for emergency services, resource-intensive specialized interventions, and financial strain due to the costs associated with treatment[9].

In addition to personal constraints, intentional poisoning poses a significant burden on emergency centres, raising concerns about resource allocation efficiency[9]. This poses a significant financial strain on hospitals, with the average cost of providing critical care for poisoning cases estimated at ₹3,67,333 per annum[10]. Hence, it is important to know the patterns and outcomes of poisoning cases in the region for proper planning, prevention, and early management. Knowing the pattern will aid in designing training modules for primary care physicians to make them aware of newer poisons and their management in the area. In accordance, the current study reports the demographic, patterns of poisoning, their causes, and outcomes to improve targeted healthcare of poisoning cases.

2. Methodology

2.1 Study Design

This retrospective observational study aimed to analyse data related to poisoning cases admitted to the hospital. The study was conducted from Jan 2019 to Dec 2023, and relevant demographic and clinical variables were collected for analysis.

2.2 Population and Setting

The study included a total of 357 individuals admitted to the hospital for poisoning. The demographic details, including age, gender, BMI, comorbidities, marital status, city of residence, educational background, occupation, financial status, and seasonal trends, were documented.

2.3 Data Collection

Data were collected from hospital records, including patient charts, admission forms, and toxicology reports. The information encompassed the mode of presentation, type of poisoning (accidental, homicide, or self-poisoning), poisonous substances involved, presenting complaints, ICU admission, outcomes, time of ingestion, time of hospital admission, time delay in treatment initiation, and duration of hospital stay.

2.4 Data Analysis

Descriptive statistics were employed to analyze demographic data, including mean age, gender distribution, BMI, comorbidities, marital status, city of residence, educational background, occupation, financial status, and seasonal trends. Frequencies and percentages were utilized for categorical variables. Comparative analyses were conducted for different variables related to the type of poisoning, presenting complaints, ICU admission, outcomes, time of ingestion, time of hospital admission, time delay in treatment initiation, and duration of hospital stay.

2.5 Ethical Considerations

Ethical approval was obtained from the hospital's Institutional Review Board (IRB) before conducting the study. Patient confidentiality was strictly maintained, and all data were anonymized for analysis. Informed consent was not required for this retrospective study.

3. Results

3.1 Demographic Characteristics

The study included 357 individuals with a mean age of 35.0 ± 15.0 years (with 34.5% aged between 20-29) (Figure 1(a)), 54.3% males (Figure 1(e)) and 98.3% being obese (BMI>24.9 kg/m^2) (Figure 1(c)). Almost 80% had a secondary or high-school education (Figure 1(d)), were mostly married (66.1%) (Figure 1(f)), resided in rural areas (86.3%) (Figure 1(g)), were majorly labourers (26.9%) or housewives (26.6%) (Figure 1(i)) and had a financial status categorized as dependent (53.2%) (Figure 1(h)).

Comorbidities were present in 15.7% of cases (Figure 1(b)) and the majority were labourers (27%) (Figure 1(i)).

Figure 1 represents the distribution of (a) age, (b) presence of co-morbidities, (c) BMI, (d) education background, (e) gender, (f) marital status, (g) city, (h) financial status, and (i) occupation.

Among the poisoning cases, 79.5% were poisoning cases, followed by accidental poisoning (23.8%) and one homicidal case (Figure 2(a)). Most poisoning cases occurred in monsoon (39.5%) (Figure 2(c)). The poisoning in most of these cases was due to pesticides (51.5%) or venomous snake bites (23.8%) (Figure 2(b) and Table S1). More than half of these cases presented directly or with relatives (59.1%) (Figure 2(d)). Detailed information on the trend of presentation to the hospital is illustrated in Figure 2.

Figure 2 represents (a) the type of poisoning, (b) the poisoning agent, (c) the seasonal trend and (d) the mode of presentation to the hospital.

