

EPIDEMIOLOGICAL AND CLINICAL PROFILE OF SNAKEBITE CASES IN DISTRICT LOWER DIR, KHYBER PAKHTUNKHWA, PAKISTAN: A DESCRIPTIVE STUDY

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Abstract

Snakebite is an important public health concern in rural communities, particularly in regions where agricultural exposure, limited healthcare access, and inappropriate first-aid practices may contribute to adverse outcomes. However, local epidemiological information from District Lower Dir, Khyber Pakhtunkhwa, Pakistan, remains limited. This study aimed to describe the epidemiological characteristics, clinical manifestations, healthcare-seeking practices, management, and outcomes of snakebite cases in District Lower Dir. An observational study with descriptive and analytical components was conducted from March 2024 to July 2026. Data from 88 identified snakebite cases were collected through hospital-record review and prospective data collection, as applicable. Information concerning sociodemographic characteristics, seasonal and geographical distribution, bite circumstances, clinical manifestations, first-aid practices, treatment, hospitalization, and outcomes was analyzed using Microsoft Excel and SPSS version 26. Frequencies and percentages were used to summarize categorical variables, while inferential tests were applied where appropriate. Out of the 88 patients, 54 (61.4%) were male, 67 (76.1%) were older than 15 years, and 84 (95.5%) were from rural areas. July and August accounted for 79.6% of cases. Samarbagh and Balambat contributed 51.1% of the total cases. The foot and toes were the most frequently affected sites (71.6%). Although 47 patients (53.4%) reported seeing the snake, its species was not identified. Tourniquet application followed by consultation with traditional or spiritual

healers was reported in 28 cases (31.8%). Common systemic manifestations included ptosis or blurred vision (64.8%), vomiting (62.5%), and muscle weakness or paralysis with respiratory difficulty (47.7%). Three deaths were recorded, giving an observed case-fatality proportion of 3.4%. Post-discharge complications were reported in 12 patients (13.6%). Snakebite cases in Lower Dir predominantly affected rural residents and were concentrated during the summer monsoon period. The frequent use of tourniquets, reliance on traditional treatment, and occurrence of systemic manifestations and post-discharge complications highlight the need for community education, timely access to appropriate medical care, and improved follow-up. Further population-based research is required to establish the true burden of snakebite and its associated risk factors.

INTRODUCTION

Snakebite envenoming is a major public health concern in tropical and subtropical regions, particularly in Africa, Asia, Oceania, and Latin America [1]. Approximately 5.4 million snakebites occur worldwide each year, resulting in an estimated 81,000–138,000 deaths [2]. More than 3,500 snake species have been described globally, of which approximately 600 are venomous [3]. In Pakistan, around 55 snake species have been reported, including 13 venomous species [4]. Medically important snakes in the country include the Asian cobra, common Indian krait, Russell's viper, saw-scaled viper, Malayan pit viper, and sea snakes [5]. Pakistan and other South Asian countries experience a considerable burden of snakebite due to extensive agricultural activities, high population density, exposure to venomous snakes, and limitations in effective prevention and treatment services [6]. An estimated 40,000 snakebites occur annually in Pakistan, resulting in approximately 8,200 deaths [1,7]. Substantial burdens have also been reported in Nepal, Sri Lanka, and Bangladesh [8–10]. However, the actual magnitude of snakebite remains uncertain because of inadequate surveillance and underreporting, particularly in rural communities where patients may seek traditional treatment rather than formal medical care. Studies from rural Sri Lanka have demonstrated that hospital records may fail to capture a substantial proportion of snakebite-related deaths [11,12].

Snake venom contains biologically active toxins and enzymes that can produce local tissue injury and systemic complications. Bites from medically important viperid species may cause pain, swelling, blistering, bleeding, and tissue necrosis [13]. Systemic complications can include coagulation abnormalities, internal haemorrhage, neurological impairment, respiratory difficulties, renal injury, and multiorgan failure. Severe envenoming may result in permanent disability or death, particularly when appropriate treatment is delayed [14]. The clinical outcome depends on several factors, including the snake species involved, the quantity of venom injected, the anatomical site of the bite, and the time elapsed before medical intervention. In rural areas, the consequences of snakebite may be aggravated by limited healthcare facilities, long distances to hospitals, inadequate transport, and inappropriate first-aid practices. Tourniquet application and reliance on traditional or spiritual healers may delay definitive treatment. Furthermore, seasonal variation, agricultural activities, and geographical differences can influence the distribution of snakebite incidents. Understanding these factors is essential for identifying vulnerable populations, improving community awareness, and strengthening access to timely medical care.

Despite the public health importance of snakebite in Pakistan, epidemiological information remains limited in several districts, including Dir Lower, Khyber Pakhtunkhwa. Inadequate local documentation restricts understanding of the

demographic characteristics, seasonal distribution, clinical manifestations, treatment patterns, and outcomes of affected patients. Therefore, the present study was conducted to investigate snakebite cases reported in Dir Lower over a 29-month period, with particular emphasis on their epidemiological and clinical characteristics.

