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COMMUNICATION

RETROSPECTIVE STUDY ON EPIDEMIOLOGY OF SNAKEBITES IN SARPANG DISTRICT, SOUTHERN BHUTAN

Bal Krishna Koirala, Jaganath Koirala & Sunil Sapkota

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RETROSPECTIVE STUDY ON EPIDEMIOLOGY OF SNAKEBITES IN SARPANG DISTRICT, SOUTHERN BHUTAN

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Abstract: Although snake bite envenomation is considered as a medical emergency with significant morbidity and mortality, accurate figures on snakebite envenomation remains scarce. We conducted a retrospective study to evaluate the snakebite epidemiology in Sarpang District located in the subtropical zone of southern Bhutan. In this study, 78 snakebite cases treated in Gelephu Referral Hospital over a period of three years from 2013 to 2015 were evaluated based on the statistical record maintained by the medical administration. Twenty-eight (35.89%) cases developed signs and symptoms of envenomation and the remaining 50 (64.01%) were found to be cases of non-venomous bites. Forty-four males and 34 females were found to be affected by snakebites within the period. While snakebites were observed in all age groups, the large majority (n=51, 65.38%) were in adults aged between 21 and 50 years. Most of the venomous bites (68%) occurred during the monsoon season, particularly between May and August. It was found that adults in the economically productive age group were the ones most affected by poisonous bites. There is an urgent need for development and adoption of snakebite management guidelines and awareness among the vulnerable sections of the population, improvement of medical facilities in referral hospitals and rural health centres, and reduction of the morbidity and mortality associated with snakebites.

Keywords: Bhutan, envenomation, epidemiology, Sarpang District, snakebite, venomous snakes, victims.

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Author Contribution: BKK - data collection, data analysis, and manuscript writing; JK - contributed in data collection, and data compilation; SS - data compilation, manuscript writing and editing.

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INTRODUCTION

Since the dawn of human civilization, snakes have appeared in many tales and myths as they are deeply rooted in man-human tradition and culture. Despite snakes having occupied an important place in ethnozoology, snakebite envenomation is an important and life-threatening medical emergency. Snakebite is one of the most neglected public health issues in poor rural communities living in the tropics (Alirol et al. 2010). Southern Asian, southeastern Asian, and sub-Saharan African countries are the regions with the highest number of snakebite cases (Kasturiratne et al. 2008). It has been estimated that 4,000,000 snakebites occur each year in Asia alone, of which approximately 50% are envenomed, resulting in 100,000 annual deaths (Chippaux 1998). The existing epidemiological data, however, remain limited and the actual impact of snakebites is very likely underestimated. The current literature on snakebite epidemiology highlights the inadequacy of the available data on this neglected tropical injury (Warrell 2010). Moreover, this is the first snakebite epidemiological study in Bhutan as the existing epidemiological data on snakebites in Bhutan remain limited. Fatal injuries from snakebites are principally caused by a relatively small group of snakes, most of which are adapted to human-modified landscapes or live in close proximity to human inhabitations.

Among the 3,509 extant species of snakes in the world (Pincheira-Donoso et al. 2013), around 300 are venomous and 200 are medically important (Warrell 2010). In Bhutan, a total of 69 species belonging to five families are known to occur, out of which venomous snakes are represented by 15 species belonging to two families, Elapidae and Viperidae (Wangyal & Gurung 2017). The most commonly found venomous snakes include two species of krait *Bungarus niger* & *B. fasciatus*, three species of cobra *Naja kaouthia*, *N. naja* & *Ophiophagus hannah*, four species of viper *Ovophis monticola*, *Protobothrops himalayanus*, *Trimeresurus erythrurus* & *T. albolabris*, and one species of coral snake *Sinomicrurus maccllellandi*. Among all 15 venomous snakes reported from Bhutan (Wangyal & Gurung 2017), only five species that are capable of delivering fatal injuries were observed in the present study location: *B. niger*, *B. fasciatus*, *N. kaouthia*, *N. naja*, and *O. hannah*.