The poisoning occurred either in the evening (26.9%) or morning hours (26.1%) (Figure 3(a)) and hospital admissions were predominantly between 12 PM to 4 PM (28.6%) (Figure 3(b)). Vomiting was the most common presenting symptom (35.3%) followed by abdominal pain (31.7%) and nausea (24.4%) (Figure 3(d)). A significant proportion (65.5%) received treatment within 1-2 hours (Figure 3(c)). A recovery rate of 72.5% was noted in the study population, with 11.5% of cases requiring referral to a higher centre, and a 4% in-hospital mortality (Figure 3(f)).

Figure 3 represents the distribution of (a) time of ingestion, (b) time of hospital admission, (c) treatment delay post ingestion, (d) presenting complaints, (e) duration of hospital stay and (f) patient outcomes.

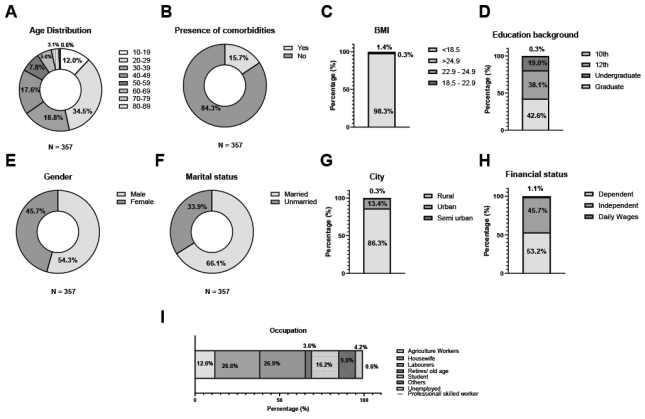


Figure 1. Demographics of the study population.

When compared between poisoning cases and accidental poisoning, differences in the demographics and presentation were noted. Most non-accidental poisoning individuals were in their 20's, while accidental poisoning occurred majorly in those within 40-49 years of age (Table 1). As most of the accidental poisoning involved snake bites, the major presenting symptom was swelling and bite marks (60%), while vomiting (60.1%), abdominal pain (59.1%) and nausea (45.4%) were the most common presenting symptoms among the poisoning group (Table 1). In accidental poisoning, the majority received treatment within 1 hour (41.2%), while poisoning received treatment between 1-2 hours after treatment (52.8%). Accidental poisoning had a 1.2% casualty rate while poisoning cases had 5.2% mortality. The detailed comparison is represented in Table 1. In-hospital mortality was highest among those admitted in the morning (Figure 4(b)).

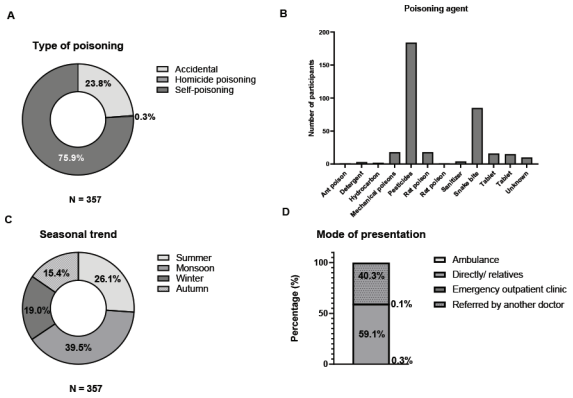


Figure 2. Patterns of poisoning in the study population.

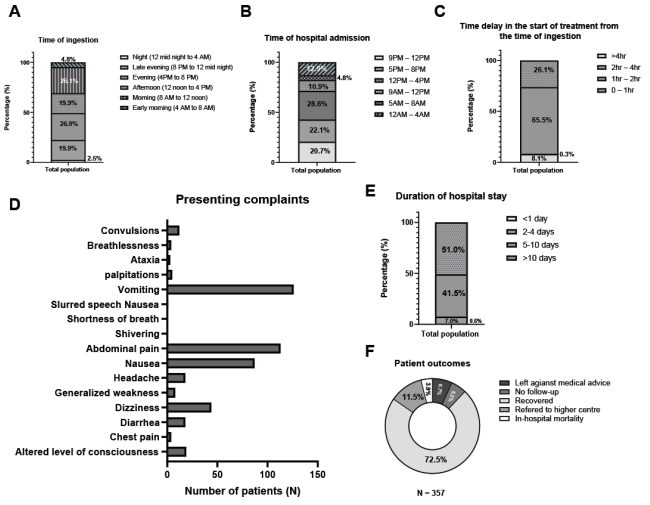


Figure 3. Distribution of In-hospital parameters in poisoning cases.

