Original Article

Understanding pediatric snakebites: Clinical and epidemiological insights from a healthcare center in Bihar, India

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Abstract

Background: Snakebites are a common medical emergency and occupational hazard for children in India, particularly in rural areas where poverty is prevalent. However, there is limited data on the epidemiology of snakebites on the Indian subcontinent. **Objective:** This cross-sectional, observational study aims to investigate the epidemiology, major clinical manifestations, and outcomes of snakebites in children under the age of 15 who were admitted to a tertiary care center in Bihar, a state in East India, and draw attention to this public health concern. **Methods:** A cross-sectional observational study was conducted at the Department of Paediatrics, Patna Medical College and Hospital, Patna. The study included all cases of snakebites with features of envenomation involving patients less than 15 years of age who were brought to the department over a 2-year period. Data were collected using a data collection form and analyzed using the Statistical Package for the Social Sciences, version 11.0 (SPSS Inc., Chicago, IL, USA). **Results:** A total of 59 cases were recorded, with 62.71% (n = 37) being male and 37.28% (n = 22) being female. Kraits were responsible for 38.9% (n = 23) of cases, vipers for 42.3% (n = 25), and cobras for 5% (n = 3). Fang marks were present in 67.7% (n = 40) of cases, and the majority of bites (84.7%, n = 50) occurred on a lower limb during the day. The age distribution showed that 16.9% (n = 10) were below 5 years old, 44% (n = 26) were between 5 and 10 years old, and 22% (n = 13) were above 10 years old. Traditional treatment was used in 44.7% (n = 22) of cases, with the most common treatments being local incision + tourniquet (22%, n = 13) and no traditional treatment (55.9%, n = 33). The highest number of cases occurred during July–September (35.5%, n = 21). **Conclusion:** Snakebites are a significant public health issue in Bihar, India, with the majority of cases occurring in rural areas. The study highlights the importance of increased awareness and preparedness among healthcare providers and the general public, particularly during the monsoon season. Early hospital transfer, prehospital management, and prevention should be promoted through regular public health initiatives.

Keywords: Children, clinical manifestations, epidemiology, outcomes, snakebite

Introduction

Snakebites are a significant cause of morbidity and mortality in India and neighboring countries, with the majority of cases being reported in rural areas. It is recognized as a crucial public health issue in these regions.[1] According to the statistics provided by the World Health Organization, it is estimated that, annually, approximately 4.5–5.4 million individuals suffer from snakebites. Among these cases, 1.8–2.7 million individuals develop clinical manifestations, and a significant number of patients (81,000–138,000) succumb to the complications associated with snakebites.[2] Within India, the "big four" species

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of snakes—the Indian cobra, common krait, Russell's viper, and saw-scaled viper—are responsible for causing approximately 90% of cases of snake envenomation.[3] In India, the common krait species is responsible for the highest number of snake envenomation cases.[4] The World Health Organization recognized the significant disease burden caused by snake envenomation and added it to their list of neglected tropical diseases in June 2017.[3] Given that a considerable number of snakebite cases are likely to be treated using traditional remedies and remain unreported, the actual incidence of such cases may be higher than official figures indicate. The present study was conducted to highlight the clinical and epidemiological characteristics of snakebite cases in Bihar and draw attention to this important public health concern.

Material and Methods

Study design

This study is a cross-sectional observational study conducted at the Department of Pediatrics, Patna Medical College and Hospital, Patna. Institutional ethical clearance was obtained from the Patna Medical College and Hospital research and ethics committee before the commencement of the study.

Inclusion criteria

All cases of snakebites with features of envenomation involving persons less than 15 years old who were brought to the Department of Pediatrics over 2 years were included in the study.

Exclusion criteria

Patients who were more than 15 years old or who were diagnosed with a bleeding or clotting disorder were excluded from the study. Patients with a preexisting neurological disorder and those who had received anti-snake venom before arrival at the hospital were also excluded from the study.