Although the episodes of human mortality caused by snake envenomation are frequently reported in national news media and heard from oral testimonies of local people, it is difficult to know the actual number of morbidity and mortality of snakebites as

these incidences are not systematically documented and studied in Bhutan. Very often, instead of going to the nearest hospital, villagers approach traditional healers who are often quacks. Though it is known that snakebites occur frequently in Sarpang District in the subtropical belt of southern Bhutan, the incidences are not documented despite the fact that the condition is a recognized medical emergency. Therefore, this study aimed to evaluate the human health issues associated with snakebite in Sarpang District through hospital-based statistics.

MATERIALS AND METHODS

Much of Sarpang consists of environmentally protected areas. Its far western region encloses a part of the uninhabited Phibsoo Wildlife Sanctuary along the India border. Northern Sarpang is part of the Jigme Singye Wangchuck National Park and its eastern and southeastern regions lie within the Royal Manas National Park. The district is divided into 12 local administrative blocks (Fig. 1).

The vegetation types here are characterized by subtropical broad-leaved forests with thick undergrowth. While its southern region is more or less topographically dominated by plains, gentle slopes dominate its northern region. The altitude ranges from 180 to 600 m and the annual rainfall varies from 2,500 to 5,500 mm with an annual average temperature of 23.8°C (National Statistics Bureau 2016).

The study was done retrospectively in Gelephu Referral Hospital (GRH) in Sarpang district, covering a three-year period (2013–2015). This government-owned hospital is situated near Gelephu Town and not only caters to the people of Gelephu alone but also acts as a tertiary care hospital and referral centre for four other districts of southern Bhutan, namely, Tsirang, Dagana, Zhemgang, and Pemagatshel.

All patients treated for snakebites in GRH (78 patients) from 2013 to 2015 were included in the study. Basic data such as cause for admission and dates of admission and discharge for each case were obtained from the general records kept in the administrative and recordkeeping sections of the hospital. The information was used to trace the relevant case files in the archives from which the necessary data were collected. In extracting data from the case notes, special consideration was given to the time and season of biting, the occupation, age and sex of victims, the species involved, if identified by medical personnel or mentioned in the record, and the

