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Epidemiological aspects of snake bites on a Liberian rubber plantation

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Summary

During a one-year period 95 patients with a history of snake bite were admitted to the hospital of a Liberian rubber plantation. The population at risk included the field workers (tappers and slashers) with an incidence of 4.2 symptomatic snake bites per thousand per year. The incidence of symptomatic bites was 1.7 per thousand in the group of non-field employees and 0.4 per thousand per year in the group of non-employees. The temporary disability was between 3 and 5 days, and the loss of workings days due to snake bites was one day per 10 000 working days on the plantation. Among the 95 patients 27 did not show any symptoms of envenoming except occasional fang marks. 64 patients developed cytotoxic symptoms alone. In this group, the night adder *(Causus maculatus)* was the main responsible snake. 4 patients showed signs of systemic envenoming. Two were haematological and two were neurological in nature and caused by *Bitis* species and *Naja* species, respectively. No fatalities were noted. A definite maximum of snake bites was observed during October and November which corresponds to the transition from rainy to dry season.

Key words: epidemiology; snake bite; Liberia.

Introduction

The Firestone Rubber Plantation at Harbel, Liberia, is situated along the coastal belt of the country near the Atlantic Ocean. It covers an area of 220 square miles. The largest part of the surface is covered by rubber trees. Around the villages and in the swampy valleys, the land is used for farming (rice, manioc, sugar cane). The climate is characterized by a dry season from Novem-

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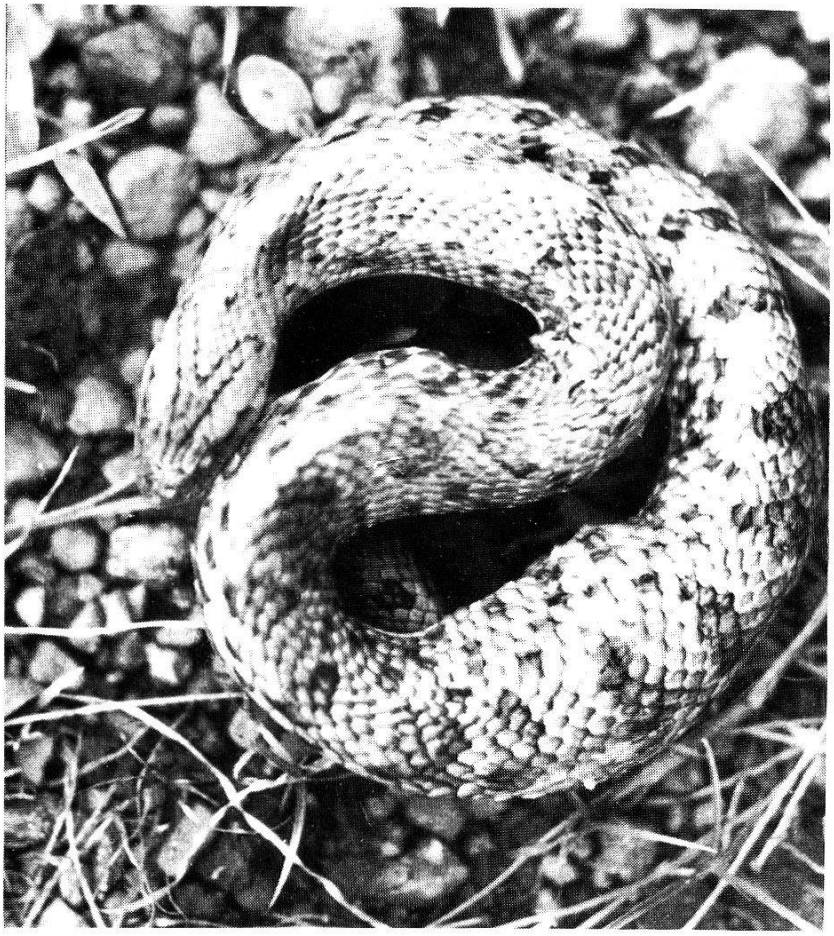

Fig. 1. *Causus maculatus.* The most common snake on the plantation.

Fig. 2. *Bitis gabonica.*

Fig. 3. *Naja melanoleuca.*

ber to April and a rainy season from May to October. According to the annual census of 1978 there were 44,547 registered inhabitants.