Data collection and analysis

A total of 59 cases were recorded during the study period. Data were collected in a data collection form after obtaining consent from the legal guardian of the patient. The data were then transferred to an Excel spreadsheet and analyzed and presented in the study. The statistical analysis of the data was performed using the Statistical Package for the Social Sciences, version 11.0 (SPSS Inc., Chicago, IL, USA).

Results

Table 1 presents the demographic details of 59 cases of snakebites with features of envenomation involving persons less than 15 years old who were brought to the Department of Pediatrics at Patna Medical College and Hospital over 2 years. The gender distribution showed that 62.71% (n = 37) were male and 37.28% (n = 22) were female. Among the identified snakes, 38.9% (n = 23) were kraits, 42.3% (n = 25) were vipers, and 5% (n = 3) were cobras. Fang marks were present in 67.7% (n = 40) of cases. The majority of bites (84.7%, n = 50) occurred on lower limbs, and 72.8% (n = 43) of bites occurred during the day. The age distribution showed that 16.9% (n = 10) were below 5 years old, 44% (n = 26) were between 5 and 10 years old, and 22% (n = 13) were above 10 years old. The majority of cases (86.4%, n = 51) visited the hospital within 12 hours of being bitten. Traditional treatment was used in 44.7% (n = 22) of cases, with the most common treatments being local incision + tourniquet (22%, n = 13) and no traditional treatment (55.9%, n = 33). There was a seasonal variation in the incidence of snakebites, with the highest number of cases occurring in July–September (35.5%, n = 21) and the lowest in January–March (13.5%, n = 8).

Table 1: Demographic details

Factors (n=59)	n (%)
Gender distribution	
Male	37 (62.71%)
Female	22 (37.28%)
Type of snake identified	
Unidentified	8 (13.5%)
Krait	23 (38.9%)
Viper	25 (42.3%)
Cobra	3 (5%)
Age	
<5 years	10 (16.9%)
5–10 years	26 (44%)
>10 years	13 (22%)
Diurnal variation	
Day	43 (72.8%)
Night	16 (27%)
Site of bite	
Lower limb	50 (84.7%)
Other	9 (15%)
Seasonal variation	
January–March	8 (13.5%)
April–June	18 (30.5%)
July–September	21 (35.5%)
October–December	12 (20.3%)
Fang marks	
Present	40 (67.7%)
Absent	19 (32.2%)
Hospital visit	
<12 h	51 (86.4%)
>12 h	8 (13.5%)
Traditional treatment	
Local incision	3 (5%)
Tourniquet	6 (10%)
Local incision + Tourniquet	13 (22%)
Herbal medicine (Local + Ingestion)	4 (6.7%)
No traditional treatment	33 (55.9%)

Figure 1 shows the seasonal variation in snake envenomation cases observed during the study period. The highest number of cases were reported during July–September (35.5%), followed by April–June (30.5%), October–December (20.3%), and January–March (13.5%). This indicates a peak in snakebite cases during the monsoon season in the region. The findings suggest the need

for increased awareness and preparedness among healthcare providers and the general public during the monsoon season to address the burden of snake envenomation.

Figure 2 presents the types of snakes involved in envenomation. Among the identified snakes, the viper was the most common type of snake, causing envenomation in 42.3% ($n = 25$) of cases, followed by kraits in 38.9% ($n = 23$) of cases, cobras in 5% ($n = 3$) of cases, and unidentified species in 13.5% ($n = 8$) of cases. These findings highlight the importance of identifying the type of snake responsible for envenomation to provide appropriate treatment and prevent complications.

In this study, it was observed that most patients, approximately 86%, sought medical attention within 12 hours of receiving a snakebite, whereas the remaining 14% presented later. Among those who sought medical attention, 44% visited a traditional healthcare practitioner first, 23% visited their primary healthcare center, and 32% went directly to a tertiary care center. Patients who sought traditional healthcare received traditional first aid interventions that are not recommended in modern medicine. Local site incisions were given to 5% of patients, whereas 10% had a tourniquet applied and 22% received both a local incision and a tourniquet. These findings suggest traditional practices are still prevalent in some parts of the country and highlight the need for increased education and awareness regarding the modern medical management of snakebites.

