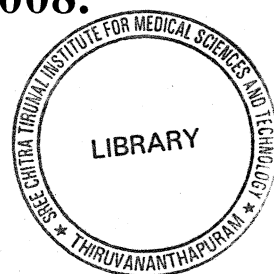


Risk factors of snake bite and health seeking behaviour of the people on North 24 Parganas district, West Bengal, India, 2008.

By

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(MAE-FETP Scholar 2007-2008)



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CERTIFICATION

This is to certify that this dissertation, titled '**Risk factors of snake bite and health seeking behavior of the people of North 24 Parganas district, West Bengal, India, 2008**', submitted by Dr. Kajal Krishna Banik, in partial fulfillment of the requirements for the degree of Master of Applied Epidemiology, is the original work done by him and has not been submitted earlier, in part or whole, for any other publication or degree.

Date 31.1.17


f DIRECTOR

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Risk factors of snake bite and health seeking behaviour of the people of North 24 Parganas, West Bengal, India, 2008

Abstract

Introduction: In last five years, average 1000 snake bite with 10 deaths reported annually among the residents of North 24 Parganas district of West Bengal. No study conducted to identify the risk factors of it. We studied the risk factors associated with snake bite and where from they receive the treatment.

Methods: We conducted a Matched case control study. The controls were selected from the same locality of the case patients and age and sex matched. We studied the selected variables and measured their association of with the cases and controls. We generated multivariate logistic regression model to test variables that were significantly associated.

We described the frequency of different methods of treatment the victims opted for.

Results: Out of 150 cases, majority 127 (84.66%) were from rural area. The variables found significant association were having ditches and holes in the house (MOR = 5.8, 95 % CI 3.24 – 12.46), pets in the house (MOR = 2.78, 95 % CI 1.24 – 4.55), sleeping on the floor (MOR = 2.03, 95 % CI 1.25 – 4.71), going out barefoot (MOR = 1.69, 95% CI 1.26 – 5.31) and food stores in house (MOR = 1.56, 95% CI 1.07 – 3.5). Trend analysis indicated strong association in more exposures in sleeping floor (χ^2 19.78). Multivariate analysis indicated ditches and holes (p = 0.0000), pets in house store in

($p=0.0085$), food store in house ($p=0.0216$), sleeping on floors ($p=0.0052$) and barefooted out ($p=0.0106$) were strongly associated with snake bite.

63% of victims went to modern medicine while 12% to traditional healers exclusively.

Discussion: Dwelling places and life styles of the people were significantly associated with snake bite. Behavioural change communication targeting rural people, health education and awareness generation by the health workers at the household level will reduce the snake bite.

Key words: snake bite, ditches and holes, sleeping on floors, pets, barefoot

Risk factors of snake bite and health seeking behaviour of the people of North 24 Parganas, West Bengal, India, 2008

1. Introduction:

Envenoming resulting from snake bites is an important public health hazard in many regions, particularly in tropical and subtropical countries.^{1,2}

In an effort to estimate the global burden of snake bite a group of researchers under world health organisation added up their estimates. Using this method, the researchers estimate that worldwide, at least 421,000 envenoming and 20,000 deaths from snake bites occur every year; the actual numbers, they suggest, could be as high as 1.8 million envenoming and 94,000 deaths. Their estimates also indicate that the highest burden of snake bite envenoming and death occurs in South and south east Asia and sub Saharan Africa, and that India is the country with the highest annual number of envenoming (81,000) and deaths (nearly 11, 000).³

Unfortunately, public health authorities, nationally and internationally, have given little attention to this problem, relegating snake bite envenoming to the category of a major neglected disease of the 21st century.⁴

The incidence of snakebites varies in national centres across the United States from 4 bites to 19 bites per 100,000 of the population. In the United States there are about 4 deaths per year from snakebites, although reporting is sporadic and figures may be higher for deaths from snakebite. Most victims in the United States are young, white and male. 50% in National studies report were aged between 18 and 28 years. The male to female ratio of

victims was 9 to one.⁵ In Croatia venomous snake bites with a mean annual incidence of 5.2 per 100,000 of the population.⁶ In Australia an annual incidence of about 15 bites per 100,000 of the population and 2 to 4 deaths were reported.⁷

Snake bite is common in developing countries. The incidence of snake bite mortality is particularly high in Africa, Latin America and Asia. 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 and India remains amongst the group of countries with the highest mortality.⁸

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.⁹

The incidence of snake bites in Bangladesh is unknown. Published estimates (Huq et al. 1995; Sarkar et al., 1999) contrast sharply with the results of population surveys in the lowlands of eastern Nepal (Sharma et al., 2004) that revealed a dramatically high annual incidence, morbidity and mortality (1,162 snake bites including 604 envenoming bites and 162 deaths per 100,000).¹⁰

India is called the land of snakes. In India, there are 216 species of snakes; of which only four are venomous snakes (cobra, krait, Russell's viper and saw scaled viper).¹¹ Snake bite is an important and serious medical problem in many parts of India. However, reliable data for the morbidity and mortality are not available since there is no proper reporting system. Moreover, the records of the large number of cases do not come to official statistics.¹²

In 2006, India reported 55,490 cases of snake bite with 1086 deaths.¹³

Maharashtra, one of the states of India with the highest incidence, reported 70 bites per 100,000 population and mortality of 2.4 per 100,000 per year. The other states with a large number of snakebite include West Bengal, Tamilnadu, Uttar Pradesh and Kerala.¹⁴

Most of the studies in India deal with clinical and management aspects. Epidemiological studies related to snake bites are very few.¹⁵

Based on an epidemiological survey of 26 villages with a total population of nearly 19,000 individuals in Burdwan district of West Bengal state in India, Hati et al worked out an annual incidence of 0.16% and mortality rate of 0.016% per year.¹⁶

In 2007, this state had 19,818 cases with 373 deaths.¹⁷

North 24 Parganas district is the largest and top the list in population in the state of West Bengal. The district is having a large area in the Sundarbans and five community development blocks are in the riverine area. In 2007, there were 1007 cases of snake bite with 11 deaths from this district.¹⁷

Some previous studies described clinical and epidemiological features of snake bites, but none, to our knowledge, identified the risk factors of snake bite by comparing group of victims of snake bite with those not, but having the similar exposure settings. We wanted to identify the risk factors associated with snake bite in the district of North 24 Parganas, West Bengal and the methods of treatment the victims opted for.

Objectives of the study

Under the above circumstances we would like to conduct the study with the following objectives-

1. to describe the time, place and person distribution of snake bite cases in the district
2. to identify the risk factors of snake bite in the people of North 24 Parganas, West Bengal state, India, 2008 and
3. to estimate the proportion of methods of treatment the victims opted for during the study period.

2. Methodology:

Study population

We conducted the study among the people of the North 24 Parganas, West Bengal, India, who were permanent resident of the district in 2008.

The estimated mid year population in 2008 was 1, 02, 14,128.

The persons who were present in the district from other places during the study period were excluded.

Study design

To identify the risk factors of snake bite, we conducted a matched case control study.

For the second objective, we described the proportions of different methods of treatment of the snake bite the victims opted.

We used captured recaptured technique to know the actual number of snake bite that could have been present and consequently the number we could have been missed.

Operational definitions

Snake bite case: Any resident of North 24 Parganas district having history of snake bite during June to September 2008, where the victim or any other adult person close to the victim had seen the snake during the bite.

Control: Any resident from the neighbourhood of the case patients not having the snake bite, matched by age (± 5 years age) and sex.

Traditional healers: Any person not having recognized degree from the state or medical council of India treating snake bite.

Rainy season: Mid June to mid October of the year

Bare footed: With out a shoe covering the entire feet.

Data collection: We collected information on personal characteristics, socio economic status, exposure to various potential risk factors; bite related characteristics like time, place, body part involved etc and the method they have opted for treatment initially and subsequently, if any.

Data collection techniques and tools: Myself as the principal investigator, and the trained community health workers collected the information by interviewing the participants. We used a pre designed, pre tested and structured questionnaire written in Bengali language for this purpose. We collected the data from the case patients and controls subjects at a mutually agreed place and time. In cases, where the victim was dead and or a minor (less than 15 years) we collected information from one available adult member of the family. Similar steps were followed in those selected control subjects.

Selection of cases and controls: We have selected all the cases of snake bite according to our case definition during the study period.

We conducted an active case search in the health centres, hospitals, clinics of private medical practitioners and among traditional healers in the district.

For the private medical practitioners we sought assistance from the members of the Indian Medical Association.

To find out maximum number of traditional healers, we applied snow- ball technique.

The controls were recruited from the neighborhood of the case patient and they were age (+_ 5 years) and sex matched.

Data analysis

We described the snake bite cases by their characteristics.

Data were analysed by using the Epi info version 6 software.

To identify the risk factors we calculated the matched Odds ratio of different exposure variables and measured their strength of association.

We did stratified analysis by removing the matching to rule out any confounder or effect modifier.

We did the trend analysis by calculating the linear χ^2 trends of variables with different intensity using StatcalC of Epi info.

We did univariate analysis to find out the association with the variables.

Then, we conducted conditional logistic regression analysis to identify independent risk factor.

We estimated the proportion of different methods of treatment taken by the snake bite victims.

We used capture – recapture technique to estimate the total number of snake bite that might be present during the study period in the district and consequently might have been missed.

Capture-recapture methods had been developed by animal ecologists as one method among others of estimating animal abundance. Capture–recapture techniques originated in wildlife studies, e.g. to estimate the number of fish in a pond. A net was used to catch a number of fish, which were counted, marked and returned to the pond. The net was used again to catch more fish that were also counted, and the number of marked fish, those caught twice, was noted. If all fish caught on the second occasion were marked, then it could be assumed that there were only these fish in the pond, whereas if no

fish in the second catch were marked, then there is likely to be a large number of fish in the pond. Statistical formulae allow us to estimate the overall number of fish in the pond based on the number of fish caught on each occasion and the number caught more than once.

If $N / M = n / R$, then $N = (M) \times n/R$

Where N is the total population size to be estimated,

M is the sample that was captured, marked and released

n is the number captured on second occasion and R is the number of marked, that were recaptured on second attempt.

Ratio of the total population to the total marked on the first attempt is equal to the ratio of the total number caught on the second attempt to the number of marked that were recaptured. $N: M = n: R$ ¹⁸

Quality assurance

We submitted the protocol for review by the faculty members and peers at the National institute of epidemiology, Chennai.

The questionnaire developed in English and was peer reviewed. It was translated into local language (Bengali) and back translated into English.

The questionnaire was pilot tested in the field and modified accordingly.

For the uniformity of data collection I trained ten community health workers with the questionnaire. I supervised few initial interviews and also cross-checked 40% of the interviews by the community health workers.

Data were double entered and checked for accuracy.

Protection of human subjects:

We collected the written informed consent from the participants.

We interviewed the participants with the questionnaire written in Bengali, confidentially in a one to one setting.

We used separate identifiers for the individual participant and no names were written on them.

We received the clearance from the ethical committee of the National Institute of Epidemiology, Indian Council of Medical research, Chennai.

3. Results:

Age and sex distribution: Total 150 cases reported during the study period. 98 cases (65%) were male. The median age of the victims was 32 years. The youngest victim was 6 years old and the eldest one was of 73 years. Maximum cases were in the 15 to 44 years age group (61.3%, 95 % CI 53 – 69.2%).

Place distribution: Snake bite cases were reported mostly from the rural areas, 127 cases (87%). Figure 1

Education status: Among the cases, 11 (7%) were illiterate and 82 (55%) had less than class X education.

Monthly family income: 117 cases (78%) had income less than Rs 2000 per month.

Type of house: 106 victims (71%) were residents of mud houses. Only 26 (17 %) case patients had brick made houses.

Occupation: Among the female victims, 19 were housewives (37%). The proportions of other occupations were 43 % agricultural workers, 21 % students. Female students were more (52%).

Seasonal distribution: The majority of cases, 104 / 150 (69 %) reported during rainy season (mid June to September). Among these 64 were males. 40 males (63%) in this group were agricultural workers.

Place of bite: 67 victims (45%) were bitten around the living place and 66% of these (44 / 67) while they were in rest. 83 victims were bitten outside the dwelling places. (Table 2). Among the victims who were bitten outside the dwelling places (N = 83), 47, (57%) were agricultural workers and (11, 13%) were involved in fishing.

Time of bite: 46 cases, (31 %) had their bites in the morning (6 AM to 11.59 AM) and 49 cases, (32 %) in the evening (6 PM to 11.59 PM). The male victims were higher in both the times, 63% each. Only 25 victims (17%) were bitten in the night (12 mid night to 5.59 AM) of which 15 were in their residence. Table 2

Body parts involved: 95 victims (63%) had their bites in the lower limbs. Table 2

How it was detected: In this study, 130 victims (87%) had seen the snakes themselves. Among the remaining 20 cases the snake had been seen by any other adult family members, 17 (85%) were less than 18 years old.