Table 1. Comparison of type of poisoning with other parameters

	Accidental Poisoning	Non-Accidental Poisoning
	N = 85	**N = 271**
Age distribution		
10-19	13 (15.3%)	30 (11.1%)
20-29	9 (10.6%)	114 (42.1%)
30-39	15 (17.6%)	52 (19.2%)
40-49	28 (32.9%)	35 (12.9%)
50-59	8 (9.4%)	19 (7.0%)
60-69	8 (9.4%)	12 (4.4%)
70-79	3 (3.5%)	8 (3.0%)
80-89	1 (1.2%)	1 (0.4%)
Gender Distribution		
Male	51 (60.0%)	142 (52.4%)
Female	34 (40.0%)	129 (47.6%)
City		
Urban	0 (0.0%)	39 (14.4%)
Semi-urban	9 (10.6%)	1 (0.4%)
Rural	76 (89.4%)	231 (85.2%)
Seasonal trend		
Summer	22 (25.9%)	70 (25.8%)
Monsoon	30 (35.3%)	111 (41.0%)
Winter	19 (22.4%)	49 (18.1%)
Autumn	14 (16.5%)	41 (15.1%)
Mode of presentation		
Ambulance	0 (0.0%)	1 (0.4%)
Directly/ relatives	56 (65.9%)	154 (56.8%)
Emergency outpatient clinic	0 (0.0%)	1 (0.4%)
Referred by another doctor	29 (34.1%)	115 (42.4%)
N	**85**	**268**
ICU admission		
Yes	46 (54.1%)	162 (60.4%)
No	39 (45.9%)	106 (39.6%)
Time of ingestion		
Early morning (4 AM to 8 AM)	6 (7.1%)	11 (4.1%)
Morning (8 AM to 12 noon)	28 (32.9%)	64 (23.6%)
Afternoon (12 noon to 4 PM)	16 (18.8%)	55 (20.3%)
Evening (4 PM to 8 PM)	20 (23.5%)	76 (28.0%)
Late evening (8 PM to 12 midnight)	15 (17.6%)	56 (20.7%)
Night (12 mid-night to 4 AM)	0 (0.0%)	9 (3.3%)
Time of hospital admission		
Midnight – Till 5 AM	11 (12.9%)	35 (12.9%)
5 AM – Till 9 AM	3 (3.5%)	14 (5.2%)
9 AM – Till 1 PM	23 (27.1%)	48 (17.7%)
1 PM – Till 5 PM	13 (15.3%)	56 (20.7%)
5 PM – Till 9 PM	22 (25.9%)	57 (21.0%)
9 PM – Till 12 AM	13 (15.3%)	61 (22.5%)

Table 1. Continued...