The general objective of this study was to investigate the epidemiological characteristics, clinical manifestations, management, and outcomes of snakebite cases in Dir Lower, Khyber Pakhtunkhwa, Pakistan. Specifically, the study aimed to describe the sociodemographic characteristics of affected patients; determine the monthly and tehsil-wise distribution of cases; document the circumstances and anatomical sites of bites; identify reported local and systemic clinical manifestations; assess first-aid practices, healthcare-seeking behaviour, and barriers to timely medical care; describe hospital management and duration of hospitalization; and determine the reported mortality and post-discharge complications among the study participants.

2. METHODOLOGY

Dir Lower is located in the northern region of Khyber Pakhtunkhwa province, Pakistan, covering an area of 1585 km² between the latitudes of 34°37' and 35°07' North and longitudes of 71°31' and 72°14' East [15]. District Lower Dir is bordered by District Upper Dir to the north, District Swat to the east, and District Malakand to the south.

The study covered all seven tehsils of Lower Dir: Balambat, Khal, Lal Qilla, Adenzai, Timergara, Samarbagh, and Munda. These administrative areas were included to examine the geographical distribution of snakebite cases across the district. The district's mountainous terrain, rural settlements, agricultural activities, and livestock-related practices provide a relevant setting for investigating snakebite epidemiology and healthcare-seeking behaviour. Exposure may occur during agricultural work, movement through

vegetation, or activities around houses and livestock shelters.

2.2 Study Period

The study was conducted over a period of 28 months, from March 2024 to July 2026. This period was selected to document snakebite cases across different seasons and to examine monthly variation in reported incidence. Data collected during the study period were used to describe the demographic characteristics, circumstances of bites, clinical manifestations, treatment-seeking practices, and outcomes of affected individuals.

2.3 Study Design

A cross-sectional observational study with descriptive and analytical components was conducted to investigate the epidemiological and clinical characteristics of snakebite cases in District Lower Dir, Khyber Pakhtunkhwa, Pakistan. The study incorporated retrospective review of documented hospital records and prospective collection of information from identified snakebite patients or their relatives, as applicable. The retrospective component provided information from existing clinical records, whereas the prospective component facilitated the collection of additional details regarding bite circumstances, first-aid practices, treatment-seeking behaviour, and post-discharge outcomes. Combining these sources was intended to improve case ascertainment and provide a broader understanding of snakebite events than hospital records alone could offer.

The study primarily focused on describing the distribution and characteristics of identified cases. Analytical comparisons were undertaken where the available data and the nature of the variables permitted appropriate statistical testing. Because the study was observational, associations identified between variables were interpreted as statistical relationships rather than evidence of causation.

2.4 Study Population

The study population comprised individuals who experienced a snakebite within District Lower Dir

during the specified study period and whose cases were identified through the study's data-collection procedures. Information was obtained directly from affected individuals whenever possible. For children, deceased patients, or individuals unable to provide information, relevant details were obtained from parents, guardians, or close relatives familiar with the incident.

A total of 88 snakebite cases were included in the final dataset. These cases formed the basis for the descriptive analysis of demographic characteristics, occupational and educational information, residential setting, monthly distribution, location and anatomical site of bites, reported clinical manifestations, treatment-seeking practices, hospital management, hospitalization, mortality, and post-discharge complications.

2.4.1 Inclusion Criteria

The study included individuals reported to have experienced a snakebite within District Lower Dir between March 2024 and July 2026 whose cases were identified through hospital-record review or prospective data collection. Eligible cases included patients who could provide relevant information themselves or through a parent, guardian, or close relative familiar with the incident. Cases were included when the available information was sufficient to establish their relevance to the study and to document at least the essential characteristics of the snakebite event.

2.4.2 Exclusion Criteria

Cases were excluded when the reported incident occurred outside District Lower Dir or beyond the specified study period. Suspected bites that could not reasonably be classified as snakebite incidents based on the available information were also excluded. Duplicate records referring to the same incident were removed to prevent double counting. In addition, records or reports containing insufficient information to establish eligibility were excluded from the final dataset.

2.5 Sampling Technique and Sample Size

A non-probability case-ascertainment approach was used to identify eligible snakebite cases from the available data sources. All eligible cases identified during the study period were considered for inclusion. The final sample comprised 88 cases. The sample size was determined by the number of eligible cases identified through the study's data-collection procedures rather than by a separately calculated population-based sample size. Accordingly, the study represents the identified cases available for investigation and should not be interpreted as a complete estimate of the incidence of snakebite across the district unless comprehensive population-level case ascertainment was achieved.

2.6 Data Collection Procedures

Data were collected using a structured epidemiological questionnaire developed specifically for the study. The questionnaire was designed with reference to relevant snakebite epidemiological assessment tools and World Health Organization recommendations. It was intended to capture information on the circumstances of snakebite incidents, patient characteristics, clinical manifestations, healthcare-seeking behaviour, treatment, and outcomes. Information was obtained from hospital records, patients, and relatives, depending on the availability of records and the respondent's ability to provide reliable information. Where necessary and feasible, follow-up communication was used to clarify information or obtain details that were not adequately documented in the original records.

2.6.1 Sociodemographic Characteristics

The questionnaire recorded available demographic and social information, including sex, age group, residential setting, occupation, educational status, and tehsil of residence or case origin. For analytical purposes, patients were classified as adults older than 15 years or children aged 15 years or younger, consistent with the categories used in the study dataset. Residential setting was classified as rural or urban.

