Am. J. Trop. Med. Hyg., 71(2), 2004, pp. 234–238

IMPACT OF SNAKE BITES AND DETERMINANTS OF FATAL OUTCOMES IN SOUTHEASTERN NEPAL

SANJIB K. SHARMA, FRANÇOIS CHAPPUIS, NILHAMBAR JHA, PATRICK A. BOVIER, LOUIS LOUTAN, AND SHEKHAR KOIRALA

Department of Medicine, and Department of Community Medicine, B. P. Koirala Institute of Health Sciences, Dharan, Nepal; Travel and Migration Medicine Unit, and Department of Community Medicine, Geneva University Hospital, Geneva, Switzerland

Abstract. Current available data on snake bites in Nepal are based solely on hospital statistics. This community-based study aimed at evaluating the impact of snake bites and determining the risk factors associated with a fatal outcome in southeastern Nepal. A total of 1,817 households, selected by a random proportionate sampling method, were visited by trained fieldworkers in five villages. Extensive data from snake bite victims during the 14 previous months were recorded and analyzed. One hundred forty-three snake bites including 75 bites with signs of envenoming were reported (annual incidence = 1,162/100,000 and 604/100,000, respectively), resulting in 20 deaths (annual mortality rate = 162/100,000). Characteristics of krait bites such as bites occurring inside the house, while resting, and between midnight and 6:00 AM were all factors associated with an increased risk of death, as were an initial consultation with a traditional healer, a long delay before transport, and a lack of available transport. An initial transfer to a specialized treatment center and transport by motorcycle were strong protective factors. Among the 123 survivors, wounds required dressing and surgery in 30 (24%) and 10 (8%) victims, respectively, the mean working incapacity period was 15 days, and the mean out-of-pocket expense was 69 U.S. dollars. Snake bite is a major but neglected public health problem in southeastern Nepal. Public health interventions should focus on improving victims' rapid access to anti-snake venom serum by promoting immediate and fast transport to adequate treatment centers, particularly for bites occurring at night.

INTRODUCTION

Snake bite is a widely distributed but neglected condition. In Asia alone, it has been estimated that four million snake bites occur each year, of which approximately 50% are envenomed, resulting in 100,000 annual deaths.[1] The incidence is particularly high in rural areas of warm regions where snakes are abundant and human activities, mainly agriculture, increase the risks of man-snake encounters.[2] Case fatality rates can be high where patients do not have rapid access to life-saving anti-snake venom serum (ASVS), a common situation in rural areas of developing countries.

In Nepal, where more than 90% of the population is engaged in agricultural activities, more than 20,000 snake bites and 1,000 deaths may occur annually according to a World Health Organization report.[3] The majority of bites take place in the Terai, the southern lowland agricultural plain bordering India. The Terai is characterized by a hot tropical climate and a high density of both human and snake populations. Of the 22 species of venomous snakes living in Nepal, several highly venomous species of snakes are found in the Terai including *Naja naja* (common cobra), *Ophiophagus hannah* (king cobra), *Bungarus caeruleus* (common Indian krait), *Bungarus fasciatus* (banded krait), and *Daboia russelii* (Russell's viper, restricted to western Nepal).[3,4] Several hospital-based epidemiologic studies conducted in the Terai showed that most envenomed patients had signs of neurotoxicity, a usual consequence of cobra and krait bites.[5–7] Reliable data on morbidity and mortality due to snake bite in Nepal are scarce because of the lack of community-based surveys. Moreover, the existing reporting system of snake bite in Nepal relies on hospital-based data that are likely to grossly underestimate both the incidence and the mortality of snake bite, as shown elsewhere.[8–12]

The identification of risk factors associated with a fatal outcome of snake bite would be very helpful to better target intervention measures. Several previous studies described clinical and epidemiologic features of fatal elapid snake bites but none, to our knowledge, identified true risk factors of death by comparing groups of victims with fatal and non-fatal outcomes.[7,8,13,14]

The objectives of this study were to assess the incidence of snake bite in the eastern Terai, to describe its related morbidity, mortality, and socioeconomic impact, and to determine the risk-factors associated with a fatal outcome.

