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**Original Research Article**

# Occupational Risk, Temporal Trends and Clinical Outcomes in Snakebite Envenomation

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**Abstract:**

**Background:** Snakebite envenomation remains a significant but neglected tropical disease, disproportionately affecting rural and agrarian populations in low- and middle-income countries. Despite global reductions in mortality, India continues to contribute substantially to the worldwide burden.

**Objectives:** To assess the occupational risk, temporal trends, clinical features, and outcomes of snakebite envenomation in a rural hospital setting.

**Methods:** This hospital-based observational study was conducted over 12 months at a tertiary care centre serving predominantly agrarian communities. A total of 100 consecutive patients with confirmed or suspected snakebite presenting within 24 hours of the incident were included. Data were collected on demographic factors, bite characteristics, clinical features, management, and outcomes.

**Results:** Farmers accounted for the majority of victims (81%), reflecting occupational vulnerability. Poisonous bites were more common among males (41 cases), while females more often sustained non-poisonous bites. Temporal analysis revealed peak incidence during evening hours (4–8 pm). The lower extremities were the most frequent bite sites (89% of cases). Vasculotoxic (28 cases) and neurotoxic (14 cases) envenomations were associated with systemic complications including bleeding, cellulitis, gangrene, and respiratory compromise. Anti-snake venom was administered in 28 cases, with supportive interventions such as diuretics, hemodialysis, and blood transfusion in selected patients. Mortality occurred in three vasculotoxic and two neurotoxic cases, whereas no deaths were observed in local toxicity cases.

**Conclusion:** Snakebite envenomation in rural regions is primarily an occupational hazard for farmers, with evening outdoor activity posing the greatest risk. Lower limb involvement predominates, and systemic envenomation contributes significantly to morbidity and mortality. Timely administration of anti-snake venom and reducing preventable deaths and complications.

**Keywords:** Snakebite envenomation, Temporal trends, Morbidity and mortality.



## Introduction

Snakebite envenomation remains a neglected tropical disease of major global health significance, particularly in low- and middle-income countries with tropical and subtropical climates. The World Health Organization (WHO) estimates that 1.8–2.7 million people are envenomed each year, resulting in 81,000–138,000 deaths, with many survivors left with chronic disability [1]. This burden is heavily concentrated in rural and agrarian regions, where health infrastructure is limited and occupational exposure is high.

Occupational risk is a critical factor influencing the incidence of snakebite. Farmers, field labourers, and outdoor workers are disproportionately affected due to frequent exposure in agricultural environments [1,2]. An Indian study reported that over 50% of venomous snakebite victims were farmers, with seasonal peaks during the monsoon when field activity is greatest [3]. In contrast, occupational bites account for a smaller proportion in high-income countries, where they primarily involve landscapers, herpetologists, or individuals directly handling snakes [4].

Temporal trends demonstrate some improvements in recent decades. Globally, snakebite mortality has declined by about 36% between 1990 and 2019, yet approximately 63,400 deaths still occurred in 2019 [5]. India alone contributes nearly 50,000 deaths annually, underscoring its disproportionate global burden [6]. Despite these reductions, progress

remains insufficient to meet the WHO's target of halving snakebite mortality and morbidity by 2030 [1]. Clinical outcomes following envenomation vary widely depending on the species involved, timeliness of antivenom therapy, and systemic complications. Morbidity in Indian case series has been reported in up to 16% of victims, including acute kidney injury (AKI), respiratory failure, and coagulopathy, though the majority recover with timely treatment [3]. AKI is a particularly serious complication in South Asia, with mortality ranging between 9% and 52% and a significant proportion progressing to chronic kidney disease [7]. Delay in hospital presentation is strongly linked to poor prognosis. For example, in pediatric cases, mortality rises to nearly 38% when antivenom is delayed beyond 12 hours, compared with less than 1% when administered within 6 hours [8].

Together, these findings highlight snakebite as both an occupational and public health emergency. Understanding the intersections of occupational risk, temporal epidemiological trends, and clinical outcomes is essential for developing targeted preventive strategies and strengthening health systems in snakebite-endemic regions.