	Accidental Poisoning	Non-Accidental Poisoning
	N = 85	**N = 271**
Presenting complaints		
Agitation	3 (3.5%)	0 (0)
Bleeding	31 (36.5%)	0 (0)
Pain	37 (43.5%)	0 (0)
Rash	1 (1.2%)	0 (0)
Swelling	51 (60%)	0 (0)
Abdominal pain	0 (0)	160 (59.7%)
Unconsciousness	1 (1.2%)	22 (8.2%)
Breathlessness	0 (0)	5 (1.9%)
Convulsions	0 (0)	12 (4.5%)
Diarrhea	0 (0)	28 (10.4%)
Dizziness	0 (0)	86 (32.1%)
Nausea	0 (0)	126 (42.0%)
Palpitations	0 (0)	5 (1.9%)
Vomiting	4 (4.7%)	163 (60.8%)
Ataxisa	0 (0)	4 (1.5%)
Blurred vision	0 (0)	2 (0.7%)
Chest pain	0 (0)	11 (4.1%)
Dyspnea	0 (0)	1 (0.4%)
Generalized weakness.	0 (0)	15 (5.6%)
Headache	0 (0)	34 (12.7%)
Shivering	0 (0)	4 (1.5%)
Tremors	0 (0)	2 (0.7%)
Time delay in the start of treatment from the time of ingestion		
0 – 1hr	35 (41.2%)	24 (8.9%)
1hr – 2hr	30 (35.3%)	143 (52.8%)
2hr – 4hr	16 (18.8%)	79 (29.2%)
>4hr	4 (4.7%)	25 (9.2%)
Duration of hospital stay		
<1 day	36 (42.7%)	145 (53.5%)
2 – 4 days	38 (44.7%)	110 (40.6%)
5 – 10 days	11 (12.9%)	14 (5.2%)
>10 days	0 (0.0%)	2 (0.7%)
Outcomes		
Left against medical advice	9 (10.6%)	15 (5.5%)
No follow-up	11 (12.9%)	8 (3.0%)
Recovered	63 (74.1%)	195 (72.0%)
Referred to higher centre	1 (1.2%)	39 (14.4%)
In-hospital mortality	1 (1.2%)	14 (5.2%)

Figure 4 compares patient outcomes with (a) duration of ingestion, (b) hospital admission and (c) treatment initiation post-ingestion.

In the mortality group (n = 14), most of them were between 30-39 years of age, residing in rural areas and during autumn (42.9%) and summer (35.7%) (Table 2). Three-quarters (78.6%) of them required ICU admission. The majority had ingested poison in the morning time (8 AM – 1 PM) (52.1%) and were admitted during the same (49.7%) (Table 2). Loss of consciousness was the most common presenting symptom occurring in more than half of the patients.

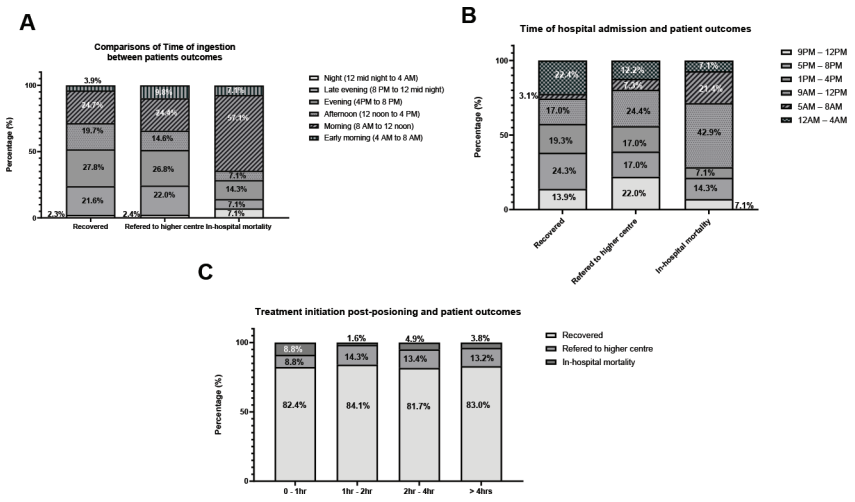


Figure 4. Treatment and patient outcomes.

Table 2. Demographics, characteristics, and presentation of patients with in-hospital mortality

	Mortality Group
N	**14**
Type of poisoning	
Self-poisoning	14 (100%)
Accidental poisoning	0 (0)
Age distribution	
10-19	2 (14.3)
20-29	2 (14.3)
30-39	4 (28.6)
40-49	1 (7.1)
50-59	0 (0)
60-69	2 (14.3)
70-79	1 (7.1)
80-89	0 (0)
Gender Distribution	
Male	9 (64.2)
Female	5 (35.8)
City	
Urban	2 (14.3)
Semi-urban	0 (0)
Rural	12 (85.7)
Seasonal trend	
Summer	5 (35.7)
Monsoon	2 (14.3)
Winter	1 (7.1)
Autumn	6 (42.9)
Mode of presentation	
Ambulance	0 (0)
Directly/ relatives	10 (71.4)
Emergency outpatient clinic	0 (0)
Referred by another doctor	4 (28.6)

Table 2. Continued...