Case fatality: The reported incidence rate of snake bite cases is 1.5 per 100,000 populations (the estimated population of the district is 10 million). The reported case fatality rate was 4 / 150 (2.66 %).

Univariate analysis: For univariate analysis, we divided the variables in four broad headings. 1). Factors related to the socio economic status of the victims, 2). Factors related to the dwelling places, 3). Factors related to the work places and 4). Factors associated with the life styles of the participants.

1. Among the socio economic factors it had been seen that the education level of the participants below class X standard had statistically significant association (Matched Odds ratio 2.07, 95 % CI 1.27 – 3.38). The other variables were not significantly associated. (Table: 3).

2. Among factors related to the dwelling places, the houses having ditches and holes in the floors or on the walls had most significant association (Matched Odds ratio 5.8, 95 % CI 3.35 – 10.03). The other variables had strong association were pets in the house (Matched odds ratio 2.78, 95 % CI

1.72 – 4.48) and had food stores in the house (Matched Odds ratio 1.56, 95 % CI 1.05 – 2.31). (Table: 3)

3. Among the working place related variables, it had been seen that going out barefooted had significant association (Matched Odds ratio 1.69, 95 % CI 1.04 – 2.74). The association of snake bite and going to the pond and water bodies for different works was statistically significant (Matched Odds ratio 1.85, 95 % CI 1.07 - 3.18). (Table: 3).

4. In relation to the life styles of the participants, sleeping on the floor had statistically significant association, (Matched Odds ratio 2.03, 95 % CI 1.27 – 3.25). (Table: 3).

There were nine variables significantly associated in univariate analysis.

Stratification: We observed the association between snake bite and presence of ditches and holes in the house stratified by income by unmatched analysis. The unmatched odds ratio in strata 1 (less than Rs 2000) was 10.97 (95% CI 5.85 – 20.55) and in strata 2 (more than Rs 2000) was 3.5 (95% CI 1.35 – 9.03). (Table: 4).

Multivariate analysis: We did conditional logistic regression analysis with the variables where strong association in univariate analysis were observed. Multivariate analysis on snake bite indicated that having (1) ditches and holes in the house, (2) going out barefoot, (3) sleeping on the floor, (4) keeping pets and (5) food stores in the house contributed to the model. The strongest factor was having ditches and holes in the floor and walls of the house (Adjusted odds ratio 6.35, 95 % CI = 3.24 – 12.46, p value = 0.0093). (Table: 5).

Trend analysis: We categorised certain exposures in different strength in increasing intensity like never, often and regular practiced variables. It had

been seen that the strength of associations appeared to be increased with increasing the practice. The Odds ratio and linear χ^2 with p value shown in table 6.

Places of treatment of snake bite cases:

We observed that the victims of snake bite had gone for different methods for their treatment. It was seen that 94 cases (63 %) went to the modern facility exclusively, whereas only 18 cases (12 %) were seen by the traditional system exclusively. The remaining had gone to both the system. (Figure: 2).

We applied capture – recapture technique to estimate the total snake bite that might be present as follows

M = total number of cases captured by formal and traditional system reported 132,

n = number of cases captured by traditional system and recapture cases, 56
and R = recaptured cases, 38

So, the total number of cases N could be 195, ($N = 132 \times 56 / 38$),

So we could have missed 45 cases, ($195 - 150$) during this study.

4. Discussion:

The socio economic factors associated with snake bite have been studied in many parts of the world including India.^{19,20} They concluded that snake bite is a rural public health problem affecting the poorer section of the society. Adult males were affected in majority of studies.²⁰ Our study revealed the same. Certain occupations have been implicated more in snake bite. It has been aptly described as an occupational hazard.²¹ They only differ in the proportions and intensity. In our study we could not find any particular occupation significantly associated.

The aim of our study was to see what else beyond these known factors could be responsible to make a person susceptible to snake bite. Our study revealed that certain issues in relation to the dwelling and working places of the people and some of their life styles were vulnerable to snake bite. Those might lead to design further studies for the prevention strategy development.

Our study revealed that snake bite is a problem for those having ditches and holes in the floors and or on the walls of their houses. People use different materials to make their houses in the rural areas. Mud houses were the commonest in the district. The floors and the walls of these houses often have ditches and holes. It was observed that people do not repair the holes regularly. Sufficient income and education can help them to keep the walls & floor free from ditches and holes. Our study revealed that monthly family income played a crucial role. The stratified analysis showed difference in the Odds ratios (10.97 vs 3.50) in two groups. But the Odds ratios and the 95 % confidence intervals for these two strata were overlapping. The crude Odds ratio falls within the strata specific ratios. So it may be concluded that there

were no confounding or effect modifiers. Multivariate analysis did not support this. The risk was increased by a general lack of awareness (how to avoid snakes, species identification, first-aid/medical treatment), inadequate or no footwear, and minimal use of torches in low light conditions. The latter is especially important amongst the high risk segment of the population: agricultural workers, and low income groups in towns and cities.²² According to world health organisation, education of the people could make the living and working environment safer in respect to snake bite. This includes repairing of the ditches and holes of the house, keeping food store and pets away from the living areas and avoiding sleep on the floor or open air and walk barefoot or going out in the dark.²¹

It has been mentioned in some studies that cracks and holes are an ideal place for rodents and other small creatures to live.¹¹ Rural people live in huts or mud houses under unsanitary conditions. Waste materials, dry cow dung, dry firewood and farm tools are often kept close to their houses. This makes the environment dirty and encourages rats, mice and lizards, which are prey of snakes.¹² Moreover because of heavy rain during monsoon, the holes and burrows occupied by snakes and rats are filled with water. Snakes get dislodged and moved towards human habitation.¹² Due to water logging and mud, it is routine practice to walk barefoot, blindly. Snakes at times are trodden and bite humans. Rural people store food grains close to their dwelling places. It is more common in agricultural workers. It is also a common practice to keep hens, ducks, cows, and goats etc as pets. All these may create a vicious cycle. Snakes may be attracted by the rodents, which may be attracted by the food grains. In and around human habitation, any

disturbance can compel the snakes to change their activity patterns and be active by both day and night. Some studies reported more bites in day time and a few reported night hours.^{19,22} Human made habitats like rice fields, piles of rubble, haystacks, piles of firewood and rubbish (where rodents thrive) are ideal snake havens. This, together with the obvious attractions of sun-warmed paths/sealed roads to an ectothermic organism, means that human-snake interaction is inevitable.²³ At the same time use of pesticides in the fields also pushed the snakes towards human dwellings. In this way snakes come closer to human dwelling and increase the possibility of snake human encounter. Snakes often come to these houses in search of prey. Snakes do not usually prey the humans. Certain behaviour of humans, like sleeping on the floor and going out barefoot; causes the snake to bite mainly as a self protection measure²³

Rural people frequently use the ponds and water bodies for their daily activities.²⁴ Our study showed that those who frequently go to the pond and water body had significant chance of snake bite. Here also the role of education and family income were not significant. The snakes bite humans whenever they are disturbed. Our study revealed an interesting fact that having a pond or water body around house was not significantly associated, but people going to work in and around these had a significant odds ratio, (MOR = 1.85, 95 % CI 1.07 – 3.18). It may be assumed that the human activities around the water bodies disturb the snakes' environment and that lead to bite. Sleeping on the floor and in the open air is a common practice in the rural areas. The incidence of envenomation is particularly high in regions where snakes are abundant and human activities like field work and sleeping

outdoors increase the risk of man-snake encounters.²⁰ These behaviour of humans brought them close to the snakes, particularly Kraits. Krait bites are commonly reported between 2 – 3 AM, and those sleeping on the floor are at a greater risk.^{8, 9}

It has been seen by earlier studies that sleeping on a cot or using bed nets may reduce the chance of snake bite.²⁵

People who used to go out barefoot had a greater chance of snake bite. It was shown by many studies that use full covered shoes may prevent snake bite.²⁴

Our study revealed that majority of the snake bite victims went for modern medical treatment facility. H S Bawaskar et al reported that majority of victims first report to mantriks (village healers) and reported to a near hospital at a late stage.¹²

In another study by S Chauhan et al it was mentioned that people had a lot of faith in traditional faith healers.²⁶ In Africa, 80% of individuals bitten by snakes first consult traditional practitioners before visiting a medical center.^{27, 28}

Limitations: Our study had three limitations. Firstly we intended to collect information of all snake bite as per our own specific case definition. The case definition was adhered so rigidly that some actual cases occurred in the dark or in a closed place could have been missed. We have used the Govt health institutions, members of the IMA and available traditional practitioners as the information source. There might be some other potential sources from where we could gather information. As a result there may be underestimation of the incidence of snake bite. To overcome these we have applied snow ball technique to involve maximum number of traditional healers. However our

estimated incidence was similar with those found in other studies conducted in our country.

Secondly the traditional healers do not maintain any written document of the cases. They only communicate us the aggregated data with out any address. This might cause some under estimation of cases too. To minimise this, we verified with local health worker.

Thirdly, the study was conducted in North 24 parganas district and the findings may not be generalisable to other places. Availability of snakes is dependent on the ecosystem of the area and their bite depends on the human snake interactions, which also differ region to region. Our findings about dwelling place and life style related factors may be specific for the district. However, the factors we identified, ditches & holes in the floors and walls of the dwelling places, keeping a food store around living place, go out in the dark or barefoot and sleeping on the floor might be generalizable to other similar settings.

Conclusion: Our study suggests opportunities to prevent or reduce the snake bite in the district. It was shown in our study that snake bite is a problem of rural area. Family income and educational status had little impact on it. Ditches and holes in the floor and on the walls of the houses , habit of going out barefooted, keeping hens, ducks, cows and goats as pets, keeping food grains store close to the dwelling places and the habit of sleeping on the floors or in the open air significantly influenced the incidence of snake bite.

Recommendations: Based on the findings of the study we could recommend to the district health authority that to prevent or at least reduce the snake bite. Firstly, there is a need to plan and implement behaviour change

communication targeted for the rural people of the district. Doctors of the primary health centres, private practitioners and community health workers can sensitise the people during their visits in the clinics and community. In the RCH programme there is provision of health education by the health workers and the outreach clinic by the PHC doctor can make use of the training.²⁵ The members of the panchayets and other opinion leaders may also be involved.

Secondly, educational materials on importance of keeping pets and food stores at a distance from dwelling places, not to go out in the dark and barefooted should be published for awareness generation. It was shown to decline incidence rates of snake bite after education programme.²⁹

Thirdly, Promotion of use of personal protective measures like wearing fully covered shoes (preferably gumboots) while in the field, using torch light while in the dark, using cots to sleep and use of bed nets.³⁰

We may propose to conduct a pilot study with sealing the ditches and holes of the houses of people in a worst affected community development block to evaluate the effectiveness of prevention.

Finally, community based surveillance with clear cut case definition will provide an opportunity to evaluate the effectiveness of the proposed intervention measures.

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Table 1: Reported incidence of snake bite by age and sex, North 24 parganas, West Bengal, India, June – September, 08

Demographic characteristics		Cases	2008 population	Annual incidence per 100,000
Age groups (years)	5 to 14	12	24,20,742	0.49
	15 to 44	92	49,12,782	1.87
	45 to 59	38	11,54,193	3.29
	60+	8	7,55,844	1.05
Sex	Male	98	53,03,175	1.84
	Female	52	49,10,953	1.05
Total		150	1,02,14,128	1.46

Table 2: Characteristics of snake bite N= 150, North 24 Parganas, West Bengal, India, 2008

Characteristics

			#	%
Socio economic status	Area of residence	Rural	127	85
		Urban	23	15
	Education	Illiterate	11	7
		Less than class X	70	55
		More than class X	69	38
	Occupation	Agriculture	64	43
		Student	31	21
		Housewife	19	11
		Fishing	16	11
		Others	20	13
	Monthly family income	Less than Rs 2000	117	78
		More than Rs 2000	33	22
	Type of house	Kuchha (mud)	106	71
		Pacca (brick)	26	17
		Others	18	12

Bite related characteristics

Location of the victim

Indoor

67

45

outdoor

83

55

Body parts bitten

Upper limbs

52

35

Lower limbs

95

63

Others

3

2

Time of bite

Morning (6 AM - 11.59 AM)

46

31

Day (12 noon - 5.59 PM)

30

20

Evening (6 PM - 11.59 PM)

49

32

Night (12 midnight - 5.59 AM)

25

17

Season

Rainy

104

69

Summer

46

31

Table 3: Matched sets according to exposure status of snake bite cases (N = 150) & controls (N = 150), North 24 Parganas, West Bengal, India, 2008