Snakes are very common in Liberia. There are at least ten species considered to be venomous (Schulze, 1973). Epidemiological investigations by Taylor and Weyer (1958) showed, that the most common snake is the night adder *(Causus maculatus)* (Fig. 1). Other viperid snakes are *Bitis gabonica* (Fig. 2), *Bitis nasicornis* and *Atractaspis corpulenta.* Among the elapid snakes *Naja melanoleuca* (Fig. 3) and *Dendroaspis viridis* are frequently seen. *Bitis arietans* and *Echis carinatus* are not found in the area.

The aim of this study was to determine the impact of snake bites on the plantation workers as judged by morbidity resulting in disability and days lost from work. Due to the organized structure of the Firestone Medical Services with 42 divisional health posts, two regional health centers and one hospital it was possible to record most of the snake bites and almost all of the symptomatic and therefore medically important ones. As the number of serious snake bites with systemic envenoming by *Bitis* species and *Naja* species was low and no new aspects concerning their symptoms and treatment were noted, these cases are not discussed in details.

Material and methods

9,694 persons were employed in the field production as tappers (Fig. 4) and slashers (grass cuters), and 2,802 were working in the factory and other services in April 1979.

The different health posts and regional health centers were advised to refer all patients with snake bites to the central hospital of the plantation for further investigation and treatment. On

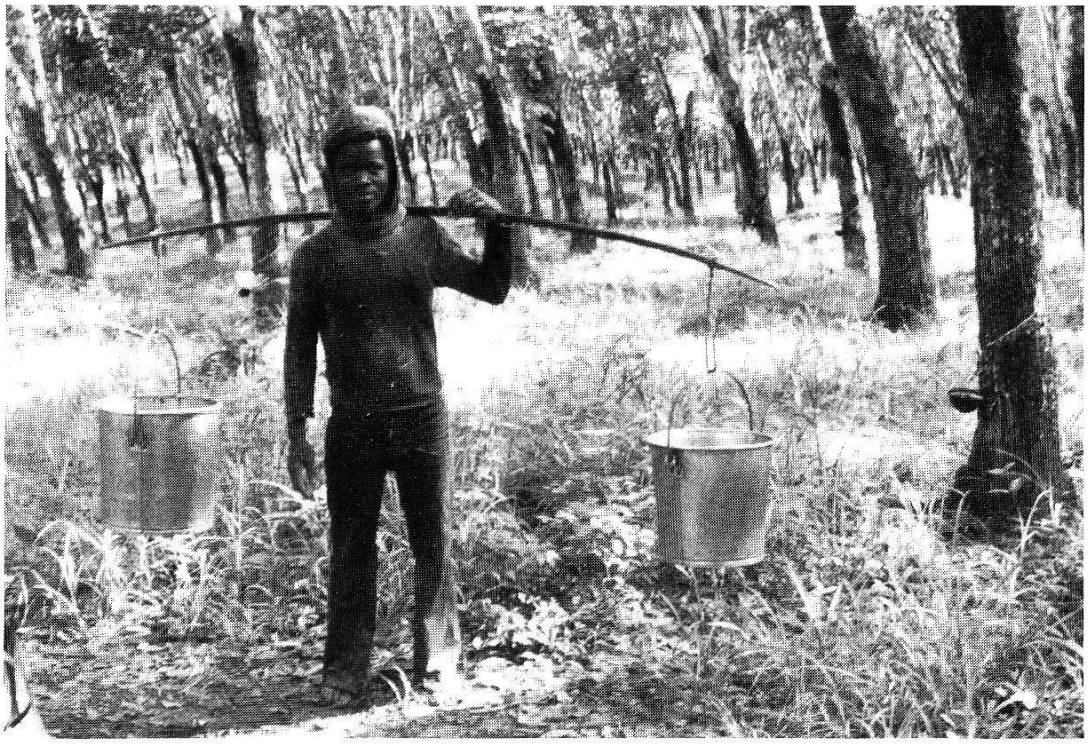

Fig. 4. A tapper on the plantation.

