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SNAKEBITE ENVENOMATION IN BENUE STATE: A STUDY OF PREVALENCE AND TREATMENT IN AGATU LOCAL GOVERNMENT AREA, BENUE STATE- NIGERIA

[1]Malik R., [2]Ada G. and [3]Udeh C.A.

[1&3]Department of Wildlife and Range Management, Federal University of Agriculture Makurdi, Benue State, Nigeria
[2]Department of Veterinary Pharmacology and Toxicology, Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria, Nigeria
***Corresponding Author:** *malikreuben@gmail.com;* +2348066496614

ABSTRACT

Although snakebites envenomation occurs frequently in Agatu Local Government area of Benue State-Nigeria, the prevalence has not been documented. This study was carried out to determine the prevalence, morbidity, mortality and management principle of the snakebite in Agatu Local Government area through retrospective data obtained from victims of snakebite covering a period of ten years (2011 –2020). Results revealed that 51.4% of snakebite victims were male while 48.6% were female. Rainy season recorded the highest cases with 60.5% while dry season was 39.5%. Body parts mostly accounted for snakebite was leg with 81.6% while the least was head with 1.6%. The aged range of 40 to 49 (30.3%) had the highest snakebite cases while the aged >70 (1.1%) had the least. Most of the victims were bitten by Puff adder (27.6%) while the least were bitten by Atracstaspis spp (4.9%). Monthly record of snakebites indicates that July had the highest occurrence 17.3% while the least was in December 1.6%. Most of the respondents were Secondary school leavers (43.1%) while non formal education had the least respondents (16.2%). Most of the victims were farmers 35.1% while the least were traders (17.3%). The ten years record of snakebite envenomation indicates that 2017 (15.7%) had the highest record of the incidence while the least was in 2010 (1.1%). Most victims 98.9% sought care from traditional healers while 0.5% of cases reported to health facilities and others (Jerusalem stone and prayer houses) respectively. Despite the high stable morbidity indicated, there was absence of fatality throughout the study period. Thus, predispose Agatu people towards their traditional snakebite treatment methods as a legitimate treatment for snakebite in their community.

Key words: Snake, snakebite, envenomation, rural dwellers

INTRODUCTION

Snakebite is a major public health issue, particularly in Sub-Saharan Africa, South and South-east Asia, and Latin America (Kasturiratne *et al.*, 2008, Longbottom *et al.*, 2018; Isbister *et al.*, 2018; Habib *et al.*, 2020). It has been estimated that 2 million people in the tropical world suffer these envenomation, resulting in about 20,000-94,000 fatalities annually (Kasturiratne *et al.*, 2008). Additionally, people living in tropical countries are at high risk of snakebite poisoning because of their involvement in farming, pastoral and hunting as means of survival. The only effective treatment is the timely administration of antivenom (Habib *et al.*, 2015). Data from Nigerian hospitals indicated that out of every 100,000 patient's admissions, 174 are attributed to snakebite envenomation (Nasidi, 2007). However,

effective antivenoms are not widely available or neither affordable in many parts of the world, especially in impoverished rural settings of sub-Saharan Africa and parts of Asia and Latin America (Harrison *et al.,* 2009). Snakebite is a global priority ranked top among other neglected tropical diseases (Potet *et al.,* 2019). Although no proper statistical data has been documented on snakebites envenomation in Nigeria and other African countries, it has been estimated that the fatality rate ranges from 2 to 16 per 100,000 annually in Nigeria, Ghana, Kenya and Senegal (Theakston *et al.,* 2003), with Nigeria accounting for one fifth of all West African region snakebite cases (Arya, 2004).

Snakebites is one of the unheeded diseases in most of the developing countries of the world (Habib *et al.,* 2015). Despite its impact, snakebite has received disappointingly low attention from pharmaceutical industries, governments, public health advocacy groups, and the global health research community (Gutierrez *et al.,* 2013). The situation remains a global medical and socio-economic problem, especially in tropical and sub-tropical countries (Williams *et al.,* 2017). Most people in the world still rely on herbal medicine and most of them have a general knowledge of medicinal plants which are used as first aid remedies to treat cough, cold fever, headache, poisonous bites and some simple ailments (Ayyanar and Savarimuthus, 2011). Thus, North-center of Nigeria depend on medicinal plants for snakebites management for thousands of years and medicinal plants have played a major role throughout the world in the treatment and managements of a variety of diseases. Rural populations are frequent victims of snakebites as they go about their daily crop production and animal rearing activities and as they reside in their homes (Igawe *et al.,* 2020). Nigeria is one of the countries in the world with wide range of snake species found in terrestrial, arboreal and aquatic habitats, this is so because of the presence of guinea vegetation coverage with abundant rodents, sparsely populated areas, with food storage facilities, unkempt bushes, holes, crevices, and areas where prey is readily or likely to be available for them (Altimari, 1998; McDiarmid *et al.,* 1999). Snakebites are associated with poverty and the most at-risk groups include farmers and their families, fishermen, hunters, woodcutters, indigenous people, and indigents class as well as people who do not have access to adequate health and educational systems (Gutiérrez *et al.,* 2017; Habib *et al.,* 2015 and Harrison *et al.,* 2009).