Occupational and educational information was documented to help characterize the populations represented among the reported cases. Where relevant, occupational categories included agricultural workers or labourers, students, and housewives. The analysis of these characteristics was intended to identify demographic groups that were frequently represented among the identified cases.

2.6.2 Temporal and Geographical Distribution

The date or month of each incident was recorded when available. Cases were grouped by month to examine seasonal variation during the study period. The monthly distribution was summarized for May, June, July, August, and September, corresponding to the months represented in the final dataset. The geographical distribution was assessed according to the seven tehsils of District Lower Dir. The number and proportion of cases recorded in each tehsil were calculated to identify areas contributing the largest numbers of cases within the study sample. These figures were interpreted as the distribution of identified cases rather than population-adjusted incidence rates because tehsil-specific population denominators were not included in the supplied dataset.

2.6.3 Circumstances and Anatomical Site of Snakebite

Information was collected on the reported location and circumstances of each bite. Incident locations were grouped into agricultural fields, shaded areas, and livestock barns, or homes, areas surrounding homes, and pathways. This classification was used to examine the settings in which snakebite incidents occurred. The anatomical site of the bite was recorded and classified into three categories: foot or toes, upper limb, and back. These categories were used to describe the distribution of bite sites and to explore the potential relationship between exposure circumstances and body regions affected. The presence of a snake at the scene and whether the respondent could identify its species were also documented.

2.6.4 Snake Identification and Evidence of Envenomation

Information was recorded regarding whether the snake was seen by the patient or a witness and whether its species could be identified. Cases in which the snake was observed but its species could not be determined were distinguished from cases in which the snake was not seen. Reported bite-site findings, including identifiable fang marks and tissue damage, were documented where information was available. Snake species identification was not assumed when no reliable identification was reported. Consequently, clinical manifestations and reported bite-site findings were used to describe the cases without attributing them to a particular snake species in the absence of adequate evidence.

2.6.5 Clinical Manifestations

Clinical information was collected to characterize the local and systemic manifestations reported or documented following snakebite. Local manifestations included pain, swelling, fever, tissue necrosis, and bleeding. The presence of local manifestations was summarized according to the information available in the records or respondent reports. Systemic manifestations included vomiting, tachycardia, gum bleeding, ptosis or blurred vision, muscle weakness or paralysis with respiratory difficulty, hematuria suggestive of possible renal involvement, and loss of consciousness. Deaths associated with the reported snakebite cases were also documented. Clinical findings were summarized individually because a patient could experience more than one manifestation. Therefore, the frequencies of individual symptoms were not treated as mutually exclusive categories. The presence of a symptom was based on the available clinical documentation or reported history; the absence of a documented symptom was not automatically interpreted as proof that the symptom had not occurred.

2.6.6 First Aid and Healthcare-Seeking Behaviour

The questionnaire recorded the reported first-aid measures and the initial treatment-seeking pathway following the bite. The documented practices included application of a tourniquet or tight bandage, washing the wound, seeking assistance from traditional or spiritual healers, proceeding directly to a hospital, and receiving no first aid before reaching a medical facility. Cases were categorized according to the reported sequence of actions. Particular attention was given to patients who initially sought traditional or spiritual treatment and those who reached a hospital after applying a tourniquet. These variables were examined to describe community responses to snakebite and potential delays in seeking formal medical care. Available information regarding the time taken to reach a healthcare facility, mode of transportation, distance-related difficulties, and transport availability was also considered. Where exact times or counts were unavailable, these circumstances were described qualitatively rather than assigned numerical values.

2.6.7 Hospital Management and Clinical Outcomes

Available records were reviewed to document the treatment provided following presentation to a healthcare facility. Reported management measures included wound care and dressing, antibiotics, analgesics, wound irrigation or drainage, antivenom administration, orthopaedic immobilization, and mechanical ventilation when clinically indicated. Hospitalization was assessed using the recorded admission status and length of stay. The available data were categorized into patients who did not require admission, those hospitalized for 1–3 days, and those hospitalized for 5–8 days. The reported mean hospitalization duration was also documented. Cases without sufficient information to assign a hospitalization category were retained as unclassified rather than allocated to an assumed category. Mortality was recorded among the identified cases. Information

on post-discharge complications was also collected, including persistent pain, muscle deformities, psychological distress, headache, scarring, and reported renal impairment. These outcomes were summarized according to the available follow-up information. Where follow-up information was unavailable, the absence of a recorded complication was not interpreted as confirmation of complete recovery.

2.7 Data Quality Assurance

Several procedures were used to improve the accuracy and consistency of the collected information. Data entered into the study dataset were checked for completeness, consistency, and possible duplication. Where feasible, entries were compared with the original hospital records, and follow-up calls were made to selected respondents to clarify information or resolve discrepancies. The dataset was reviewed for missing values, inconsistent category assignments, and errors in numerical entry. Frequencies and percentages were checked against the total number of included cases. Denominators were selected according to the variable being described, and the possibility of multiple symptoms in the same patient was considered when summarizing clinical manifestations. Information that was missing or insufficiently documented was not replaced with assumed values. In particular, the lack of a recorded symptom, treatment, or complication was distinguished from a confirmed negative finding wherever the available data permitted this distinction.

