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Original Article

# Epidemiology, Severity, and Associated Factors of Poisoning Cases and Patient Outcomes

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## Abstract

**Background and aims:** Poisoning represents a significant public health concern in the developing world. This study aimed to investigate the epidemiology, severity, and factors associated with poisoning incidents in the rural regions of western India.

**Methods:** The required data were retrospectively collected from patients admitted to a private 20-bed rural hospital located in Pune, India, for acute poisoning between 2015 and 2019. The study examined patient characteristics, routes and types of exposure, and associated outcomes. Severity assessments were conducted using the Poison Severity Score (PSS) and the Glasgow Coma Scale (GCS) poisoning severity systems. Statistical analyses were performed using the Kruskal-Wallis and chi-square tests.

**Results:** Overall, 386 cases of poisoning were analyzed in this study. The primary sources of poisoning were accidental incidents or envenomation (48.9%), followed by intentional poisoning (42.2%). Poisoning of unknown origin accounted for 8.8% of cases. In terms of the route of exposure, bites or stings (50.7%) were the most common, followed by ingestion (48.7%) and inhalation (0.5%). According to the GCS, mortality was observed in 33% of patients with severe poisoning compared to 15% of those with moderate-grade poisoning. Based on the PSS, 10.5% of patients classified with severe grades of poisoning experienced mortality. All patients with mild severity of poisoning survived and were subsequently discharged from the hospital. An intermediate correlation was observed between GCS and PSS ($r=0.54$, $P\leq0.001$). The overall mortality rate was 3.6% (14 out of 386), while six patients were discharged against medical advice.

**Conclusion:** The findings revealed that the outcomes of poisoning incidents are influenced by patient characteristics, the nature of toxic exposure, and access to an adequate quality of care. Both the GCS and the PSS are effective in predicting clinical severity in patients with poisoning. However, the PSS would benefit from modifications to account for cardiovascular and neurological variables.

**Keywords:** Epidemiology, Severity, Poisoning, Poison severity score, Glasgow coma scale

## Introduction

According to the World Health Organization, approximately 90% of unnatural deaths occur due to poisoning in low- and middle-income countries.[1] The incidence of poisoning in India ranks among the highest globally. In 2014, India reported 316 828 unnatural deaths, as documented in the National Crime Records Bureau report. Intentional self-poisoning emerged as the second most prevalent cause of these unnatural deaths, accounting for 17.9% of the total fatalities (the National Crime Records Bureau).[2] Furthermore, it is estimated that five to six individuals per hundred thousand in India die annually from acute poisoning, making it the fourth leading cause of mortality in rural areas of the country.[3]

Among toxic agents, pesticides represent the most common and lethal systemic poisons in developing countries. The precise rate of pesticide poisoning in India remains unknown; however, it is estimated that between 1 and 1.5 million incidents annually occur, with nearly one-third of these cases being potentially fatal. The high incidence of pesticide poisoning can be attributed to several factors, including agricultural-based economies, poverty, unsafe handling practices, illiteracy, ignorance, and the widespread availability of these toxic substances. Following pesticides, other substances that may lead to poisoning include pharmaceuticals, household chemicals, and animal bites. Of these, pesticides and pharmaceuticals are often used intentionally, whereas animal bites and the ingestion of corrosives, kerosene, and other miscellaneous agents typically occur accidentally.[4]

Although India accounts for nearly half of all global snakebite deaths, this issue remains an underappreciated cause of accidental mortality, particularly in rural areas. This underrecognition is partly due to the tendency of many individuals to forgo modern medical treatment, opting instead for ineffective remedies provided by unqualified practitioners who rely on outdated healing methods. Additionally, the incorrect identification of snake species and the misinterpretation of bite marks can significantly affect treatment decisions and patient outcomes. It is crucial to enhance healthcare services, improve education, and implement awareness campaigns to effectively address this public health issue and prevent avoidable deaths and disabilities.[4,5]

