Incidence of snake bite and corresponding compensation payments in the Kannur district of Kerala, India

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ABSTRACT - Data on snake bite cases were collected from a hospital that is the main centre for the diagnosis and treatment of envenomation and poisoning in the Kannur district of Kerala (India), from 2012-2015. Data on financial compensation for snake bite was collected from the Kannur Forest Department in the same period. A total of 770 snake bites were recorded, of which 487 were from *Hypnale hypnale* (hump-nosed pit-viper), 281 from *Daboia russelii* (Russell's viper), and one incidence each of bites by *Naja naja* (Indian spectacled cobra) and *Bungarus caeruleus* (common krait). Snake bites were most frequent in summer and during the wet season and most common in individuals aged 40-50 years. Although 770 snake bite cases were recorded in the period, Kannur Forest Department paid snake bite compensation in only 452 cases (58%). This amounted to US\$0.63m for snake bite mortality and US\$1.081m for morbidity. We suggest that increasing the knowledge and awareness of the general public about venomous snakes could reduce the risk of snake bite.

INTRODUCTION

The World Health Organization estimates that India has the highest snake bite mortality in the world (Singh & Singh, 2013). This is due to the large number of medically significant snake species in and around human habitations, lack of medical facilities, improper first aid and treatment, inadequately trained clinicians, and reliance on traditional snake bite treatment (Whitaker & Whitaker, 2012). Acquiring snake bite data is difficult and the data are likely incomplete (Ahmed et al., 2008). Nevertheless, Kerala appears to be among the Indian states with a high incidence of snake bite (Philip, 1994).

About 60 species of venomous snakes are present in India, of which four venomous species, *Naja naja* (Indian spectacled cobra), *Bungarus caeruleus* (common krait), *Daboia russelii* (Russell's viper) and *Echis carinatus* (saw-scaled viper) are well known as major threats to human life in most parts of the Indian mainland (Whitaker & Captain, 2004). More recently a fifth species, *Hypnale hypnale* (hump-nosed pit-viper) which is often misidentified as *E. carinatus* (Simpson & Norris, 2007) has been considered as no less important and causes serious complication such as acute kidney injury, hematological manifestations, and other organ involvement, in some cases leading to death if not treated (Kularatna & Ratnatunga, 1999; Shivanthan et al., 2014).

Under the Kerala Rules for Compensation to Victims of Attack by Wild Animals 1980, (latest amendment in 2014), compensation is paid for both mortality and morbidity following snake bite. Snakes come under the Schedule of Indian Wildlife Protection Act 1972 administered by the Forest Department and thus even though snake bites occur

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mostly in agriculture areas, the Forest Department is tasked with compensation.

This study of snake bite in Kannur district was undertaken to document the species involved, seasonality, frequency, and associated compensation costs.

METHODOLOGY

Geography of Kannur district

Kannur district of Kerala lies between latitudes 11° 40' to 12° 48' N and longitudes 74° 52' to 76° 07' E, with elevation ranging from sea level to the highest point in Paithalamalla Grasslands (1372 m above mean sea level). In a 2011 survey, Kannur had a population of 2,523,003 which gives a human density of 852/km². The district can be divided into three regions; highlands comprising mountains with major plantations such as coffee, rubber, tea, cardamom and timber; midlands of undulating hills and valleys with agricultural activity; and lowlands with rivers, deltas and seashore. The district has a humid climate with a hot season from March to the end of May followed by the south-west monsoon that continues until the end of September. The annual average rainfall is 3438 mm of which more than 80% occurs during the south-west monsoon.

Collection of data

We collected snake bite data for the period 2012 to 2015 from Pappinisseri Visha Chikilsa Kendram (PVCK), a hospital exclusively for the diagnosis and treatment of envenomation and poisoning in Kannur district. The data included the names, ages, and gender of snake bite victims, and the month and year of the bite. The species of snake implicated was identified from the bite marks by the experienced medical practitioners in PVCK and observations of victims. We also consulted doctors and some victims to understand the circumstances of snake bite. In addition, information on compensation paid to victims of snake bite mortality or morbidity in the period 2012 to 2015 was obtained from the Forest Divisional Office in Kannur to give an understanding of the economic impact of snake bite.