	Number of case control sets concordant for exposure status		discordant for exposure status		MOR	95 % CI
	Case exposed	Case unexposed	Case exposed	Case unexposed		
Exposure in relation to socio economic status						
Education less than class X	42	33	51	24	2.12	1.30 - 3.45
Family Income < Rs 2000 per month	88	18	29	15	1.93	1.03 - 3.60
Mud house	74	25	32	19	1.68	0.95 - 2.97
Exposure in relation to dwelling places						
Cracks & holes in walls and floors	21	27	87	15	5.8	3.35 - 10.03
Pets in the house	38	25	64	23	2.78	1.72 - 4.48
Food stores in the house	25	20	64	41	1.56	1.05 - 2.31
Firewood store in the house	25	67	30	28	1.07	0.64 - 1.79
Pond / waterbody around house	85	20	23	22	1.04	0.58 - 1.87
Cultivated land around house	32	71	29	18	1.61	0.89 - 2.90

Table 1. Association between snake bite and ditches & holes in the house stratified by income

Exposure in relation to life style

Outside defecation	21	69	32	28	1.14	0.68 - 1.89
Sleeping on the floors	38	35	52	25	2.08	1.29 - 3.35
Firewood collection	18	85	27	20	1.35	0.75 - 2.40
Going out in the dark	52	24	47	27	1.74	1.08 - 2.79

Exposure in relation to work places

Going out barefooted	57	23	44	26	1.69	1.04 - 2.74
Putting hand in the holes/ dark places	25	69	30	26	1.15	0.68 - 1.95
Going pond/ waterbodies for work	73	20	37	20	1.85	1.07 - 3.18
Grazing cattles	20	63	38	24	1.58	0.95 - 2.63

Table 4: Association between snake bite and ditches & holes in the house stratified by Income in North 24 Prarganas, West Bengal, India 2008

	Cases (N = 150)		Controls (N = 150)		Unmatched OR	95 % CI
Stratum (All)	#	%	#	%		
Exposed	108	72	36	24		
Unexposed	42	28	114	76	8.14	4.85 - 13.66
Stratum 1 (Income less than Rs 2000)						
Exposed	90	77	24	23		
Unexposed	27	23	79	77	10.97	5.85 - 20.55
Stratum 2 (Income more than Rs 2000)						
Exposed	18	55	12	26		
Unexposed	15	45	35	74	3.5	1.35 - 9.03

Table 5: Factors associated with snake bite in conditional multiple logistic regression, North 24 Parganas, west Bengal, India, 2008

		Adjusted OR		
	Variables	Crude odds ratio	Estimate	95 % Confidence interval
Snake bite	Ditches & holes in the floor& walls	5.8	6.35	3.24 - 12.46
	Going out barefooted	1.69	2.59	1.26 - 5.31
	Sleeping on floor	2.03	2.43	1.25 - 4.71
	Pets in house	2.78	2.38	1.24 - 4.55
	Food store in house	1.56	1.93	1.07 - 3.50

model chi - square = 68.63, DF = 8

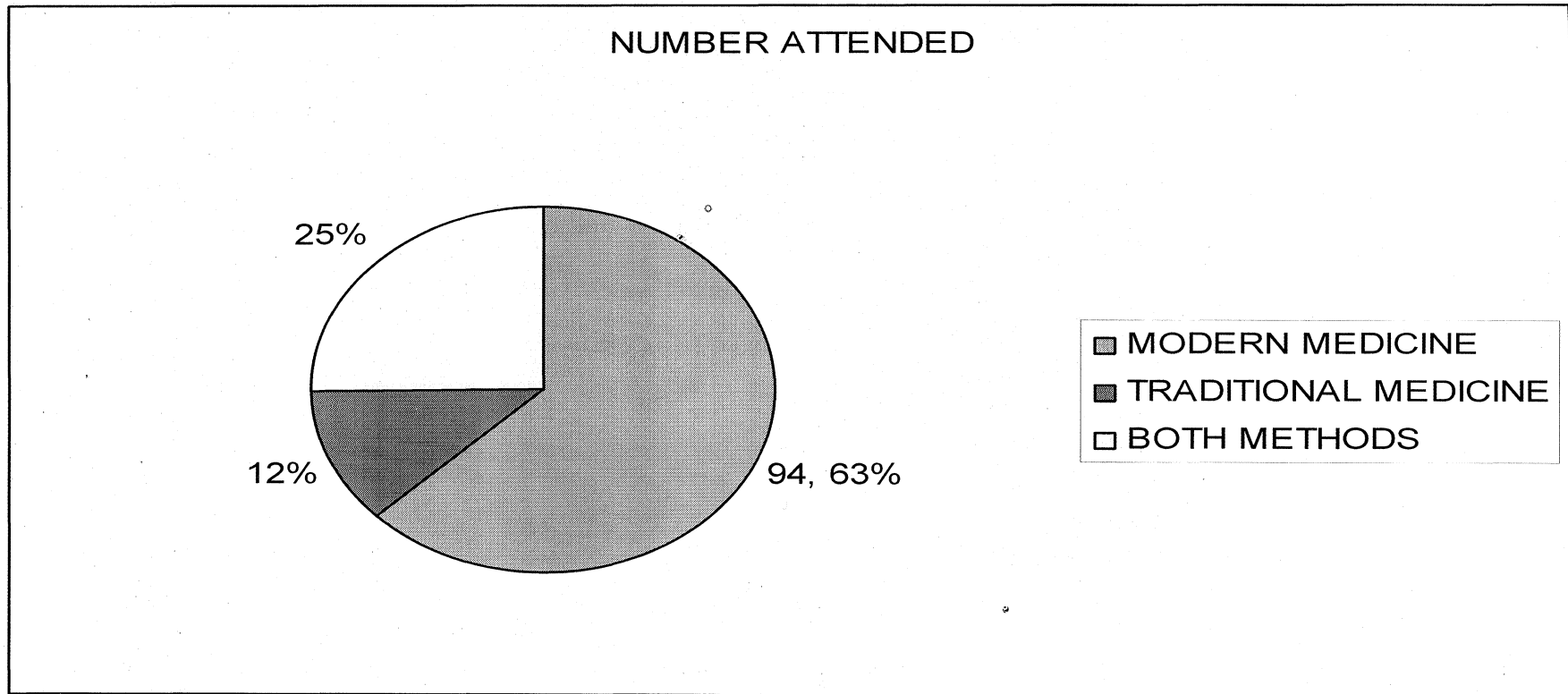
Table 6: Association of snake bite to increasing intensity of exposure variables in North 24 Parganas, West Bengal, India, 2008

Activity	Grades of exposures	Cases N = 150		Controls N = 150		Odds ratio	X ² for linear trend	p value
		#	%	#	%			
Sleeping on the floor	Never practised	60	40	87	58	Ref.	19.78	0.00001
	Often practised	46	31	51	34	1.57		
	Regularly practised	44	29	12	8	5.32		
Works in the ponds	Never practised	40	27	57	38	Ref.	24.21	0.00000
	Often practised	41	27	74	49	0.79		
	Regularly practised	69	46	19	13	5.18		
Barefooted outings	Never practised	49	33	67	45	Ref.	12.5	0.00041
	Often practised	59	39	68	45	1.19		
	Regularly practised	42	28	15	10	3.83		
Going out in the dark	Never practised	51	34	71	47	Ref.	6.07	0.01373
	Often practised	75	50	64	43	1.63		
	Regularly practised	24	16	15	10	2.23		

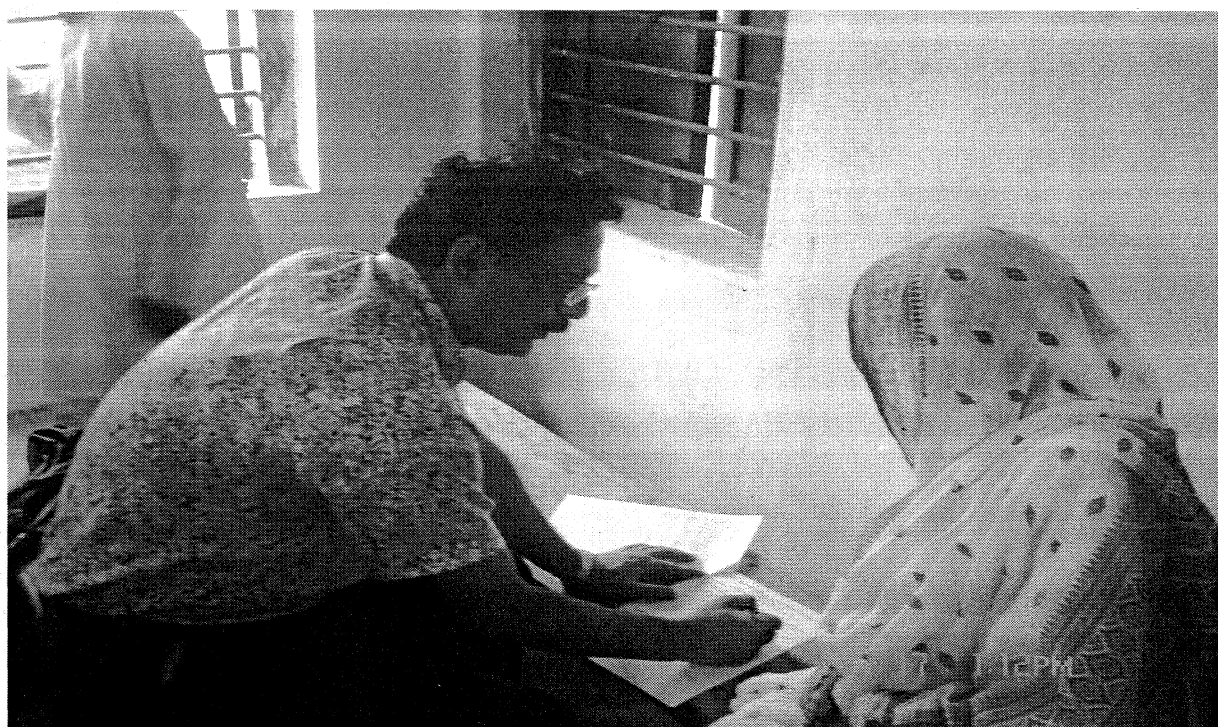
Figure 1: Blockwise distribution of snake bite and deaths in North 24 Parganas, West Bengal, India, June – September, 2008



Figure 2: Pie chart showing the proportion of methods opted for treatment by snake bite victims, North 24 Parganas, West Bengal, India, 2008



Dr Kajal Krishna Banik, MAE – FETP scholar interviewing a victim of snake b



Annexure 1:

Consent form for the investigation of the risk factors for snake bite in the district of North 24 Parganas, West Bengal, India in 2008

Greetings,

I am Dr. Kajal Krishna Banik and am working with the National Institute of epidemiology, under Indian council of medical research, Chennai, as a scholar for Master in applied epidemiology, Field epidemiology training programme (MAE - FETP) to look into factors that may put you at risk for snake bite or protect you from them. We are doing this research as a response to more than one thousand people had snake bite in this district in 2007. Since snake bite is a public health problem and often occurs at the same time in the district, it is also being looked at. The faculty members from the National Institute of Epidemiology, Chennai will supervise the work.

To find out why people get snake bite, we need to ask questions to persons who had snake bite and to persons who did not though they live in the similar settings. We will also like to see where they would like go for the treatment. Thus, between May 2008 and October 2008, we will be asking the same questions to all the persons with snake bite, as well as to some healthy members of the district. In case of minor case patients or unfortunate death of the person we would like to ask the same questions to one available adult family member of the deceased person. We would like to ask these few questions to you once confidentially. Answering these questions will be voluntary and it will take about 15 to 20 minutes of your time.

For case patients only: For this study, we will go to your area and ask the same questions we asked you to one of your neighbors. However, we will not

mention any medical information about you and we will not mention that we come and see them because there was a case of disease in their area.

Taking part in this survey is voluntary. No compensation will be paid to you for taking part in this study. You can choose not to take part. You can choose not to answer a specific question. You can also stop answering these questions at any time without having to provide a reason. This will not affect your rights to health care in any of the health care facilities in the district or outside, or any other rights. There is no specific benefit for you if you take part in the survey. However, taking part in the survey may be of benefit to the community, as it may help us to understand the problem, its causes and potential solutions. When the results will have been analyzed, a report will be shared with all the participants and the local health officials concerned with public health, so that the right measures can be taken to prevent & control snake bite in the district.

- The information we will collect in this survey will remain between you and the doctor. We may ask questions about various specific things you do. This does not mean that we think that these things you do would put you at risk for snake bites. It does not mean either that we think that these things you do would protect you from snake bite neither. We will not write your name on this form. We will only use a code instead. Only the doctor will know the key to this code. It will be kept under lock and key. It will be destroyed after the project.

If you wish to find out more about this survey before taking part, you can ask me all the questions you want. You can also contact Dr.Kajal Krishna Banik, MAE-FETP Scholar (VII th Cohort) and principal investigator of this survey attached to the National Institute of Epidemiology, Chennai, who will be happy to give you more details. The contact numbers of Dr Banik are 093310 48886

(Mobile) and 033- 2475- 5996 (Residence). If you agree to take part in the study after satisfying yourself, we will go ahead now.