The serious complications and high mortality rates associated with poisoning are frequently correlated with delayed diagnosis and inadequate medical management. Typically, the management of a poisoned patient relies on clinical signs, symptoms, and routine laboratory tests. However, some researchers have utilized a range of laboratory tests as prognostic markers to identify patients at high risk. Various scoring systems have been developed to predict outcomes in poisoning cases, aiding clinicians in assessing the severity and potential prognosis for affected individuals.[6-8] Globally, decision-makers employ the Poison Severity Score (PSS) and the Glasgow Coma Scale (GCS) to assess the severity of poisoning and predict patient outcomes. These tools are instrumental in guiding treatment decisions aiming at reducing the incidence of poisoning-related fatalities.[9] In the hospitals included in our study, the PSS and the GCS were utilized as scoring systems to assess the severity of poisoning cases in rural settings.

This study aimed to investigate the patterns and outcomes of acute poisoning incidents in rural western Maharashtra, a region where there is limited research on such incidents. Collecting data on the characteristics, types, extent, and severity of poisoning cases in this area will significantly aid in the development of targeted interventions designed to reduce morbidity and mortality. Such information is essential for implementing effective planning, prevention, and treatment strategies.

## Materials and Methods

### *Study Design, Site, and Duration*

A one-year retrospective study was conducted in a rural region of western Maharashtra to investigate the epidemiology, severity, and risk factors associated with poisoning cases. The research took place at a private 20-bed rural hospital in Narayangaon, located 50 km from Pune, India, which typically experiences 2-3 admissions per day. A total of 386 patients were assessed using a convenient sampling method, taking into account the feasibility of the study. The data were collected from all patients, both children and adults, who were admitted to the hospital for acute poisoning between 2015 and 2019. Patients treated in the outpatient department, those transferred to other hospitals, and individuals with incomplete medical records were excluded from the analysis.

### *Data Abstraction and Assessment of Poisoning Severity*

A pre-designed patient profile form was utilized to collect data regarding patient characteristics, routes and types of exposure, and outcomes from patients' medical records. Severity assessments were conducted according to the indicators outlined in the GCS and the PSS systems. The PSS for each patient was determined using guidelines from the International Programme on Chemical Safety or the European Association of Poisons Centres and Clinical Toxicologists. The presence of specific symptoms was verified against the medical chart, and the severity grading assigned to each case was based on the most severe symptom(s) or sign(s) observed. Severity was rated on a scale from 0 to 4, indicating no toxicity to severe life-threatening symptoms or death.[10] GCS scores were calculated based on the assessment of motor, verbal, and eye responses. The levels of response were scored from 1, indicating no response, to the maximum values of 4 for eye-opening response, 5 for verbal response, and 6 for motor response.[11] Cases of discharge against medical advice were excluded from the severity assessment and subsequent comparisons with clinical outcomes.

### *Statistical Analysis*

The obtained data were analyzed using SPSS (version 26.0). Descriptive statistics, including frequencies, percentages, means, and standard deviations, were reported. The Kruskal-Wallis test and chi-square test were employed for the quantitative and qualitative assessments of the data, respectively. A significance level of 0.05 was established for all statistical tests.

## Results

In general, 386 cases of poisoning were retrieved from the medical records department of the hospital. Among these cases, the majority were male, accounting for 218 (56.5%) of the total, resulting in a male-to-female ratio of 1:1.3. The median age of the patients was 28 years, with an interquartile range of 1–83 years. The primary reason for poisoning was accidental (48.9%), followed by intentional (42.2%) and unknown causes (8.8%). The predominant route of exposure was through bites or stings (50.8%), followed by ingestion (48.7%) and inhalation (0.5%). The agents responsible for poisoning were categorized as animal bites and stings (50.8%), household and agricultural products (41.4%), drugs (5.8%), unspecified agents (1.5%), and miscellaneous substances (0.5%) (Figure 1). Notably, the substances used for suicide attempts were primarily organophosphate pesticides, followed by various household agents. Additionally, animal bites and stings were identified as the most common causes of accidental poisoning. The length of hospitalization ranged from 1 day to 33 days, with a mean duration of stay of 5.7 days.