RESULTS

Snake bite data

A total of 770 snake bites were recorded in PVCK during the year 2012-2015 (Table 1) of which 63% of the bites were reported from *H. hypnale* (hump-nosed pit-viper, Fig.1B), and 37% from *D. russelii* (Russell's viper, Fig. 1A). Of the total of 281 bites considered to be by *D. russellii*, 169 were suspected to be from adult snakes and 112 from juveniles. There was one incidence of a bite each by Indian spectacled cobra, *N. naja* and common krait, *B. caeruleus*.

Snake bites varied seasonally (Table 1). Bites from *H. hypnale* average 14/month but rose to an average of 23/ month during September to November. Most bites were of laborers working in rubber or cashew plantations and of people living adjacent to forest areas. Monthly variations were also observed in *D. russelii*, with an average of 8 bites/ month, but rose to an average of 14/month during the months of May to August, when bites by juvenile snakes were more frequent. The single incidence of bites by *N. naja* and *B. caeruleus* were reported in the months of May and October respectively.

Significant variation was observed in sex ratio of snake bite victims. During 2012-2015, men had 70% of the bites by *D. russelii* ($\chi^2 = 47.06$, df=1, p<0.001) and 64% of bites by *H. hypnale* ($\chi^2 = 38.54$, df=7, p<0.001). Significant difference was observed in the number of snake bites among different age class (Fig. 2; $\chi^2 = 282.15$, df=7, p<0.001). People belonging to age class 40- 50 had the highest bite rate compared with other classes.

Compensation data

During the three year period, the Kannur Forest Department made 452 compensation payments for snake bite mortality or morbidity (Table 2). In each of the financial years (April-March) of 2012-2013 and 2013-2014, 12 death cases were reported and in the year 2014-2015 this rose to 16, giving a total of 40 deaths in all (Table 2). This was verified from the postmortem reports. A compensation payment amounting to about US\$1590 (Rs 1 lakh) was given by the Forest Department in each case of mortality; amounting to a total of about US\$0.63m (Rs 40 lakh) paid in the three year period. Over the three year period, a total of 412 cases of compensation of morbidity were applied for and backed up with a formal doctor's certificate resulting in a total payment of about US\$1.081m (Rs 67.99 lakh).

DISCUSSION

The snake species responsible for bites treated by the PVCK hospital were almost exclusively victims of *H. hypnale* and *D. russelii*. The annual rate of bites recorded from this



Figure 1. Examples of major species of snakes involved in snake bite cases in Kannur district of Kerala (A) *H. hypnale* Humpnosed pit-viper; (B) *D. russelii* Russell's viper



Figure 2. Number of snake bites in relation to the age of the victim in Kannur district (2012-2015)

main treatment centre amounts to roughly nine people per 100,000 of the population in Kannur district. However, the rate would be expected to be considerably higher than this as some victims would seek treatment from other clinics/ hospitals, from traditional healers or even no treatment. The bite frequency peaked during the summer and monsoon season, reflecting agricultural activity, flooding, increased snake activity, and abundance of their natural prey (Ahuja & Singh, 1954; Sawai & Honma, 1976; Kasturiratne et al., 2008).

Hypnale hypnale is terrestrial, nocturnal, and usually

Table 1. Number of snake bites cases reported during 2012-2015 at the Pappinisseri Visha Chikilsa Kendram hospital Kannur

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Indian spectacled cobra					1								1
Common krait										1			1
Hump-nosed pit-viper	28	21	27	23	45	31	31	35	61	83	62	40	487
Russell's viper	15	14	11	9	51	64	33	22	18	13	15	16	281
Total	43	35	38	32	97	95	64	57	79	97	77	56	770

Table 2. Compensation paid by the Forest Department in Kannur District to snake bite victims suffering mortality or morbidity (Indian rupees)