CONSENT FORM

I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions about it and any questions I have asked have been answered to my satisfaction. I consent voluntarily to participate as a participant in this study and understand that I have the right to withdraw from the study at any time without in any way it affecting my further medical care.

Name of the study participant or of
the available adult member of the family

Signature/thumb
of the study participant or
the available adult member
of the family

Name of the witness

Signature of the witness

Name of the interviewer

Signature of the interviewer

Identifiers **collection** **form**

Name of the interviewer:

Place:

ID1 name:		ID2 name:		ID3 name:	
ID4 name:		ID5 name:		ID6 name:	
ID7 name:		ID8 name:		ID9 name:	

Annexure 2:

Questionnaire for risk factors of snake bite in the people of North 24 parganas, West Bengal, India, 2008

GENERAL INFORMATION:

Please mark ☒ to the most appropriate response

ID No.

AGE:

SEX: 1. male 2. Female

1. Where do you live in? (a) urban area (b) rural area
2. What is your educational qualification? (a) illiterate (b) less than secondary level (X class) (c) more than secondary level (X class)
3. What is your occupation? (a) agriculture (b) student (c) housewife (d) fishing e) others
4. What is your monthly family income? (a) less than Rs 2000 (b) more than Rs 2000
5. What kind of house you live in? (a) kuchcha, made of mud (b) pucca, made of bricks (c) others, specify
6. Did you have the snake bite? (a) yes (b) no

IF THE RESPONSE IS "NO" THEN PLEASE GO TO QUESTION NO 15

7. How did you recognise that it was a snake bite? (a) I have seen the snake (b) others have seen the snake
8. Where were you when the snake had bitten you? (a) indoor, inside a room (b) outdoor, outside the room
9. What you were doing in the indoor when you got the bite? (a) resting (b) actively doing some work

10. Where you were in the outdoor when you got the bite? (a) in the field
(b) in the backyard (c) on the road (d) in the forest (e) in and around the water
body

11. When you got the snake bite? (a) morning(6 AM to 11.59 AM) (b) Day
(12 noon to 5.59 PM) (c) .Evening (6 PM to 11. 59 PM) (d) Night (12 midnight to
5.59 AM)

12. Which part of your body got the bite? (a) upper limb (b) lower limb (c)
trunk (d) others, specify.....

13. What you were doing when the snake bite occurred? (a) walking
(b) working (c) farming (d) resting (e) fishing (f) other, specify.....

14. In which season did you have the snake bite? (a) rainy season (b) dry
season

RISK FACTORS RELATED WITH DWELLING PLACE

15. Do the walls and floors of your rooms have any crack or hole? (a) yes
(b) no

16. Do you have ducks, hens and cattle in your house as pet? (a) yes (b)
no

17. Do you keep paddy or other food grains in your house? (a) yes (b) no

18. Do you store firewood within 50 feet of your dwelling place? (a) yes
(b) no

19. Do you have any water body within a radius of 50 meter of your
dwelling place? (a) yes (b) no

20. Do you have any cultivated land within a radius of 50 meter of your
dwelling place? (a) yes (b) no

RISK FACTORS RELATED WITH LIFE STYLE

21. Do you sleep on the floor of your room? (a) regularly (b) occasionally (c) never
22. Do you offer food to your pets? (a) regularly (b) occasionally (c) never
23. Do you go out to the field or water bodies for defecation? (a) regularly (b) occasionally (c) never
24. Do you go out to take wood from the store? (a) regularly (b) occasionally (c) never
25. Do you go to the water body for bathing or other works? (a) regularly (b) occasionally (c) never
26. Do you go out in the dark? (a) regularly (b) occasionally (c) never

RISK FACTORS RELATED WITH WORKING PLACE

27. Do you go out bare footed to the fields? (a) regularly (b) occasionally (c) never
28. Do you put your hands in the holes in the house, field or water body? (a) regularly (b) occasionally (c) never
29. Do you go to the water bodies for bathing or washing? (a) regularly (b) occasionally (c) never
30. Do you go to the jungles or the bushes for collection of firewood? (a) regularly (b) occasionally (c) never
31. Do you go out to the field for grazing the cattle? (a) regularly (b) occasionally (c) never

HEALTH SEEKING BEHAVIOURS RELATED

1. When you first decided to seek for help? (a) Immediately (b) within 2 hours
(c) within 6 hours

2. Where you have gone for treatment? (a) to the local health centre (b) to local practitioner (c) to local RMP (d) to the traditional healer

3. Did you seek medical assistance from any other source later? (a) Yes (b) no

If yes, please tell us

4. Where from you have sought assistance? (a) to the Government health centre (b) to local medical practitioner (c) to local RMP (d) to the traditional healer

FOR THE PERSONS WHO DID NOT HAVE A SNAKE BITE

5. If you have a snake bite in the future to which place you will like to go?
(a)) to the Government health centre (b) to local medical practitioner (c) to local RMP (d) to the traditional healer (e) all (f) none

6. If you want to go to all of them where to go first? (a) to the Government health centre (b) to local medical practitioner (c) to local RMP (d) to the traditional healer.

Annexure 3:

Govt. West Bengal
District Health & Family Welfare Samiti
Office of the Chief Officer of Health
North 24 Parganas, Barasat
Tel-2552-3129 / 2552-3772

Memo No 1878

Date 6/5/2008

ORDER

Subject: Study on 'Risk factors of snake bite and the health seeking behavior of the people bitten by snakes in North 24 Parganas'

The undersigned is pleased to inform you that Dr. Kajal Krishna Banik, a scholar from the National Institute of Epidemiology, Chennai has been assigned to undertake a community based study on 'Risk factors of snake bite and the health seeking behavior of the people bitten by snakes in North 24 Parganas' under the supervision of the faculty members of the said institute.

Dr. Banik requested us to inform him regarding the snake bite cases in the district during May, 2008 to October, 2008.

Accordingly you are requested to extend all sorts of cooperation to him. You are also requested to preserve all information about snake bite cases under your care during May, 2008 to October, 2008 for the study.

You may contact Dr. Kajal Krishna Banik over his telephone no. 033-2475-5996 (Res.), 93310-48886 or 9474348411 (mobile) or E-mail I D banik_kajal@yahoo.co.in

Dr. Banik will contact you as and when required.

MEMO NO 1878/ (50) Dt. 6/5/2008

Chief Medical Officer of Health
North 24 Parganas

Copy forward for kind information to:

The Superintendents of Barasat Dist. Hospital,
All Sub Divisional Hospitals,
State General Hospitals,
All Block Medical Officers of Health,
Dr. Kajal Krishna Banik

Chief Medical Officer of Health
North 24 Parganas

Annexure 4:

INDIAN MEDICAL ASSOCIATION
BENGAL STATE BRANCH

OFFICE HOURS
12 NOON-7 P.M.
(MONDAY-SATURDAY)

11/3, DR. BIRESH GUHA STREET,
KOLKATA-700 017
PHONE NO: 2287-9252/2281-0758
2289-8728/ FAX - 2289-8729
15/05/2008

Ref: Circular No: /08-09/

To

The Hony. Secretaries of Local Branches
Under I.M.A. Bengal State Branch
IMA IN NORTH 24-PARGANAS

Sub: Study on Risk factors of snake bite
cum health sacking behavior of the people
in the district of North 24- Parganas.

Dear Sir,

It gives me pleasure to inform you that one of our friend Dr. Kaja Krishna Banik has been assigned to undertake the study mentioned above by the National Institute of Epidemiology(ICMR) Chennai as a part of his dissertation for MAEFETP.

Dr. Banik requested us to inform you about the study and supply all the relevant information about snake bite that our members come across during May 2008 to November 2008. May I request you kindly circular the information among your branch members and request them to communicate Dr. Kaja Krishna Banik over his telephone No. 2475-5996(Residence) or 93310-48886 and 9474348411 (Mobile) or send the information to Dr. Banik by E-mail banik-kajal @ yahoo co.

Dr. Banik will be available as and when required.

Thanking you,

Yours sincerely,


(Amitabha Bhattacharya)
Hony.State Secretary

LITERATURE REVIEW FOR A STUDY ON RISK FACTORS OF SNAKE BITE AND HEALTH SEEKING BEHAVIOUR OF THE PEOPLE OF NORTH 24 PARGANAS, WEST BENGAL, INDIA, 2008

Snake bite: a preventable public health issue

Problem statement

Snake-bite is an important and serious medicolegal problem in many parts of the world, especially in South Asian countries. It has been estimated that 5 million snake-bite cases occur worldwide every year, causing about 100,000 deaths¹. 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.² 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.³

On an average, nearly 2,00,000 persons fall prey to snake-bite per year in India and 35,000-50,000 of them die every year⁴. But data on the morbidity and mortality of snake-bite are unreliable due to improper reporting system; 80 per cent of individuals bitten by snakes in Africa first consult traditional practitioners before visiting a medical centre.^{5,6}

The snakes most commonly associated with human mortality in India are cobra (*Naja naja naja*), krait (*Bungarus caeruleus*), Russell's viper (*Vipera russelli*) and saw scaled viper (*Echis carinatus*)⁷. Snake-bite incidences vary from region to region and depend upon (i) the natural habitat of particular species of snake in the region; and (ii) probability of human being coming in contact. In Maharashtra highest incidences of snake-bites have been reported (70 bites per 100,000 population and mortality of 2.4 per 100,000/ yr).⁸ The

other States which show high incidences include Tamil Nadu, Uttar Pradesh and Kerala.⁹ However, there have been no epidemiological studies related to snake-bite incidence from the State of Andhra Pradesh.

Snake bite is a common medical emergency and an occupational hazard, more so in tropical India, where farming is a major source of employment. Children of field workers, forced into child labor are in a life risking occupation.

There are about 3000 species of snakes in the world known to date, out of which 300 species are poisonous to man.¹⁰ The number of deaths due to snake bite in India is estimated to be about 15,000-20,000 per year.¹¹

Of the 4 major virulent types of poisonous snakes in India viz, Cobra, Krait, Russels viper and *Ecchis carinata* (saw scaled viper), the common species encountered in and around Davangere, are the vipers and cobra.¹²

Male predominance, higher incidence in field areas, involvement of lower extremities is common features in many studies. We had more number of cases bitten during day time as people are engaged in farming, contrary to nocturnal occurrence in few studies.¹³

Snakebite is a common acute medical emergency faced by rural populations in tropical and subtropical countries with heavy rainfall and humid climate.^{14,15}

There are no accurate records available to determine the exact epidemiological or even mortality in snakebite cases in Maharashtra. Mud houses with grooves in wall and the basement give easy shelter for snakes and rats particularly in N and A districts and hut with a loose stone basement. Villagers always sleep on the floor and are more risky for krait bites.¹⁶

Majority of victims first report to mantriaks (village healer) and reported to a near hospital at a late stage when patient is at stake.^{17,18}

Thus many cases of snake bite may remain unnoticed.

Farmers and villagers in Kokan region have very small huts, because of restricted space they avoid to use cot and prefer to sleep on a floor bed make them more prone for krait bite poisoning.¹⁷ Thus in rural people snake bites are more likely to occur during essential activities, such as agricultural work, and are thus hard to avoid.¹⁹

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.²⁰

A lot of faith is put in traditional faith healers, snake charmers, and other alternative systems of medicine, such as ayurveda, unani medicine, homeopathy, and the Tibetan medicines and herbs. In semi-urban and rural areas these practitioners are often the earliest and easiest help available.

There is a lack of systematic data on the number of people treated by these non-registered medical practitioners, since only a minority manages to reach hospitals directly. In Kenya, it was found that 68% of the snakebite victims had sought treatment from traditional healers. In a study of pediatric patients from India, it was found that only 12% received such treatment.

The above data clearly shows that despite the advances in medical sciences, the improvement in transport facilities and the increase in education level, people still have a lot of faith in traditional healers.²¹

To understand the problem of snake bite, one has to have the basic information on snake, why snakes bite humans and what one should do to manage the snake bite.

Some basic facts on snakes:

Snakes' place in animal kingdom:

Snakes belong to phylum Chordata, class Sauropsida and order Squamata. It is an elongate reptile of the sub order Serpentes. Like all reptiles, snakes are ectothermic and covered in scales. All snakes are carnivorous. They are devoid of eyelids, limbs, external ears and vestiges of forelimbs. In order to accommodate their narrow bodies, paired organs of the snakes appear one in front of the other.

A literary word for snake is Serpent (a Middle English word which comes from old French and ultimately from Serp, means to creep. In modern usage, the term serpent usually refers to mythic or symbolic snake. In Christianity, the serpent is sometimes identified with devil, as in the Biblical account of Adam and eve, but also with healing, as in the Biblical account of the brass serpent of Moses. The serpent is also the symbol of healing arts.²²

.Evolution of snakes:

Phylogeny of snakes is poorly known because snake skeletons are typically small and fragile, making fossilisation uncommon. However 150 million year old specimens readily definable as snakes with lizard like skeletal structures have been uncovered in South America and Africa. It has been agreed, on the

basis of morphology, that snakes descended from lizards. Molecular evidence reinforces this; it is hypothesised that snakes share a common venomous ancestor with several lizard families, forming the Toxicofera clade.

