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Polyvalent Antivenom Use and Predictors of Mortality from Paediatric Snakebite at a Tertiary Centre in Northwestern Nigeria

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Abstract

Snakebite envenomation is a neglected tropical disease and a significant public health concern in the tropics, especially in sub-Saharan Africa. Children are particularly vulnerable due to their smaller body mass and exposure to high-risk environments. This study aimed to evaluate the use of polyvalent anti-snake venom (PASV) and identify risk factors for mortality from snakebites among children treated at a tertiary hospital in Northwestern Nigeria. A 5-year retrospective review was conducted at the Emergency Pediatric Unit (EPU) and Accident & Emergency (A/E) Department of Federal Teaching Hospital, Katsina. Data from 2019 to 2023 were extracted from medical records, including demographic details, clinical features, treatment received (including PASV), time to hospital presentation, severity of envenomation, and outcomes. Statistical analyses included chi-square tests, t-tests, and logistic regression. Twenty-six children (aged 18 years or less) were treated for snakebite during the study period, with a male predominance (M: F = 11.9:1). Pain (96.2%) and swelling (38.5%) were the most common symptoms. Severe envenomation was recorded in 19.2%, with systemic effects including heamatotoxicity (7.7%), neurotoxicity (3.8%), and respiratory failure (3.8%). PASV was administered to 61.5% of patients, with adverse reactions in 25%, including one fatal case. There were four deaths among the 26 subjects, giving a mortality rate of 15.4%. Univariate analysis showed that younger age, severe envenomation, non-use of PASV, adverse PASV reactions, and delayed presentation were associated with mortality. Firth penalized logistic regression showed that the presence of severe envenomation (aOR: 6.129, 95% CI: 2.576-10.999, p-value = <0.001) and delayed presentation at the hospital (aOR: 4.547, 95% CI: 0.144-8.419, p-value = 0.032) were independent predictors of mortality. Snakebite envenomation in children carries a significant risk for morbidity and mortality. Severe envenomation and delayed presentation are independent predictors of poor outcomes. The use of PASV is beneficial but requires timely administration and preparation for potential adverse effects. Public health education, early referral, and standardized treatment protocols are critical to improving outcomes in pediatric snakebite victims.

Keywords: Children, Polyvalent anti-snake venom, Predictors of mortality, Snakebite

INTRODUCTION

Envenomation from snakebite is a significant medical emergency in the tropics, contributing substantially to morbidity and mortality, particularly in rural and underserved communities (Gutiérrez et al., 2017; Chippaux, 2017). The global burden of snakebite has been estimated at approximately 5.4 million bites annually, resulting in more than 138,000 deaths and around 400,000 cases of permanent disability (Patikorn et al., 2022; Kasturiratne et al., 2008). In recognition of its devastating impact, the World Health Organization (WHO) has classified snakebite envenoming as a neglected tropical disease (Warrell et al., 2010; WHO, 2019).

Nigeria bears one of the highest burdens of snakebite globally, with an estimated incidence of 497 bites per 100,000 population per year and a case fatality rate of about 12% (Habib et al., 2001; Habib & Abubakar, 2011; Oboh et al., 2021). Children are particularly vulnerable due to their natural curiosity, tendency to walk barefoot in snake-prone environments, and limited awareness of danger (Avila-Aguero et al., 2001; Ariaratnam et al., 2008). Moreover, their smaller body mass increases the risk of severe systemic envenomation and rapid progression of complications (Williams et al., 2010).

Timely administration of polyvalent anti-snake venom (PASV) remains the cornerstone of effective treatment, capable of reversing many systemic and local effects of envenomation (Gutiérrez et al., 2010). However, several factors hinder its optimal use, including limited availability, high cost, risk of hypersensitivity reactions, lack of standardized protocols for dosage and administration, and frequent inappropriate or delayed use (Patil, 2013; Abubakar et al., 2010; Potet et al., 2021).

A significant gap in the existing literature pertains to the paucity of data on pediatric snakebite cases in Northwestern Nigeria. While snakebite envenomation is recognized as a major public health concern in Nigeria, most studies have predominantly focused on adult populations, leaving the epidemiology, clinical outcomes, and management of paediatric cases under-reported and poorly understood in this region. This knowledge gap hampers the development of targeted interventions and effective management strategies tailored to children.