	Mortality Group
N	**14**
ICU admission*	
Yes	11 (78.6)
No	3 (21.4)
Time of ingestion	
Early morning (4 AM to 8 AM)	1 (7.1)
Morning (8 AM to 12 noon)	8 (57.1)
Afternoon (12 noon to 4 PM)	1 (7.1)
Evening (4 PM to 8 PM)	2 (14.3)
Late evening (8 PM to 12 midnight)	1 (7.1)
Night (12 mid-night to 4 AM)	1 (7.1)
Time of hospital admission	
Midnight – Till 5 AM	1 (7.1)
5 AM – Till 9 AM	3 (21.4)
9 AM – Till 1 PM	6 (42.9)
1 PM – Till 5 PM	1 (7.1)
5 PM – Till 9 PM	2 (14.3)
9 PM – Till 12 AM	1 (7.1)
Time delay in the start of treatment from the time of ingestion	
0 – 1hr	4 (28.6)
1hr – 2hr	5 (35.7)
2hr – 4hr	5 (35.7)
>4hr	0 (0)
Duration of hospital stay	
<1 day	7 (50.0)
2 – 4 days	6 (42.9)
5 – 10 days	1 (7.1)
>10 days	0 (0)

Table 2. Continued...

	Mortality Group
N	**14**
Poisoning compound	
Tablet	1 (7.1)
Pesticides	13 (92.9)
Presenting complaints	
Abdominal pain	6 (42.9)
Consciousness	8 (57.1)
Breathlessness	2 (14.3)
Convulsions	3 (21.4)
Diarrhea	4 (28.6)
Dizziness	1 (7.1)
Nausea	1 (7.1)
Palpitations	1 (7.1)
Vomiting	7 (50.0)

*- Directly admitted to ICU at the time of admission. No indicates those who either required ICU at a later stage or were referred to other centres.

Table S1. List of poisoning substances used

Poisoning Substance Used	Count
T. Anxit 0.5 mg	1
Activmax	1
Amitraz	1
ANT poison (Deltamethrin), Glass powder	1
Anxit 0.25 mg	2
Atrazine (Herbicide)	1
Butox (Delltamethrin)	4
$CuSO_4$ powder	1
Dettol	1
Domex with liquid	1
Engine oil (Hydrocarbon)	2
Insecticide	1
Kribhco-DAP (Di Ammonium Phosphate)	1
Laxman Rekha (Cypermetrin)	3
Liquid detergent	1
Miscellaneous	18
Organic yield enhancer	1
Organocarbamates	16
Organophosphates	113
Paraquat	11
Phenol	1
Plant origin (Growth stimulant)	1
Polypills	15

Table S1. Continued....

Poisoning Substance Used	Count
Pyrethrium	1
Pyrethroid	23
Pyrethroid organophosphate	1
Randitidine, and PPi	1
Rat poison (brodifacoum)	5
Ratal (zinc phosphide)	10
Sanitizer	3
Snakebite	85
T. Olanzapine 7.5 mg	1
Tab alprazolam	2
Tab amlodipine 5 mg	1
Tab Benzodiazepine	1
Tab Myotop 150	1
Tab Nite 5 mg	1
Tab Oxcarbazepine 300 mg	1
Tab Clonazepam and alprazolam	1
Tab alprazolam	1
Tab clonazepam	1
Thiamethoxam (Insecticide)	1
Copper sulphate powder and thimit	1
Thimit	2
Thyronorm 100 MCG	2
Unknown	10
Zinc phosphate	2
Zinc phosphate	1