Fossil evidence suggests that snakes may have evolved from burrowing lizards, such as Varanids or a similar group during the Cretaceous period. An early fossil snake, *Najash rionegrina*, was a two-legged burrowing animal with a sacrum, and was fully terrestrial. One extant analog of these putative ancestors is the earless monitor *Lanthanotus* of Borneo, although it also is semi aquatic. As these ancestors became more subterranean, they lost their limbs and their bodies became more streamlined for burrowing. According to this hypothesis, features such as the transparent, fused eyelids and loss of external ears evolved to combat subterranean conditions such as scratched corneas and dirt in the ears with snakes re-emerged onto the surface of the earth much as they are today.

Primitive groups among the modern snakes, pythons and boas, have vestigial hind limbs: tiny, clawed digits known as anal spurs which are used to grasp during mating.

An alternative hypothesis, based on morphology, suggests that the ancestors of snakes were related to mosasaurs – extinct aquatic reptiles from the Cretaceous – which in turn are thought to have derived from varanid lizards. Under this hypothesis, the fused, transparent eyelids of snakes are thought to have evolved to combat marine conditions (corneal water loss through osmosis), while the external ears were lost through disuse in an aquatic environment, ultimately leading to an animal similar in appearance to sea – snakes of today. In recent years, genetic studies have indicated that snakes

are not as closely related to monitor lizards as it was once believed, and therefore not to mosasaurs, the proposed ancestor in the aquatic scenario of their evolution. However, there is more evidence linking mosasaurs to snakes than to varanids. Fragmentary remains that have been found from the Jurassic and Early Cretaceous indicate deeper fossil records for these groups, which may eventually refute either hypothesis.

The great diversity of modern snakes appeared in the Paleocene, correlating with the adaptive radiation of mammals following the extinction of the dinosaurs. There are over 2,900 species of snakes ranging as far northward as the Arctic Circle in Scandinavia and southward through Australia and Tasmania. Snakes can be found on every continent (with the exception of Antarctica), dwelling in the sea, and as high as 16,000 feet (4900m) in the Himalayan Mountains of Asia. There are numerous islands from which snakes are conspicuously absent such as Ireland, Iceland and New Zealand.²²

Types of snake: The term poisonous snake is mostly incorrect - poison is inhaled or ingested whereas venom is injected.²³

Basically snakes are of two distinct varieties, the Poisonous and Non poisonous. Of the 2500-3000 species of snakes distributed world-wide, about 500 are venomous. The major families in the Indian subcontinent are:

Elapidae which includes common cobra, king cobra and krait, Viperidae which includes Russell's viper, pit viper and saw-scaled viper and Hydrophidae (the sea snakes).²⁴

Of the 52 poisonous species in There are 14 venomous species in Nepal.

These include pit vipers (5 species), Russell's viper, kraits (3 species), coral snake and 3 species of cobra including the king cobra.²⁵

Varieties of venomous snakes:

All venomous snakes existing in nature belong to the following families:

1. *Colubridae*: include genera *Lampropeltis*, *Heterodon*, *Coluber*, *Dispholidus*, *Thelotornis*, *Boiga*, *Rhabdophis*, etc. Common names are King snake, Hognose, Racer, Bird snakes, Boomslang, etc.
 2. *Elapidae*: include genera *Naja*, *Bungarus*, *Dendroaspis*, *Micrurus*, *Calliophis*, *Maticora*, etc. Common names are Cobras, Kraits, Mambas, Coral snakes, etc. Most venomous snakes of Australia belong to this family.
 3. *Viperidae*: The largest snake family. The true vipers (*Viperinae* subfamily) include *Vipera*, *Echis*, *Bitis*, *Cerastes*, etc. Common names are vipers, asps, adders, etc. The pit vipers (*Crotalinae* subfamily) have a heat-sensing foramen or 'pit' between each eye and nostril and elliptical pupils and include genera *Crotalus*, *Sistrurus*, *Agkistrodon*, *Bothrops*, *Lachesis*, etc. Common names are Rattlesnakes, Cottonmouth, Copperheads, Ferde- lance, Bushmaster, etc.
 4. *Hydrophiidae* : These are the true sea snakes. They are the most poisonous snakes existing with extremely potent venoms. There are some 50 species belonging to genera like *Hydrophis*, *Lapemis*, *Pelamis*, etc. Fortunately, human bites are rare and most do not cause systemic envenomation.
- Some other snake families may occasionally produce human envenomation (e.g. *Atractaspididae* in Africa and the Middle East) but such bites are rare. The *Colubridae* family includes both venomous and non-venomous species. The poisonous members are rear-fanged snakes i.e. they have enlarged teeth

in the rear part of their mouth. When attacking, these snakes seem to chew their victims.

They do not have true venom glands. However, there is the Duvernoy's gland which is an evolutionary modification of the salivary gland. The secretion produced by this gland may also be toxic to man but is less dangerous than other snake venoms.

The other venomous snakes are front-fanged snakes because they have venomous teeth (fangs) in the front of the upper jawbone. The fangs of Viperinae and Crotalinae serpents are retractable.

When their jaws close, the two fangs are folded under the roof of the mouth and covered with a fleshy sheath. When attacking a prey, as the snake opens its mouth, the fangs are rotated forward when the upper jaw sets in a vertical position. Each fang has a channel, through which the venom is rapidly injected into the bite. The Elapidae have immovable fangs projecting from their upper jaw – short fangs attached to the maxillary bones. There are some species, the so called 'spitting' cobras, which eject their poison under pressure, in a jet, from a distance of 2 to 2.5 meters by rapid powerful contraction of muscles around the venom glands.²⁶

Identification of snakes:

Poisonous snakes: The shape of the head in poisonous snakes is triangular or elliptical, the eye balls are elliptical. There are heat sensitive traps on the back of the pit vipers. The fangs look just like the injection syringe. The scales on the abdominal cavity are arranged in one layer. The tail usually compressed. These are usually nocturnal in habit.

Non poisonous snakes: The shapes of the head of these snakes are rounded or oval. The eye balls are circular in shape. The trap is usually absent in non poisonous snakes. The abdominal scales are arranged in different layers. They have a long tail. They can be seen any time of the day.²⁷

Habits of snakes: They prefer cool, dark, damp places where food is easily available. But often, human territory provides such a habitat for snakes.

Snakes follow rodents and insects in human dwelling places. Once inside, snakes use wall cavities, crawl spaces and attics as their dens. They prefer firewood piles, garbage, bushy areas, gardens, banks of the small streams and ponds. Snakes have been found in the kitchens behind furniture and other appliances.

Since snakes are cold - blooded, they hibernate during winter months and become quite inactive. They will eat little or no food during this extreme climate. Some snakes hatch their eggs inside the body, some lay eggs and some give birth to live babies. Most snakes have their babies in the fall. The greatest period of activity differs in different countries depending on the weather and climate. Snakes are most active at night and this is the time when humans and pets run the risk of getting a bite.²⁸

The vast majority of snakebite deaths in India have been attributed to the four common, medically important species of snakes known as the Big Four.

Though their ranges overlap, each has unique microhabitat and prey preferences. The Russell's viper (*Daboia russellii*) is nocturnal, lives in rocky areas with dense thickets (like agave and pandanus) interspersed with small open spaces, and feeds largely on gerbils (*Tatera indica*). The Saw-scaled Viper (*Echis carinatus*) is nocturnal and prefers areas with large, open and

sandy clearings, where it can be found on or just above the ground, often under rocks or on thorny bushes where it preys on mice, lizards and arthropods. The Spectacled Cobra (*Naja naja*) is active both by day and night, favours bushy spaces bordering agricultural land, and typically lives in rat holes and termite mounds in bunds bordering rice fields. It feeds on mice, rats, frogs and toads. The Common Krait (*Bungarus caeruleus*) is nocturnal, lives in holes and is partial to human-made habitats, such as stacks of tiles, granite rocks, or wood. These are good places for it to find mice, lizards and other snakes to eat. This microhabitat preference leads to a large percentage of krait bites occurring in people's homes. One Indian study quoted a figure of 83% . In and around human habitation, disturbance can compel any of these snakes to change their activity patterns and be active by both day and night. Human made habitats like rice fields, piles of rubble, haystacks, piles of firewood and rubbish (where rodents thrive) are ideal snake havens. This, together with the obvious attractions of sun-warmed paths/sealed roads to an ectothermic organism, means that human-snake interaction is inevitable. The risk is increased by a general lack of awareness (how to avoid snakes, species identification, first-aid/medical treatment), inadequate or no footwear, and minimal use of torches in low light conditions. The latter is especially important amongst the high risk segment of the population: agricultural workers, and low income groups in towns and cities.²⁹

Foods for snakes:

All snakes are strictly carnivorous, eating small animals including lizards, other snakes, small mammals, birds, eggs, fish, snails or insects. Because snakes cannot bite or tear their food to pieces, prey must be swallowed whole.

The body size of a snake has a major influence on its eating habits. Smaller snakes eat smaller prey. Juvenile pythons might start out feeding on lizards or mice and graduate to small deer or antelope as an adult, for example.

The snake's jaw is the most unique jaw in the animal kingdom. Contrary to popular belief, snakes do not dislocate their jaws; they disarticulate their jaws, the jaw acts like a hinge opening down up to 180°. Snakes have a very flexible lower jaw, the two halves of which are not rigidly attached, and numerous other joints in their skull allowing them to open their mouths wide enough to swallow their prey whole, even if it is larger in diameter than the snake itself as snakes do not chew. For example, the African egg-eating snake has flexible jaws adapted for eating eggs much larger than the diameter of its head. This snake has no teeth, but does have bony protrusions on the inside edge of its spine which are used to aid in breaking the shells of the eggs it eats. While the majority of snakes eat a variety of prey animals, there is some specialization by some species. King cobra and the Australian Bandy – bandy consume other snakes. Pareas twesakji and other snail-eating Colubrids of sub family Pareatinae have more teeth on the right side of their mouths than on the left, as the shells of their prey usually spiral clockwise.^{22, 26}

Risk factors for snake bite: Snake bite is an accident, resulting mostly from an unintentional encounter between humans and snake. However the following factors may be considered as a risk factor for snake bite.

Agent factors:

- Some species remain away from human habitation (e.g. Cobra), whereas, some remain in proximity of human habitation (e.g. Viper and krait).

- Use of insecticide in paddy field kills rodents and frogs, which are natural food of the snakes

Host factors:

- Occupational exposures: Cultivation, Fishing, cattle grazing.
- Outdoor sleeping habit
- Walking bare foot
- Movement without light during night
- Unsupervised child
- Visual impairment of host

Environment factors:

- Thatched house with cracks in floor and wall
- Stock food grain & refuse in the court-yard
- Presence of natural food of snake (e.g. rodent, frog, poultry) in the house
- Deforestation and encroachment of natural habitat of snakes

A snake does not wish to bite humans and waste venom on prey too large to consume. Most will remove themselves if at all possible and, even when cornered, will often withhold venom when biting.³⁰

Envenomation to human may occur through unintentional interactions or more commonly due to intentional encounters with snakes (while handling and milking venom). It was reported earlier, that the majority of the snake-bites

(82%) occur among the rural population, who are bitten in agricultural fields while working and also during sleeping outdoors.

Most patients are unable to identify the snake species either because of ignorance or poor visibility during darkness. In the present investigation, snake-bite cases were observed in almost all age groups (except 81- 90 yr), the majority being in males aged 21-50 yr, while the male to female ratio was 3:1. In the previous studies reported from Ambajogai (Maharashtra) 18 and Karnataka¹⁹, the male to female ratio was found to be 3.2:1 and 2:1, respectively. Studies from other countries also indicate male victim preponderance; male: Female ratio was reported as 1.9:1 in Thailand and 1.3:1 in Pakistan. The predominance of male victims suggests a special risk of outdoor activity. The commonly affected age groups were observed to be 10-40 yr in Nepal, 15-44 yr in Pakistan and 6-40 yr in Zimbabwe. A study reported an incidence of 7-15 per cent in children less than 10 yr. The sex ratio seems to be almost uniform in all the earlier reports with males being affected twice or thrice as commonly as females.²³

Males (n=433) were bitten more often than females (n=200). Two hundred and fifty six (40.4%) cases were in the age range of 11-15 years. The cases were seen during two periods, i.e., Oct, Nov, Dec (n=210) and Apr, May, June (n=199). Most (n=506) were encountered in the lower limbs. Male predominance, higher incidence in field areas, involvement of lower extremities are common features in many studies (4- 7). We had more number of cases bitten during day time as people are engaged in farming, contrary to nocturnal occurrence in few studies.

