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Prevalence of snakebites in Taraba and Plateau States of Nigeria

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Abstract
Snakebite is a public health problem that plagues many rural communities in Nigeria. The full extent is hardly known due to outright unavailability of adequate medical records to indicate the incidence, mortality and morbidity in any state in Nigeria. This study was undertaken to outline the epidemiological profile of snakebites in the middle belt region of Nigeria, using Plateau and Taraba States as a case study. Records of 917 cases of snakebites from eight secondary health facilities, spread across the two states were collected retrospectively, covering January 1999 to December 2003. The data (age, sex and occupation of victims, monthly variation in incidence and prevalence) were extracted. This was analyzed using chi-square test and simple percentages. The results showed that the average male to female preponderance ratio was 2.1:1. Adults between the ages of 15 and 44 years accounted for 62.9% (n=592) of all cases. 41.1% (n=340) of victims were farmers. The average case fatality rate was 13.7% (n=126); with 19.1% (n=64) for Plateau State. The highest incidence of 40.4 bites per 100000 per year occurred in Taraba State. Polyvalent antisnake venom (ASV) was given to all the patients managed. Snake bite is endemic in these areas and accounts for significant morbidity and mortality among the indigenous population.

Keywords: Snakebite; Antisnake venom (ASV); epidemiology; Taraba; Plateau; Rural communities.

Introduction

Snakebite envenomation is a major public health hazard in many parts of the world, both in temperate and tropical regions. Venomous snakes are found throughout most of the world (including many oceans), except for a few islands, frozen environments, and high altitudes (World Health Organization, 2007). Populations in these regions therefore experience high morbidity and mortality due to poor access to health services, which are often suboptimal, scarcity of drugs and antivenom, (which is the only specific treatment), poor training of health workers on snakebite management, and long delays before starting treatment.

A large number of victims survive with permanent physical disability, due to local tissue necrosis with psychological trauma. Since most snakebite victims are young (the economic impact of their disability is considerable (Hansdak *et al*., 1998). Despite the scale of its effects on populations, snakebite has not received the attention it

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deserves from national and international health authorities, and may therefore be appropriately categorized as a neglected tropical disease (Kasturiratne *et al*, 2008). In line with the WHO policy on alleviation of poverty and development of the third world countries, there is need therefore for the discovery and development of candidate vaccine for the immunization of man and animals in snake infested areas for entry into product development. (Ekwere *et al*, 2009)

It has been estimated that worldwide, venomous snakes cause "5.4 million bites, about 2.5 million envenomings and over 125,000 deaths annually" Chippaux,1998) "more than 3 million bites per year resulting in more than 150,000 deaths" (White, 2000) or "several million bites and envenomings annually with tens of thousands of deaths" (Gutierrez *et al*, 2006) and more specifically 5 million snakebite cases occur worldwide every year, causing about 100,000 deaths (Mathew and Gera, 2004). The venomous snakes in Africa are known to belong to four main families namely, the colubridae, elapidae, viperidae and hydrophidae (Warrel, 1984).The elapid and particularly the viperid snakes are responsible for most bites in the savannah region of Africa.

The problem of snakebite is enormous in some parts of Nigeria particularly in Gombe, Plateau and Taraba States. The areas of highest concern lie around the southeast, south and northern parts of these states, where they have a contiguous border. The vegetation is typically savannah and the terrain mountainous and rocky, a habitat that is well adapted to *E. carinatus* (Warrel and Arnet, 1976). In Nigeria, the most common poisonous snakes are the elapids and the vipers. These include the *Naja melanolema* (black cobra) and *Naja nigricolis* (spitting cobra), and the *Viperid echis carinatus* (carpet viper) and *Bitis arietans* (puff adder) (Akubue, 1997; Omogbai *et al*, 2002). However, studies in Plateau state of Nigeria have shown that snake bites are mainly caused by two species of snakes namely Cobra (*Naja nigricollis*) and Carpet viper - *Echis carinatus* (Aguiyi *et al*, 1999) and majority of the snakes found in the agricultural areas of the state are harmful. The most prevalent venomous snakes in Plateau and Taraba states of Nigeria, are *Echis carinatus ocellatus* (the saw scaled carpet viper), *Bitis arietans* (Puff adder) and *Naja nigricollis* (the spitting cobra). Other less important snakes include *Dipholidus typus* (Boomslang), *Causus maculatus* (Night Adder) and *Naja haje* (Egyptian cobra) (Pugh and Theakson, 1980).