### *Patient Characteristics and Factors Associated With Causes of Poisoning*

In terms of gender, accidental poisoning was more prevalent among males, with 116 cases (61.3%), compared

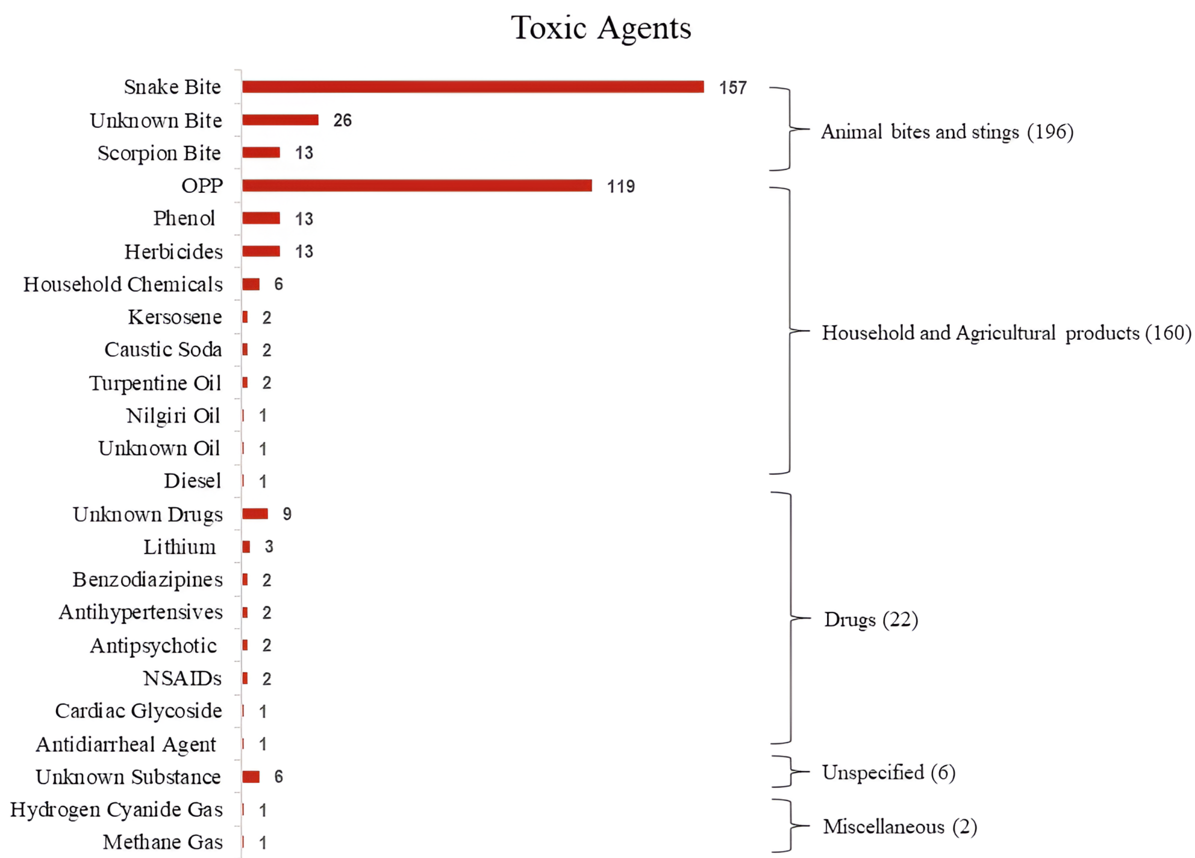


**Figure 1.** Toxic Agents

to females, who had 73 cases (38.6%), yielding a statistically significant difference ($P = 0.008$). Among patients aged 1–25 years, the most common reasons for poisoning were intentional poisoning (n = 81, 49.6%), followed by accidental poisoning (n = 71, 37.5%). In contrast, for patients aged 26–50 years, accidental poisoning was the most frequent cause (n = 83, 43.9%), followed by intentional poisoning (n = 62, 38%). The predominant route of accidental poisoning was bites or stings (168 cases, 88.8%), whereas ingestion (n = 163, 100%) was the most common route for intentional poisoning (Table 1).