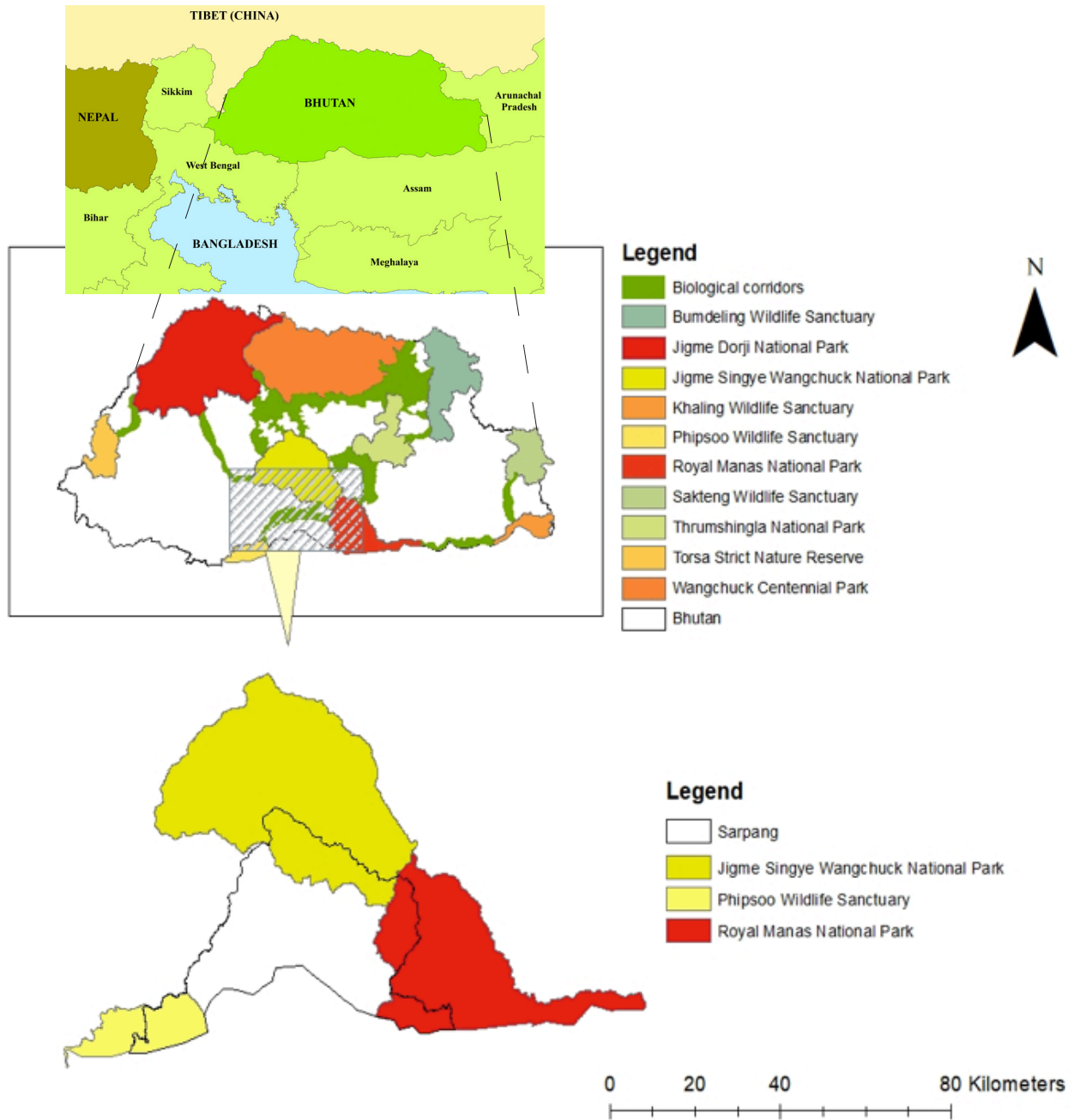


Figure 1. Map of the study area, Sarpang District in southern Bhutan

duration of stay in the hospital, if admitted. Information on clinical management of patients and types of anti-venoms administered were also recorded.

The overall data were classified into different categories: the number of victims under each specific age group, gender group, and outdoor and admitted patients. The age groups 1–20 and 61–70 years were classified as economically unproductive while the age-group 21–60 years was classified as economically productive based on the population structure of Bhutan.

Statistical analyses

Statistical tools such as the statistical package for the social sciences (SPSS) (version 16.0 For Windows) and Microsoft Excel 2010 were used to perform data analyses. An Independent sample t-test was performed to access the significance of the difference between both age and gender groups in relation to snakebites. A relative vulnerability with 95% confidence intervals was calculated for assessing the risk of snake bites by different characteristics of exposure.

RESULTS

In this retrospective study from June 2013 to July 2015, a total of 78 snakebite cases that were registered in GRH were analyzed (Table 1).

Out of the 78 cases registered, 28 (35.89%) developed signs and symptoms of envenomation and were admitted to the hospital for an extended period of time considering the magnitude of complication. The mean duration of the hospital stay was 3.85 days, ranging from two to 10 days. The remaining (n=50, 64.01%) patients received only outpatient treatment as the cases were not considered medical emergencies. While snakebite was observed in all age groups, the large majority of victims (n=51, 65.38%) were adults aged between 21 and 50 years (Fig. 2).

The outdoor patients (n=50) with minor snakebite injuries were kept under observation for a day or less to evaluate the manifestations of any clinical symptoms. Subsequently, the cases were verified, treated, and discharged.

Out of the 78 cases registered, 44 were of males and 34 were of females (Table 2). The results demonstrated

that there was a slight difference between number of male and female victims (1.3:1, 56% vs 44%). An independent-samples t-test conducted to compare the vulnerability of gender groups to snakebites suggested that there was no significant difference between male (M=7.33, SD=2.80) and female (M=5.67, SD=3.93) victims; $t(10)=0.84, p>0.05$. On the other hand, statistical results suggest that there was a significant difference between the unproductive age group (M=0.94, SD=0.99) and the productive age group (M=2.54, SD= 0.97) in incidences of snakebites; $t(40)=-2.88, p<0.05$.