Furthermore, the safety and efficacy of PASV in children require thorough evaluation. Currently, there is limited region-specific data on the safety profile and adverse reactions associated with PASV in children, which is critical for guiding clinical practice and ensuring patient safety. This study aims to address these gaps and optimize treatment protocols, thereby improving patient outcomes and informing public health policies regarding snakebite management in children.

With this background, we aimed to study the use of polyvalent anti-snake venom and the risk factors for mortality from snake bites among children at the Emergency Pediatric Unit (EPU) and Accident and Emergency (A&E) unit of the Federal Teaching Hospital, Katsina.

METHODOLOGY

This study was a retrospective review of medical records conducted at the Federal Teaching Hospital Katsina (FTHKT), a 700-bed tertiary hospital located in Katsina, Northwestern Nigeria. The Hospital serves as a referral center for the state and neighboring states in Nigeria and Niger Republic. The medical records of patients admitted with snake bites at the EPU and A/E of FTHKT for a period of five years from January, 2019 to December, 2023 were retrieved. Data extracted include patients' hospital numbers, sociodemographic characteristics (age, gender and place of residence), place of bite, month of the year when the snake bites occurred, time interval between bite and presentation to the hospital, circumstance of bite, site of bite, signs and symptoms, treatment received (including polyvalent antivenom use), duration of hospital stay as well as outcome (discharge or death). As depicted in Table 1, the severity of envenomation was graded as none, mild, moderate, and severe (Ahmed et al., 2012).

Table 1: Grading of snake envenomation

Grade	Description	Features
0	None	None
1	Mild	Local swelling and pain
2	Moderate	swelling, pain, ecchymosis beyond site of bite, mild systemic or laboratory manifestations
3	Severe	Marked local inflammation, severe systemic symptoms and signs, significant laboratory derangements

OUTCOME

Outcome was categorized as discharge or death. The factors that affected the outcome, such as age, gender, site of bite, presence/ grade of envenomation, prehospital care, and hospital care, were evaluated.

Inclusion criteria:

Clinical diagnosis of snake bite

Age of 18 years or below

Exclusion criterion:

Incomplete medical records

ETHICAL CONSIDERATION

Ethical approval for the study was obtained from the Research Ethics Review Committee of the Federal Teaching Hospital Katsina (FTHKTHREC.REG.24/06/22C089). All patient records were handled and retrieve with anonymity to ensure confidentiality.

STATISTICAL ANALYSIS

The results obtained from the study were expressed as frequencies and percentages and statistical analyses were carried out using the Statistics Product and Services Solution (SPSS) version 26.

The chi-square test and Fisher's exact test were used as appropriate for bivariate analyses to determine the factors affecting mortality. Logistic regression was then used for multivariate analyses.

Data Quality and Validation

To ensure the accuracy, reliability, and integrity of the data used in this retrospective study, several measures were undertaken throughout the data collection and validation process. The data were extracted from patient medical records, hospital database, and relevant clinical documentation.

Firstly, a standardized data extraction form was developed and pilot-tested to ensure clarity and consistency. Trained data collectors independently reviewed all relevant records and entered data into the form. To minimize errors, dual data entry was performed, with discrepancies reconciled through cross-verification by a senior researcher.

Secondly, data validation measures included cross-checking entered data against original records to verify correctness and completeness. Any discrepancies identified were resolved by consulting the original medical documentation or consulting with clinical staff involved in patient care.

Thirdly, data quality was monitored through regular supervision and periodic audits during the extraction process. Outliers and inconsistent data points were flagged and reviewed for validation or correction. Missing data were documented, and efforts were made to retrieve missing information from alternative sources within the hospital records. When data could not be retrieved, they were appropriately marked, and their potential impact on the the analysis was considered.

Finally, the overall data management process complied with ethical standards and data protection regulations. These comprehensive validation procedures aimed to ensure that the data used in this study are accurate, complete, and reliable, thus underpinning the validity of the study findings.