Year	Mortality		Morbidity	
	No.	Compensation Amount (Rs)	No.	Compensation Amount (Rs)
2012-2013	12	1,200,000	160	689,000
2013-2014	12	1,200,000	76	1,450,000
2014-2015	16	1,600,000	176	4,660,000
Total	40	4,000,000	412	6,799,000

sluggish but will bite when threatened or provoked (Das, 2002). It is more abundant in Parassinikadavu, Mayyil and Mallapattam areas of the district and the victims were mainly the people working in rubber tapping and other plantations. Daboia russelii is found widely across the district, mainly in agricultural lands, open forests, and gardens and is mostly a nocturnal forager. However, in cooler conditions it becomes active during daylight hours and spends more time thermoregulating (Daniel, 2002). A high incidence of bites by D. russelii in Kerala has been recorded previously (Mahadevan & Jacobsen, 2009). This species mates during the months of December- January and produces young mainly during May to July (Mallow et al., 2003, Whitaker & Captain, 2004). The highest frequency of bites by this species was during the months of May to August (14/month) and these were more often delivered by juveniles. Juvenile D. russelii are more nervous and active than adults (Warrell, 2010) and are likely to be present in greater numbers than adults in this period.

The victims of snake bite recorded at the PVCK hospital, were more likely to be men than women. As more men are engaged in work in the fields their chances of being bitten by a snake are greater, similar results were reported elsewhere (Suchithra et al., 2008; David et al., 2012). We found that the 40-50 years age group was more prone to snake bite compared to other age classes, again we believe this is due to their higher encounter rate with snakes. This contrasts with two other studies where risk of death from snakebite was greater at the age 5–14 years and 15–29 years (Sawai & Honma, 1976).

Echis carinatus (saw-scaled viper) has been reported to be the most serious cause of snake bite morbidity and mortality in South Asia (Chand 1990; Alirol et al., 2010). In Kannur district *E. carinatus* is restricted to the Kannur-Kasaragod border (Chemmeni) and no bites were reported during the study period, although a few cases have been reported previously (Dr. Murali, PVCK, Kannur). The other two species reported as minor causes of snake bite in Kannur, *N. naja*, and *B. caeruleus*, are distributed widely across the entire district although *N. naja* is apparently absent from the area of Kannur town (Riyas Mangad, Snake rescuer, Malabar Awareness and Rescue Centre for Wildlife).

Economics of snake bite

Enormous effort, money and time are involved in the management of snake bite cases. Costs associated with a snake bite begin with travel to the hospital and end in to post treatment expenses. Hospital charges vary according to the hospital and location. Generally local people in Kannur rely on the PVCK hospital and Pariyaram Medical College. The cost of treatment in these institutions is lower than in private hospitals. A vial of antivenom may cost US\$10 to \$16 (Rs 600 -1000). Antivenom administration depends on the species and degree of envenomation. In some snake bite cases, 20 vials of antivenom is prescribed. Kerala Forest Department pays compensation for snake bite treatment which is a major support to such victims. However, only 58% of the cases known to this study appear to have received compensation. The reason for this may be that a few victims can easily pay for themselves while others may have been unaware that they could claim compensation from the Forest Department.

Mitigation

The incidence of snake bite may be minimised in a number of ways. Regular rodent control is advised to avoid snakes in human habitations. During periods of high snake activity (May-July for *D. russelii* and Sept- Dec for *H. hypnale*), more precaution are to be taken during agriculture/ gardening practices, grass/wood collection etc. Especially people working on agricultural lands or in rubber/cashew plantations have to take greater care. Rural inhabitants should avoid sleeping on the ground. Isolation of snake habitat from human living space is essential to reduce human-snake conflict. For example, plants pots must be kept away from courtyards and branches of trees near windows must be cropped to help prevent snakes entering houses. An education programme on the conservation of non-venomous snakes in Kerala has achieved positive attitudinal change among the local people (Balakrishnan, 2010), a similarly focused approach towards an awareness of the general public towards venomous species would be expected to reduce the frequency of snake bite morbidity and mortality.

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