Out of the 28 cases of poisonous bites, the highest incidence (28.57%) of cases of envenomation occurred in the age range between 41 and 50 years while adults between 21 and 50 years accounted for 64.28% of the victims. Of the 28 hospitalized victims, two fatal cases were observed due to severe envenomation, which resulted in irreversible complications. The majority of snakes responsible for bites in the study were unidentified. The victims who succumbed to envenomation were suspected to be bitten either by kraits or cobras. Cobras and kraits are the two major groups of medically important species found in the study

Table 1. Age group and gender-wise distribution of snake bite cases (n=78) registered in Gelephu Referral Hospital, southern Bhutan

Year	2013		2014		2015		Total
Age- group	Male	Female	Male	Female	Male	Female	
1–10	0	1	0	1	2	1	5
11–20	3	2	1	2	0	2	10
21–30	4	3	3	2	4	3	19
31–40	3	2	5	2	3	2	17
41–50	3	3	1	3	3	2	15
51–60	2	1	2	1	4	1	11
61–70	0	0	0	0	1	0	1

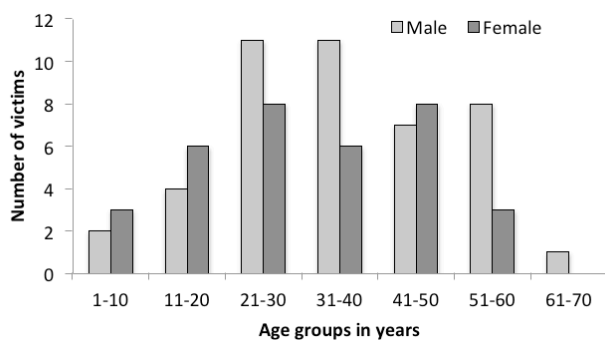


Figure 2. Age and sex distribution of the victims of snakebites in Gelephu Referral Hospital, southern Bhutan, during the study period

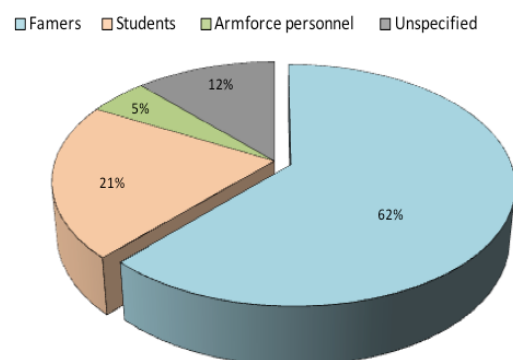


Figure 3. Distribution of snakebite cases based on occupation in Gelephu Referral Hospital, southern Bhutan, during the study period

Table 2. The ratio between male and female victims of snakebites registered in Gelephu Referral Hospital, southern Bhutan

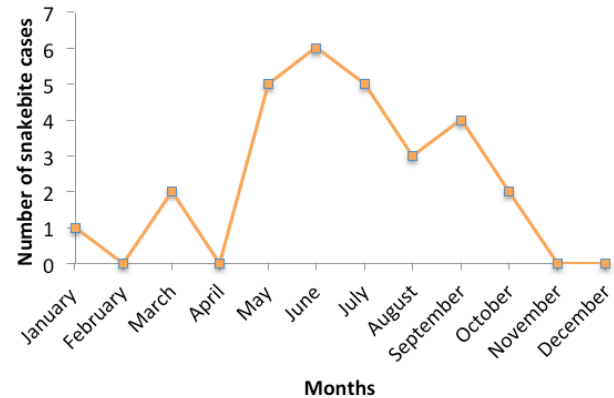
Year	Male		Female	
	Individuals	%	Individuals	%
2013	15	19.23%	12	15.38%
2014	12	15.38%	11	14.10%
2015	17	21.80%	11	14.10%
Total	44	56.42%	34	44.58%

area. A relatively low mortality rate ($n=2$, 0.02%) in 78 cases was observed during the three-year period in GRH, Sarpang.

Anti-snake venom (ASV) was administered to patients showing signs of systemic envenomation like clinically important coagulation abnormality or systemic affects such as ptosis or respiratory weakness caused by neurotoxicity. All patients were treated with recommended doses of ASV following the guideline of World Health Organization (W.H.O) (Warrell 2010); lyophilized, polyvalent enzyme refined equine immunoglobulin, supplied with 10ml sterile water for injections I.P., manufactured by Premium Serum and Vaccines Pvt. Ltd., Junnar Taluk, Pune District, Maharashtra 410504, India, is currently used as ASV in GRH. The timely administration of ASV remains the mainstay to reduce the morbidity and mortality associated with snakebites. Polyvalent ASV was the most important drug used to treat the patients and its administration showed excellent outcomes with only two cases of mortality out of the 28 envenomation cases enrolled. According to Pore et al. (2015), however, polyvalent ASV cannot be assumed to be uniformly effective for all poisonous snake bites as several factors affect region-specific observation of ASV use.