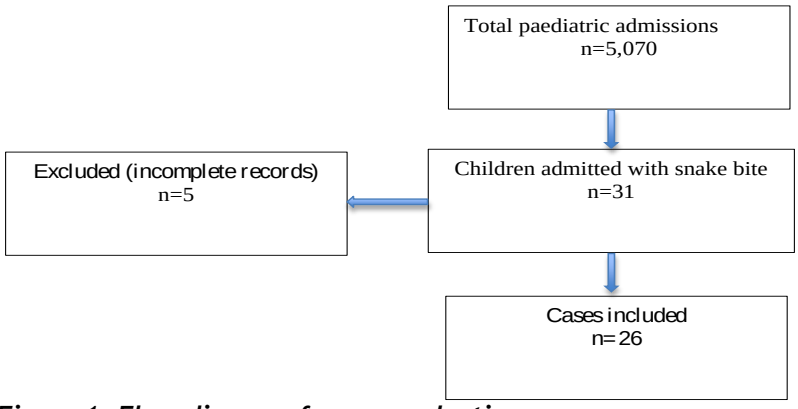

Figure 1: Flow diagram for case selection process

RESULTS

Over the period under review, a total of 26 children were admitted with snake bite, aged between six years and 18 years, with most children within the ages of 5-10 years. There were more males than females (male: female = 11.9:1). These are shown in Figure 2.

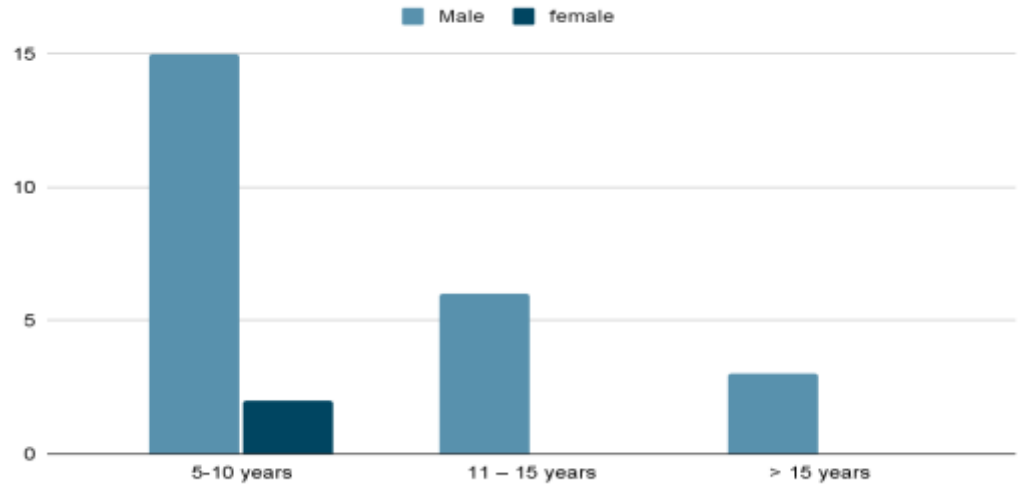

Figure 2: Age and gender distribution of patients with snakebite

Clinical features of snakebite among subjects
The clinical features of snakebite among subjects are summarized in Table 2. Most patients presented with pain (96.2%). The next most common symptom was local swelling, while the least common was convulsion, which occurred in only one patient (3.8%).

Table 2: Clinical features of snakebite among subjects

Clinical feature	Frequency (%)
Pain	25 (96.2)
Swelling	10 (38.5)
Bleeding	7 (26.9)
Headache	7 (26.9)
Fever	6 (23.1)
Weakness	5 (19.2)
Convulsion	1 (3.8)

As shown in Table 3, the majority (38.5%) of the subjects did not present with systemic envenomation. The others had mild, moderate, and severe envenomation as 19.2%, 23.1% and 19.2%, respectively among those with severe systemic envenomation, 7.27%, 4.15%, and 1.4% presented with heamatotoxicity, neurotoxicity, and respiratory failure, respectively.

Table 3: Severity of envenomation and type of systemic envenomation among subjects

Grade of envenomation	Frequency (%)
None	10 (38.5)
Mild	5 (19.2)
Moderate	6 (23.1)
Severe	5 (19.2)
Type of systemic envenomation	
Haematotoxicity	2 (7.7)
Neurotoxicity	1(3.8)
Respiratory failure	1 (3.8)

The time interval between bite and presentation to the hospital ranged from 30 minutes to 10 days, with a median (IQR) of 13.00 (34) hours.