MATERIALS AND METHODS

This community-based survey took place in December 2001 in five Village Development Committees (VDCs) totaling 78,311 people (2001 census),[15] randomly selected from three districts of the eastern region of Nepal: Chulachuli, Itahara, Kerabari, Shivgunj, and Rajghat VDCs. The five VDCs are situated in the vicinity of a Red Cross sub-center, exclusively dedicated to the clinical management of victims of snake bites, located in Damak, Jhapa District (Figure 1). Ethical clearance was obtained from the Ethical Review Committee of the B. P. Koirala Institute of Health Sciences, a teaching hospital located in Dharan, Eastern Nepal.

Sample size. Given an expected annual incidence of snake bite of 300/100,000 with a 95% confidence interval between 200/100,000 and 400/100,000, 10,000 people should be surveyed, representing approximately 1,700 households.

In each VDC, households were randomly selected by a population proportionate sampling method. Every eighth household starting from the center of each ward (VDCs are usually divided into nine wards each in Nepal) was surveyed by one of the eight teams of specifically trained fieldworkers. These teams were supervised by two senior faculty members (SKS and NJ) of the B. P. Koirala Institute of Health Sciences. The head of each household (or another senior family member in his or her absence) was interviewed after informed consent was obtained. The general characteristics of the household were recorded, as well as any snake bite that had occurred to any permanent member(s) of the household during the 14 months prior to the survey (since the 2000 Dashain festival, the most important and widely celebrated religious event of the Hindu calendar in Nepal).

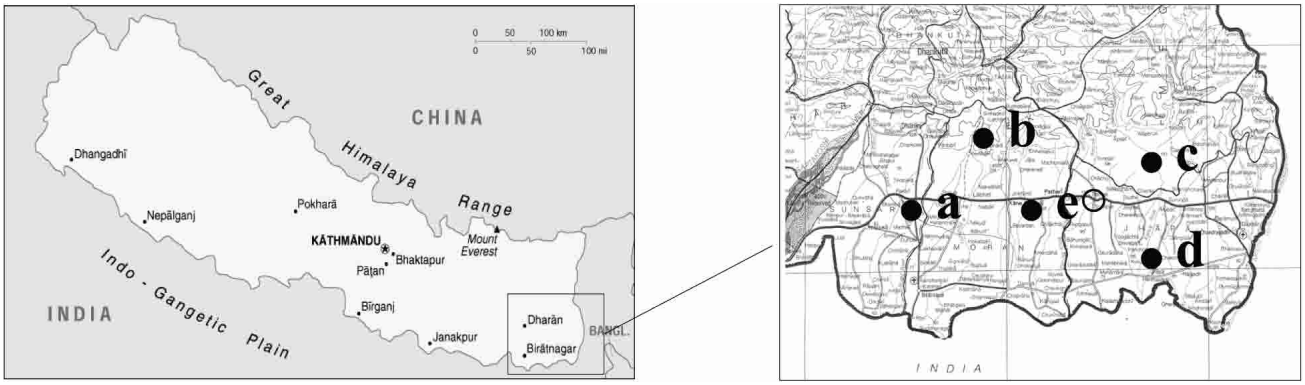

FIGURE 1. Maps of Nepal and the surveyed area. The villages surveyed were **a**, Itahara; **b**, Kerabari; **c**, Chulachuli; **d**, Shivgunj; and **e**, Rajghat. ○ = Damak Red Cross Health Centre.

Each victim of snake bite (or one of his or her close parents if the victim was absent, dead, or unable to give reliable answers) was interviewed using a standardized questionnaire. Information about the victim (age, sex, education level, occupation), the snake bite (location and type of activity at the time of bite, time of bite, site, type of snake), its management (first-aid, treatment, transport), immediate medical and longer-term outcome, and economic burden were recorded. Probable envenoming was defined as the occurrence of at least one of the following symptoms: eye ptosis, vomiting, dyspnea. All households with a history of snake bites were later re-visited by the principal investigator to confirm the date of the event.

Based on the household survey, we computed the annual incidence rate of snake bites, envenomed snake bites, and death-related snake bites based on the number of people living in the surveyed households for a 12-month period.

Frequencies and proportions were used to describe the characteristics of the people with a snake bite. To identify risk factors associated with death, odds ratios and 95% confidence intervals (CIs) were calculated. Mean values and *t*-tests were used for continuous characteristics such as age. Logistic regression was used to adjust for potential confounders. All statistical tests were two-tailed, with a significance level of $P < 0.05$. Statistical analyses were performed using SPSS version 11.0 (SPSS, Inc., Chicago, IL).