Figure 3 displays the local manifestations observed in the snakebite cases. The most commonly observed local manifestation was swelling, which was present in 54 (91.5%) of the cases. Ecchymosis was present in 14 (23.7%) cases, whereas blister formation was seen in only 4 (6.7%) cases. Pain was reported in 47 (79.6%) cases, and local heat was observed in 38 (64.4%) cases. Only one case reported bleeding at the site of the bite. These observations could aid in the early clinical diagnosis and management of snake envenomation cases.

Table 2 presents the clinical features and outcomes observed in 59 of the snake envenomation cases. Among the local manifestations, pain and tenderness were the most common symptoms, reported in 51 patients (86.4%), followed by swelling in 52 patients (88.1%) and bleeding from the local site in 35 patients (59.3%). Regional lymphadenopathy was reported in only six patients (10.1%), whereas blistering and gangrene were observed in two (3%) and three (5%) patients, respectively. Hematological manifestations were present in 41 patients (69.4%), with bleeding at the site of the snakebite being the most common manifestation in

Table 2: Manifestations and clinical outcomes of snakebite cases

Factors (n=59)	n (%)
Local manifestations of snakebites	
Pain and tenderness	51 (86.4%)
Bleeding from the local site	35 (59.3%)
Regional lymphadenopathy	6 (10.1%)
Swelling	52 (88.1%)
Blistering	2 (3%)
Gangrene	3 (5%)
Hematological manifestations	
Bleeding at the site of the snakebite	35 (59.3%)
Hematuria	1 (1%)
Ecchymosis	2 (3%)
Gum bleeding	2 (3%)
Gastrointestinal bleeding	1 (1%)
Neurological manifestations	
Ptosis	12 (20.3%)
Convulsion	1 (1%)
Respiratory paralysis	5 (8%)
Altered sensorium	9 (15.2%)
Outcome	
Death	3 (5%)