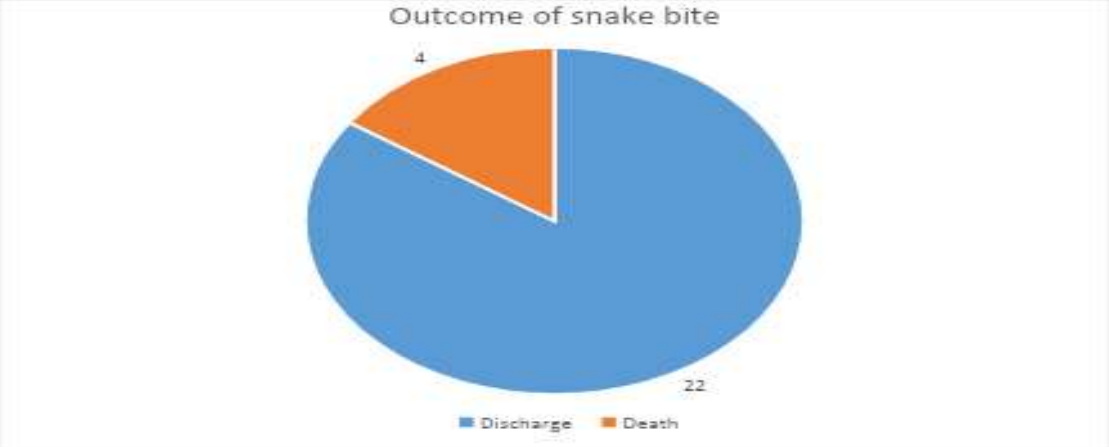

Figure 3: Outcome of snake bite among subjects

Figure 3 summarizes the outcome of snake bite among subjects. Twenty-two patients (84.6%) were discharged home, while four patients died, giving a mortality rate of 15.4%. The duration of hospital stay ranged from 1 to 18 days, with a median duration (IQR) of 1 day (4-5.4 days).

The treatments received by the patients in the hospital are summarized in Table 4. All patients received analgesia, and most were given intravenous fluids, antibiotics, and polyvalent snake antivenom (PSAV). Only those with systemic envenomation received blood transfusions, oxygen therapy, and anticonvulsants (for hematotoxicity, respiratory failure, and neurotoxicity, respectively).

Table 4: Treatment received by the patients with snakebite in the hospital

Treatment given	Frequency (%)
Analgesics	26 (100)
Antibiotics	23 (88.5)
Tetanus toxoid	23 (88.5)
Intravenous fluid	19 (73.1)
PASV	16 (61.5)
Blood transfusion	2 (7.7)
Oxygen therapy	1 (3.8)
Anticonvulsants	1 (3.8)

The polyvalent anti-snake venom (PASV) was administered to 16 (61.5%) patients, of whom four developed adverse reactions (25%). While most patients had mild reactions, one (25%) developed a severe reaction in the form of angioedema and hypotension. These are summarized in Table 5.

Table 5: Grading, clinical presentation and outcome of adverse reactions to PASV

Grade	Frequency (%)	Mortality (%)	Clinical presentation
Mild	3 (75)	0 (0)	Vomiting, skin rash
Severe	1 (25)	1 (100)	Angioedema, hypotension

Risk factors for mortality among patients with snakebite

The factors associated with a poor outcome (death) include younger age (p = 0.002), severe envenomation (p = 0.001), non-use of PASV (p = 0.001), presence of an adverse reaction to PASV (p = 0.031), and delayed presentation at the hospital (p = 0.042). After subjecting these predictor variables to Firth penalized logistic regression, the presence of severe

envenomation (aOR: 6.129, 95% CI: 2.576-10.999) and delayed presentation at the hospital (aOR: 4.547, 95% CI: 0.144-8.419) were independent predictors of mortality (Tables 6 and 7).

Table 6: Risk Factors for Mortality from Snake Bite Among Subjects – Univariate Analysis

Variable	Category	Frequency (%)	Died	Discharged	P-value
Age Group	5–10	17 (65.4)	3	14	
	11–15	6 (23.1)	0	6	
	>15	3 (11.5)	1	2	*0.002#**
Gender	Male	24 (92.3)	4	20	
	Female	2 (7.7)	0	2	0.134*
Severity of Envenomation	None	10 (38.5)	0	10	
	Mild	5 (19.2)	0	5	
	Moderate	6 (23.1)	0	6	
Type of Envenomation	Heamatotoxicity	2 (7.7)	1	0	
	Neurotoxicity	1 (3.8)	1	0	
	Respiratory failure	1 (3.8)	1	0	0.077*
Use of PASV	Yes	16 (61.5)	2	14	*0.001#**
	No	10 (38.5)	3	7	
Adverse Reaction to PASV	None	12 (75.0)	0	12	
	Mild	3 (18.8)	0	3	
	Severe	1 (6.2)	1	0	*0.031#**
Time to Hospital Presentation	<1 hour	3 (11.5)	0	3	
	1–6 hours	5 (19.2)	0	5	
	7–12 hours	11 (42.3)	1	10	
	13–24 hours	3 (11.5)	1	2	
	>24 hours	4 (15.4)	2	2	*0.042#**