In many Traditional African Societies where snake envenomation is endemic, there is a strong belief in the efficacy of first aid measures such as incisions, application of a tight strip of tourniquet, instillation of potassium permanganate and use of 'black stone'. In Nigeria (especially Shendam and Langtang local government areas), earlier studies indicate that the use of plants forms the main or part of treatment used by traditional healers in these areas (Ekwere *et al*, 2009). Management of snake envenomation is mainly by specific treatment with polyvalent anti-snake venom (ASV). In a non-hospital setting, however, hospital care is often sought after traditional medicinal treatment has failed (Snow, 1994).

Snake envenomation is the diverse clinic –pathological syndrome that develops following successful injection of venom into man by a venomous snake. The clinical features depend on the family and the specie of the snake, the volume of venom injected and the age of the offending snake. Neurotoxic snakes (Elapidae) produce blockade of neuromuscular transmission as the main pathophysiological effect. Haemotoxic snakes (Viperidae) principally cause coagulopathy and cardiovascular changes. Snakebite inflicts a sustained psychological torment in many inhabitants

who reside in snake –infested areas. Envenomation therefore accounts for a significant level of mortality, with attendant distortions in family and social structure following loss of the breadwinners: morbidity (prolonged hospital stay and incidental expenses); amputation (disability), loss of income and productivity, so anti-snake venom (ASV) remains the reliable treatment for serious snakebites.

The aim of this study is to bring to the fore the menace of snake envenomation confronting the people of this study area, highlighting the incidence between both sexes, across different age groups and occupations.

Experimental

This is a retrospective study in snake endemic areas of Taraba and Plateau States of Nigeria over a 5-year period (January 1999 to December 2003), in trying to assess the prevalence, morbidity and mortality in these study areas. The data was obtained from the outpatient department (OPD) of Specialist and general hospitals as supplied by their medical record offices. The information was analyzed based on the epidemiological features of snakebite on presentation, age and number of deaths and seasonal incidence of cases treated by these hospitals.

The data was analyzed using chi-square test.

Case fatality rates (CFR) were computed using the formula:

$$CFR = M/N * 100$$

Where M is the number of deaths due to snakebites during the period and N the number of cases of snakebites recorded during the same period. The annual crude mortality rates (CMR) were calculated using the formula:

$$CMR = 100000M/5years * P$$

Where M is the number of deaths due to snakebites during the period and P, the population of the Local Government Area where the hospital is located.

Results and Discussion

A total of 917 patients were received and managed by these hospitals from January,1999 to December, 2003. 63.5% (n=582) and 36.5% (n=335) were in Taraba and Plateau States, respectively (Table 1).

Table 1: Number of Snakebite patients managed in health facilities in Taraba and Plateau States (1999 – 2003)

State	Health facility	Number of cases	Number of deaths
Taraba	General hospital, Bambur	289	34
	Specialist Hospital, Jalingo	173	14
	General Hospital, Zing	51	2
	General hospital, Wukari	38	8
	General hospital, Bali	24	4
	General hospital, Gembu	7	Nil
	Total	582	62
Plateau	General hospital, Langtang	67	18
	General hospital, Shendam	268	46
	Total	335	64

Table 2: Distribution by sex in snakebite patients admitted to health facilities in Plateau and Taraba States (1999 – 2003)