### *Assessment of Poisoning Severity Using the GCS and PSS and Comparative Analysis of Severity Assessment Systems*

The assessment of poisoning severity utilizing the GCS revealed that out of 12 patients with severe poisoning, 4 (33%) succumbed to their condition. In contrast, among 63 patients classified as having moderate poisoning, 10 (15.8%) experienced mortality. Of the total cohort of 380 patients, more than 80% (n = 305) demonstrated clinical improvements in the mild poisoning group. Additionally, clinical improvement was observed in 13.9% (n = 53) and 2.1% (n = 8) of patients with moderate and severe poisoning, respectively.

According to the PSS, all patients classified with fatal poisoning (n = 12) experienced mortality. Conversely, only 0.5% of patients with severe poisoning (n = 2 out of 21) died. Approximately 63% (n = 239) of patients with minor poisoning exhibited clinical improvements, followed by 28.4% (n = 108) and 5% (n = 19) of patients with moderate and severe poisoning, respectively.

Based on the GCS and PSS scoring systems, all patients classified with mild or minor severity survived and were subsequently discharged from the hospital. An intermediate correlation was identified between the GCS and PSS, with a correlation coefficient of $r = 0.54$ ($P < 0.001$). Furthermore, a strong correlation ($P \leq 0.0001$) was noted between clinical outcomes and the severity scores of both the GCS and PSS (Tables 2 and 3).

### *Factors Associated With Outcomes of Poisoning*

In-hospital mortality was recorded at 3.6% (14 out of 386 patients), comprising 12 males and 2 females. More than half of the fatalities (n = 8) occurred within the 26–50 years age group (Table 4). The primary causes of death were intentional (suicide) in 11 cases (78.5%) and accidental poisoning in 3 cases (21.4%). Agents contributing to these fatalities included organophosphorus compounds (n = 8), paraquat (n = 3), snake bites (n = 1), unknown bites (n = 1), and kerosene (n = 1).

## Discussion

Poisoning incidents in India are insufficiently documented, particularly in rural areas. According to our findings, the most prevalent intent behind poisoning

**Table 1.** Patient Characteristics and Factors Associated with Causes of Poisoning

| Characteristics | Causes of Poisoning n (%), (N = 386) | | | | *P* Value |
|---|---|---|---|---|---|
| | Total (n = 386) | Accidental (n = 189) | Intentional (n = 163) | Unknown (n = 34) | |
| Gender | | | | | |
| Male | 218 (56.4) | 116 (61.3) | 78 (47.8) | 24 (70.5) | 0.008 |
| Female | 168 (43.5) | 73 (38.6) | 85 (52.1) | 10 (29.4) | |
| Age | | | | | |
| 1-25 | 168 (43.5) | 71 (37.5) | 81 (49.6) | 16 (47) | 0.12 |
| 26-50 | 155 (40.1) | 83 (43.9) | 62 (38) | 10 (29.4) | |
| 51-75 | 60 (15.5) | 34 (17.9) | 18 (11) | 8 (23.5) | |
| Above 75 | 3 (0.7) | 1 (0.5) | 2 (1.2) | 0 | |
| Route of poisoning | | | | | |
| Bite or sting | 196 (50.7) | 168 (88.8) | 0 | 28 (82.3) | 0.0001 |
| Ingestion | 188 (48.7) | 19 (10) | 163 (100) | 6 (17.6) | |
| Inhalation | 2 (0.5) | 2 (1) | 0 | 0 | |
| Agents involved | | | | | |
| Bites and stings from animals | 196 (50.7) | 193 (52.7) | 1 (16.6) | 2 (14.2) | 0.005 |
| Household and Agricultural products | 160 (41.4) | 145 (39.6) | 3 (50) | 12 (85.7) | |
| Drugs | 22 (5.7) | 20 (5.4) | 2 (33.3) | 0 | |
| Unspecified | 6 (1.5) | 6 (1.6) | 0 | 0 | |
| Miscellaneous | 2 (0.5) | 2 (0.5) | 0 | 0 | |

*Note*. N: Total population; n: Part of the total population. $P \leq 0.05$ is statistically significant.