*Fisher's exact test used for all comparisons, # Statistically significant p-value ($p < 0.05$)

Table 7: Risk Factors for Mortality from Snake Bite Among Subjects – Firth Penalized Logistic Regression

Predictor variable	Category	aOR	95% CI	P-value
Age	Age 5-10 years	1.268	1.701-2.666	0.111
Severity of Envenomation	Presence of severe systemic envenomation	6.129	2.576-10.999	< 0.001#
Time to hospital presentation	> 6 hours	4.547	0.144-8.419	0.032#
Administration of PASV	No administered	14.107	1.211-69.411	0.100
Adverse Reaction to PASV	Present	3.331	2.838-9.278	0.093

aOR - adjusted Odd's Ratio, CI - Confidence Interval, # Statistically significant p-value ($p < 0.05$)

DISCUSSION

This study provides valuable insight into the use of polyvalent anti-snake venom (PASV) and risk factors for mortality among children treated for snakebite at a tertiary hospital in Northwestern Nigeria over a five-year period.

The number of children with snakebite reviewed in our study was relatively low (26 over five years), likely reflecting underreporting, poor healthcare access, reliance on traditional care, or inadequate documentation—factors previously highlighted in the literature (Habib et al., 2001; Warrell et al., 2010; Chippaux, 2017).

The predominance of cases among children aged 5–10 years is consistent with existing evidence that younger children are more vulnerable due to increased outdoor exposure, walking barefoot, and curiosity-driven behavior (Avila-Aguero et al., 2001; Williams et al., 2010; Ariaratnam et al., 2008).

The striking male predominance (male: female ratio of 11.9:1) observed in this study likely reflects gender-based behavior patterns such as outdoor play and cattle herding, which have been frequently reported in similar contexts (Oguche et al., 2002; Michael et al., 2011). Pain and swelling were the most common presenting features, typical of viperid envenomation, which is the dominant snakebite type in West Africa (Warrell, 2010; Gutiérrez et al., 2017; Abubakar et al., 2010). Severe systemic complications—including haematotoxicity, neurotoxicity, and respiratory failure occurred in 15.4% of patients, highlighting the clinical seriousness of such bites.

The severity of envenomation was an independent predictor of mortality (aOR 8.155), corroborating previous studies that emphasize the significant increase in risk of fatality associated with delayed or inadequate management of severe cases (Patil, 2013; Gutiérrez et al., 2017; Potet et al., 2021). PASV was administered in 61.5% of patients. Notably, its non-use was significantly associated with mortality in univariate analysis (p = 0.001), although statistical significance was lost in multivariate analysis (p = 0.062), likely due to limitations in sample size. This reinforces existing evidence on the life-saving potential of antivenom, especially when administered early (Chippaux & Goyffon, 2006; WHO, 2016).

Adverse reactions to PASV occurred in 25% of recipients, including one fatality, reflecting the known risk of hypersensitivity reactions, particularly in polyvalent formulations derived from animal sera (de Silva et al., 2016; Gutiérrez et al., 2010). This highlights the importance of well-trained personnel, emergency resuscitation readiness, and standardized administration protocols during antivenom therapy.

Delay in hospital presentation was a notable issue in this study, with only 11.5% presenting within the first hour. The median delay was 13 hours, with some arriving days after the bite. Delayed presentation was independently associated with increased mortality (aOR 4.272), consistent with evidence that time to antivenom administration is a key determinant of survival (Alirol et al., 2010; Gutiérrez et al., 2017; Warrell, 2010). Harmful prehospital practices, such as tourniquet use (69.2%) and the application of traditional topical or oral concoctions, were prevalent findings echoed across sub-Saharan Africa and known to worsen outcomes (Habib & Abubakar, 2011; Alcoba et al., 2020). The findings of this study align with prior observations regarding the high burden and mortality associated with snakebite envenomation in tropical, resource-limited settings. Global estimates suggest over 5.4 million bites and 138,000 deaths annually, with a disproportionate burden in sub-Saharan Africa (Patikorn et al., 2022; Kasturiratne et al., 2008). Nigeria, in particular, is recognized for its high snakebite incidence and mortality, especially in rural areas (Habib et al., 2001; Oboh et al., 2021). The increased vulnerability of children is consistent with existing literature that links smaller body mass and greater exposure risks to more severe outcomes (Avila-Aguero et al., 2001; Ariaratnam et al., 2008).