RESULTS

Incidence and mortality. A total of 1,817 households inhabited by 10,550 persons (mean = 5.8 persons/household) were visited in December 2001. The persons interviewed were mainly males (male:female ratio = 4.2:1) and farmers (74%) with a mean age of 45 years. A history of snake bite was reported by 143 persons during the preceding 14 months. The annual incidence of snake bites was thus 1,162/100,000 (95% CI = 957/100,000–1,366/100,000). Half of the snake bites (52%) had signs of probable envenoming, resulting in an annual incidence of envenomed snake bites of 604/100,000 (95% CI = 461/100,000–758/100,000).

Twenty of the 143 victims had a fatal outcome, resulting in a case-fatality rate for envenomed snake bites of 27% and an annual mortality rate due to snake bites of 162/100,000 (95% CI = 86/100,000–239/100,000). The vast majority (n = 16; 80%) of all deaths occurred in the village of residence (n = 8) or during transport to a health care center (n = 8), while only four deaths (20%) occurred in a hospital or treatment center.

Characteristics of the 143 victims of snake bites. The victims had a mean age of 32 years and the majority were males (60%) and literate (69%) (Table 1). Agriculture was the dominant profession (44%) and 49% of the victims lived in a *kucha*, a traditional hut with mud walls. Most of the snake bites occurred during the rainy season (68%; Figure 2), outside the house (82%), while farming (21%), doing other work (32%), or walking (32%) and mostly during the day (50%) or between 6:00 PM and midnight (40%). Snakes were identified by 61% of the victims and were most frequently reported as cobras (58%), water snakes (24%), and common kraits (12%).

Determinants of fatal outcome. When compared with the characteristics of the 123 survivors, residing in a wooden house, being bitten inside the house, resting, and being bitten between midnight and 6:00 AM were risk factors statistically associated with a fatal outcome, while age, sex, village of residence, occupation, season, and site of bite were not (Table 1).

The presence of sign(s) of envenoming, an initial visit to a traditional healer and a lack of available transport were all statistically associated with an increased risk of death (Table 2). The delay before transport (hours) was significantly longer ($P = 0.004$) for victims with a fatal outcome (mean = 67, quartile = 23–60–105) than for survivors (mean = 30, quartile = 10–20–35). An initial transport to the Damak Red Cross sub-center, treatment with ASVS, and transport by motorcycle were strongly associated with a decreased risk of death. Initial transport to the Damak Red Cross sub-center and transport by motorcycle remained significant when adjusted in a regression logistic model for socioeconomic factors such as age, sex, village of residence, education level, occupation, house type, and time and location of the snake bite. None of the various first-aid methods used were associated with improved survival.

Morbidity and socioeconomic impact. A total of 123 patients survived a snake bite. The wound at the bite site required dressing in 30 patients (24%) and surgery in 10 patients (8%). The median dressing time was 10 days (range = 1–122). A scar with deformity was observed during the survey in eight patients (7%) while six patients (5%) had evidence of

TABLE 1
Characteristics of 143 patients with snake bite and relationships with fatal outcome in Terai, Nepal