2.8 Data Management and Statistical Analysis

The collected data were initially entered, organized, and cleaned using Microsoft Excel. The cleaned dataset was subsequently analyzed using IBM Statistical Package for the Social Sciences (SPSS), version 26. Data were summarized using descriptive and, where appropriate, inferential statistical methods.

2.8.1 Descriptive Statistics

Categorical variables were summarized using frequencies and percentages. These included sex, age group, residential setting, occupation, educational status, month of occurrence, tehsil, incident location, anatomical bite site, snake sighting, reported clinical manifestations, first-aid practices, healthcare-seeking behaviour, hospitalization category, mortality, and post-discharge complications. Percentages were generally calculated using the total sample of 88 cases as the denominator. Where a variable applied only to a subgroup, the subgroup denominator was used and identified accordingly. Because individual patients could have been present with multiple clinical manifestations, symptom frequencies were analyzed separately and were not expected to sum to the total sample. The monthly and tehsil-wise distributions were presented as frequencies and percentages to describe the temporal and geographical patterns of identified cases. The mean hospitalization duration was reported as provided by the study dataset; its interpretation depended on the availability and completeness of the underlying length-of-stay data.

2.8.2 Inferential Statistics

Chi-square tests of independence were used, where appropriate, to assess associations between categorical variables. The suitability of each test depended on the variables being compared, the independence of observations, and the expected frequencies in the contingency table. Where expected cell counts were too small for a reliable chi-square approximation, an appropriate alternative, such as Fisher's exact test, was considered where applicable. Statistical significance was assessed using a two-sided significance level of ($p < 0.05$). The chi-square test was applied only when a clearly defined comparison and appropriate expected frequencies were available. Descriptive differences in the number of cases across months or anatomical sites were not automatically interpreted as statistically significant without a valid statistical comparison

and an appropriate reference distribution. The results were interpreted in the context of the observational study design. Any associations identified were considered exploratory and were not taken to establish causal relationships.

2.8.3 Handling of Missing Data

Missing or incomplete information was handled on a variable-specific basis. Cases were retained in the overall sample when they met the study eligibility criteria, even if some individual variables were unavailable. For each analysis, the denominator reflected the number of cases with relevant information where necessary. No unreported clinical findings or outcomes were assumed to be absent. Similarly, cases without a documented hospitalization category or post-discharge outcome were treated as unclassified or as having unavailable information, rather than being assigned to an unsupported category. This approach was intended to reduce misclassification and maintain transparency in the reporting of findings.

2.9 Ethical Considerations

The study was conducted in accordance with established principles of research ethics, including respect for participants, confidentiality, and voluntary participation. Approval or permission was obtained from the relevant local health authorities before data collection, as applicable to the study procedures. Participants were informed about the purpose of the investigation and the nature of the information being collected. Participation in direct interviews or follow-up communication was voluntary, and respondents were informed that they could decline to answer questions or withdraw from participation without penalty. For children and individuals unable to provide informed responses, information was obtained from an appropriate parent, guardian, or relative, subject to the applicable consent procedures. Confidentiality was maintained during data handling and reporting. Personally identifying information was excluded from the analytical dataset and research outputs wherever

possible, and findings were presented in aggregated form. Information obtained from hospital records and respondents was used for the stated research purpose.

3. RESULTS

3.1 Outline of Study Findings

A total of 88 snakebite cases were recorded during the 29-month study period. The findings are

presented according to the sociodemographic characteristics of patients, temporal and geographical distribution of cases, circumstances of snakebite, anatomical sites affected, clinical manifestations, first-aid practices, healthcare-seeking behaviour, hospital management, and post-discharge outcomes. Descriptive statistics are presented as frequencies and percentages, while statistical tests are reported where app

3.2 Sociodemographic Characteristics of Snakebite Patients

3.2.1 Distribution by Sex, Residential Setting, and Age Group

Table 3.1. Sociodemographic characteristics of patients presenting with snakebite (N = 88)

Variable	Category	Frequency (n)	Percentage (%)
Sex	Male	54	61.4
	Female	34	38.6
Residential setting	Rural	84	95.5
	Urban	4	4.5
Age group	Adults (>15 years)	67	76.1
	Children (≤15 years)	21	23.9
Total		88	100.0

Table 3.1 presents the sociodemographic distribution of the study population. Males constituted the majority of patients, accounting for 54 cases (61.4%), whereas females represented 34 cases (38.6%). A marked predominance of cases was observed among rural residents, who accounted for 84 (95.5%) of the reported snakebite incidents. Only four cases (4.5%) were recorded among urban residents. Adults older

than 15 years represent 67 (76.1%) of the study population, while children aged 15 years or younger accounted for 21 (23.9%) cases. These findings indicate that the reported burden of snakebite was concentrated among males, rural residents, and adults. However, these proportions describe the distribution of cases within the study population and do not establish differences in population-level incidence or risk.