4. Discussion

Our study findings observed patterns of poisoning among patients admitted to the emergency centre. Most of the patients had a high school or lower education status, likely due to the predominantly rural origin of participants (Figure 1(d)). In tandem, the study unveiled a higher prevalence of poisoning cases in rural areas, which could be due to the location of the healthcare centre (Figure 1(g)). Accidental cases constitute less than one-fourth of the study population (Figure 2(a)). Accidental poisoning was majorly due to snake venom bites (90% of them due to vipers) occurring in the mornings and evenings of the monsoon season (35.3%) (Table 1). Epidemio-toxicological profile studies of

poisoning cases in India observed increasing accidental poisoning during daytime and in the monsoon season due to tremendous usage of pesticides and insecticides and the higher prevalence of snakes[11,12]. Major presenting symptoms included swelling, pain, and bleeding (Table 1). Chaudari *et al*., in 2016 also noted similar patterns of symptoms among snakebite victims[13]. Snake bites also account for the majority of poisoning cases in rural areas of India, accounting for 1.2 million deaths over the last two decades[14,15]. However, the current study observed a low mortality rate in accidental poisoning, which is attributable to the majority of them receiving treatment within the first hour of poisoning (Table 1).

Three-fourths of participants were admitted due to non-accidental poisoning (Figure 2(a)). Most of the participants in the poisoning groups were within the age bracket of 20-29 years of age (Table 1). Although the reasons are not delved into in this study, as observed by previous studies this pattern could be due to the myriad challenges faced by youngsters, from academic pressures to family issues and impulsive behaviours[16,17]. No predisposition in gender was observed among the participants (Table 1), but previous studies have observed differences in gender with both male[18,19] and female[20,21] predominance. Pesticides, especially organophosphates were the most common poisoning agent (Figure 2 and Table S1). A systematic review considered pesticides as the major cause of poisoning with an incidence of 63%[9]. Organophosphates are the most common poisoning agent in India as it is easily accessible and lacks stringent laws[22]. Responding to this, the government of India have implemented bans on highly hazardous pesticides, resulting in a significant decrease in pesticide suicides (RR 0.52, 95% CI 0.49-0.54) and total suicides nationally[2]. Vomiting, abdominal pain and nausea were the most common presenting symptoms, with a similar profile of symptoms being observed with organophosphate poisoning in published literature (Table 1)[23].

In the mortality group (n = 14), most of them were between 30-39 years of age, residing in rural areas with autumn and summer (Table 2). An epidemiological study observed similar seasonal patterns with poisoning[24]. Loss of consciousness was the most common presenting symptom occurring in more than half of the patients. A multicenter retrospective study observed a five-fold risk of mortality among poisoning patients with loss of consciousness[25]. The majority had ingested poison in the morning and were admitted during the same period. Three-quarters of the non-accidental poisoning cases required ICU admission, with more than 70% having a treatment delay of more than one hour (Table 2). Delays in admission to hospital and lack of information on the poisoning agent and its antidote have been cited as major reasons for morbidity and mortality among poisoning cases[26]. Hence, developing a centralized information centre with standardized protocols for the effective management of poisons in each region may assist in delivering a better standard of care among poisoning cases and in reducing mortality[27].

5. Limitation of the Study

As with any retrospective study, the current investigation is limited by the lack of details and non-uniformity of the records in the existing data on file. Due to the confidentiality and the sensitivity of the nature of admissions, follow-up of individuals for additional information was not feasible.

6. Summary and Conclusion

The study highlights that poisoning is disproportionately common among young males in rural populations, with pesticides and snake bites emerging as major causes. The findings underscore the significant role of family conflicts in suicidal cases. As a crucial takeaway, the study advocates for the establishment of poison information centres and dedicated toxicological units in tertiary care hospitals to enhance poison-related healthcare and prevention.