	All snake bites total = 143 n (%)	Deaths total = 20 n (%)	P*
Mean age (years)	32	29	0.38
Sex	–	–	0.61
Male	86 (60)	11 (13)	–
Female	57 (40)	9 (16)	–
Village Development Committee	–	–	0.48
Chulachuli	37 (26)	7 (19)	–
Ithara	41 (29)	7 (17)	–
Kerabari	24 (17)	3 (13)	–
Shivgunj	13 (9)	0	–
Rajghat	28 (20)	3 (11)	–
Education	–	–	0.38
Illiterate	45 (32)	8 (18)	–
Literate	98 (69)	12 (12)	–
Occupation	–	–	0.55
Agriculture	61 (44)	9 (15)	–
Other work	12 (9)	0	–
Student	34 (25)	5 (15)	–
Housewife	32 (23)	5 (16)	–
House type	–	–	0.04
Kucha (mud walls)	70 (49)	9 (13)	–
Tin	44 (31)	3 (7)	–
Wood	21 (15)	7 (33)	–
Other	8 (6)	1 (13)	–
Time of the year	–	–	0.82
Rainy season	97 (68)	14 (14)	–
Dry season	46 (32)	6 (13)	–
Location at time of bite	–	–	0.006†
Indoors	26 (18)	8 (31)	–
Resting	13 (9)	3 (23)	–
Active	13 (9)	5 (38)	–
Outdoors	117 (82)	12 (10)	–
Field	67 (47)	5 (7)	–
Backyard	17 (12)	6 (4)	–
Road	20 (14)	0	–
Forest/riverside	13 (9)	1 (8)	–
Type of activity at time of bite	–	–	0.01
Walking	45 (32)	2 (4)	–
Working	45 (32)	7 (16)	–
Farming	30 (21)	3 (10)	–
Resting	16 (11)	6 (38)	–
Playing	7 (5)	2 (29)	–
Time of bite	–	–	0.02
Morning (6:00 AM–11:59 AM)	30 (21)	3 (10)	–
Day (noon–5:59 PM)	41 (29)	6 (15)	–
Evening (6:00 PM–11:59 PM)	57 (40)	5 (9)	–
Night (midnight–5:59 AM)	15 (11)	6 (40)	–
Use of light (evening/night)	14 (23)	2 (14)	0.70
Site of bite	–	–	0.79
Lower limb	113 (79)	15 (13)	–
Upper limb	29 (20)	5 (17)	–
Trunk	1 (1)	0	–
Snake identified	87 (61)	11 (13)	0.56
Name of snake	–	–	0.32
Cobra	34 (58)	9 (26)	–
Water snake	14 (24)	0	–
Common krait	7 (12)	1 (14)	–
Rat snake	2 (3)	0	–
Pit viper	1 (2)	0	–
Banded krait	1 (2)	0	

* Testing differences between the 123 survivors and the 20 subjects with a fatal outcome. *P* values were measured by Pearson's chi-square test for categorical variables and an independent samples *t*-test for continuous variables.
† Statistical test between indoor and outdoor categories.

a chronic wound (>6 months duration). No victims needed amputation. The median time of bed rest and working incapacity were 4 (range = 0–90) and 7 (range = 0–183) days, respectively. The personal expenses due to the snake bite are detailed in Table 3. Patients and their families spent a mean of 69 U.S. dollars (SD = 100, minimum = 0, maximum = 780, quartiles = 19–38–76).

DISCUSSION

The annual incidence of all (1,162/100,000) and envenomed (602/100,000) snake bites and the annual mortality from snake bites (162/100,000) found in this study are the highest reported in Asia based on a recent literature review.[1] Annual mortality rates up to 32/100,000 and 81/100,000 were previously found by community-based surveys in India (West Bengal Province) and the Philippines, respectively.[10,11] These figures indicate that snake bites are a very serious public health problem in southeastern Nepal, perhaps on the increase.[7]

The high case-fatality of snake bites found in this study can be partly explained by the highly venomous species of snakes (cobras, kraits) predominant in this region.[4] Case-fatality rates greater than 20% have been reported in Nepal among hospitalized patients with signs of envenoming.[5–7] Bites occurring inside the house, while resting, and between midnight and 6:00 AM were significantly associated with an increased risk of death. Common kraits are known to enter houses at night in search of food and to bite their human victims while they are sleeping on the floor, a common sleeping habit among Hindus in the rural Indian subcontinent.[13,16,17]

The neurotoxic effects of krait or cobra venom are usually clinically evident within the first hour after the bite, rapidly progressing to respiratory paralysis.[18] Not surprisingly, fatal outcome was more likely when victims delayed their departure to the Damak Red Cross Health Center, the reference treatment center for snake bites in the surveyed area. As previously observed elsewhere, the large majority (80%) of the victims died in their villages or during transport.[8] The most common causes of delay before departure were an initial consultation of a traditional healer and lack of available transport. Moreover, since krait bites are generally painless with little or no local skin changes, victims might not have recognized the bite or might not have felt sufficiently compelled to seek treatment immediately. Several cases of morning paralysis after krait bites have been described in the literature.[17,19] Consultation of a traditional healer is a classic cause of delay and exposes the patient to useless or dangerous interventions.[9,13,14,16] Fortunately, only 22% of the victims initially consulted a traditional healer in our study, a much lower percentage than found in some other snake bite–endemic areas.[12,20] Both the non-availability of transport and the inappropriateness of transport means were associated with an increased risk of death. Some patients even had to be carried on stretchers or a person's back for several hours. Interestingly, the use of a motorcycle, the quickest means of transport on the simple trails linking most villages in rural Nepal, was strongly associated with survival.