Fatal snake bites in the developing countries like India are far too common to feature in local news paper headlines. Thus in rural people snake bites are more likely to occur during essential activities, such as agricultural work, and are thus hard to avoid. Krait and Russell's are common culprits for fatality in this part of Maharashtra.⁵ Krait bite occurred during night hours. A villager always sleeps on the floor and is more risky for krait bites.³¹

Of the 14 500 people admitted to Kilinochchi Hospital in Srilanka, in the period of review, 303 had been bitten by snakes; 94 were women (31%) and 209 were men (69%). Age distribution was that 68 (22%) were <18 years old; 138 (45%) were between 18 and 40 years; and 97 (32%) were over 40 years. The median age of victims was 32 years, with the youngest (1%ile) being 1.5 years and the oldest (99%ile) being 79 years. The peak incidence of bites was in the harvesting season from February to March, but almost 23 bites occurred every month. The place of bite was close to the home (25%) and the rest in or around the fields. The time of the bite was during the day for 133 (44%), and at night for 168 (56%). The location of the bite on the body was on the legs for 146 (48%); on the feet 121 (39%); on the hands 22 (7%), on the arms 7 (2%) and on the toes 7 (2%).³²

In their study of 10 years experience in snake bite management, D P Punde et al from Maharashtra state of India mentioned that 67.5 % were from poisonous snake bites, 68.9 % between May to November. Occupation wise it was 36 % among farmers, 30 % were students and 27.6 % were housewives.³³

In a hospital based study, Kirte RC et al have mentioned that among the cases 69.4 % were males, 97.4 % were agricultural workers and labourers.

The maximum cases were reported in June to August, 35.5 %. The case fatality was 4.3 %.³⁴

In a study conducted in Islamabad capital territory, it was mentioned that the maximum cases reported in summer and among them 70 % were males. 83 % cases had their bites on the lower limbs.³⁵

Hati et al narrated that males were 54.72 % among the cases. The highest incidence was among the 21 to 30 years and the maximum cases reported in July and August. 53 % of the cases were bitten on their lower limbs. 65 . 4 % were treated by the traditional healers (Ojhas). A proportion of cases (8.46 %) had gone to the hospitals after consulting the Ojhas first.³⁶

The lower limb was the most common site of bite (66 cases, 94.3%), and they occurred mostly at night (43 cases, 63.2%). Walking barefooted or wearing slippers, and incompletely covering the feet at night were the most common predisposing factor for snakebite (66 cases, 94.3%). Most cases (60, 85%) suffered outdoor bites. Incidence rates for snakebite declined after the health education program, indicating the possibility of avoiding snakebite simply by wearing shoes and not walking barefooted.

Snakebites affected mainly the lower limbs (94.3%). This supports the feasibility of preventing bites by not walking about barefooted.³⁷

Bio Ken Snake farm, Watamu, Kenya resolved that in order to prevent snake bite, following steps were required.

In the house: Do not keep livestock in the house, especially chickens. Snakes can smell them and come in to hunt. Keep your animals in secure pens at night a little distance from your house. Store food in containers to discourage rats and mice - rats come in to hunt for them. Raise beds above floor level

and use a mosquito net, also a safeguard against centipedes, scorpions and snakes.

In the compound: Clear heaps of rubbish away from the house. Do not have piles of firewood, thatching material, coconut husks or similar near the house. Do not have shade trees overhanging the house. Keep grass short or ground clear around your house, and clear underneath low bushes so that snakes cannot hide close to the house.

Use a lamp or torch if you have to go outside the house at night. Wear shoes, especially during the rainy season. Be very careful when clearing bush for planting. Look first before grasping a handful of grass or bush to cut.

The high incidence of snake bite between 0400 hours to midnight corresponds well with the period of maximum outdoor activity observed in most studies.

The incidence of snake bite shows a distinct seasonal pattern closely related to rainfall and temperature which compels the reptiles to come out of their shelter.³⁸

Paul reported an incidence of 7-15 percent in children less than 10 years.³⁹

This study reported 37% incidence in the second decade of life.³⁹ The sex ratio seems almost uniform all over with males being affected twice or thrice as commonly as females. For obvious reasons, bites are maximal in lower limbs (about two thirds) with 40 percent occurring in feet alone.

Most bites in Bangladesh are recorded between May and October with highest number in June. Lower and upper limbs are most common sites of snakebite, but it may happen in other sites as well. In order to prevent snake bite, the following may be avoided: handling piled up woods, rocks; putting

hands in holes; careless fresh water fishing; walking through bushes and village foot walks at night without shoes and light, and sleeping in the floor of hut. Traditional snakebite doctor or 'ohza' treats most of the victims of snakebite in rural areas before hospitalization.⁴⁰

Most victims of Krait bites (*b. caeruleus*, *B. ceylonicus*) are bitten while asleep on the floor of their huts at night in India, Sri Lanka, Pakistan and Thailand. It seems likely that these snakes enter human dwellings at night in pursuit of their natural prey of other snakes and skinks. They bite when inadvertently rolled on or touched by sleeping humans.⁴¹

The risk is increased by a general lack of awareness (how to avoid snakes, species identification, first-aid/medical treatment), inadequate or no footwear, and minimal use of torches in low light conditions. The latter is especially important amongst the high risk segment of the population: agricultural workers, and low income groups in towns and cities.²⁹

The large difference in gender of the patients can be attributed to the fact that men typically work daily in the fields and may be more active at night, while women, for the most part, stay in or around their houses and compounds. Boys tend to travel wider and play at games putting them at greater risk than girls. Snakebite incidence in Kannur District peaks at the onset of the monsoon.

Equally, there is evidence of substantial improvement in awareness and treatment protocol; 7364 bites from the period of 1964-1990 had a mortality of

2.9% (215 deaths), while 5686 bites from 1990-2000 had a mortality of 1% (62 deaths).²⁹

In the present study majority were in the age group of 15-60 years followed by the age group of 6-14 years. The male: female ratio was 2.1:1. In a similar study from Ambajogai (Maharashtra) 88% cases were in age group of 11-50 years and male female ratio was 3.2:1. Male preponderance has been observed in other studies also. Male: Female ratio was 1.9:1 in Thailand, 1.3:1 in Pakistan¹⁰ and 2:1 in Karnataka (India). The age groups commonly affected were 11-50 years in Maharashtra, 10-40 years in Nepal, 15-44 years in Pakistan¹⁰ and 6-40 years in Zimbabwe.⁴²

Management of snake bite:

Diagnosis of snake bite cases

The common dilemma in deciding to treat snake bite victims is whether the bite has been inflicted by a venomous or non venomous species. Majority of bites are from non poisonous snakes and the initial signs and symptoms are due to the acute anxiety and panic state of the victim. Definitive diagnosis requires positive identification of the snake and clinical manifestations of envenomation. The snake may be brought into the health care facility – alive or dead, whole or in parts – for identification, though this is not very common. If the snake is not available, it may be possible to distinguish the bite as that of a venomous snake, by the pattern of fang marks, from that of a non venomous species or another animal, like rats, and from puncture wounds caused by inanimate objects. In the absence of positive identification,

objective signs and symptoms of envenomation become the mainstay of diagnosis.

Clinical manifestations of envenomation:

Since the venom of most snakes is capable of affecting various organ systems of the body due to its mixed nature, it is misleading to label venom from a species as 'neurotoxic', 'hemotoxic', 'cardiotoxic', or 'myotoxic'.

However, it is true that the most deleterious effects are seen on the nervous, hematologic, cardiovascular, and respiratory systems. The manifestations are also influenced by protective clothing, general health of the victim, pathogens in the mouth of the snake (tetanus for instance), type of first aid rendered, and individual patient susceptibility.

Elapid bites can cause local burning pain lasting for a few hours and some local edema, but the color of the skin is not changed. Hemorrhages, bruises, blisters and local tissue necrosis are less common. Lymphadenopathy and lymphangitis may occur.

Systemic neurotoxic effects start within 30 to 60 minutes (range 10 minutes to several hours) of envenomation and manifest as cranial nerve palsies (heaviness of eyelids, blurred vision, ptosis, pupillary dilatation, dysphonia, dysarthria, salivation), abdominal pain, vomiting, diarrhea, disturbed gait, respiratory weakness and paralysis. The neurotoxic effects are progressive but are reversible with antivenin and prolonged supportive care (upto 7 days). The venom of the African spitting cobras is not neurotoxic to humans but may cause intense ocular pain with blepharospasm, palpebral edema, corneal erosions, panophthalmitis and blindness. The viperine and crotaline poisons consist of proteolytic ferments that destroy different kinds of proteins,

including proteins of vascular wall and blood cells. Envenomation causes hemorrhages because of breaches of vascular wall as well as disturbances of the coagulation system. Rapid swelling, erythema, and ecchymosis can develop, involving the entire affected body part, along with pain. Blistering and tissue necrosis follows. The microcirculation is disturbed and hypotension may occur, partly contributed by the release of biogenic amines from affected tissues. Nausea, vomiting, perioral paresthesias, myokymia, altered sensorium, tachycardia, tachypnea, and respiratory distress may also occur depending on severity.

Many snake venoms can provoke disseminated intravascular coagulation (DIC) syndrome manifesting as petechiae, bleeding from gums and puncture sites, hematomas, melena, epistaxis, and hematuria. This is most common with Viperidae bites.

It may be helpful to describe the manifestations according to a clinical grading scale as follows

Mild Swelling, erythema and ecchymosis are limited to the immediate area.

None or insignificant. Normal, including all coagulation parameters

Moderate Swelling, erythema and ecchymosis extending beyond bite area.

Non-life-threatening signs and symptoms - nausea, vomiting, perioral numbness, myokymia, and mild hypotension. Mildly abnormal coagulation profile without clinically significant bleeding. Mild abnormalities on other laboratory tests.

Severe Rapid swelling, erythema, or ecchymosis involving the entire body part. Blistering and tissue necrosis. Marked systemic disturbance. Systolic blood pressure < 80 mmHg, altered sensorium, tachycardia, tachypnea,

vomiting and respiratory distress. Neurological signs. Bleeding from multiple sites. Coagulation profile is abnormal, including unmeasurable prothrombin time (PT) and partial thromboplastin time (PTT), platelet count less than 30,000/ μ L, and reduced or even undetectable fibrinogen. Other tests may also be markedly abnormal.

Note: The ultimate grade of severity of any envenomation is determined on the basis of the most severe sign symptom, or laboratory abnormality. For example, systolic blood pressure < 80 mmHg in the absence of local swelling should be graded as a severe envenomation. Elapid bites may not have prominent local manifestations.

First aid for venomous snake bites

☐ REASSURE THE VICTIM. Most bites do not result in severe envenomation, if at all.

☐ Allow bite to bleed freely for some time, say for a minute.

☐ Cleanse and rapidly disinfect area with Povidone iodine ointment, assuming that the subject is not allergic to iodine. In case of iodine allergy, use another antiseptic.

☐ Remove all constrictive clothing, watch, jewelry, bands, etc, close to the injured place.

☐ If bite is on hand, finger, foot or toe, wrap leg/arm rapidly with 3" to 6" crepe bandage (not a tourniquet) past the knee or elbow joint.

Leave area of fang marks open. Wrap no tighter than one would for a sprain.

Make sure pulses are present.

□ In some places a venom extractor (e.g. Sawyer Extractor) is available. In this case, if the person is trained in its use, a venom extractor is applied immediately until there is no further drainage from the fang marks.

□ SUCKING OF THE WOUND IS NOT RECOMMENDED – it can be dangerous for the rescuer if there are cuts or bruises in the mouth or lips and can further contaminate the wound with oral bacterial flora.

□ If extractor is not available, apply hard direct pressure over bite using a sufficiently large gauze pad folded in half twice. The gauze pad may be soaked in Povidone iodine solution if available. Strap gauze pad firmly in place with adhesive tape

□ Overwrap dressing above and below bite area with crepe bandage, but not too tight. Make sure pulses are present. Otherwise reapply.

□ Immobilize bitten extremity, use splinting if available, and ask the victim to remain still. It should be noted that snake poison is absorbed mainly through lymphatics. Lymph circulates more slowly through an immobilized extremity, and therefore, when immobilized, general symptoms of poisoning progress much more slowly.

□ If possible, try and keep bitten extremity at heart level or in a gravity-neutral position. Raising it above heart level can cause antivenom to travel into the body. Holding it down below heart level can increase swelling.

□ Bites to face, torso or buttocks are more of a problem. Disinfect, shave hair and apply pressure dressing with gauze pad and tape.

Crepe bandaging can not be applied to such bites but an extractor may be used if available.

❑ TRANSPORT VICTIM TO THE NEAREST HEALTH FACILITY WHERE ANTIVENIN IS AVAILABLE AS SOON AS POSSIBLE.

❑ Antivenom is the only specific treatment for snakebite and must not be delayed waiting for prominent signs of envenomation to appear.

❑ Remember envenomation is likely to be much more serious in a child or frail person. Also, bites in the head and neck region are apt to be more serious because of the possibility of damage to the large veins, leading to rapid systemic spread of the venom.