## Materials and Methods

**Study Design and Setting:** This was an observational, hospital-based study conducted at a tertiary care centre. The study was carried out over a defined period of 12 months. The hospital caters to both emergency and referred cases of snakebite from surrounding villages and agricultural communities, thereby providing a representative sample of the regional burden.

**Study Population:** A total of 100 consecutive patients presenting with a history of snakebite and admitted to the emergency or medical wards were included. Both poisonous and non-poisonous snakebite cases were considered. Patients of all ages and both genders were eligible.

**Inclusion Criteria:**

- Patients with a confirmed or clinically suspected history of snakebite.
- Cases presenting within 24 hours of the bite.
- Patients (or guardians) providing informed consent.

**Exclusion Criteria:**

- Patients with uncertain history of bite or other causes of envenomation.
- Cases discharged against medical advice before initiation of treatment.

**Data Collection:** Data were collected using a structured proforma at admission and during the course of hospital stay. Information was obtained through direct patient/attendant interview, clinical examination, and review of medical records.

## Result

The results of this observational study, encompassing 100 cases of snakebite, reveal distinct demographic, clinical, and management trends. A predominant proportion of snakebite victims were farmers (81 cases), illustrating the occupational risk faced by individuals in agrarian regions, while housewives and students each accounted for 9 cases, and there was a single snake charmer affected (Figure 1). This demographic distribution highlights the exposure risk for those frequently engaged in outdoor or field activities.

Analysing gender and type of snake exposure, males represented the majority of poisonous bite cases (41 males with poisonous, 25 with non-poisonous bites), whereas among females, 24 experienced non-poisonous and 10 poisonous bites (Figure 2). A notable trend emerged in the timing of snakebite events: poisonous snakebites occurred most commonly during the evening hours (27 cases, 4 pm to 8 pm), followed by nighttime (10 cases, 8 pm to 6 am), morning (9 cases, 6 am to 12 pm), and afternoon (5 cases, 12 pm to 4 pm). The occurrence of non-poisonous bites was also highest in the evening (23 cases), with descending frequency in the afternoon (8), night (12), and morning (6). This temporal pattern suggests increased risk during active and twilight periods, potentially linked to both human activity and snake behaviour (Figure 3).

Assessment of anatomical bite sites revealed that exposure of the lower extremities far outweighed upper limb involvement—with 49 lower extremity cases in non-poisonous and 40 in poisonous bites, compared to just 9 and 2, respectively, for the upper extremities (Table 1). This pattern underscores the likelihood of snake encounters while walking or working at ground level.

When evaluating clinical features, local toxic effects were present in 26 vasculotoxic cases and 10 neurotoxic cases. A smaller subset included presentations without local toxicity: 2 vasculotoxic and 4 neurotoxic cases. (Table 2 and Table 3).

Management strategies reflected the severity of envenomation. Anti-snake venom (ASV) therapy was administered in 28 cases, while supportive care such as diuretics, hemodialysis, and blood transfusion was required in 9, 5, and 3 cases respectively, indicating that a substantial fraction of patients experienced significant systemic complications necessitating specialized interventions (Table 3).

Outcome analysis revealed that neurotoxic bites resulted in two deaths out of 14 cases, vasculotoxic in three deaths out of 28 cases, and there were no deaths among cases of local toxicity.

This demonstrates the higher lethality associated with systemic effects of neurotoxic and vasculotoxic

envenomation compared to local effects (Table 4). Overall, these results underscore the occupational and behavioural predispositions in snakebite epidemiology and clarify the critical importance of early identification and targeted therapeutic management, especially for bites manifesting significant systemic toxicity. This study provides actionable insights into the distribution, risks, clinical features, and outcomes of snakebite cases in a hospital setting.