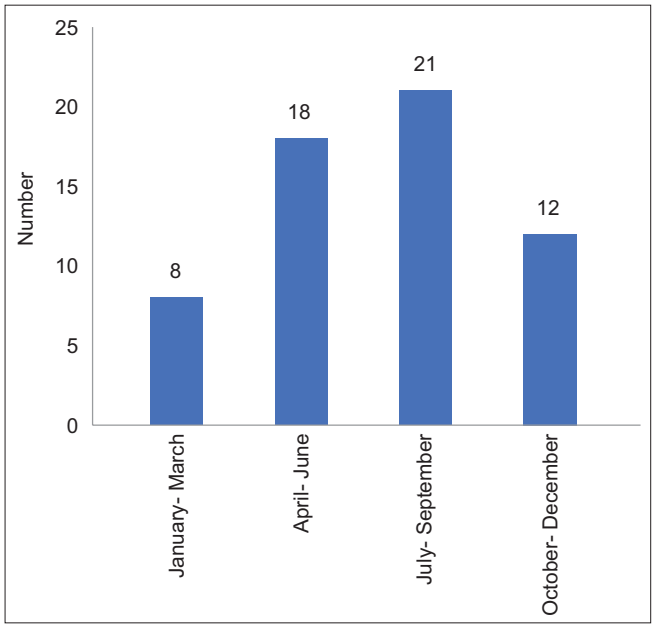

Figure 1: Seasonal variation of snake envenomation cases

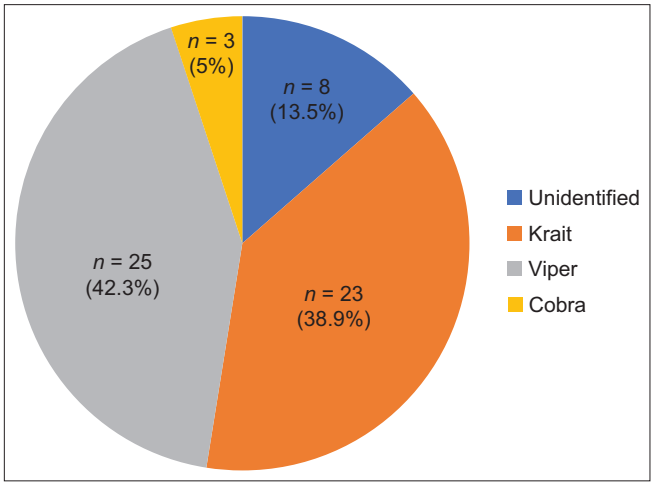

Figure 2: Types of snakes involved in envenomation

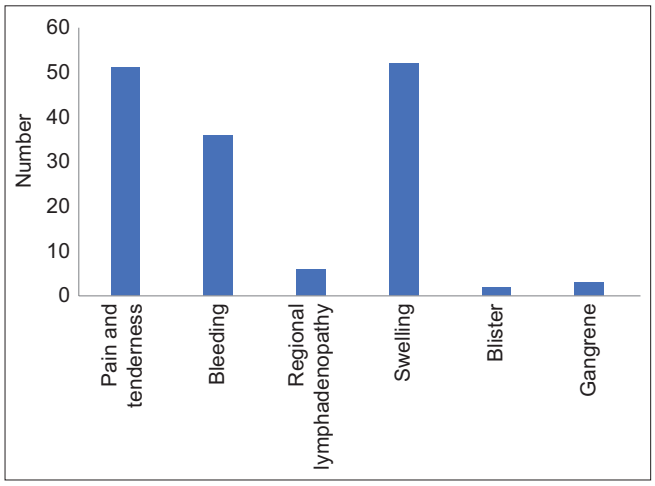

Figure 3: Local manifestations of snakebites

35 patients (59.3%). Neurological manifestations were observed in 27 patients (45.8%), with ptosis being the most common symptom in 12 patients (20.3%), followed by altered sensorium in nine patients (15.2%). Five patients (8%) had respiratory paralysis, and one patient (1%) had convulsions. Out of the 59 patients, 3 (5%) died due to snake envenomation complications.

Figure 4 illustrates the neurological manifestations observed in snakebite envenomation cases. The most common neurological manifestation observed was ptosis, which was seen in 12 patients (20.3%). Altered sensorium was observed in nine patients (15.2%), respiratory paralysis in five patients (8%), and convulsions in only one patient (1%). The findings highlight the potential severity of neurological manifestations in snakebite envenomation cases and the need for prompt medical attention to prevent fatal outcomes.

In low-income countries, traditional healers are frequently the first line of care for snakebite victims, resulting in a significant proportion of patients seeking treatment from these sources before seeking hospital care. Furthermore, patients are often treated at primary healthcare centers rather than being referred to higher-level facilities, leading to an underestimation of the severity of the disease in studies conducted at tertiary healthcare centers.

Discussion

Snakebites are considered a neglected tropical disease and a significant public health threat in India.[5] The occurrence of snakebites is usually higher from June to November in rural India.[6] It is estimated that the number of deaths from snakebites in India is around 50,000 per year,[4] although this figure varies among studies. Despite numerous investigations on this topic, there is still a dearth of information on snakebites in India. Four highly venomous snake species—the common cobra (*Naja naja*), common krait (*Bungarus caeruleus*), Russell's viper (*Dabiola russelii*), and saw-scaled viper (*Echis carinatus*)—are believed to be responsible for the majority of fatal snakebites in India.[7,8]