The present study also revealed that relatively large proportions of snakebite incidences are experienced by farmers when compared to other occupational groups. Combining both venomous and non-venomous snakebites, the farmer group accounted for 62% cases ($n=48$). This was followed by cases that involved students ($n=16$, 21%), unspecified ($n=9$, 12%), and armed force personnel ($n=4$, 5%) (Fig. 3).

Most of the venomous bites (68%) occurred in the monsoon season, particularly between May and August. The event of snakebites showed a sudden escalation in May while the maximum incidence occurred in June (21.42%); a decreasing trend of snakebite cases was observed towards late autumn and winter months. Cold season, particularly between November and February,

**Figure 4. Monthly distributions of venomous bite cases (n=28) in Gelephu Referral Hospital, southern Bhutan, during the study period**

represented the minimum incidences of snakebites (Fig. 4).

DISCUSSION

In this study, the majority of the snakebite victims were adults, which signified that an active population is at higher risk of snakebites. The high incidence of snakebites in the vulnerable age group of 21–50 years could be due to occupational exposure, being the economically productive age group. There was only a slight difference between number of male and female victims (1.3:1, 56% vs 44%), which suggests that both males and females are equally likely to be bitten by snakes. A similar finding was also reported by Pandey (2016) and Poudyal et al. (2016) from Nepal. This could be because of the equal exposure of both genders to outdoor activities, as the majority of the population in the study area is represented by an agrarian society.

The majority of victims ($n=50$, 64%) did not demonstrate signs and symptoms of envenomation. These patients were treated and discharged within a day or less. This finding suggests that a relatively large proportion of snakebite cases are attributed to non-venomous snakes. It is also likely that victims are exposed to dry bites. The relatively large proportion of incidences of non-venomous snakebites observed in this study agree with the general statement of Das (2012), who admitted that majority of the southeastern Asian snakes are non-venomous and, according to Holve (2007), out of the roughly 3,000 known species of snakes, only 15% are considered dangerous to humans.

The study found that more farmers were bitten by snakes as compared to other occupational groups. This

could be due to the fact that people of this occupational category, especially in rural communities, have to engage in various outdoor activities such as collecting firewood and fodder from forest, herding cattle, and spending extended periods of time working in fields, which make them highly vulnerable to snakebites. The majority of people, however, were unable to identify the snakes that bit them, except the species that were very common and those belonging to the cobra family due to their distinctive characteristic of spreading the hood when provoked. This could be due to the occurrence of incidences at night, vanishing of the snake before the victim could see it, misleading descriptions provided by the victim, or inadequate knowledge of medical professionals in species identification.

Most of the venomous bites (around 68%) occurred during the months of May, June, July, and August, which corresponds to the early to peak monsoon season in Bhutan with average temperature and rainfall of 26.48°C and 1,002.55mm, respectively. This season is characterized by increased humidity and temperature that introduce conducive climatic conditions for snakes to emerge out of their shelters in search of food and other ecological requirements. This findings agree with Pandey (2006) and Joshi (2010), who also observed the occurrence of such seasonal patterns in cases of snake envenomation. This is a peak season for agricultural activity, where the economically productive portion of the population spends considerable time in the fields, which also increases the probability of snakebites. The incidences of snakebites are higher during the rainy season and during periods of intense agricultural activity (Suleman et al. 1998; Ariaratnam et al. 2008).

CONCLUSION

Since this study is the first of its kind in the country, the true incidence of snakebites in rural Bhutan is largely unknown. The present available data are entirely based on hospital statistics that constitute a very small percentage of cases of snakebites. The present study, however, evidently revealed that snakebites were more common in rural areas and that, more importantly, people who were largely engaged in agricultural activities were those mostly affected by poisonous snakebites. The development and adoption of snakebite management guidelines, raising awareness among the

vulnerable sections of the population, improvement of medical facilities in referral hospitals and rural health centers, and proper management and transfer of snakebite victims to hospitals are recommended in reducing the morbidity and mortality associated with snakebite incidences.

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