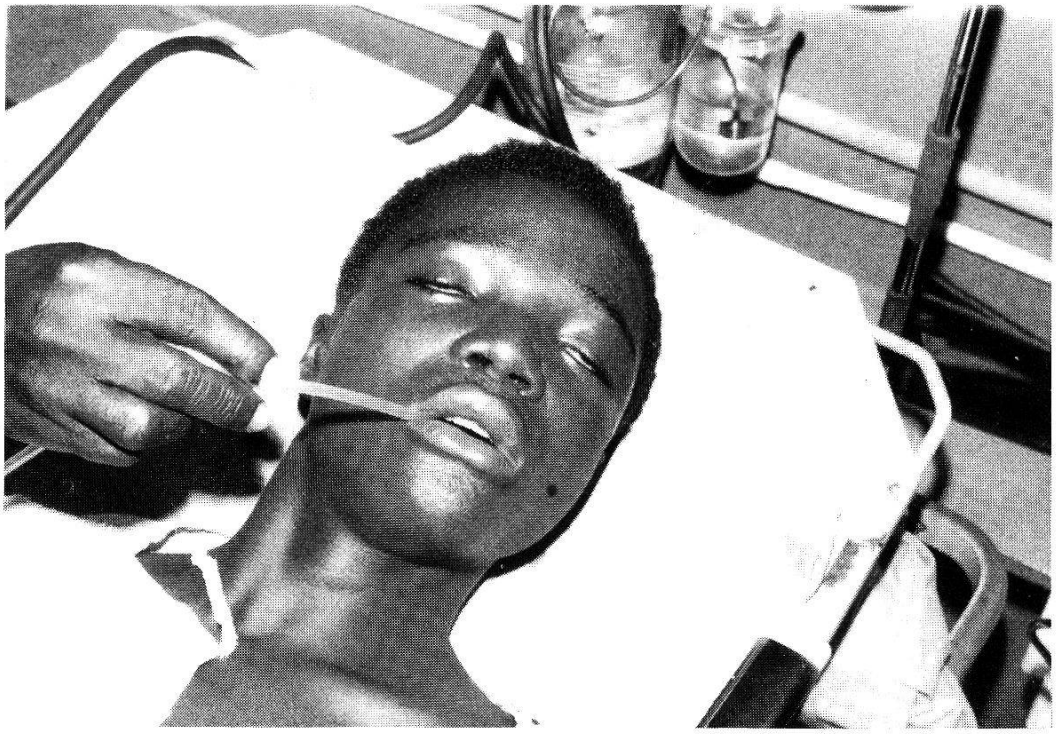

Fig. 5. Patient after a bite by *Naja melanoleuca.* Note the typical ptosis of the eye lids.

admission, a direct inquiry was made about occupation, circumstances of the bite, history of previous snake bites and identification characteristics of the particular snake.

As immunodiagnostic methods (Theakston et al., 1977) were not available for the diagnosis in cases where the snake was not killed, a collection of formaline-fixed snakes was shown and the patient asked to identify the offending snake. This method – known to be doubtfull – was only used in case of bites with symptomatic envenoming. As the number of venomous snakes on the plantation is limited to the five species mentioned, this identification method could give some information.

When the snake was killed and brought along – what happened in a minority of the cases (5%) – it was identified according to the classification of Maegraith (1944) and Cansdale (1961).

Hematocrit and white blood count were determined in each patient. Bleeding time and coagulation time was performed routinely in the first 25 patients. Since there were no positive findings except in two cases with envenoming by *Bitis* species the routine determination of the bleeding and coagulation time was abandoned and only performed when systemic envenoming was suspected.

After physical examination, the patient was kept in the hospital for at least 12 hours for observation. In the event that local cytotoxic or systemic symptoms appeared, the patient was hospitalised until full recovery. As to treatment, Tetanus Toxoid 0.5 ml i.m. was given to all patients. In case of cytotoxic envenoming, the treatment was limited to bed rest and analgesics. Antivenin was given only in the event of systemic envenoming by *Bitis* species. As an alternative to antivenin Prostigmine was used successfully to treat one patient, who had been bitten by *Naja melanoleuca* and who presented generalised neurological symptoms (Fig. 5) including ptosis of the eyelids, aphasia and respiratory failure. Prostigmine was given in the dose of 0.5 mg every 15 minutes for several hours according to Naphade and Shetti (1977).

Results

Bite numbers. During a period of 12 months from November 1978 to October 1979, 95 patients with snake bite were admitted. 76% of the patients were men, 17% women and 7% children. Peak admissions occurred in October and November averaging 13.5 cases per month. During the remaining months of the study year, the average number of bites per month was 6.8 (Fig. 6). 10% of the victims gave a history of one previous snake bite and 4% had been bitten at least twice before. 69% of the bites occurred in the morning, 20% in the afternoon and 11% during the night.