The most striking features of first-aid methods used by villagers were the quasi-universal use of tourniquets (88%) and the total absence of use of the pressure-immobilization method. The use of tourniquets, which can increase local complications by increasing tissue anoxia and triggering severe systemic envenoming right after their removal, is currently strongly discouraged by most experts.[2,21]

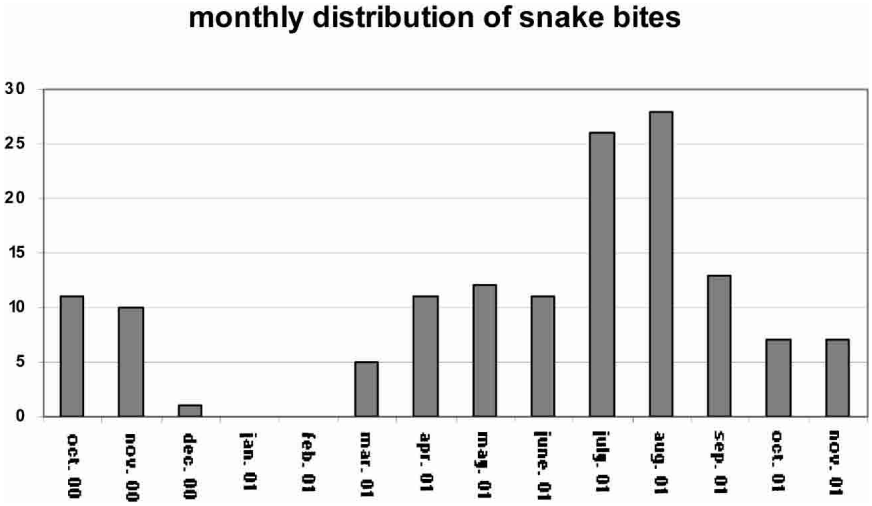

FIGURE 2. Monthly distribution of the 143 snake bites in Terai, Nepal.

The consequences of snake bites among survivors are not negligible. Approximately one-third of the patients in this study had a wound requiring dressing or surgery (without amputation) and scars with limb deformities (7%), and chronic wounds (5%) were not rare. To our knowledge, the socioeconomic consequences of snake bites had never been evaluated. Since most of the bites occurred in young adults during the rainy season, a time of high farming activity, the working incapacity of the victims imposed a substantial burden on households. Moreover, the out-of-pocket expenses were high among survivors, often equivalent to several months of income in a country where 38% and 83% have daily incomes of less than 1 and 2 U.S. dollars per day, respectively.[22] These socioeconomic aspects deserve to be further evaluated prospectively in a cohort of snake bite victims in the future.

Concerning the weaknesses of this study, its retrospective design might have created some degree of recall bias. Moreover, because all teams of interviewers could not be supervised permanently, we can not exclude that some bias occurred during the selection of households within villages, with an over-sampling of households with an episode of snake bite. Consequently, both the annual incidence and mortality of snake bites might have been overestimated. Nevertheless, this community-based approach allowed for a better detection of cases than hospital-based data analysis and was conducted on a large sample of the local population. The true impact of snake bites in this region should be defined in the future by a well-controlled, prospective, community-based survey.

These findings will help to design interventions aimed at decreasing the incidence and case-fatality rate of snake bites

TABLE 2
Risk factors associated with a fatal outcome in 143 patients with snake bite in Terai, Nepal

Exposure	Number (%) of patients exposed	Crude odds ratio of death	95% confidence interval
Use of oral chilly	63 (44)	0.37	0.13–1.09
First aid			
Tourniquet	126 (88)	0.73	0.19–2.8
Washing	32 (22)	0.85	0.26–2.74
Incision	17 (12)	0.8	0.17–3.8
Mud/garlic/ashes	11 (8)	–	
Salt	11 (8)	0.6	0.07–4.92
Bandage	10 (7)	0.67	0.08–5.57
Sucking	5 (4)	–	
Snake stone	5 (4)	1.57	0.17–14.77
None	6 (4)	6.72	0.89–50.75
Signs of envenomation			
Any sign	75 (53)	3.1	1.06–9.06
Difficulty opening eye	68 (48)	1.77	0.68–4.63
Breathing difficulty	45 (32)	5.22	1.92–14.24
Vomiting	38 (27)	5.54	2.05–14.96
First place treatment			
Damak Health Center	70 (49)	0.15	0.04–0.53
Traditional healer	31 (22)	6.29	2.31–17.16
Health post	12 (8)	2.62	0.47–14.54
Treatment			
Antivenom serum	37 (51)	0.1	0.03–0.38
Cause of delay			
Transport impossible	28 (20)	4.48	1.64–12.27
Traditional healer	18 (13)	5.48	1.81–16.6
No sense of danger	10 (7)	–	
Patient's ignorance	4 (3)	2.11	0.21–21.3
Mode of transport			
Motorcycle	60 (42)	0.06	0.01–0.44
Cycle	32 (22)	2.11	0.76–5.84
Bus	22 (15)	1.46	0.44–4.86
Taxi	14 (10)	0.45	0.06–3.61
Carried by humans	6 (4)	6.72	0.89–50.75