**Table 2.** Assessment of Poisoning Severity Using the GCS and PSS

| Severity Scale | Rural Hospital (N = 380) | | *P* Value |
|---|---|---|---|
| | Improved, n (%) | Deceased, n (%) | |
| Glasgow Coma Scale | | | |
| Mild | 305 (80.2) | 0 | 0.0001 |
| Moderate | 53 (13.9) | 10 (2.6) | |
| Severe | 8 (2.1) | 4 (1.1) | |
| Poison Severity Scale | | | |
| Minor | 239 (62.9) | 0 | 0.0001 |
| Moderate | 108 (28.4) | 0 | |
| Severe | 19 (5) | 2 (0.5) | |
| Fatal | 0 | 12 (3.2) | |

*Note*. DAMA: Discharge against medical advice; GCS: Glasgow Coma Scale; PSS: Poison Severity Score; N: Total population. $P \leq 0.05$ is considered statistically significant. DAMA cases (n = 6) were excluded from severity assessment.

**Table 3.** Comparative Analysis of Severity Scoring Systems (GCS and PSS)

| Outcomes | GCS Score Mean ± SD | PSS Score Mean ± SD |
|---|---|---|
| Improved | 13.62 ± 1.34 | 1.44 ± 0.72 |
| Deceased | 8.65 ± 2.46 | 3.87 ± 0.34 |
| Total | 13.53 ± 1.61 | 1.42 ± 0.78 |
| *P* value | 0.0001 | 0.0001 |

*Note*. GCS: Glasgow Coma Scale; PSS: Poison Severity Score; SD: Standard deviation.

was accidental (48.9%), followed by intentional (42.2%). This contrasts with the result of numerous studies conducted in India, China, and Uganda, which identified intentional poisoning as the predominant motivation for such incidents[12-15] This discrepancy may be attributed to variations in geography and occupational factors.[16,17]

Snake bites are the leading cause of accidental poisoning, followed by unknown bites and scorpion stings. The incidence of snake bites was higher among men (59.3%) compared to women (40.6%). This finding is consistent with the results of several other studies,[18-20] reporting a higher incidence of snake bites in men. This trend may be attributed to behavioral factors and the nature of their farming occupations. The most significant factor in this context is the work environment of farm workers. The presence of thick and dense grassland increases their susceptibility to snake bites. It was observed that the majority of poisoning cases involved patients aged 1–25 years, particularly children between the ages of 1 and 12, with snake bites identified as the primary cause of accidental poisoning. This may be attributed to their increased engagement in outdoor activities. In rural India, older children are frequently tasked with various outdoor responsibilities, such as cattle grazing, grass cutting, and collecting firewood, placing them at greater risk for snake bites.[13,18-20] The findings of the present study revealed that the majority of snake bites occurred during the monsoon