Situations under which bites occurred were as follows. 61% occurred under the rubber trees, 12% in the grass, 8% in or around the village, 11% while walking on the road, 8% while farming or gardening. The four bites caused by *Naja* and *Bitis* species belonged to this last group. The two bites by *Naja* species occurred in gardens around houses and the two bites by *Bitis* species on manioc farms. Of the 77 employees, who were bitten, 64 bites occurred while carrying out their duties (83%).

Location of bites. The feet were bitten in 93% of the cases. There was almost no difference between the right and the left foot – 46 versus 42. Bites occurred on the lower leg in 3%, while the hands were involved in 4% – 3 on the right, one on the left hand.

Incidence. The overall incidence of symptomatic snake bites was 1.5 bites per thousand people per year. The highest incidence of 4.2 symptomatic bites

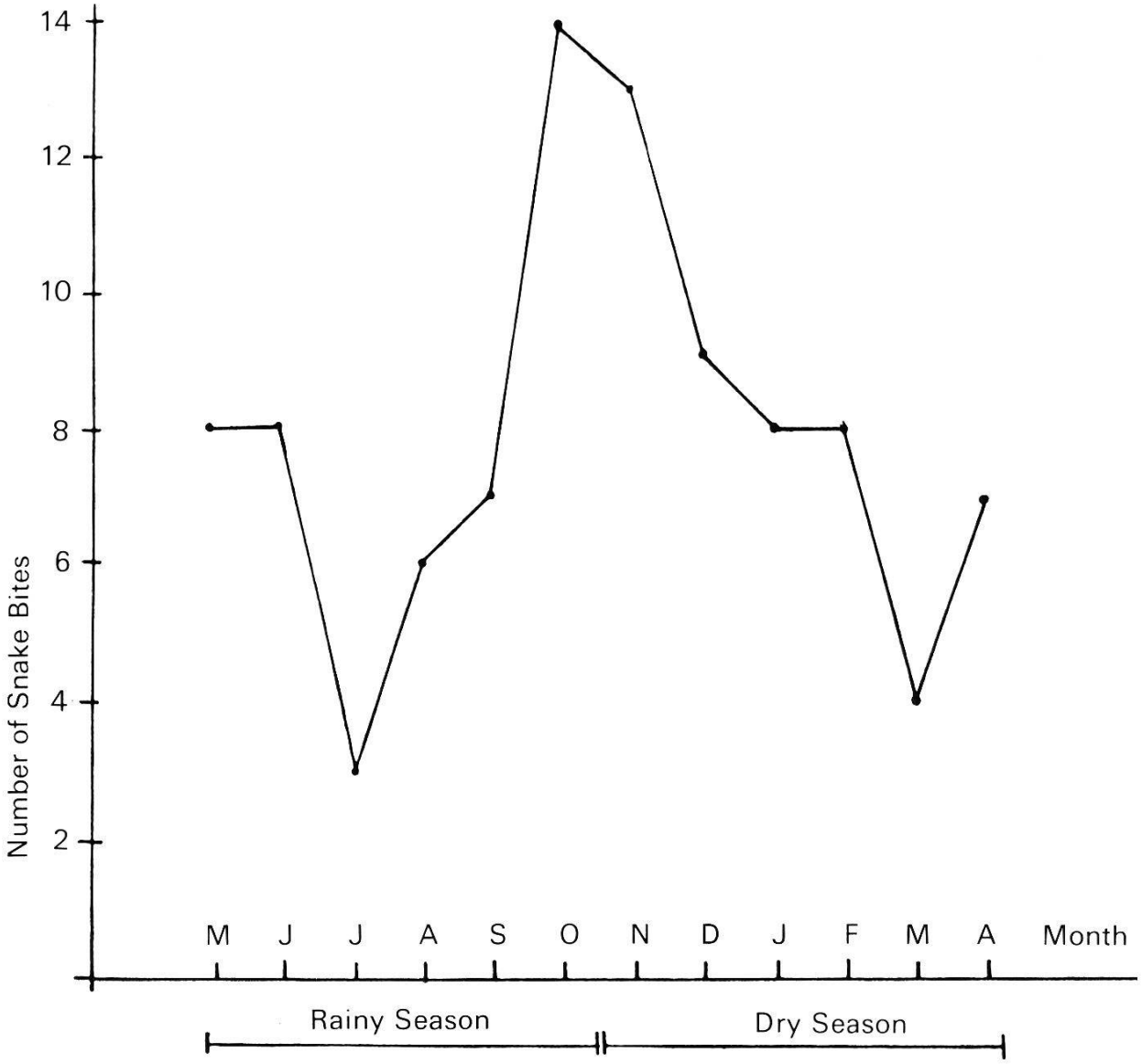

Fig. 6. Number of snake bites during November to April 1978/79 (dry season) and May to October 1979 (rainy season).

was seen in the field workers while on duty. The number of working days lost was 305 or one day per 10,000 working days on the plantation. The non-field employees had an incidence of 1.7 bites per thousand per year and the non-employees 0.4 bites per thousand per year.

Identification of snakes. Among the 68 patients with symptomatic snake bite, 29 or 42% gave a correct identification of the snake, which was in agreement with the symptoms observed. 12 or 18% were obviously unable to properly identify the offending snake. 27 or 40% could not give any information at all. Included in this group are the 10 bites wich occurred at night time. Clinically, those snakes which either could not be identified or were poorly characterized, produced symptoms typical of the viperid group. Among the snakes identified were 24 *Causus maculatus* (83%), two *Naja* species, two *Bitis* species and one *Dendroaspis viridis*. The clinical symptoms of this bites corresponded to the identification.

Effects of envenoming. Of the 68 symptomatic bites cytotoxic reaction i.e. swelling and local pain was observed in 64 or 94% of the patients. Two showed local blistering and one developed a local infection of the lower leg with following abscess formation. Incision and drainage had to be performed. The cytotoxic envenoming resulted mainly from bites by *Causus maculatus.* There were two hematological reactions with increased bleeding and coagulation time. Hematuria was noted in the first patient, but no spontaneous bleeding was seen in the second. Both were caused by *Bitis gabonica.* Among the two neurotoxic reactions one was caracterised by lidptosis (Fig. 5), dysarthria and respiratory distress. The other patient had nausea, vomiting, al low bloodpressure of 70/40 mm Hg, tachycardia and muscular fasciculations. Both envenomings resulted from bites by *Naja melanoleuca.*