TABLE 3
Direct and indirect cost borne by the 123 survivors of snake bites in Terai, Nepal (in U.S. dollars)

Type of expenses	No. (%) of patients reporting out-of-pocket expense	Mean (SD) cost per patient	Total cost
Direct cost			
Drug and dressings	68 (55)	42 (64)	2,856
Health worker	45 (37)	27 (50)	1,215
Transport	70 (57)	10 (10)	700
Traditional healer	11 (9)	3 (2)	33
Indirect cost			
Salary and hiring	91 (74)	27 (27)	2,457
Others	42 (34)	29 (62)	1,218
Total	123 (100)	69 (103)	8,479

in this region. Health education should not only promote measures of protection from snake bites such as wearing gum boots while farming,[2] but also interventions focused on slowing down the absorption of venom at the bite site and decreasing the time between the bite and treatment with specific ASVS. Educating the community about the risks of domestic bites, especially those occurring at night, and about the need to avoid any delay before transport should be key messages. Traditional healers should be included in such discussions. A significant place should be given to the avoidance of ineffective or deleterious first-aid measures and to the promotion of potentially effective ones like the pressure-immobilization method, which can slow down the absorption of venom from the site of the bite from elapid snakes such as cobras and kraits.[2,23] Rapid transport by motorcycle could well be the most important single measure to prevent death and complications from snake bites in southeastern Nepal. Setting up a system of volunteer motorcycle owners ready to transport snake bite victims should be negotiated with community leaders in each village. Additionally, the continuous provision by the Nepalese Ministry of Health of life-saving ASVS, free of cost, to a sufficient number of health centers and hospitals with adequately trained medical staff is of crucial importance.

Snake bite is an underestimated public health problem sharing most of the characteristics of neglected diseases such as visceral leishmaniasis or human African trypanosomiasis. It causes substantial mortality, morbidity, and socioeconomic hardship to poor populations living in rural tropical areas, where access to life-saving treatment, ASVS, remains difficult or impossible.

Received December 28, 2003. Accepted for publication February 14, 2004.

Acknowledgment: We thank Chandra Shah (health assistant in charge of the Damak Health Centre) for his precious contribution to the fieldwork.

Financial support: The study was funded by the Sonisca Foundation.

Authors' addresses: Sanjib K. Sharma, Department of Medicine, B. P. Koirala Institute of Health Sciences, Dharan, Nepal, Telephone: 977-25-525-555, Fax: 977-25-520-251. François Chappuis and Louis Loutan, Travel and Migration Medicine Unit, Geneva University Hospital, 24 Rue Micheli-du-Crest, Geneva, Switzerland, Telephone: 41-22-372-9610, Fax: 41-22-372-9626. Nilhambar Jha, Department of Community Medicine, B. P. Koirala Institute of Health Sciences, Dharan, Nepal, Telephone: 977-25-525-555, Fax: 977-25-520-251. Patrick A. Bovier, Department of Community Medicine, Geneva University Hospital, Geneva, Switzerland, Telephone: 41-22-372-3311, Fax: 41-22-372-9626. Shekhar Koirala, B. P. Koirala Institute of Health Sciences, Dharan, Nepal, Telephone: 977-25-525-555, Fax: 977-25-520-251.

Reprint requests: François Chappuis, Travel and Migration Medicine Unit, Geneva University Hospital, Rue Micheli-du-Crest 24, 1211 Geneva 14, Switzerland, Telephone: 41-22-372-9610, Fax: 41-22-3729626, E-mail: francois.chappuis@hcuge.ch.