What not to do if bitten by a venomous snake

❑ Do not eat or drink anything unless okayed by the doctor.

❑ Do not drink any alcohol or use any systemic medication.

❑ Do not engage in physical activity. Injured person should not move or sit because it may cause dizziness, weakness and collapse. Patients should be transported after they have been immobilized and in supine position.

❑ Do not apply mouth suction to bite.

❑ Do not cut into, incise burn, cauterize, or apply electric shocks to bite marks.

❑ Do not apply either hot or cold packs.

❑ Do not apply a narrow, constrictive tourniquet such as a cord or a belt.

❑ Crepe bandaging or other wide strapping must not be wrapped so tight as to cut off systemic venous or arterial circulation. Properly applied, such bandages will NOT compromise the systemic circulation.

❑ Strapping should be applied above and below the injury, but should not cover an edema. If the edema increases rapidly, the bandaging should be loosened in order to avoid additional pressure to extremity.

❑ Do not remove dressings / wraps until arrival at hospital and antivenom is ready.

❑ Do not waste time or take any risks trying to kill, capture or bring in offending snake. However, make a mental note of its features and narrate that to the medical personnel.

❑ Do not waste time in getting treatment from by well-meaning faith healers. They succeed apparently in some cases because these bites are 'dry'. Once systemic envenomation develops, antivenin is the only specific treatment.

❑ Do not attempt to administer antivenin outside a health facility to avoid undesirable complications.

Treatment of snake bites

After a bite from any venomous snake, the victim should be moved beyond striking distance, and placed at rest, kept warm, and transported immediately to the nearest medical facility where antivenin is available. The injured part of the body should be immobilized in a functional position at the level of the heart. Rings, watches, and constrictive clothing should be removed, and no stimulants should be administered. If paramedical personnel are involved in transportation of the victim, they should concentrate on support of the airway and breathing, administration of oxygen, and establishment of intravenous access in the unaffected limb, during transport. If a tourniquet or constriction band has been placed as first aid, it should be left in place until the victim is evaluated in hospital and, if appropriate, infusion of anti venom is initiated. Subject must be reassured throughout the journey. In hospital aggressive supportive care is required.

Once airway, breathing, and circulation have been established, a rapid but adequate history should be obtained, including time of the bite, description of the snake, first-aid measures, coexisting medical conditions, drug and food allergies, and allergy to horse serum. The physical examination should be complete, with special attention to the cardiovascular, pulmonary, and neurologic systems. The bite should be examined for fang and teeth marks, scratches, edema, erythema, and ecchymoses. During initial evaluation, baseline circumferential measurements at points above and below the bite area helps in assessment of edema later on.

Baseline laboratory studies should include a complete blood count including platelet count, coagulation profile (international normalized ratio of prothrombin time, activated partial thromboplastin time, fibrinogen level), serum electrolytes, blood urea nitrogen and serum creatinine, and urinalysis. Ideally, laboratory studies should be repeated after each infusion of antivenom serum. Additional tests like measurement of creatine kinase, blood grouping with cross-matching, chest radiography, and electrocardiography may be indicated on the basis of the victim's age or medical history or the severity of the envenomation. Tetanus toxoid should be administered if indicated by the history. Since manifestations of envenomation can be delayed, it is desirable that all patients be under observation for a minimum of one day. If no clinical or laboratory manifestations have presented during this time, the patient may be discharged. A mild envenomation syndrome at one hour could progress to a severe syndrome within several hours and, without continuous observation and appropriate supportive and antivenin treatment, lead to death. Monitoring in an intensive care unit is recommended for all patients of severe

envenomation treated with antivenom. There have been no controlled trials to establish the efficacy of pretreatment with adrenaline, antihistamines and corticosteroids in snake bites but some clinicians pretreat routinely. Anti cholinesterase drugs may be successful in partially overcoming the neurotoxicity of cobra venom.

Antivenin appropriate to the species biting, or polyvalent antivenin, is the only specific treatment for poisonous snake bites available in India.

Currently there are four manufacturers of polyvalent anti snake venom serum – namely M/s Bharat Serums & Vaccines Ltd [product branded as ASVS], M/s Serum Institute of India Ltd [brand SiiASVS], M/s Haffkine Biopharmaceutical corporation Ltd [product known by the generic name of Lyophilized Polyvalent Anti snake Venom serum] and M/s Vins Bioproducts Ltd [brand VINS ASVS].

All products are available in 10 mL vials, priced between Rs. 250 to 400 per vial in the open market. Of these, ASVS is available as a ready to use solution, the others are lyophilized products requiring reconstitution with the supplied diluent prior to use. In general all polyvalent antislake venom serums available in India are purified immunoglobulin preparations of equine origin (horse serum) and have a shelf-life of 2 years under appropriate cold storage ($2 - 8^{\circ}\text{C}$) conditions. Each vial is capable of neutralizing 0.6 mg each of *Naja naja* and *Vipera russelli* venoms and 0.45 mg each of *Bungarus caeruleus* and *Echis carinatus* venoms. The use and the possible complications of antislake venom serum are outlined in the next section.

Rigorous follow-up care is also important. The injured extremity should be maintained in a functional position. The wound should be cleaned and covered with a sterile dressing. Blebs, vesicles, and necrotic tissue may

require surgical debridement after several days. Assessment and follow-up treatment should aim at preservation of joint mobility and muscle strength.

The complications of snake bites include pain, wound infection, DIC, compartment syndrome, respiratory paralysis and renal failure. Pain can be excruciating at the site of the bite wound and in the affected limb. Analgesics must be administered but opioid analgesics should be avoided if the venom is known to have neurotoxic components. Secondary bacterial infection of the bite wound is unlikely if adequate care is taken but possible. Some authorities routinely administer prophylactic cephalosporins or other broad spectrum antibiotics.

Tetanus immunization, however, should be brought up to date. Antibiotics should be administered if there is clinical and microbiologic evidence of wound infection. Respiratory support is the most important part of management in cobra bites. Even an adequate dose of neutralizing antivenin may not restore normal respiration quickly or prevent the onset or worsening of respiratory failure. However, antivenin does reduce overall ventilatory dependence substantially.

Consumption coagulopathy or DIC, compartment syndrome and renal failure are serious complications that will require management in intensive care units.

Using polyvalent antislake venom serum

Snake venom antiserum is administered by intravenous (IV) route, either undiluted at the rate of not more than 1 mL per minute or else diluted in IV fluid (normal saline or 5% dextrose; 500 mL – 1000 mL in adults and 20 mL/kg in children) and infused as rapidly as tolerated over 1 – 4 hours.

Lyophilized powder preparations will require reconstitution prior to use. The initial reconstitution should be with the diluent supplied by the manufacturer, before subsequent dilution. It is always advisable to consult the package insert first. When reconstituting or diluting antivenin, it should be mixed by gentle swirling rather than shaking to avoid foaming. It is NOT ADVISABLE to inject antivenin locally at the site of the bite. The initial dose depends upon the estimated severity of envenomation: 5 vials (50 mL) are recommended for mild, 5 – 10 vials (50 – 100 mL) for moderate and 10 – 20 vials (100 – 200 mL) for severe cases. Additional infusions should be repeated hourly until progressive swelling in the bitten part is arrested and systemic symptoms abate.

Precautions: Before administration of any product prepared from horse serum precautions are necessary to avoid dangerous hypersensitivity reactions.

Allergic reactions upon prior exposure to horse serum, if any, must be enquired into and the clinical history must be taken carefully, including any report of urticaria, asthma or other conditions suggestive of allergic predisposition. A skin test MUST then be performed in every patient, regardless of the history.

SKIN TEST: Inject intradermally 0.02 – 0.03 mL of a 1:10 dilution of the antivenin using a disposable tuberculin syringe. A control test in the opposite extremity using normal saline, facilitates interpretation. A positive reaction to a skin test will occur within 5 – 30 minutes. The shorter the interval between injection and the onset of the skin reaction, the greater is the sensitivity. If there is no history of allergy and the skin test is negative, proceed with administration of antivenin.

If the history is negative but the skin test is mildly positive, proceed as follows. Prepare in separate sterile syringes 1:100 and 1:10 dilutions of the antivenin. Inject subcutaneously 0.1, 0.2 and 0.5 mL of the 1:100 dilution, at 15 minute intervals, keeping a resuscitation kit for anaphylactic reactions handy. Repeat with 1:10 dilutions and finally, if no major untoward reactions occur, with undiluted (reconstituted) antiserum. If no reactions still, proceed with administration of the suitably reconstituted and diluted antivenin. If a systemic reaction occurs after any injection, place a tourniquet proximal to the site of injection and administer Adrenaline 1:1000 injection [0.5 – 1.0 mL in adults by intramuscular or subcutaneous route, repeatable several times at 10 minute intervals according to blood pressure and pulse] proximal to the tourniquet or into another extremity. Wait at least 30 minutes before injecting another dose of antivenin. If no further reaction occurs, continue till 0.5 mL of the undiluted antivenin has been administered. Then switch to the intramuscular route and continue doubling the dose at 15 minute intervals until the entire dose has been injected intramuscularly.

If allergy history is present, and the skin test is also strongly positive, use of the antivenin may be dangerous, especially if the positive skin reaction is accompanied by other allergic manifestations. In such cases the risk of administering antivenin must be weighed against the risk of withholding it, keeping in mind that significant envenomation may be fatal. Patients who do develop signs of impending anaphylaxis on skin test or injections of graded dilutions of antiserum present a very difficult choice and expert consultation should be sought.²⁶

Snake venoms: The venom is modified saliva, delivered through fangs. The fangs of 'advanced' venomous snakes like viperids and elapids are hollow in order to inject venom more effectively, while the fangs of rear-fanged snakes such as the Boomslang merely have a groove on the posterior edge to channel venom into the wound. Snake venoms are often prey specific, its role in self-defense is secondary. Venom, like all salivary secretions, is a pre-digestant which initiates the breakdown of food into soluble compounds allowing for proper digestion and even "non-venomous" snake bites (like any animal bite) will cause tissue damage.

Snake venoms are complex mixtures of proteins and are stored in poison glands at the back of the head. In all venomous snakes these glands open through ducts into grooved or hollow teeth in the upper jaw.^{43, 44} These proteins can potentially be a mix of neurotoxins (which attacks the nervous system), hemotoxins (which attacks the circulatory system), cytotoxins, and many other toxins that affect the body in different ways.⁴⁴ Almost all snake venom contains hyaluronidase, an enzyme that ensures rapid diffusion of the venom.⁴³

Venomous snakes that use hemotoxins usually have the fangs that secrete the venom in the front of their mouths, making it easier for them to inject the venom into their victims.⁴⁴ Some snakes that use neurotoxins, such as the mangrove snake, have their fangs located in the back of their mouths, with the fangs curled backwards. This makes it both difficult for the snake to use its venom and for scientists to milk them.⁴⁴ Elapid snakes, however, such as cobras and kraits are proteroglyphous, possessing hollow fangs which cannot be erected toward the front of their mouths and cannot "stab" like a

viper, they must actually bite the victim. It has recently been suggested that all snakes may be venomous to a certain degree, the harmless snakes having weak venom and no fangs.⁴⁵

How to avoid snake bite?

It is misconception that snakes are always venomous and dangerous because majority of snakes are harmless to humans. Even if venomous, in general, most snakes avoid confrontation with humans but will strike if provoked or feeling threatened. Remember the following to avoid snake bites:

- ☐ Never pursue or persecute a snake.
- ☐ When in the countryside or in potential snake territory, do not blindly put hands or feet under stones, in crevices, or within leaf litter or other debris. Similarly, do not blindly lift up stones, twigs, straw or dry grass.
- ☐ Avoid high grass. Have a long stick to make a check path in the grass.
- ☐ Wear proper (closed) shoes that a snake cannot bite through.
- ☐ Use an electric torch at night.
- ☐ Phenol (carbolic acid) is not an effective snake repellent. When camping outdoors at night, bleaching powder would probably do the job better.
- ☐ Do not take even a dead snake casually in your hand: reflex actions may cause bites up to 1 hour after a snake has died, even after decapitation.

Overall remember that PREVENTION IS BETTER THAN CURE.

Avoiding Snakebites

Some bites, such as those inflicted when snakes are accidentally stepped on or encountered in wilderness settings, are nearly impossible to prevent.

But experts say a few precautions can lower the risk of being bitten:

- Leave snakes alone. Many people are bitten because they try to kill a snake or get a closer look at it.
- Stay out of tall grass unless you wear thick leather boots, and remain on hiking paths as much as possible.
- Keep hands and feet out of areas you can't see. Don't pick up rocks or firewood unless you are out of a snake's striking distance. (A snake can strike half its length, Hardy says.)
- Be cautious and alert when climbing rocks.

What do you do if you encounter a snake when hiking or picnicking? Says Hardy: "Just walk around the snake, giving it a little berth--six feet is plenty. But leave it alone and don't try to catch it."