Discussion

Snake bite is very definitely an occupational hazard on this rubber plantation. The field workers are exposed to a greater risk judging from the incidence of 4.2 symptomatic bites per thousand per year compared to 1.7 bites per thousand per year in non-field employees. The number of working days lost is low, and the disability is temporary.

This figures can be considered as accurate. Due to the particular situation of the rubber plantation with the highly developed medical services, the easy access to medical facilities, the supervision and instruction of the population by the village health assistants, the proportion of patients with symptomatic snake bites, who would fail to report to the health centers, can be considered as minimal. The proportion of bites without envenoming can not be appreciated, because these patients likely fail to report to hospital as they do in most African countries.

Symptomatic bites on field workers occurred mainly under the rubber trees, and they were almost exclusively caused by *Causus maculatus.* This envenoming produces moderate effects, primarily swelling and local pain, which usually resolves within 3–5 days. This observation is in accordance with the findings in patients with bites by *C. maculatus* from Nigeria reported by Warrell et al. (1976).

Field workers report never seeing the "Cassava snake" (*Bitis* species) and the "Black snake" (*Naja* species) under rubber trees. Assuming that this assertion is correct, it is interesting to note that serious bites with systemic envenoming occurred only in non-field workers and field workers not on duty, who were engaged in various activities like farming and gardening. The incidence of four bites with systemic envenoming (*Bitis* species, *Naja* species) compared to 64 bites with local symptoms alone is relatively low. Thanks to appropriate treatment, no fatalities occurred from this potentially deadly bites.

Büttikofer (1890), Johnston (1906), and Taylor and Weyer (1958) reported

a high prevalence of *Causus maculatus* in Liberia. In the climatically similar area of Western Ghana Swiecicki (1965) found an almost equal pattern. This author collected a maximum of snakes in October and November while in this study a peak incidence of snake bites were noted during these same two months corresponding to the transition from the rainy to the dry season.

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