**Table 4.** Factors Associated with Outcomes of Poisoning

| Characteristics | Outcomes of Poisoning n (%), (N=386) | | | | *P* Value |
|---|---|---|---|---|---|
| | Total (n=386) | Recovered (n=366) | DAMA (n=6) | Death (n=14) | |
| Gender | | | | | |
| Male | 218 (56.4) | 203 (55.4) | 3 (50) | 12 (85.7) | 0.008 |
| Female | 168 (43.5) | 163 (44.5) | 3 (50) | 2 (14.2) | |
| Age | | | | | |
| 1-25 | 168 (43.5) | 162 (44.2) | 3 (50) | 3 (21.4) | 0.5 |
| 26-50 | 155 (40.1) | 146 (39.8) | 1 (16.6) | 8 (57.1) | |
| 51-75 | 60 (15.5) | 55 (15) | 2 (33.3) | 3 (21.4) | |
| Above 75 | 3 (0.7) | 3 (4.5) | 0 | 0 | |
| Route of poisoning | | | | | |
| Bite or sting | 196 (50.7) | 193 (52.7) | 1 (16.6) | 2 (14.2) | 0.0001 |
| Ingestion | 188 (48.7) | 171 (46.7) | 5 (83.3) | 12 (85.7) | |
| Inhalation | 2 (0.5) | 2 (0.5) | 0 | 0 | |
| Agents involved | | | | | |
| Animal bites and stings | 196 (50.7) | 193 (52.7) | 1 (16.6) | 2 (14.2) | 0.005 |
| Household and agricultural products | 160 (41.4) | 145 (39.6) | 3 (50) | 12 (85.7) | |
| Drugs | 22 (5.7) | 20 (5.4) | 2 (33.3) | 0 | |
| Unspecified | 6 (1.5) | 6 (1.6) | 0 | 0 | |
| Miscellaneous | 2 (0.5) | 2 (0.5) | 0 | 0 | |

*Note*. DAMA: Discharge against medical advice; GCS: Glasgow Coma Scale; PSS: Poison Severity Score; N: Total population; n: Part of the total population, $P \leq 0.05$ is statistically significant.

season, which extends from June to September. This trend is likely due to the increased agricultural activities that take place during this period. Additionally, snake activity tends to rise during the monsoon season as a result of the warm weather and rainfall.[21-24]

Pesticides were identified as the most common cause of intentional poisoning. As an agrarian country, India heavily relies on organophosphorus pesticides for crop protection and pest control. Consequently, farmers who accidentally overexpose themselves while handling these pesticides are at risk of experiencing adverse health effects. Furthermore, due to their low cost and easy accessibility, these pesticides have also become a substance of choice for self-poisoning.[25] The situation is similar in the neighboring countries such as Bangladesh and Sri Lanka.[21, 26] It has been observed that the majority of pesticide poisoning cases were due to self-harm, which can be attributed to the easy availability of pesticides in rural areas, where agricultural activities are predominant. In this study, males (56.5%) were more affected than females (43.5%). This male predominance may be linked to the greater vulnerability of males to the stress and strain associated with monsoon-dependent agricultural practices, as well as other occupational hazards.[27] Conversely, female self-poisoning can be attributed to factors such as heightened emotional volatility, illiteracy, ignorance, marital conflicts, family disputes, economic hardship, and a lack of support from family members regarding their long-term illnesses. The results of a study conducted by Peshin and Gupta demonstrated a notable shift in the epidemiology of self-poisoning cases in Central India, transitioning from predominantly male farmers to young housewives.[28] Poisoning by household agents was identified as the second-highest cause of self-harm, following pesticide exposure. The observation that all self-poisoning cases involved poisonous substances obtained from within or just outside the home highlights the urgent need for proper storage and management of these agents.[29] Poisoning due to pharmaceutical products was detected in 5.8% of the cases. While self-harm associated with the consumption of pharmaceutical products is a significant concern in urban areas, it is also increasingly prevalent in rural regions. In the present study, the highest incidence of abuse was related to sedatives and hypnotics, followed by non-steroidal anti-inflammatory drugs. This finding contrasts with the report submitted by the Poison Statistics National Data 2018 in the United States, indicating that the highest incidence of abuse was associated with analgesics, followed by sedatives, hypnotics, and antipsychotics.[30] Intentional drug poisoning was reported in 63.6% of cases among women, compared to 27.3% among men, with the highest prevalence observed in the 1-25 years age group, particularly among adolescents and young adults. The increased incidence of cases among females can be attributed to factors such as domestic violence, the emotional challenges faced by young women and girls, and their heightened vulnerability to stress during puberty.