The mortality rate of 15.4% in this cohort mirrors findings from earlier Nigerian studies (Habib et al., 2001; Oguche et al., 2002), though it remains higher than rates observed in better-resourced health systems, underscoring the critical role of timely, quality care. Independent predictors of mortality in our study, "severe envenomation and delayed presentation" are well-documented in global studies as primary drivers of poor outcomes (Alirol et al., 2010; Gutiérrez et al., 2017; Potet et al., 2021). Although the non-use of PASV and occurrence of adverse reactions did not retain significance in multivariate analysis, they remain important clinical considerations, especially in settings with overlapping risk factors and constrained healthcare resources.

Strengths and Limitations

A key strength of this study lies in its focus on a vulnerable population of children in a region with a high burden of snakebite envenomation. The comprehensive collection of clinical data over a five-year period provides valuable insights into the spectrum of clinical manifestations and treatment outcomes at a tertiary referral hospital.

However, several limitations must be acknowledged. The retrospective design limits the ability to control for all potential confounders, and the relatively small sample size (n = 26) may restrict the generalizability of the findings. Additionally, important details were not obtained, including the PASV product name, lot number, dose given, and pre-medication administered. Moreover, the reliance on hospital records means that the true incidence of snakebite, especially in rural or remote settings where many victims may not seek hospital care, is likely underestimated.

Implications for Practice and Future Research

The findings from this study advocate for several practical and research-oriented actions:

- **Early Intervention:** Emphasizing public education on the importance of early hospital presentation following a snakebite could reduce the incidence of severe envenomation and subsequent mortality.
- **Standardization of Antivenom Protocols:** Development and implementation of evidence-based protocols for PASV administration, including strategies to minimize adverse reactions, are crucial. Training healthcare providers on these protocols can improve patient management and outcomes.
- **Improvement in Prehospital Care:** Community outreach programs should address the risks associated with traditional first-aid measures, such as tourniquet use and application of unverified topical treatments, by promoting rapid transfer to healthcare facilities.
- **Further Research:** Future prospective studies with larger sample sizes are needed to validate these findings and explore additional factors, such as the role of specific snake species and the biochemical parameters of envenomation, that may influence outcomes. Exploring alternative antivenom formulations or adjunctive therapies may also contribute to more effective management strategies in pediatric patients.

CONCLUSION

Snakebite in children remains a serious public health concern in Northwestern Nigeria, with significant mortality primarily driven by severe envenomation and delayed hospital presentation. The use of PASV improves outcomes, but accessibility, affordability, and safety must still be addressed. Public education, early referral systems, and strengthened hospital protocols for snakebite management are urgently needed to reduce preventable deaths.

REFERENCES

Abubakar, I. S., Abubakar, S. B., Habib, A. G., Nasidi, A., Durfa, N., Yusuf, P. O., ... & Warrell, D. A. (2010). Randomised controlled double-blind non-inferiority trial of two doses of savannah antivenom in patients envenomed by saw-scaled or carpet vipers in Nigeria. *PLoS Neglected Tropical Diseases, 4*(7), e767. [Crossref]

Ahmed, S. M., Ahmed, M., Nadeem, A., Mahajan, J., Choudhury, M., & Pal, J. (2012). Emergency treatment of a snake bite: Pearls from literature. *Journal of Emergencies, Trauma and Shock, 1*(2), 97–105. [Crossref]

Alcoba, G., Chabloz, M., Eyong, J., Wanda, F., Ochoa, C., Comte, E., ... & Chappuis, F. (2020). Snakebite epidemiology and health-seeking behavior in Akonolinga health district, Cameroon: Cross-sectional study. *PLOS Neglected Tropical Diseases, 14*(6), e0008334. [Crossref]

Alirol, E., Sharma, S. K., Bawaskar, H. S., Kuch, U., & Chappuis, F. (2010). Snake bite in South Asia: A review. *PLoS Neglected Tropical Diseases, 4*(1), e603. [Crossref]

Ariaratnam, C. A., Sjöström, L., Raziek, Z., Kularatne, S. A. M., & Warrell, D. A.