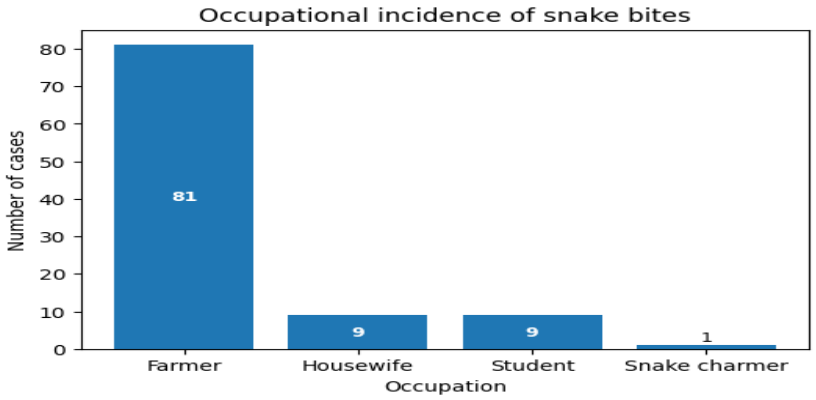


**Figure 1: Occupational distribution of snakebite cases**

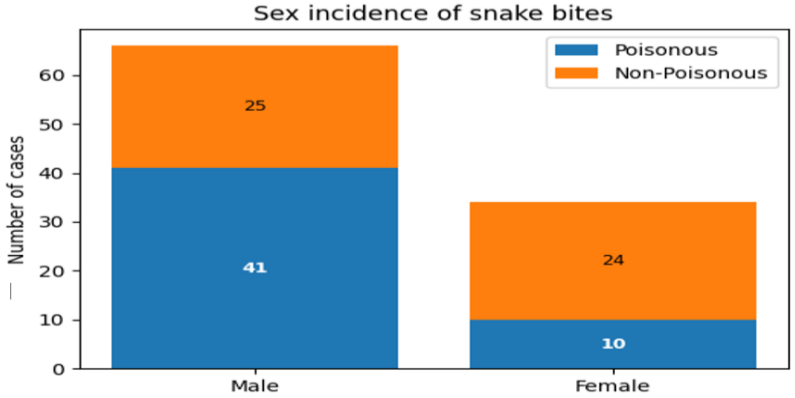


**Figure 2: Sex-wise incidence of snakebite cases (Poisonous vs Non-poisonous)**

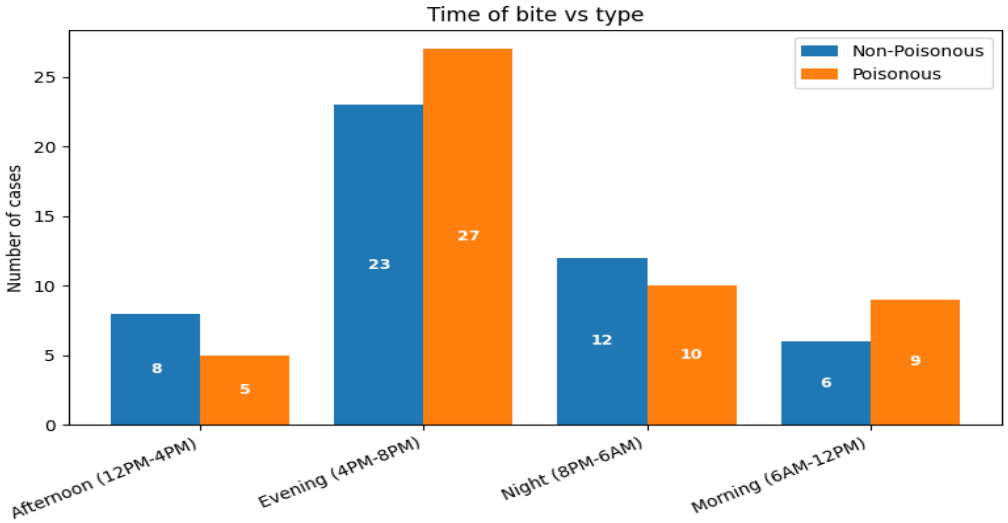


**Figure 3: Time of bite in relation to type of snakebite**

**Table 1: Distribution of snakebite cases according to site of bite**

| Site | Non-Poisonous | Poisonous |
|---|---|---|
| Upper Extremity | 9 (9.0%) | 2 (2.0%) |
| Lower Extremity | 40 (40.0%) | 49 (49.0%) |
| Total = 100 | 49 (49.0%) | 51 (51.0%) |