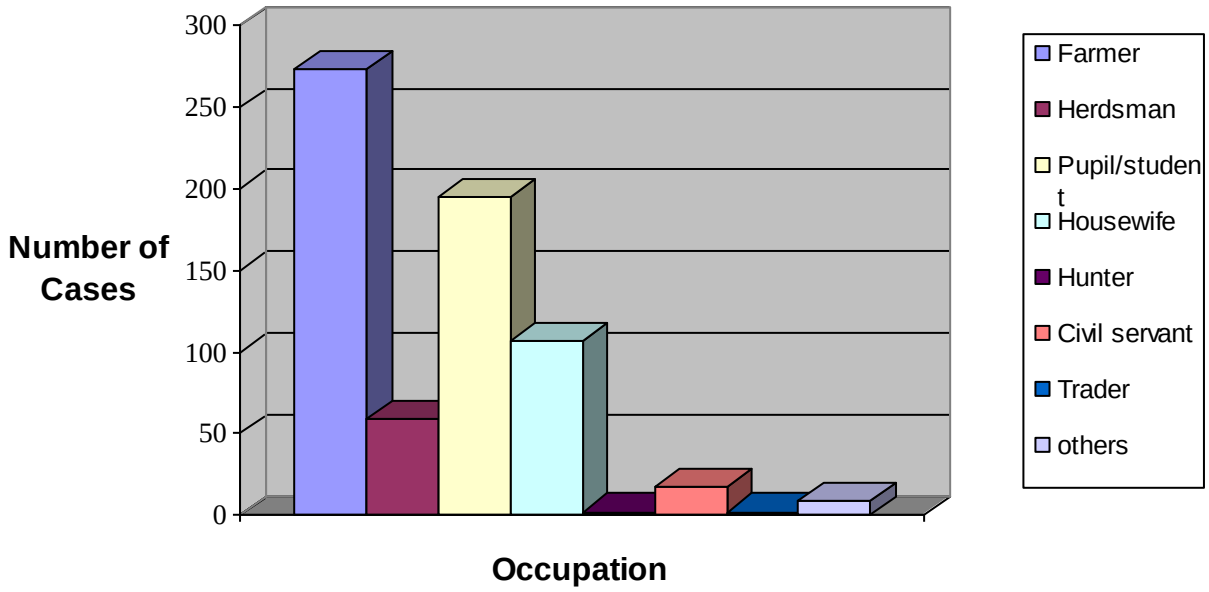
Facility	Number of Males	Number of Females	Male –Female preponderance ratio
Bambur	215	74	2.9:1
Jalingo	116	57	2.0:1
Zing	34	17	2.0:1
Wukari	24	14	1.7:1
Bali	19	5	3.8:1
Gembu	5	2	2.5:1
Langtang	35	32	1.1:1
Shendam	165	103	1.6:1
Taraba state	413	169	2.4:1
Plateau state	200	135	1.5:1
Total	613	304	2.1:1

Males accounted for 68% (n=519) of cases. The least male-female preponderance ratio was observed in Langtang (1.1:1).

Table 3: Age Distribution of Snake Bite Victims Managed by Health facilities in Plateau and Taraba States between 1999 and 2003

	Age range (years)					
Health facility	0-4	5-14	15-44	45-60	+60	Total
Bambur	16	104	141	24	4	289
Jalingo	5	27	123	13	5	173
Zing	0	6	33	9	3	51
Wukari	1	5	27	4	1	38
Bali	0	2	22	0	0	24
Gembu	0	2	5	0	0	7
Langatang	2	11	45	7	2	67
Shendam	5	40	196	23	4	268
Total	29	174	592	80	19	917
Percentage	3.2	21.4	64.6	8.7	2.1	100

Age distribution of snakebite victims. Only 35.4% (n=325) of all victims were outside the 15 to 60 age range.



Others include children under care and house helps

Victims were mainly farmers by occupation (41.1%; n=340). The distribution is shown in Figure 1 below.