(2008). Antivenom treatment of snake envenoming in Sri Lanka. *Transactions of the Royal Society of Tropical Medicine and Hygiene, 102*(11), 1121-1126. [Crossref]

Avila-Aguero, M. L., Paris, M., & Herrera, M. L. (2001). Snake bites in children: Epidemiological and clinical aspects in Costa Rica. *Toxicon, 39*(10), 1485–1490.

Chippaux, J. P. (2017). Snakebite envenomation turns again into a neglected tropical disease! *Journal of Venomous Animals and Toxins including Tropical Diseases, 23*, 38. [Crossref]

Chippaux, J. P., & Goyffon, M. (2006). Venoms, antivenoms and immunotherapy. *Toxicon, 44*(7), 693-706. [Crossref]

De Silva, H. A., Ryan, N. M., & de Silva, H. J. (2016). Adverse reactions to snake antivenom, and their prevention and treatment. *British Journal of Clinical Pharmacology, 81*(3), 446-452. [Crossref]

Gutiérrez, J. M., Calvete, J. J., Habib, A. G., Harrison, R. A., Williams, D. J., & Warrell, D. A. (2017). Snakebite envenoming. *Nature Reviews Disease Primers, 3*, 17063. [Crossref]

Gutiérrez, J. M., León, G., Lomonte, B., & Angulo, Y. (2010). Antivenoms for snakebite envenomings. *Infectious Disease Clinics of North America, 20*(2), 317–345.

Habib, A. G., & Abubakar, S. B. (2011). Factors affecting snakebite mortality in north-eastern Nigeria. *International Health, 3*(1), 50–55. [Crossref]

Habib, A. G., Gebi, U. I., & Onyemelukwe, G. C. (2001). Snakebite in Nigeria. *African Journal of Medicine and Medical Sciences, 30*(3), 171–178.

Kasturiratne, A., Wickremasinghe, A. R., de Silva, N., Gunawardena, N. K., Pathmeswaran, A., Premaratna, R., ... & Lalloo, D. G. (2008). The global burden of snakebite: A literature analysis and modelling based on regional estimates of envenoming and deaths. *PLoS Medicine, 5*(11), e218. [Crossref]

Michael, G. C., Grema, B. A., Aliyu, I., Alhaji, M. A., & Lawal, T. O. (2011). Snakebite mortality in northern Nigeria: Risk factors and treatment challenges. *Clinical Toxinology in Africa*, 99–108.

Oboh, M. A., Nwaorgu, O. G. B., & Onwubere, B. J. (2021). Epidemiology and clinical presentation of snakebite in Nigeria: A review. *African Journal of Clinical and Experimental Microbiology, 22*(3), 320-328.

Oguche, S., Bukbuk, D. N., & Watila, I. M. (2002). Snake bite in children: A ten-year retrospective review. *Annals of African Medicine, 1*(2), 78–80.

Patikorn, C., Blessmann, J., Suntrarachun, S., Hinjoy, S., Blessmann, G., & Mueller, I. (2022). Global epidemiology, health burden and clinical management of snakebite envenoming: A literature review. *Acta Tropica, 232*, 106521.

Patil, N. (2013). Snake bite: Clinical features and management. *International Journal of Medicine and Public Health, 3*(1), 50–54.

Potet, J., Smith, J., & McIver, L. (2021). Reviewing evidence of the clinical effectiveness of commercially available antivenoms in sub-Saharan Africa identifies the need for a multicentre, multi-antivenom clinical trial. *PLoS Neglected Tropical Diseases, 15*(4), e0009461. [Crossref]

Warrell, D. A. (2010). *Guidelines for the management of snakebites* (2nd ed.). World Health Organization, Regional Office for South-East Asia.

Williams, D., Gutierrez, J. M., Harrison, R., Warrell, D. A., White, J., Winkel, K. D., & Gopalakrishnakone, P. (2010). The Global Snake Bite Initiative: An antidote for snake bite. *The Lancet, 375*(9708), 89–91. [Crossref]

World Health Organization. (2016). *Guidelines for the management of snakebites* (2nd ed.). apps.who.int

World Health Organization. (2019). *Snakebite envenoming: A strategy for prevention and control*. who.int