The venomous snake species in sub-Sahara Africa are known to belong to four main families- the colubridae, elapidae, viparidae and hydrophidae. In Nigeria, *Naja melanoleuca*, *Naja nigricolis*, *Echis carinatus*, *Echis ocellatus* and *Bitis arietans* have long been recognized as the venomous snake of medical important but other species may cause fatal snakebites in particular areas (Omogbai *et al.,* 2002; Habib *et al.,* 2001). They are responsible for about 95% snakebite cases in Nigeria (Adeiza and Minka, 2019; Abubakar *et al.,* 2010). Snakebite poisoning may be associated with both intense pains as well as the systemic effects such as necrosis, fibrinolysis, haemolysis and haemorrhage from the presence of poisonous venom in the circulation (Ada *et al.,* 2020; Ada *et al.,* 2019). The study was carried out to identify snake species responsible for poisoning, the prevalence, morbidity, mortality and management principle of the snakebite in Agatu Local Government area.

MATERIALS AND METHODS

Study Area

The study was carried out in Agatu Local Government Area of Benue State, North Central Nigeria. It stretches from Latitude 7^{o} 45^{1} and 8^{o}N and Longitude 7^{o} 50^{1} and 8^{o} E. Habitants are predominantly farmers and fishermen **(**Gbue, 1999)