3.2.2 Occupational and Educational Characteristics

Table 3.2. Reported occupational and educational characteristics of patients according to sex

Sex	Reported category	Frequency (n)	Percentage within sex (%)
Male	Farmers or labourers with no formal education	36	66.7

	Students	10	18.5
	Higher education	8	14.8
Male subtotal		54	100.0
Female	Housewives	29	85.3
	Students	5	14.7
Female subtotal		34	100.0

Table 3.2 shows the reported occupational and educational characteristics of male and female patients. Among males, 36 (66.7%) were classified as farmers or labourers with no formal education, while 10 (18.5%) were students and eight (14.8%) had attained higher education. Among females, housewives constituted the largest category, accounting for 29 (85.3%) cases, whereas five (14.7%) were students. The distribution indicates that snakebite cases occurred among individuals

engaged in agricultural, labour-related, domestic, and educational activities. The predominance of farmers and labourers among male patients may reflect occupational exposure to environments where snakes are encountered. Nevertheless, the available data describe the characteristics of affected individuals rather than demonstrating an independent association between occupation, educational attainment, and snakebite occurrence.

3.3 Temporal Distribution of Snakebite Cases

3.3.1 Monthly Distribution

Table 3.3. Monthly distribution of reported snakebite cases during the study period

Month	Frequency (n)	Percentage (%)
May	4	4.5
June	12	13.6
July	43	48.9
August	27	30.7
September	2	2.3
Total	88	100.0

Table 3.3 demonstrates a pronounced concentration of snakebite cases during July and August. July recorded the highest number of cases, with 43 (48.9%), followed by August, with 27 (30.7%). Together, these two months accounted for 70 cases (79.6%) of the total study population. June contributed 12 cases (13.6%), whereas four cases (4.5%) were recorded in May and two (2.3%) in September. The observed distribution indicates

that most recorded snakebite incidents occurred during the middle of the year, particularly in July. This temporal pattern may be relevant to the planning of seasonal prevention activities and healthcare preparedness. The monthly frequencies describe the observed concentration of cases; statistical significance should be interpreted only in relation to a prespecified statistical hypothesis and an appropriate comparison distribution.

3.4 Circumstances and Anatomical Distribution of Snakebite

3.4.1 Location of Snakebite Incidents

Table 3.4. Distribution of snakebite incidents according to reported location

Location	Frequency (n)	Percentage (%)
Agricultural fields, shaded areas, or livestock barns	66	75.0
In or around homes and along pathways	22	25.0
Total	88	100.0

Table 3.4 shows that most snakebite incidents occurred in agricultural fields, shaded areas, or livestock barns, accounting for 66 (75.0%) cases. The remaining 22 (25.0%) incidents occurred in or around homes and along pathways. Thus, three-quarters of the reported bites were associated with outdoor or work-related environments. The predominance of incidents in agricultural and livestock-associated settings suggests that routine

outdoor activities may provide important opportunities for human-snake encounters in the study area. These findings support the relevance of preventive education concerning footwear, environmental awareness, and safe practices during agricultural work. However, the combined categories encompass different environments, and their individual contributions cannot be determined from the available data.

3.4.2 Anatomical Site of Envenomation

Table 3.5. Distribution of snakebite cases by anatomical site

Anatomical site	Frequency (n)	Percentage (%)
Foot and toes	63	71.6
Upper limb	22	25.0
Back	3	3.4
Total	88	100.0

Table 3.5 indicates that the foot and toes were the most frequently affected anatomical sites, accounting for 63 (71.6%) cases. Upper-limb involvement was reported in 22 (25.0%) patients, whereas the back was affected in only three (3.4%) cases. The findings demonstrate that bites involving the foot and toes constitute the largest proportion of recorded incidents. The predominance of bites to the foot and toes may be associated with exposure during walking,

agricultural activities, and movement through areas inhabited by snakes. These observations highlight the potential importance of protective footwear and caution when walking or working in vegetation and other environments where snakes may be present. The findings describe the distribution of bite sites among affected patients and should not be interpreted as population-level risk estimates.

3.4.3 Snake Sightings and Bite-Site Findings

Table 3.6. Patient-reported snake sightings and associated bite-site findings

Parameter	Category	Frequency (n)	Percentage (%)
Snake sighting	Snake seen, but species not identified	47	53.4
	Snake not seen	41	46.6
Total for snake sighting		88	100.0
Bite-site findings among patients who saw the snake	Clear fang marks	42	89.4*
	Tissue damage without identifiable fang marks	5	10.6*
Total with reported snake sighting		47	100.0

*Percentages for bite-site findings are calculated using the 47 patients who reported seeing the snake as the denominator.

As shown in Table 3.6, 47 patients (53.4%) reported seeing the snake but were unable to identify its species, relying instead on a verbal description of its morphology. The remaining 41 patients (46.6%) did not see the snake during the incident. Among those who reported a sighting, clear fang marks were documented in 42 (89.4%) cases, while five (10.6%) showed tissue damage without identifiable fang marks. These findings

demonstrate that visual contact with a snake did not necessarily permit reliable species identification. Consequently, patient descriptions alone may be insufficient for definitive species-level classification. The bite-site observations provide additional clinical information, although wound appearance alone cannot establish the snake species or determine the severity of envenomation. The findings for the 41 patients who did not see the snake were not separately quantified in the available data.