The present study assessed the effectiveness of both the GCS and PSS in relation to clinical outcomes. Our findings indicated that both the GCS and PSS were effective in predicting the severity of poisoning among patients, consistent with the results of other studies. Churi et al [7] found a moderate correlation between the GCS and PSS, concluding that both scoring systems are effective tools for assessing poisoning severity. Similar findings were reported by Davies et al[8] and Akdur et al.[31] However, in our study, it was found that the PSS was more challenging to apply in poisoned patients compared to the GCS, which aligns with the findings of previous studies.[8,31] In contrast to the GCS, which consists of a limited number of variables, the PSS includes 12 distinct categories based on the affected organ systems, each with numerous variables. This complexity makes the GCS easier to remember and apply. Additionally, the PSS does not incorporate blood pressure monitoring within its cardiovascular system variables, despite the fact that fluctuations in blood pressure can result from a toxin's effects on cardiac contractility, peripheral vascular resistance, intravascular volume, and neuronal function. Furthermore, the assessment of the nervous system in the PSS lacks critical components such as ocular and motor responses, which are included in the GCS. This omission may compromise the sensitivity and accuracy of the PSS.[32] However, the significance of these ratings can considerably vary depending on the specific type of exposure. Several studies have demonstrated significant variability among raters when using the PSS and GCS for severity assessment.[33] Developing an exposure-specific scoring system or a modified version of the PSS could enhance the reliability and usability of the assessment tool.[34]

The mortality rate observed in our study was 3.63%, which is lower than the rates reported in other studies conducted in India, where mortality ranged from 10% to 20%.[17,30] This phenomenon may be attributed to several factors, including the composition of the poison, the dosage ingested, the interval between ingestion and hospitalization, and the accessibility of medical assistance. Previous studies reported a significant correlation between the delay in seeking hospitalization and mortality rates in cases of poisoning. In many rural areas, poisoning victims are initially taken to local primary health centers before being referred to specialized hospitals in nearby cities. This referral process often leads to prolonged delays in receiving medical care following the consumption of toxic substances[35-37] Our study was performed at a private 20-bed hospital equipped with modern healthcare facilities located in a rural area. As a result, poisoning patients received immediate, high-quality medical care with minimal time lag, which may contribute to the low mortality rate observed in our study. Additionally, the reduced mortality rates and shorter lengths of stay may reflect the effectiveness of the management approaches employed in this setting.

## Conclusion

The findings of the present study demonstrated that the outcomes of poisoning are influenced by various factors, including patient characteristics, routes of toxic exposure, types of poison, and access to adequate quality of care. Both the GCS and the PSS were found to be effective tools for assessing clinical severity among patients with poisoning. However, the PSS has shown limited clinical utility due to its complexity in comparison to the GCS. Consistent with the findings of previous studies and our observations, we contend that the PSS cannot be universally applied to all types of exposures, which limits its generalizability. This necessitates critical modifications that may incorporate cardiovascular, ocular, and motor variables. Given the significant burden of poisoning in India, there is a pressing need for additional surveillance studies to explore the epidemiological patterns of poisoning and to develop strategies for raising awareness within rural populations.

### Authors' Contribution

**Conceptualization:** Ali Haider Asad, Asawari Raut.
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**Formal analysis:** Ali Haider Asad, Asawari Raut.
**Funding acquisition:** Ali Haider Asad, Asawari Raut.
**Investigation:** Ali Haider Asad, Asawari Raut.
**Methodology:** Ali Haider Asad, Asawari Raut.
**Project administration:** Ali Haider Asad, Asawari Raut.
**Resources:** Ali Haider Asad, Asawari Raut.
**Software:** Ali Haider Asad, Asawari Raut.
**Supervision:** Ali Haider Asad, Asawari Raut.
**Validation:** Ali Haider Asad, Asawari Raut.
**Visualization:** Ali Haider Asad, Asawari Raut.
**Writing–original draft:** Ali Haider Asad, Asawari Raut.
**Writing–review & editing:** Ali Haider Asad, Asawari Raut, Vaibhav R. Suryawanshi.

### Competing Interests

The authors declare that there is no conflict of interests regarding the publication of this article.

### Ethical Approval

The study received approval from the Institutional Ethics Committee of Bharati Vidyapeeth (Deemed to be University) Medical College (Reference No. BVDUMC/IEC/100E).


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