REFERENCES

1. Chippaux J-P, 1998. Snake-bites: appraisal of the global situation. *Bull World Health Organ 76:* 515–524.
2. Warrell DA, 1999. WHO/SEARO Guidelines for the clinical management of snake bites in the southeast Asian region. *Southeast Asian J Trop Med Public Health 30 (suppl 1):* 1–85.
3. World Health Organization, 1987. Zoonotic disease control: baseline epidemiological study on snake-bite treatment and management. *Wkly Epidemiol Rec 42:* 319–320.
4. Bhetwal BB, O'Shea M, Warrell DA, 1998. Snakes and snake bites in Nepal. *Trop Doct 28:* 193–195.
5. Handsak SG, Lallar KS, Pokharel P, Shyangwa P, Karki P, Koirala S, 1998. A clinico-epidemiological study of snake bite in Nepal. *Trop Doct 28:* 223–226.
6. Heap BJ, Cowan GO, 1991. The epidemiology of snake bite presenting to British Military Hospital Dharan during 1989. *J R Army Med Corps 137:* 123–125.
7. Sharma SK, Khanal B, Pokhrel P, Khan A, Koirala S, 2003. Snakebite-reappraisal of the situation in Eastern Nepal. *Toxicon 41:* 285–289.
8. Trevett AJ, Lalloo DG, Nwokolo N, Kavau IH, Warrell DA, 1994. Analysis of referral letters to assess the management of poisonous snake bite in rural Papua New Guinea. *Trans R Soc Trop Med Hyg 88:* 572–574.
9. Sawai Y, Toriba M, Itokawa H, de Silva A, Perera GLS, Kottegoda MB, 1984. Study on deaths due to snakebite in Anuradhapura District, Sri Lanka. *Snake 16:* 7–15.
10. Hati AK, Mandal M, De MK, Mukherjee H, Hati RN, 1992. Epidemiology of snake bite in the District of Burdwan, West Bengal. *J Indian Med Assoc 90:* 145–147.
11. Watt G, Padre L, Tuazon L, Hayes CG, 1987. Bites by the Philippine cobra (*Naja naja philippinensis*): an important cause of death among rice farmers. *Am J Trop Med Hyg 37:* 636–639.
12. Snow RW, Bronzan R, Roques T, Nyamawi C, Murphy S, Marsh K, 1994. The prevalence and morbidity of snake bite and treatment-seeking behavior among a rural Kenyan population. *Ann Trop Med Parasitol 88:* 665–671.
13. Bawaskar HS, Bawaskar PH, 2002. Profile of snakebite envenoming in western Maharashtra, India. *Trans R Soc Trop Med Hyg 96:* 79–84.
14. Looareesuwan S, Viravan C, Warrell DA, 1988. Factors contributing to fatal snake bite in the rural tropics: analysis of 46 cases in Thailand. *Trans R Soc Trop Med Hyg 82:* 930–934.
15. Sharma HB, Goutam RP, Vaidya S, 2002. *District Demographic Profile of Nepal*. Kathmandu: Informal Sector Research and Study Center.
16. Theakston RDG, Phillips RE, Warrell DA, Galagedera Y, Abeysekara DTDJ, Dissanayaka P, de Silva A, Aloysius DJ, 1990. Envenoming by the common krait (*Bungarus caeruleus*) and Sri Lankan cobra (*Naja naja naja*): efficacy and complications of therapy with Haffkine antivenom. *Trans R Soc Trop Med Hyg 84:* 301–308.
17. Saini RK, Singh S, Sharma S, Rampal V, Manhas AS, Gupta VK, 1986. Snake bite poisoning presenting as early morning neuroparalytic syndrome in Jhuggi dwellers. *J Assoc Physicians India 34:* 415–417.
18. Trishnananda M, Oonsombat P, Dumavibhat B, Yongchaiyudha S, Boonyapisit V, 1979. Clinical manifestations of cobra bite in the Thai farmer. *Am J Trop Med Hyg 28:* 165–166.
19. Bawakar HS, Bawaskar PH, 1992. Snake bite (a clinical observation). *Bombay Hosp J 34:* 190–194.
20. De Silva A, 1981. Snakebites in Anuradhapura District. *Snake 13:* 117–130.
21. Gold BS, Dart RC, Barish RA, 2002. Bites of venomous snakes. *N Eng J Med 347:* 347–356.
22. United Nations Development Program, 2002. *Human Development Report 2002*. New York: Oxford University Press.
23. Sutherland SK, Coulter AR, Harris RD, 1979. Rationalisation of first-aid measures for elapid snakebite. *Lancet 1:* 183–186.