Figure 1: Occupation of Victims of snake bites admitted in eight health facilities in Plateau and Taraba states between 1999 and 2003

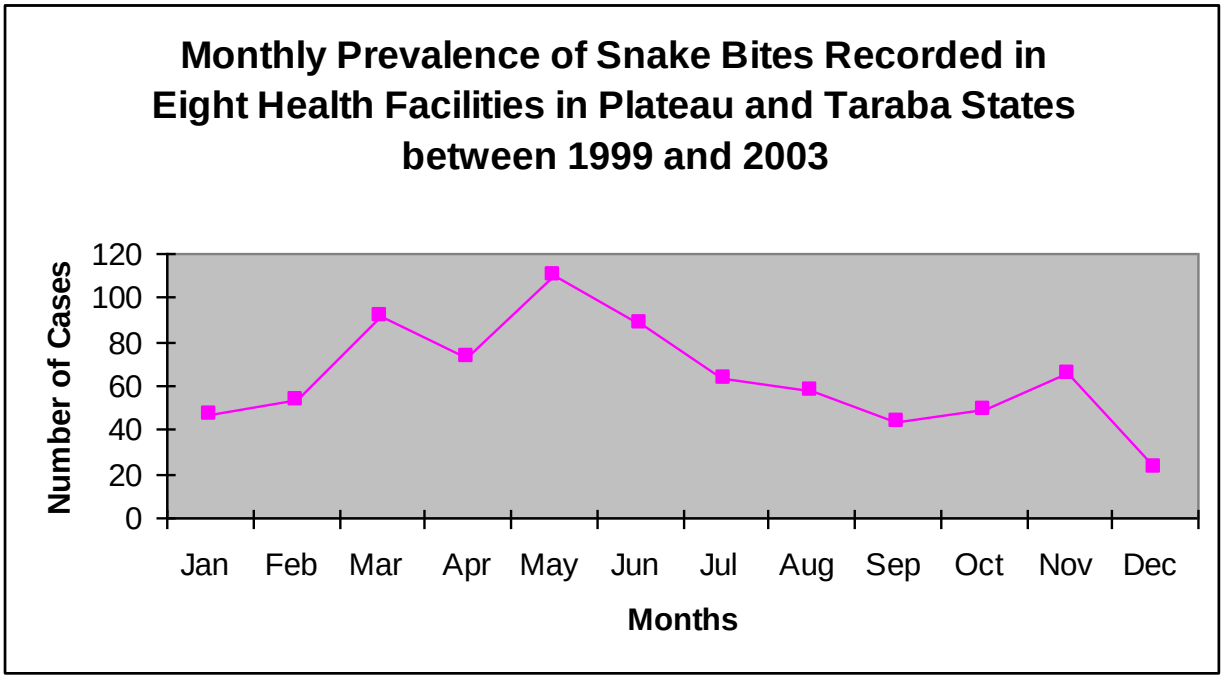


Figure 2: Monthly prevalence of Snakebites recorded in eight health facilities in Plateau and Taraba States between 1999 and 2003

Table 4: Sex Distribution of Patients who died from Snakebites in Five Health facilities in Plateau and Taraba States between 1999 and 2003

Sex	Number of Cases	Percentage
Male	76	60.3
Female	50	39.7
Total	126	100.0 .

Table 5: Age Distribution of fatalities from snakebites in five health facilities in Plateau and Taraba States between 1999 and 2003

Age range (years)	0-4	5-14	15-44	45-60	>60	Total .
Number of cases	0	20	95	11	0	126
Percentage	0	16	75.3	8.7	0	100.0

Table 6: Occupation of snakebite patients who died in five General Hospitals between 1999 and 2003

Occupation	Mortality (Nos.)	Percentage
Farmer	51	40.4
Herdsman	4	3.1
Pupil/student	26	20.9
Housewife	41	32.5
Trader	Nil	Nil
Civil servant	Nil	Nil
Others*	4	3.1
Total	126	100.0

*Under care, house helps. 40.3% (n-25) of deaths occurred in farmers followed closely by housewives, which accounted for 32.3% (n=20) for all deaths.