3.5 Clinical Manifestations of Snakebite

3.5.1 Local Manifestations

Table 3.7. Occurrence of reported local manifestations among snakebite patients

Parameter	Category	Frequency (n)	Percentage (%)
Local manifestations	One or more local manifestations reported	77	87.5
	Local manifestations not reported in the supplied data	11	12.5
Total		88	100.0

Reported local manifestations included pain, swelling, fever, tissue necrosis, and bleeding from the bite site.

Table 3.7 shows that local manifestations were reported in 77 (87.5%) patients. The documented manifestations included pain, swelling, fever, tissue necrosis, and bleeding at the bite site. These findings indicate that local clinical involvement was common among the patients included in the

study. The individual frequencies of the local manifestations were not available, preventing a comparison of their relative occurrence. The remaining 11 cases are classified as having no local manifestation reported in the supplied data rather than as confirmed symptom-free cases. Recording each manifestation separately would provide a more detailed description of the local clinical

presentation and improve comparisons with other snakebite studies.

3.5.2 Systemic Manifestations and Mortality

Table 3.8. Frequency and proportion of reported systemic manifestations and deaths

Clinical manifestation or outcome	Frequency (n)	Percentage of total cases (%)
Ptosis or blurred vision	57	64.8
Vomiting	55	62.5
Muscle weakness or paralysis with respiratory difficulty	42	47.7
Tachycardia	40	45.5
Gum bleeding	24	27.3
Loss of consciousness	4	4.5
Hematuria suggestive of renal involvement	3	3.4
Deaths	3	3.4

Percentages were calculated using the total study population (N = 88). Clinical manifestations were not mutually exclusive.

Table 3.8 demonstrates that several systemic manifestations were reported among the study participants. Ptosis or blurred vision was the most frequently documented feature, occurring in 57 (64.8%) patients, followed by vomiting in 55 (62.5%). Muscle weakness or paralysis accompanied by respiratory difficulty was reported in 42 (47.7%) patients, while tachycardia occurred in 40 (45.5%). Gum bleeding was documented in 24 (27.3%) cases. Less frequent findings included loss of consciousness in four (4.5%) patients and hematuria suggestive of renal involvement in three

(3.4%). Three deaths were recorded, corresponding to a crude case-fatality proportion of 3.4% among the 88 reported cases. The observed neurological, neuromuscular, respiratory, and bleeding manifestations indicate that the clinical presentation extended beyond local wound effects in a proportion of patients. However, the available data do not establish the confirmed snake species or the specific mechanism responsible for each manifestation. As individual patients may have experienced multiple symptoms, the frequencies in Table 3.8 should be interpreted independently rather than summed to calculate a total number of affected patients.

3.6 First-Aid Practices and Healthcare-Seeking Behaviour

3.6.1 First-Aid Practices Before Hospital Presentation

Table 3.9. Distribution of patients according to reported first-aid practices and initial healthcare-seeking behaviour.

Reported practice	Frequency (n)	Percentage (%)
Tourniquet or tight bandage applied, followed by consultation with traditional or spiritual healers without formal hospital treatment	28	31.8
Tourniquet applied, wound washed, and patient subsequently taken to hospital	42	47.7
Tourniquet applied, followed by direct hospital attendance	11	12.5
No first aid administered before reaching a medical facility	7	7.9
Total	88	100.0*

The percentages total 99.9% because of rounding.

Table 3.9 shows variation in the first-aid measures and initial healthcare-seeking practices reported by patients. The largest group comprised 42 (47.7%) patients who applied a tourniquet, washed the wound, and subsequently attended hospital. Eleven (12.5%) applied a tourniquet before proceeding directly to hospital. In contrast, 28 (31.8%) applied a tourniquet or tight bandage and sought assistance from traditional or spiritual healers without receiving formal hospital treatment, while seven (7.9%) received no first aid before reaching a medical facility. Tourniquet

application was common among the reported first-aid practices. The proportion of patients who initially consulted traditional or spiritual healers without formal hospital treatment also represents an important feature of the observed healthcare-seeking pattern. These findings highlight the relevance of community education on appropriate first aid and timely referral. Tight tourniquets should be avoided because they may cause additional tissue injury; prompt medical assessment, immobilization of the affected limb, and timely transport to an appropriate healthcare facility are preferred.

3.6.2 Time to Hospital Arrival and Transport-Related Barriers

Table 3.10. Reported characteristics of hospital arrival and barriers to healthcare access

Parameter	Reported finding	Frequency (n)	Percentage (%)
Time for hospital arrival	Predominantly 1-5 hours	Not reported	Not calculable
Mode of transport	Private vehicle or public transport	Not reported	Not calculable
Reasons for delay	Long travel distances	Not reported	Not calculable
	Lack of readily available transport	Not reported	Not calculable

Table 3.10 summarizes the reported patterns of hospital arrival and transport-related barriers. Most patients reportedly reached hospital within 1-5 hours of the snakebite incident, with private vehicles and public transport serving as the principal means of transportation. Long travel distances and the limited availability of transport were identified as the main reasons for delays in reaching medical care. These observations suggest that geographical accessibility and transport

availability may influence the timeliness of healthcare-seeking in the study area. However, because category-specific frequencies were not provided, the magnitude of each barrier cannot be quantified. Further analysis of the interval between the bite and first medical contact, the distance travelled, and the time to definitive treatment would provide a more comprehensive assessment of prehospital delays.