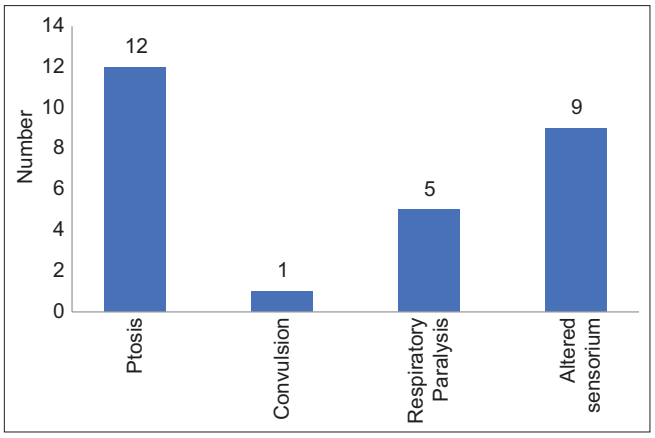

Figure 4: Neurological manifestations of snakebite envenomation

The unfavorable gender difference in the incidence of snakebites toward males has been recognized for a long time. One of the reasons for this could be the higher representation of boys in fieldwork activities compared to girls, who are more often occupied with household chores. Our study findings showed a similar pattern of male preponderance (62.71%) compared to the studies conducted by Shrestha (55% males) and Jamieson and Pearn.[8,9]

Unintentional snakebites are often observed in the lower limbs, particularly in children who may startle the snake accidentally while playing in or working in fields.[10] Conversely, bites to the upper extremities often occur due to playful or investigative behavior by children approaching snakes. Our study found 84% of snakebite patients had been bitten on a lower limb, which is Consistent with the findings of Kulkarni and Anees (79.9%) and Thapar *et al.* (80.9%).[11,12] Snakebites commonly occur during daytime hours, which is likely related to increased occupational and daytime activities.[13,14] Conversely, bites occurring at night among children were often the result of sleeping on the ground.

The bulk of incidents occurred in rural India. The majority of these people work in fields without protective gear and access to transportation at night, which result in people walking around barefoot at night[15]—all of these factors contribute to snakebites in rural areas. Snakebites in India are predominantly a rural problem and are linked to occupational exposure and activity in fields. A lack of protective equipment and transportation in these settings, combined with walking barefoot at night, increases the risk of snakebites.[16]

Envenomation can elicit a spectrum of clinical manifestations, including severe local reactions, such as pain, tenderness, and bleeding from the site of the bite. Additionally, hemato-toxicity features, such as ecchymosis, hematuria, and bleeding from the bite site may produce neurotoxicity features, such as ptosis and respiratory paralysis.[15]

In rural India, conventional medical professionals are the primary point of contact when seeking out healthcare. However, poor management at the primary level is likely to occur, given that most

rural Indians seek guidance and care from these professionals. Traditional healthcare practitioners are visited by about 15% of patients, who may receive treatment such as local site incision and tourniquet application. The prevalence of traditional healthcare practitioner consultation in our study was lower than that reported in a South African study.[17] A study at a tertiary care center in India found that the most common complication was acute kidney injury (AKI) (25%), with a mortality rate of 8%. Early recognition, prompt supportive measures, and timely administration of antivenom are crucial for improving outcomes.[18] These findings suggest there is a need to improve the management of snakebite cases at the primary healthcare level in rural India.

Role of primary care physicians

Our study has relevance for the practice of primary care physicians, particularly those operating in regions with a high incidence of snakebites. The specific focus on pediatric snakebite cases provides a crucial resource for primary care practitioners, offering nuanced insights into the demographic, clinical, and epidemiological intricacies of this vulnerable patient cohort. Primary care physicians are the first point of contact. Understanding the prevalent snake species and their associated clinical manifestations enhances the diagnostic capabilities of primary care physicians, enabling them to swiftly identify and initiate appropriate management for snakebite cases during their early stages. The delineation of treatment practices, notably the prevalence of traditional remedies, underscores the imperative for primary care physicians to actively engage in community education initiatives. By dispelling misconceptions and advocating evidence-based interventions, primary care physicians can play a pivotal role in fostering a more informed and health-conscious community.[19]

Limitations

One of the limitations of the present study is the potential underestimation of morbidity status because a significant proportion of snakebite patients seek treatment from traditional healers or primary healthcare facilities rather than tertiary healthcare facilities. This trend is particularly prevalent in impoverished nations, which may result in an incomplete representation of the true incidence and severity of snakebite envenomation in these populations.