**Table 2: Distribution of cases with and without local toxicity**

| Category | VT | NT |
|---|---|---|
| With local toxicity | 26 (51.0%) | 10 (19.6%) |
| Without local toxicity | 2 (3.9%) | 4 (7.8%) |
| | 28 (54.0%) | 14 (27.5%) |

**Table 3: Treatment modalities given in snakebite cases**

| Treatment | Cases |
|---|---|
| ASV | 28 (100.0%) |
| Diuretics | 9 (32.1%) |
| Hemodialysis | 9 (17.9%) |
| Blood transfusion | 3 (10.7%) |

**Table 4: Type of envenomation and associated mortality**

| Type | Cases | Deaths |
|---|---|---|
| Neuroparalytic | 14 (27.5%) | 2 (14.3%) |
| Vasculotoxic | 28 (54.9%) | 3 (10.7%) |
| Locally toxic | 9 (17.6%) | 0 (0.0%) |
| | 51 (100%) | 5 (9.8%) |

## Discussion

The present observational study highlights the complex interplay of occupational exposure, temporal patterns, and clinical outcomes in snakebite envenomation in a rural agrarian setting.

Farmers constituted the overwhelming majority of victims, underscoring snakebite as an occupational hazard for individuals engaged in agricultural activities. This finding is consistent with prior reports from India and South Asia, where farming communities are disproportionately affected due to their frequent outdoor exposure and barefoot agricultural practices [9]. Housewives and students, though less frequently affected, also represent at-risk groups owing to domestic and peri-domestic exposures.

Gender distribution revealed a male predominance in poisonous bites, reflecting greater outdoor activity and occupational risk in this group. Female victims were more frequently affected by non-poisonous bites, possibly related to peri-household encounters. These trends emphasize the need for gender- and occupation-specific preventive strategies, including community awareness and protective footwear [10]. The temporal analysis showed peak incidence of bites during evening hours, coinciding with both human outdoor activity and snake foraging behaviour.

This pattern mirrors observations from other Indian and tropical settings, where dusk and early night are established high-risk periods [11]. Preventive measures, such as use of torches during evening hours and safe farming practices, could help reduce exposure during these vulnerable times.

Anatomical distribution demonstrated a strong predilection for lower limb involvement, particularly the feet and legs, which is in line with the common mode of accidental contact while walking or farming at ground level. This reiterates the importance of simple protective measures like wearing boots or leg guards in endemic areas [12].

Clinically, vasculotoxic and neurotoxic bites produced the most severe systemic manifestations. Vasculotoxic cases presented with bleeding, cellulitis, and gangrene, while neurotoxic cases demonstrated paralysis and respiratory compromise, both contributing significantly to morbidity and mortality [13]. Local toxicity, though painful and debilitating, was rarely fatal. These findings support the heterogeneity of clinical syndromes based on venom type, highlighting the need for early recognition and syndrome-based management [14].

Treatment outcomes further underscore the critical role of timely administration of anti-snake venom (ASV). In this cohort, patients requiring additional interventions such as hemodialysis, diuretics, or blood transfusion had evidence of systemic complications, particularly acute kidney injury and hematological derangements [15]. Mortality was confined to systemic envenomation—three deaths in vasculotoxic cases and two in neurotoxic cases—emphasizing that fatal outcomes are largely preventable with prompt and appropriate care [16].

The study findings reinforce the importance of strengthening rural health systems to ensure rapid access to ASV and supportive care. Community education regarding early hospital presentation, coupled with preventive measures such as safe footwear and use of light sources at night, are key to reducing the burden [17]. Furthermore, the temporal and occupational patterns identified here should inform public health strategies targeting the most vulnerable groups [18].