Table 7: Case Fatality Rates due to snake bites in Eight Health Facilities in Plateau and Taraba States between 1999 and 2003

Facility	Case fatality rate (%)	Crude Mortality Rate (deaths /100,000/yr	Incidence (number of bites per 100,000 per year)
Bambur	11.8	4.8	40.4
Jalingo	8.1	2.0	25.1
Zing	3.9	0.5	13.5
Wukari	21.1	1.8	8.4
Bali	16.7	0.3	1.5
Gembu	0	0	0.7
Langatang	26.9	2.4	9.0
Shendam	17.1	4.2	24.7
Taraba State	10.7	1.3	12.0
Plateau State	26.4	2.6	10.0

The case fatality rate was higher in Plateau State (26.4%) than in Taraba State (10.7%),

The data collated over the study period showed that 917 cases of snakebites were received and managed by the eight health facilities (Table 1). The male to female preponderance ratio was 1.1:1 (Table 2).adults within the age bracket of 15-44 years represented 64.6% (592) of all cases (Table 3). Farmers received the most bites (Figure 1), while the months of April, May and June had the highest incidence. Mortality was highest in males (60.3%, n=76), farmers (40.4%, n=51) and in those between 15-44 years (75.3%, n=95).

The incidence of snakebite was found to be higher in males and those between the ages of 15 and 44 years. A significant proportion of bites occurred during field work mostly in farmers and herdsmen, a reflection of the agrarian nature of the communities under survey. Seasonal variation influences anthropological activities (e.g. farming and wood gathering) and reptile habits. This agrees with the findings of Madaki *et al.* (2005), who showed that there is a strong association between seasonal changes and incidence of snakebites. While males encountered more bites than females, the data shows that risk of fatality from bites was the same ($\chi^2 = 0.0000091$, $p<0.05$).

Overall case fatality rate was calculated to be 13.7%. It is known that prognosis worsens as the time between envenomations and initiation of specific antivenom therapy increases (Warrel, 1987) and most people would recourse to traditional medicines before seeking medical attention (Snow *et al*, 1994). The incidence of bites is high in warm regions, where snakes are abundant and economic activities are mainly agricultural. In most developing counties, up to 80% of people bitten by snakes consult first traditional practitioners and only subsequently resort to modern medicine, thus accounting for the long delays before they receive proper treatment(Chippaux,1998, Snow *et al*, 1994). Notified cases, data on which are used to determine morbidity, therefore cover only a small proportion of the true numbers. In some areas the high morbidity from snakebites should denote a high prevalence of venomous species, notably in populous regions. High mortality and/or case fatality rates mean that treatment of envenomations is not adequate. Many reasons adduced for the high mortality rate include scarcity of health facilities, unavailability of drugs and antivenins, poor training of health workers on snakebite management, and long delays before starting treatment. Each location has to be examined individually to determine the particular reasons which prevail there.

In other parts of the world, snakebite incidence and severity have also been recorded. In Europe for instance, snakebites are relatively rare. The snakes involved belong to the Vipera genus, represented by a few species that are not among the most venomous: *V. aspis* (asp viper), *V. ammodytes* (sand viper), *V. berus* (common viper),and *V. latastei* (Lataste's viper). In Great Britain, there are approximately 200 hospitalizations a year from snakebites but no deaths have been reported since 1975 (Reid, 1976, Warrell, 1993). In France, the annual incidence is about 2.5 per 100000 inhabitants; however, the annual morbidity is rather less than 0.5 per 100000 people and the case fatality rate is about 0.3% (Jouglard, 1995). In Switzerland, the morbidity is very low, corresponding to approximately 0.1 case per 100000 residents per year (Stahel *et al*, 1985). In rural areas of southern Europe rates are higher. In Spain and Italy, Gonzales, (1982) and Pozio (1988) have shown that the annual incidence of snakebites may reach 5 per 100000 people. In Italy, the morbidity is about 1 per 100000 per year with a case fatality rate of 0.1-0.6%, and the annual mortality from snake-sites ranges from 0.01 to 0.04 per 100000 people (Beer, 1995).