3.7 Hospital Management and Clinical Outcomes

3.7.1 Treatment Modalities

Table 3.11. Reported treatment modalities used in hospital management of snakebite patients

Treatment modality	Reported use
Wound care and dressing	Reported
Antibiotic therapy	Reported
Analgesia	Reported
Wound irrigation and drainage	Reported
Antivenom administration	Reported

Orthopedic immobilization	Reported
Mechanical ventilation	Used when indicated

Table 3.11 summarizes the treatment modalities reported during hospital management. These included wound care and dressing, antibiotics, analgesia, wound irrigation and drainage, antivenom administration, orthopedic immobilization, and mechanical ventilation when clinically indicated. The reported interventions encompassed local wound management, symptom control, specific treatment for envenomation, and supportive care for patients requiring respiratory assistance. The available data do not specify the

number of patients who received each intervention or the clinical indications for individual treatments. Accordingly, the table describes the range of reported management approaches rather than their frequency of use or comparative effectiveness. Quantitative reporting of antivenom administration, mechanical ventilation, and other interventions would allow a more detailed assessment of clinical management patterns and resource requirements.

3.7.2 Hospital Admission and Length of Stay

Table 3.12. Reported hospital admission status and duration of hospitalization

Hospitalization parameter	Category	Frequency (n)	Percentage of total cases (%)
Admission status	Did not require admission	27	30.7
Duration of hospitalization	1-3 days	22	25.0
	5-8 days	11	12.5
Admission status or duration not specified	Other or unclassified cases	28	31.8
Total		88	100.0

Table 3.12 presents the available information on hospital admission and length of stay. Twenty-seven patients (30.7%) reportedly did not require admission. Among the patients with a specified duration of hospitalization, 22 (25.0% of the total study population) stayed for 1-3 days, while 11 (12.5%) were hospitalized for 5-8 days. The supplied results also reported a mean hospitalization time of 3.5 days. The available categories do not fully characterize the admission status or hospitalization duration of all patients. Therefore, the reported mean should be interpreted cautiously until its denominator and calculation method are established. Length of stay is best summarized among admitted patients, with the number of patients included in the calculation

and an appropriate measure of variability. Complete reporting would facilitate a more accurate description of hospital resource utilization and the duration of care required by snakebite patients.

3.7.3 Post-Discharge Sequelae

Table 3.13. Reported residual or delayed sequelae following hospital discharge

Outcome parameter	Category	Frequency (n)	Percentage (%)
Post-discharge outcomes	One or more residual or delayed sequelae reported	12	13.6
	Sequelae not reported in the supplied data	76	86.4
Total		88	100.0

Reported sequelae included persistent pain, muscle deformities, psychological distress, headache, scarring, and renal impairment. Table 3.13 indicates that 12 patients (13.6%) experienced residual or delayed complications following discharge. The reported sequelae included persistent pain, muscle deformities, psychological distress, headache, scarring, and renal impairment. These findings suggest that the clinical consequences of snakebite extended beyond the initial hospital episode in a subset of

patients. The frequencies of individual complications and the duration of post-discharge follow-up were not available. The remaining 76 cases should therefore be interpreted as cases without reported sequelae in the supplied results rather than as confirmed cases with complete recovery. Systematic follow-up would help establish the frequency, duration, and clinical significance of long-term complications and provide a more comprehensive assessment of patient outcomes.

3.8 Geographical Distribution of Snakebite Cases

3.8.1 Tehsil-Wise Distribution

Table 3.14. Geographical distribution of snakebite cases by tehsil

Tehsil	Frequency (n)	Percentage (%)
Samarbagh	26	29.5
Balambat	19	21.6
Khall	15	17.0
Timergara	12	13.6
Adenzai	9	10.2
Lal Qilla	5	5.7
Munda	2	2.3
Total	88	100.0

Percentages were calculated from the reported frequencies and rounded to one decimal place. Table 3.14 demonstrates variation in the number of reported snakebite cases across the seven tehsils. Samarbagh recorded the highest number, with 26 cases (29.5%), followed by Balambat with 19 (21.6%) and Khal with 15 (17.0%). Timergara accounted for 12 cases (13.6%), while nine (10.2%) were reported from Adenzai. The lowest numbers were observed in Lal Qilla, with five cases (5.7%), and Munda, with two cases (2.3%).

Samarbagh and Balambat together accounted for 45 cases, representing 51.1% of the study population. This distribution identifies these two tehsils as the principal contributors to the recorded case burden during the study period. Nevertheless, the number of reported cases alone does not establish that residents of these tehsils had a higher underlying risk of snakebite. Population size, occupational exposure, access to healthcare, and differences in case reporting may influence the observed geographical pattern.

4. DISCUSSION

Snakebite is an important public health problem associated with substantial health and socioeconomic consequences, particularly in resource-limited settings [16,17]. This study documented 88 snakebite cases in District Lower Dir over 29 months, providing evidence of their demographic characteristics, seasonal distribution, clinical manifestations, treatment-seeking practices, and outcomes.