7. References

1. National Crime Records Bureau. Accidental deaths and suicides in India.
2. Bonvoisin T, Utyasheva L, Knipe D, Gunnell D, Eddleston M. Suicide by pesticide poisoning in India: A review of pesticide regulations and their impact on suicide trends. BMC Public Health. 2020; 20:1-6. https://doi.org/10.1186/s12889-020-8339-z PMid:32075613 PMCid: PMC7031890
3. Mew EJ, Padmanathan P, Konradsen F, Eddleston M, Chang SS, Phillips MR, Gunnell D. The global burden of fatal self-poisoning with pesticides 2006-15: Systematic review. J

Affect Disord. 2017; 219:93-104. https://doi.org/10.1016/j.jad.2017.05.002 PMid:28535450
4. World Health Organization. Snakebite envenoming: A strategy for prevention and control.
5. Van Hoving DJ, Hunter LD, Lategan HJ, Marks CJ. The burden of intentional self-poisoning on a district-level public Hospital in Cape Town, South Africa. *Afr J Emerg Med*. 2018; 8(3):79-83. https://doi.org/10.1016/j.afjem.2018.03.002 PMid:30456153 PMCid: PMC6223584
6. Sharma A, Balasubramanian P, Gill KD, Bhalla A. Prognostic significance of blood glucose levels and alterations among patients with aluminium phosphide poisoning. Sultan Qaboos Univ Med J. 2018; 18(3):e299. https://doi.org/10.18295/squmj.2018.18.03.006 PMid:30607269 PMCid: PMC6307647
7. Guan N, Guariglia A, Moore P, Xu F, Al-Janabi H. Financial stress and depression in adults: A systematic review. PloS one. 2022; 17(2):e0264041. https://doi.org/10.1371/journal.pone.0264041 PMid:35192652 PMCid: PMC8863240
8. Ryu S, Fan L. The relationship between financial worries and psychological distress among US adults. *J FAM ECON ISS*. 2023; 44(1):16-33. https://doi.org/10.1007/s10834-022-09820-9 PMid:35125855 PMCid: PMC8806009
9. Mittal C, Singh S, Kumar-M P, Varthya SB. Toxic epidemiology of poisoning exhibited in Indian population from 2010 to 2020: A systematic review and meta-analysis. BMJ Open. 2021; 11(5):e045182. https://doi.org/10.1136/bmjopen-2020-045182 PMid:34031112 PMCid: PMC8149432
10. Nambiar R, Dae D, Anjali S. Burden of poisoning on a critical care unit in southern India. Natl Med J India. 2019; 32(4):197-9. https://doi.org/10.4103/0970-258X.291291 PMid:32769238
11. Parekh U, Gupta S. Epidemio-toxicological profile of poisoning cases-a five-year retrospective study. J Forensic Leg Med. 2019; 65:124-32. https://doi.org/10.1016/j.jflm.2019.05.013 PMid:31153007
12. Karanth JB, Maribashetti K, Karanth G. Clinico-epidemiological study done at a tertiary care centre in western ghats of South India and outcome of snakebite cases. Int *J Trop Med Health*. 2023; 44(18):33-9. https://doi.org/10.9734/ijtdh/2023/v44i181476
13. Chaudhari TS, Patil TB, Paithankar MM, Gulhane RV, Patil MB. Predictors of mortality in patients of poisonous snake bite: Experience from a tertiary care hospital in central India. *Int J Crit Illn Inj Sci*. 2014; 4(2):101. https://doi.org/10.4103/2229-5151.134145 PMid:25024937 PMCid: PMC4093960
14. Aggarwal N, Sawlani KK, Chaudhary SC, Usman K, Dandu H, Atam V, Rani S, Chaudhary R. Study of pattern and outcome of acute poisoning cases at tertiary care hospital in North India. *J Family Med Prim Care*. 2023; 12(9):2047-52. https://doi.org/10.4103/jfmpc.jfmpc_592_23 PMid: 38024899 PMCid: PMC10657109