In Europe with a population of about 730 million, the annual number of snakebites could reach 25000, of which 8000 involve an envenomation. About 90% of envenomed patients are hospitalized and about 30 deaths could result every year. In the Middle East, the snake species involved in bites are more dangerous than in Europe: *V. lebetina* (Levantine viper), *V. xanthina, V. palestinae* (Palestine viper) or their cognates (Onuaguluchi, 1960, Amr and Amr, 1983). Although data are lacking, the incidence of snakebites appears to be low. In North Africa, scorpion stings are more frequent events. Cerastes spp., a rather common Viperidae in North Africa and in Middle East, are not very

dangerous, although the venom can provoke local necrosis. In the Middle East with the population of about 160 million, the annual number of snakebites could be as high as 20000, with about 15 000 envenomations per year; probably not more than 60% of these victims visit the hospital for medical attention and the mortality can be estimated at 100 deaths every year.

In Canada and the US with a population of about 270 million, the annual incidence of snakebites, particularly in the USA, is similar to that observed in Europe. According to Russell,1980, approximately 45000 snakebites occur each year in North America. Of these bites about 10000 are inflicted by venomous species, 6500 require medical intervention, and approximately 15 individuals thus bitten die each year. The case fatality rate is very low in view of the high toxicity of the venom of some of the species of snakes (e.g. Crotalus spp.). The implementation of adequate treatment is probably the reason for this low case fatality rate. The deaths that do occur are mainly due to delayed or insufficient treatment or to people refusing therapy.

In Central and South America, the prevalence of snakebites is significantly higher with Crotalidae being responsible for most envenomations, provoking oedema, necrosis, and haemorrhages. In savanna areas of South America, the bite of *Crotalus durissus terrificus*. (tropical rattlesnake) provokes neurotoxic envenomations associated with mild inflammation, severe rhabdomyolisis, and renal failure, while in Central America, the bite of *C. durissus durissus* induces severe local oedema and necrosis but no neurotoxicity or rhabdomyolisis. Recent studies showed that the use of antivenin has contributed to a significant improvement in envenomation prognosis. However, in Ecuador, the case fatality rate ranges from 5.4% for envenomations treated in hospital (Kerrigan,1991) to 6.3% in some bush areas (Touzet,1986) ; the annual snakebite morbidity has been evaluated to be 30 per 100000, with the associated mortality being 1.8 per 100000 per year (Touzet,1986) . In Costa Rica, the current average annual morbidity and mortality reported by health services is about 20 per 100000 and 0.4 per 100000, respectively (Gutierrez,1995, Rojas *et al*,1997); however, in the 1970s, mortality was around 0.5 per 100000. Some surveys in forest areas have found a high incidence of snakebites, especially among Indians (Chippaux *et al*, 1984, Chippaux and Theakston,1987.). In Brazil, the notified annual morbidity from snakebites is about 15 per 100000 people mainly from Bothrops spp. The reported incidence of envenomation for the whole of Brazil is about 20000 cases per year, e.g. 15 per 100000 population (Jorge and Ribeiro 1992). Mortality from snakebites in Sao Paulo State, where available data are probably more relevant, reaches 0.04 per 100000 (Lebrao *et al*., 1995).

In Africa, the prevalence of snakebites is underestimated by health authorities, mainly because the reporting system is inaccurate. Moreover, the poor organization of health facilities in many countries complicates the management of patients and accounts for the great variation in the case fatality rate. Bites occur especially in plantations (Chippaux and Bressy.1981). In industrial plantations the snakebite incidence can be as high as ten times that in closed village plantations, largely because the industrial plantations attract more venomous snake species because of the abundance of prey they contain. In banana plantations mainly Causus maculates (spotted night adder), an aggressive adder not really harmful to healthy adults, is involved. In palm tree plantations or in rubber plantations, black cobras (*Naja melanoleuca*) and green mambas (Dendroaspis spp.) are frequent. In forest regions, the gaboon vipers and their cognates