Though poisonous snakes can be dangerous, snake venom may have a positive side. Clinical trials reported in the February 2002 issue of the *Journal of Evaluation in Clinical Practice* indicate that a venom-derived product called ancrod could provide significant benefits in treating stroke. Earlier proposals using snake venom to treat neuromuscular disorders such as multiple sclerosis never reached the clinical trial stage.

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Do s to avoid snake bite: According to the Pediatrics Kerala, the website of Indian Academy of PEDIATRICS Kerala state branch : The best treatment of snake bite is prevention. It observed that, the frequency of snake bite is at peak in the rainy season in farmland open country areas. One must wear long mud shoes, gloves and thick long clothes in such surroundings. The chances of snake bite are at the highest at dusk or in the night hours. hence one should not go out without a powerful torch. While trekking in a jungle, always use high shoes, gloves and wear thick clothing. And some do not sleep on the ground increases the chances of snake bite. It should be avoided. Swimming in the sea snake harboring areas of sea.

How do you avoid snake bites? Dr Charlie Easmon, specialist adviser in travel medicine

- ☐ Wear long boots and trousers (which in rainforests also provide some protection against leeches).
- ☐ Make a noise (or to be more correct vibrations in the surroundings - snakes are deaf, but react to 'shaking'). Beat and bash with a long branch or twig in the area three to five paces ahead, and stand still for a short time before taking the next step. By far the majority of snakes prefer to flee if given the chance. An exception is the uncontrollably aggressive Australian Taipan, which also strikes out unpredictably. Puff adders are very quiet but dangerous snakes, if you see one sneak away with as little noise as possible.
- ☐ Avoid going out in a snake area in darkness. If it is necessary to do so, then take a strong torch with you. Snakes prefer to evade bright light and vibrations.

- If you see a snake, you should stand completely still. It will instinctively prefer to go away and most snakes predominantly attack moving targets.
- Do not put your hands down into holes, dark cavities or cracks in rock, even if something has fallen down it. To reclaim anything, you can attempt to fish it out with a stick, standing well away from the hole. Creepy-crawlies other than snakes (for example scorpions) may also be poisonous, and they are all lightning fast.
- The best possible advice is not to touch a snake in the wild. The worse thing you can do is try to pick one up so that the doctor can identify it! If you see a 'dead' snake, you should keep well clear. Many people have been bitten two or three times by 'dead' snakes. Only if someone has been bitten should you make sure that the snake is killed and take it along for identification, but hold it by its tail and continue to watch out for its head, or preferably put it in a sack that can be held away from the body.
- All sea snakes (Hydrophiidae) are potentially extremely poisonous and snorkellers and scuba divers should not attempt to inspect them more closely. Sea snakes typically occur on the coasts of south-east Asia and Australia.⁴⁶

Snakes and common misbeliefs

Snake means death! It is amazing to find foolish and utterly absurd misbeliefs like this and many more about this misjudged creature. Compelling folklores, stories, myths and legends have us convinced. Below are the some common beliefs about snakes.

1. It is totally erroneous to believe that snake bites can be cured by mantras, mantriks, magic spells roots and herbs. Do you know that in

our country about 25,000 people die playing fools to such beliefs? Anti-Venom is the only cure for the snake bite! The other remedies are useful to relieve fear and treat shock, but should never be substituted for or interfere with the anti-venom treatment. Snake bites are cured only when timely treatment is rendered to the patient. Mantriks casting spells, using snake stones to suck out the venom, Naagveli, kinds of oil, ash etc. are all futile. The snake stone is merely a benzoin or a gall stone, and has no effect on the venomous bite.

2. *Snakes are revengeful.* There is no scientific basis to this. A snake's brain is not developed to the extent of retaining memory. It is said that if you kill a snake, another (its mate) will follow you and take revenge. That, of course is wrong, but may have some basis in fact. When you kill a snake it expels its musk from the anal opening; it is very possible that a nearby snake may show up to investigate what the musk (a sex - attractant) is all about.
3. *Snakes guard wealth.* This is a common misbelief. Old crumbling houses, 'wadas' are ideal for snakes as they find plenty of hiding places together with rats and mice. In the days of yore, people often buried their wealth and it could be a possibility that a snake and the hidden wealth were unearthed together, giving this impression.
4. Old snakes have hair on them. Hair does *not* grow on snakes. Periodically snakes cast off moults and if some moults remain, it appears like hair. Sometimes some snake charmers even stick hair onto the snake's head.

5. *Snakes hypnotize.* This is believed to be so because snakes stare fixedly as they do not have eyelids and cannot blink.
6. *Snakes sway to the music of the flute.* This misbelief has been strengthened by our ever popular but ludicrous Hindi films. Even though it is now proven that they can detect some airborne sounds, there is no evidence that snakes can appreciate music. Snakes are said to dance to music. While playing the flute, the snake charmer sways and the snake moves to the swaying movement. It is the natural instinct of the snake to keep a close track of any moving object. In fact they instinctively stay away from artificial vibrations. The music of the snake-charmers only serves to charm the audience.
7. *Cobras, particularly the king cobra, are supposed to wear a 'nagmani' that makes one a millionaire.* The poor Irula tribal snake-catcher has a good answer to the legend of the jewel or light in the head of the snake. When asked about this belief, an Irula will reply, "if it was so we would be rajas not snake-catchers."
8. *Snakes suck milk from a cow's udder by coiling around its legs. This is not true.* Milk is not part of a snake's natural diet. Where they would find it in nature, how they would obtain it with no powers of suction and with over hundred sharp teeth in the way, and of what nutritional value a few spoonfuls of milk would be to a snake, are questions that should be considered.
9. *Sand boa bites cause leprosy.* The blotches on the skin of the sand boa have given rise to this notion. Since this harmless snake has a body pattern that vaguely resembles that of patients suffering from this

dreaded disease,*people are quick to make this association. Actually, snakes are clean and free of disease.

10. *A green tree snake pierces a man's head with its pointed head.* The vine (common green whip) snake is accused of poking one's eyes out or 'stinging' one on the forehead. Actually, the pointed nose of this harmless snake is soft and rubbery. The vine snake can inflict a painful (but harmless) bite on the finger or even on the nose, but no one has ever received an eye injury.

11. *Snakes like the sweet pungent smell of the kevada or the raat-ki-rani.*
This is an unproven statement.

12. *A small snake of Kashmir is supposedly so deadly that it melts the snow it passes through !*

13. The tails of rat snakes, despite various stories about them, are no more dangerous than pieces of rope and so not have stingers, do not suffocate cows, lash down paddy and so on.

14. Bites by a snake with rings on its body, does not give the victim's body a ringed pattern.

15. In north western India, kraits are supposed to suck a man's breath away as he sleeps. This is perhaps the farmer-labourer's explanation for the respiratory paralysis that a severe krait-bite brings on.

16. In Maharashtra, the little earth bound saw scaled vipers are believed to jump through the air for six feet or more. Six inches would be more accurate.

17. Cobras are believed to mate with rat snakes, but they in fact mate with only their own species and generally keep away from the larger and sometimes cannibalistic rat snakes.
18. The red sand boa has an extremely blunt tail; thus there are several popular stories about 'two headed snakes'. Just as it fools the mongoose and other predators into attacking its tail while the head seeks escape, a large percentage of humans are also fooled.
19. *Pregnant women loose their eyesight if they see a snake.* This is not true.
20. Snakes hold their own tail in their mouth, form a coil and chase people. Snakes use their tails as whips.
21. *Pythons suck their prey from a distance.*

Many of our old traditions respect flora and fauna. These sacred traditions had a meaning and were observed thoughtfully. For example, worshipping the banyan tree during *vata poornima*, or worshipping bullocks. But somewhere down the line, these traditions lost their meaning and became plain ceremonies and rituals. The very next day after worshipping the bullocks we are cruel to them or we cut down the beautiful banyan tree that we worshipped! Similarly, *Nag Panchami* is celebrated with fervor. We perform a puja, pay obeisance to the snake only for that day and the next day if it crosses our path we are scared to death and kill it. Due to lack of proper information, misbeliefs and fears, many important species of flora and fauna have become rare and are threatened with extinction ; consequently, disturbing the natural cycle of coexistence. Rampant killing of the snake has led to enormous increase in the number of rodents, which in turn destroy food

grain. Records indicate that about 26 % of food grain produced in the country every year gets destroyed due to rodents. The number is likely to increase if the number of snakes continues to decrease at today's pace. Legal restrictions can control the destruction to some extent. The Wild Life Protection Act of 1972 passed by the Government of India has included all Indian snakes in the list of animals to be protected from being killed. The Act also bans sale of items made from snake skin. Exceptional import licenses are issued, but strictly for scientific purposes. Snakes will continue to be killed until we all learn to observe these rules.⁴⁷

Modern Myths About Snakes

Below is a list of common myths regarding snakes and snake behavior and some possible explanations for these tales.

Charming Snakes

A popular myth about snakes is that they are somehow able to hypnotize or "charm" their prey so that the prey is unable to escape. There is no evidence to support the claim that snakes charm their prey. This myth may have resulted from the observation of small animals and birds becoming "frozen with fear" when confronted by snakes, however they are not being charmed. Often an adult female bird will flutter about in front of a snake in order to distract the snake from the fledglings in her nest. Another possible explanation may be that many animals are unable to perceive the slow approach of a long thin snake as dangerous. Finally, the fact that a snake is unable to blink may have something to do with the origin of this myth. Rat snake (*Elaphe obsoleta*)

Hoop Snakes

According to folklore, when frightened a hoop snake will bite its tail and form a rigid circle which allows it to travel downhill like a wagon wheel. Obviously, snakes are not anatomically equipped for rolling. There are no reliable accounts of this event ever taking place. The hoop snake myth may have originated from the observed behavior of mud snakes. Mud snakes in the southern United States will occasionally lie in a loose coil shaped like a loop, but when confronted they slither away from danger like other snakes.

Poisonous Breath

Some people believe that hognose snakes (*Heterodon platirhinos*; also called spreading adders or puff adders) are able to mix poison with their breath and kill a person at a distance of over twenty feet. In reality the breath of hognose snakes is harmless. Hognose snakes exhibit perhaps the most elaborate bluffing behavior of any snake. They may spread their hoods, hiss, and even strike, although they don't attempt to bite. If they are continually harassed, they will flip over on their back and play dead. Hognose snakes rarely bite people and their bite is usually less bothersome than a bee sting. Eastern Hognose Snake (*Heterodon platirhinos*)

Rattlesnakes Add One Rattle Every Year

It is often suggested that rattlesnakes add one rattle every year. Contrary to this belief, a rattlesnake adds one rattle every time it sheds its skin. Snakes may shed several times a year, each time adding a new rattle; in addition rattles may break off. For these reasons, counting rattles is not usually an accurate method of determining a rattlesnake's age.

Snakes Travel in Pairs

Another myth regarding snake behavior is that snakes travel in pairs, the survivor seeking revenge if one is killed. This myth is entirely false, snakes hardly ever travel in groups or pairs. Snakes do not have any social bonds and would feel in no way vengeful if one of its conspecifics were to be killed. One possible explanation for this myth may be that in a prime habitat situation, several snakes of the same species may be observed in a small area. Another possible explanation for the origin of this myth could be related to the typical reproductive behavior of snakes. During the mating season a male snake may closely follow a female snake much as a buck deer trails a doe during the rut.

Striking

Unfortunately some people are uninformed about the striking capabilities of snakes. Many people believe that snakes can only strike from a coiled position. In reality, snakes can bite or strike from any position. Coiling does however, increase the distance that a snake can strike. A common inquiry relating to cottonmouths (*Agkistrodon piscivorous*), concerns their ability to bite underwater. Cottonmouths can in fact bite underwater, which makes sense since they live in wetland habitats, and feed on fish and water snakes. A related myth states that injured snakes die before sundown. This myth is of course false. A mortally wounded snake will usually die quickly, just like any other animal. Time of day has no bearing on the death of any animal. The origin of this myth may be related to the fact that nerve reflexes may cause

muscle twitches for several hours after death, resulting in movements of the body and jaws. Because of the lingering nerve reflexes, even a dead venomous snake can be dangerous.

Sucking Milk

In farming communities throughout the world, it is a common superstition that snakes suck the milk from cows and goats. In North America, the milksnake (*Lampropeltis triangulum*) acquired its common name based on this myth.

Although milksnakes may be common around barns, they lack the anatomical structures necessary to suck. A snake drinks by submerging its head, or at least its mouth, in water and it then takes in water by expanding its body wall.

Milksnakes are common in barns because barns house an abundant supply of small rodents, their primary prey.

Swallowing Young

Many people believe that mother snakes will swallow their young when confronted with danger. Despite countless hours of observation, this behavior has never been documented. Swallowing young would not serve as a protective strategy in snakes because anything that enters the esophagus soon arrives in the stomach where it is promptly digested. Although thousands of dissections have been performed on female snakes, none have revealed a stomach full of baby snakes belonging to the same species.

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