Conclusion

Snakebites are a neglected tropical disease in India that pose occupational hazards for farmers, plantation workers, herders, and hunters. Despite numerous studies, there remains a dearth of information on the epidemiology of snakebites on the Indian subcontinent. Traditional first aid measures have been found to cause more harm than good in snakebite victims. Prompt mobilization and transport to hospitals and the timely administration of anti-snake venom remain the cornerstone ways to reduce morbidity and mortality associated with snakebites. Immediate awareness campaigns targeting rural populations are crucial for promoting prevention and treatment measures.

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Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Chakma JK, Menon JC, Dhaliwal RS; Indian Council of Medical Research. White paper on venomous snakebite in India. Indian J Med Res 2020;152:568-74.
2. World Health Organization. Snakebite envenoming. World Health Organization. 2023. https://www.who.int/health-topics/snakebite. [Last accessed on 2023 Jun 22].
3. World Health Organization. Snakebite in India. World Health Organization. 2023. https://www.who.int/india/health-topics/snakebite. [Last accessed on 2023 Jun 22].
4. Mitra S, Agarwal A, Shubhankar BU, Masih S, Krothapalli V, Lee BM, *et al.* Clinico-epidemiological profile of snake bites over 6-year period from a rural secondary care centre of northern India: A descriptive study. Toxicol Int 2015;22:77-82.
5. 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.
6. Bhardwaj A, Sokhey J. Snake bites in the hills of north India. Natl Med J India 1998;11:264-5.
7. Sulabh S, Shivahre PR. Common poisonous snakes of India—A review. World J Pharm Res 2018;1:431-42.
8. Jamieson R, Pearn J. An epidemiological and clinical study of snake-bites in childhood. Med J Aust 1989;150:698-702.
9. Shrestha BM. Outcomes of snakebite envenomation in children. J Nepal Paediatr Soc 2011;31:192-7.
10. B R H, L H, A J L, *P* K C, K B V. A study on the clinico-epidemiological profile and the outcome of snake bite victims in a tertiary care centre in southern India. J Clin Diagn Res 2013;7:122-6.
11. Kulkarni ML, Anees S. Snake venom poisoning: Experience with 633 cases. Indian Pediatr 1994;31:1239-43.
12. Thapar R, Darshan BB, Unnikrishnan B, Mithra P, Kumar N, Kulkarni V, *et al.* Clinico-epidemiological profile of snakebite cases admitted in a tertiary care centre in south India: A 5 years study. Toxicol Int 2015;22:66-70.
13. Bawaskar HS, Bawaskar PH, Bawaskar PH. Snake bite in India: A neglected disease of poverty. Lancet 2017;390:1947-8.
14. Yaqoob A, Ali Mufti S. A study on the clinical, epidemiological profile and the outcome of the snake bite victims in Kashmir Valley. J Family Med Prim Care 2022;11:680-4.
15. Vaiyapuri S, Vaiyapuri R, Ashokan R, Ramasamy K, Nattamaisundar K, Jeyaraj A, *et al.* Snakebite and its socio-economic impact on the rural population of Tamil Nadu, India. PLoS One 2013;8:e80090.
16. Sulochana AK, Raveendran D, Krishnamma AP, Oommen OV. Ethnomedicinal plants used for snake envenomation by folk traditional practitioners from Kallar forest region of South Western Ghats, Kerala, India. J Intercult Ethnopharmacol 2015;4:47-51.

17. Margono F, Outwater AH, Lowery Wilson M, Howell KM, Bärnighausen T. Snakebite treatment in Tanzania: Identifying gaps in community practices and hospital resources. Int J Environ Res Public Health 2022;19:4701.
18. Krishana VM, Sheikh NA, Soren. C. Clinical profile and outcome of snake bite envenomation in children: A retrospective study in a tertiary care centre KIMS Narketpally. Int J Inf Res Rev 2014;1:155-8.
19. Monteiro WM, Farias AS, Val F, Neto AVS, Sachett A, Lacerda M, *et al.* Providing antivenom treatment access to all Brazilian Amazon indigenous areas: 'Every life has equal value'. Toxins (Basel) 2020;12:772.