## Conclusion

Snakebite envenomation remains a major occupational and public health challenge in rural settings, with farmers being the most affected group and evening hours posing the highest risk. Most bites involved the lower limbs, reflecting ground-level exposure during agricultural work. Vasculotoxic and neurotoxic bites were associated with significant morbidity and mortality, whereas local toxicity was rarely fatal. The study highlights the need for timely administration of anti-snake venom and community awareness to reduce preventable deaths and complications.

## References:


1. World Health Organization. Snakebite envenoming: a strategy for prevention and control [Internet]. Geneva: WHO; 2019 [cited 2025 Sep 11]. Available from: https://www.who.int/publications/i/item/9789241515641
2. Alirol E, Sharma SK, Bawaskar HS, Kuch U, Chappuis F. Snake bite in South Asia: a review. PLoS Negl Trop Dis. 2010;4(1):e603.
3. Pati S, Sinha R, Mohanty A, Sahoo J, Mohanty AK, Samal A. Clinical profile and outcome of venomous snake bite in eastern India. J Family Med Prim Care. 2023; 12(4):789–95.
4. Seifert SA, Boyer LV, Benson BE, Rogers JJ. A prospective study of occupational snake bites in the United States. Wilderness Environ Med. 2011; 22(2):122–6.
5. GBD 2019 Diseases and Injuries Collaborators. Global, regional, and national burden of snakebite envenoming, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. Lancet Glob Health. 2021; 9(9):e1230–41.
6. Suraweera W, Warrell D, Whitaker R, Menon G, Rodrigues R, Fu SH, et al. Trends in snakebite deaths in India from 2000 to 2019 in a nationally representative mortality study. eLife. 2020; 9:e54076.
7. Priyamvada PS, Mithra P, Jeganathan N, Singh P, Srinivas BH, Dutta TK, et al. Snake bite induced acute kidney injury: Clinical profile and predictors of poor outcome. Trop Med Int Health. 2023; 28(6):439–48.
8. Singh K, Kumar A, Rani R, Kaur H. Pediatric snake envenomation: Predictors of poor outcome and mortality. Indian J Crit Care Med. 2024; 28(1):23–30.
9. Bawaskar HS, Bawaskar PH. Snakebite envenoming: A neglected tropical disease in India. Trans R Soc Trop Med Hyg. 2016; 110(1):3–4.
10. Sharma SK, Chappuis F, Jha N, Bovier PA, Loutan L, Koirala S. Impact of snake bites and determinants of fatal outcomes in southeastern Nepal. Am J Trop Med Hyg. 2004; 71(2):234–8.
11. Michael GC, Thacher TD, Shehu MIL. The effect of pre-hospital care for venomous snake bite on outcome in Nigeria. Trans R Soc Trop Med Hyg. 2011; 105(2):95–101.
12. Punde DP. Management of snake-bite in rural Maharashtra: a 10-year experience. Natl Med J India. 2005; 18(2):71–3.
13. Warrell DA. Guidelines for the management of snake-bites. 2nd ed. Geneva: World Health Organization; 2016.
14. Mohapatra B, Warrell DA, Suraweera W, Bhatia P, Dhingra N, Jotkar RM, et al. Snakebite mortality in India: a nationally representative mortality survey. PLoS Negl Trop Dis. 2011; 5(4):e1018.
15. Priyamvada PS, Mithra P, Jeganathan N, Singh P, Srinivas BH, Dutta TK, et al. Snake bite induced acute kidney injury: Clinical profile and predictors of poor outcome. Trop Med Int Health. 2023; 28(6):439–48.
16. Ghosh S, Maisnam I, Dutta TK, et al. A study of clinical profile of snake bite with special reference to hematological, renal, and neurological complications. J Assoc Physicians India. 2011; 59:44–8.
17. Suraweera W, Warrell D, Whitaker R, Menon G, Rodrigues R, Fu SH, et al. Trends in snakebite deaths in India from 2000 to 2019 in a nationally representative mortality study. eLife. 2020; 9:e54076.
18. Alirol E, Sharma SK, Bawaskar HS, Kuch U, Chappuis F. Snake bite in South Asia: a review. PLoS Negl Trop Dis. 2010; 4(1):e603.