Males accounted for 61.4% of cases, consistent with findings from Shorkot (70%) [18] and Hazara (57.7%) [19]. This predominance may reflect greater occupational exposure during agricultural and outdoor activities, as also reported across South Asia [27–30]. Adults older than 15 years represented 76.1% of patients, while 95.5% of cases occurred among rural residents. Similar rural predominance has been documented in southern India and Hazara [19,22]. The high representation of male farmers and labourers and female housewives further highlights the potential influence of occupational and domestic exposure [20,22,29,31–33]. The substantial proportion of patients with limited formal education also emphasizes the importance of accessible community awareness and prevention programmes [8,22]. A pronounced seasonal pattern was observed, with July and August accounting for 79.6% of cases. This finding is consistent with studies from Hazara and Nepal, which reported increased snakebite occurrence during rainy months [19,21]. Seasonal agricultural activities and changes in snake habitats may contribute to increased human–snake contact [24]. Geographically, Samarbagh and Balambat together accounted for 51.1% of cases. Similar geographical clustering has been reported elsewhere in South Asia [19,24]. However, without tehsil-specific population denominators, these figures represent case distribution rather than comparative incidence rates.

The foot and toes were the most frequently affected sites (71.6%), followed by the upper limbs (25.0%) and back (3.4%). This pattern agrees with regional studies reporting a predominance of

lower-extremity bites [18,20,22]. Preventive measures, including appropriate footwear and caution during agricultural activities, may therefore be particularly relevant. Although 53.4% of patients or witnesses saw the snake, species identification remained uncertain, reflecting the limitations of identification based on visual recollection [18,19]. Tourniquet application was common, and 31.8% of patients sought traditional or spiritual treatment before hospital care. Similar practices have been documented in Pakistan and other South Asian countries [19,20,22,31–33]. Such findings emphasize the need to discourage harmful first-aid practices and promote prompt medical assessment. Transport difficulties and limited access to healthcare may further delay treatment in rural communities [8,21,22]. Clinical manifestations included local pain, swelling, bleeding, and tissue necrosis, alongside systemic symptoms such as vomiting, tachycardia, ptosis or blurred vision, and muscle weakness with respiratory difficulty. Ptosis or blurred vision was reported in 64.8% of cases, while vomiting occurred in 62.5%. These manifestations are compatible with clinically important neurotoxic or haemotoxic effects described in South Asian snakebite literature [20]. However, species identification and venom type could not be established from these findings alone. Three deaths were recorded, yielding an observed case-fatality proportion of 3.4%, compared with 3.8% in Karnataka [22] and 7.69% in Hazara [19]. This comparison should be interpreted cautiously because differences in case ascertainment, disease severity, and referral patterns may influence reported mortality. Hospital stays varied, with 27 patients not admitted, 22 hospitalized for 1–3 days, and 11 for 5–8 days. Post-discharge complications were reported in 12 patients (13.6%), including persistent pain, muscular deformity, psychological distress, scarring, headache, and renal impairment, consistent with sequelae described in previous studies [32,34–46]. Incomplete hospitalization classification and follow-up limit

conclusions about overall recovery and long-term morbidity.

5. CONCLUSION

The present study provides an overview of 88 snakebite cases identified in District Lower Dir over 28 months. Cases predominantly involved males, adults, and rural residents, with the highest number recorded during July and August. Samarbagh and Balambat contributed the largest proportions of identified cases, while bites to the foot and toes were the most common. Tourniquet application and initial consultation with traditional or spiritual healers were important features of treatment-seeking behaviour. Patients presented with diverse local and systemic manifestations, and three deaths and 12 reports of post-discharge complications were documented. These findings highlight the public health importance of snakebite in rural Lower Dir and the need to improve preventive awareness, discourage harmful first-aid practices, and facilitate timely access to appropriate medical care. However, incomplete follow-up, uncertain snake species identification, and possible under-ascertainment limit the generalizability of the findings. Larger population-based studies with systematic clinical documentation and long-term follow-up are needed to estimate the true burden of snakebite and improve prevention and patient outcomes.

6. RECOMMENDATIONS

Based on the findings of this study, community awareness programmes should be strengthened in rural areas of District Lower Dir, particularly before and during the peak snakebite season in July and August. Educational campaigns should focus on snakebite prevention, the use of protective footwear during agricultural activities, and caution when working near vegetation, pathways, and livestock shelters. Community members should also be informed about the importance of seeking prompt medical care following a suspected snakebite.

Harmful first-aid practices, particularly tourniquet application and delays caused by reliance on traditional or spiritual healers, should be addressed through targeted health education. Local health authorities should promote appropriate first aid and timely transportation to healthcare facilities. Improving referral systems, emergency transport, and access to adequately equipped medical facilities in remote communities may help reduce delays in treatment and improve patient outcomes.

Healthcare facilities should strengthen snakebite surveillance and maintain standardized records of patient characteristics, clinical manifestations, treatment, hospitalization, and outcomes. Appropriate clinical assessment and timely management should be ensured, with antivenom and respiratory support provided when clinically indicated. Follow-up services should also be encouraged to identify persistent pain, physical disability, psychological distress, and other post-discharge complications. Further prospective, community-based research should be conducted across all seven tehsils of Lower Dir to identify cases that may be missed by hospital-based surveillance and to estimate the population-level burden of snakebite. Future studies should include reliable population denominators, detailed information on treatment delays and clinical severity, and systematic long-term follow-up to identify factors associated with complications and mortality.

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