15. Suraweera W, Warrell D, Whitaker R, Menon G, Rodrigues R, Fu SH, Begum R, Sati P, Piyasena K, Bhatia M, Brown P. Trends in snakebite deaths in India from 2000 to 2019 in a nationally representative mortality study. Elife. 2020; 9:e54076. https://doi.org/10.7554/eLife.54076 PMid: 32633232 PMCid: PMC7340498
16. Mathew R, Jamshed N, Aggarwal P, Patel S, Pandey RM. Profile of acute poisoning cases and their outcome in a teaching hospital in North India. *J Family Med Prim Care*. 2019; 8(12):3935. https://doi.org/10.4103/jfmpc.jfmpc_832_19 PMid:31879639 PMCid: PMC6924236
17. Chatterjee S, Verma VK, Hazra A, Pal J. An observational study on acute poisoning in a tertiary care hospital in West Bengal, India. Perspect Clin Res. 2020; 11(2):75. https://doi.org/10.4103/picr.PICR_181_18 PMid:32670832 PMCid: PMC7342341
18. Kaur S, Gupta S, Sadiq S, Khajuria V. Spectrum of acute poisoning: A retrospective observational study in a tertiary care hospital in North India. *Natl J Physiol Pharm Pharmacol*. 2016; 6(3):247. https://doi.org/10.5455/njppp.2016.6.10022016121
19. Ahuja H, Mathai AS, Pannu A, Arora R. Acute poisonings admitted to a tertiary level intensive care unit in northern India: Patient profile and outcomes. *J Clin Diagn Res:* JCDR. 2015; 9(10):UC01. https://doi.org/10.7860/JCDR/2015/16008.6632 PMid:26557594 PMCid: PMC4625313
20. Rageh OE, Sabra HK, Alammar AA, Alanazi ON, Nagy A, Kabbash IA. Profile and outcomes of acute poisoning in the toxicology treatment and control centre at Tanta University Hospital, Egypt. *BMC* Pharmacol Toxicol. 2023; 24(1):1-8. https://doi.org/10.1186/s40360-023-00650-5 PMid:36737823 PMCid: PMC9896829
21. Laher AE, Motara F, Gihwala R, Moolla M. The profile of patients presenting with intentional self-poisoning to the Charlotte Maxeke Johannesburg Academic Hospital emergency department, South Africa. *S Afr Med J*. 2022; 112(5):347-51. https://doi.org/10.7196/SAMJ.2022.v112i5.16366 PMid:35587248
22. Kamath SD, Gautam VK. Study of organophosphorus compound poisoning in a tertiary care hospital and the role of *Peradeniya organophosphorus* poisoning scale as a prognostic marker of the outcome. *J family med prim care*. 2021; 10(11):4160. https://doi.org/10.4103/jfmpc.jfmpc_518_21 PMid:35136783 PMCid: PMC8797078
23. Robb EL, Regina AC, Baker MB. Organophosphate Toxicity. 2023. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024.
24. Nistor N, Jitareanu C, Frasinariu OE, Ciomaga IM, Rugina AL, Streanga V. Epidemiologic profile and triggering factors of voluntary poisoning in teenagers. Medicine. 2017; 96(5). https://doi.org/10.1097/MD.0000000000005831 PMid: 28151858 PMCid: PMC5293421

25. Reda GB, Abate HK, Mekonnen HM, Gared AZ, Beko ZW. The outcome of poisoning and associated factors among patients admitted at referral hospitals in northwest Ethiopia, 2022: A multicenter retrospective study. Open access emergency medicine; 2023. p. 415-25. https://doi.org/10.2147/OAEM.S414743 PMid:38022741 PMCid: PMC10640818
26. Jesslin J, Adepu R, Churi S. Assessment of prevalence and mortality incidences due to poisoning in a South Indian tertiary care teaching hospital**.** Indian J Pharm Sci. 2010; 72(5):587. https://doi.org/10.4103/0250-474X.78525 PMid:21694990 PMCid: PMC3116303
27. Woyessa AH, Palanichamy T. Patterns, associated factors, and clinical outcomes of poisoning among poisoning cases presented to selected hospitals in Western Ethiopia: Hospital-based study. Emerg Med Int. 2020. https://doi.org/10.1155/2020/5741692 PMid:32455021 PMCid: PMC7225863