(Bitis spp.) are especially responsible for numerous bites in village plantations and in rice fields. In savanna areas, the most abundant snakes are Echis spp. These Viperidae are probably responsible for the greatest number of accidents and deaths by envenomation in Africa (Warrell and Arnett, 1976). Towns also are not spared venomous snakes and snakebites occur in the capital cities of African countries (Chippaux and Bressy, 1981). In some rural regions, during the rainy season, envenomations involve up to 10% of hospitalized patients. In Nigeria, a study in the Benue valley estimated that the annual incidence of snakebites was up to 600 per 100000 inhabitants and that the case fatality rate was 12.3%, mainly from Echis ocellatus bites (Pugh and Theakston,1980) . In the North Province of Cameroon, E. ocellatus is also responsible for a high morbidity A survey in a rural area of Senegal showed that the annual mortality from snakebites was 11.7 per 100000 inhabitants (Pison and Trape 1995) . In Benin, the overall incidence can reach 450 bites per 100000 in some rural areas, with 5.9% lethality (Chippaux,1988) , while notifications give annual morbidity and mortality as 70 per 100000 and 1 per 100000, respectively (Fayomi *et al*, 1997) ; less than 30% of patients treated in health centres are admitted to hospital.

In Asia, there is a wide variation in the incidence of snakebites, according to human activities and the snake species involved. In Japan, the general incidence of snakebites is approximately 1 case per 100000 people; the case fatality rate is less than 1% and the overall mortality is about 0.5 per 100000. Nevertheless, the morbidity is more important in the south of the country, where it can reach up to 340 cases per 100,000 residents with a 0.7% case fatality rate (Kawamura and Habu 1989). The mortality due to snakebites seems to be highest in Myanmar, where 70% of the bites involve *V. russelli* (Naing, 1985); however, these data may simply be a reflection of the better reporting system in this country, where the reporting of snakebite deaths has been obligatory for many years.

In Australia, the estimated annual incidence of snakebites ranges from 3 to 18 per 100000 (White,1996) with the average mortality rate being 4 per 100000 per year (Sutherland and Leonard 1995). Most of bites are due to Pseudonaja spp., which are involved in about a half of deaths, as well as Notechis spp. and Oxyuranus spp., which together are responsible of nearly all the deaths from snakebites in Australia. Bites occur during the warm months in the south of Australia and all year round in the tropical north of the country. In Papua New Guinea, the mortality from snakebites in the Central Province is estimated at over 7.9 per 100000 inhabitants . Most of the Pacific islands are free from venomous snakes except sea snakes, whose venom is neurotoxic, but which are not aggressive. From the whole of Oceania with a population of about 20 million, more than 10000 snakebites and 3000 envenomations are reported every year. Most individuals involved (70%) are hospitalized and 200 people die from such bites every year (Lallo *et al*,1995).

Available epidemiological data shows that snakebites remain a public health problem in most countries, even if it is difficult to be precise about the actual numbers involved. The global figures given by Swaroop & Grab (Swaroop and Grab, 1954) over 50 years ago were greatly underestimated. The true incidence of and mortality from snake envenomations could exceed 5 million per year, with an associated mortality level of 125,000 persons per year. About 2.5 million people are envenomed each year, half of which request medical care; probably more than 100000 individuals suffer from severe malady.

Conclusion

Agricultural activities are associated with most of the bites. The snake species involved can be very dangerous because of the toxicity of their venom or abundance in areas close to human settlements. Finally, health facilities and availability of antivenin have to be considered in implementing the treatment of envenomations. In most developing countries, lack of medical attention, especially antivenin therapy, leads to high mortality levels. Snakebite is endemic within the study area. Mortality is unacceptably high and implies failure of envenomation treatment. Snakebite as an occupational hazard in these states means that stringent measures need to be taken by appropriate authorities to reduce the incidence. Considerable effort will be needed to develop studies on snakebite epidemiology and improve the distribution and use of antivenin. Novel interventions such as the antisnake protein vaccine of natural origin would be required to overcome the challenges associated with antisnake venom use.

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