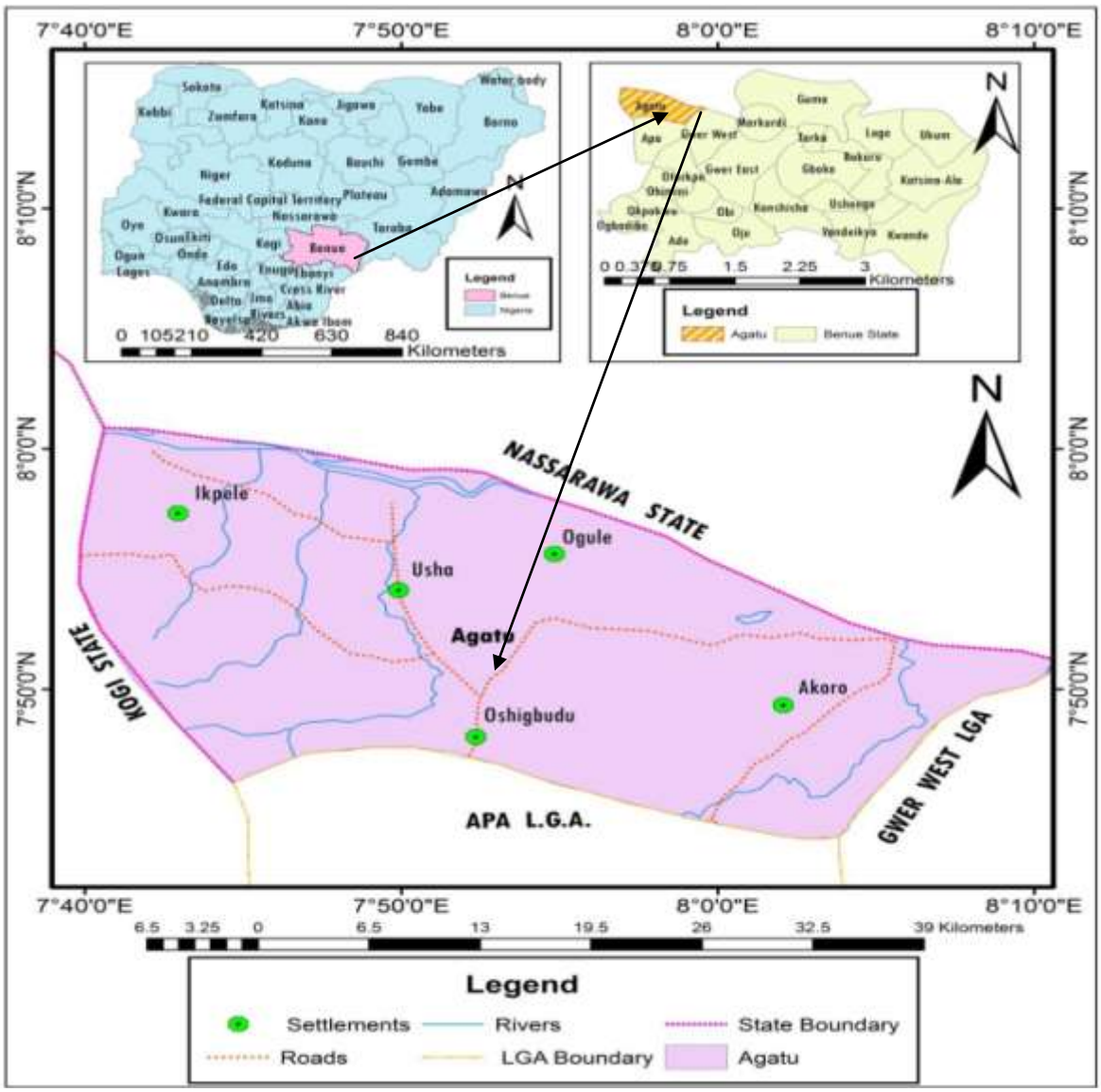

Figure 1: Study area

Source: Adopted and modified from administrative map of Nigeria National Bureau of Statistic (2020).

Administration of Questionnaire

The retrospective study was carried out in some selected villages in Agatu Local Government area from 2011 – 2020 to assess the prevalence, morbidity, mortality, snake species and snakebite management principles. The data was obtained from the victims of snakebite and herbalist as described by (Shehu *et al.*, 2017).

Data collection

The data were purposefully collected using 200 questionnaires. Color photo plates of adult snakes known to be distributed in the vicinity were used for confirmation of snake species by respondents

Data Analysis

The data was analyzed using descriptive statistics

RESULTS

The results revealed that 51.4% of snakebite were Male while 48.6% were Female (Figure 2). Rainy season recorded the highest cases of snakebite 60.5% while dry season had 39.5 % (Figure 3). The part of the body that are mostly accounted for snakebite is Leg with 151 (81.6%) while head was 3 (1.6%) (Figure 4). Age of 40-49 has the highest cases of snakebite (30.3%) while the lowest was aged >70 (1.1%) (Figure 5). The results also indicated that Puff adder has the highest bite rate of 27.6% while the least bite rate was Atracstaspis spp 4.9% (Table 1). The monthly record of snakebite indicated that it was mostly July 32 (17.3%) while the least was December 3 (1.6%) (Figure 6). Secondary school leavers were observed to have the highest number of cases (43.1%) while the least was non formal education (16.2%) (Figure 7). Most of the respondents were Farmers 35.1% while the least were traders 17.3% (Figure 8).

The record of snakebite envenomation illustrated that 2017 (15.7%) had the highest incidence of snakebite while 2010 (1.1%) had the least (Figure 9). Most victims of snakebites 185 (98.9%) sought care from traditional healers as the first point of care while 1(0.5%) reported to the health authorities and others (Jerusalem stone and prayer houses) respectively (Figure 10).

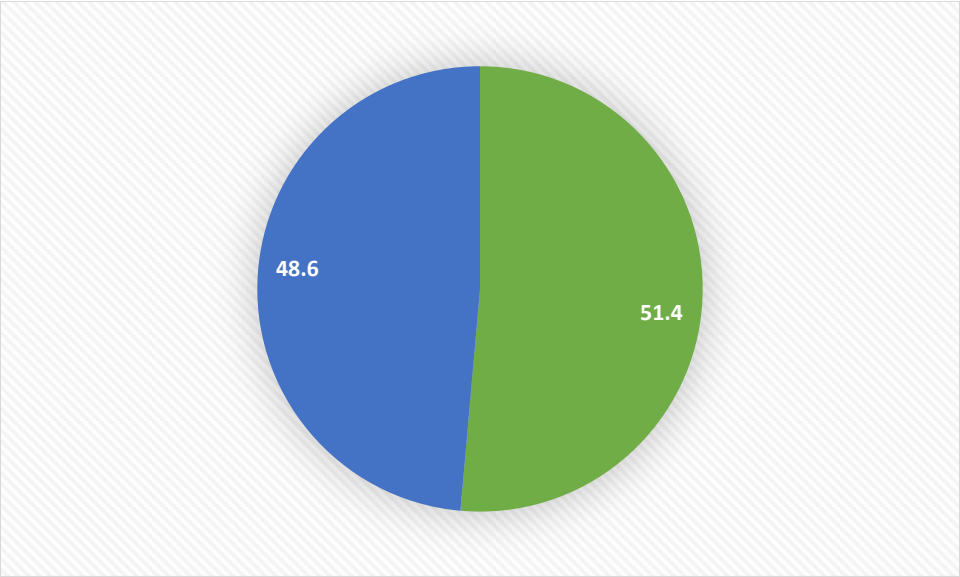

Figure 2: Gender distribution of Snakebite victims

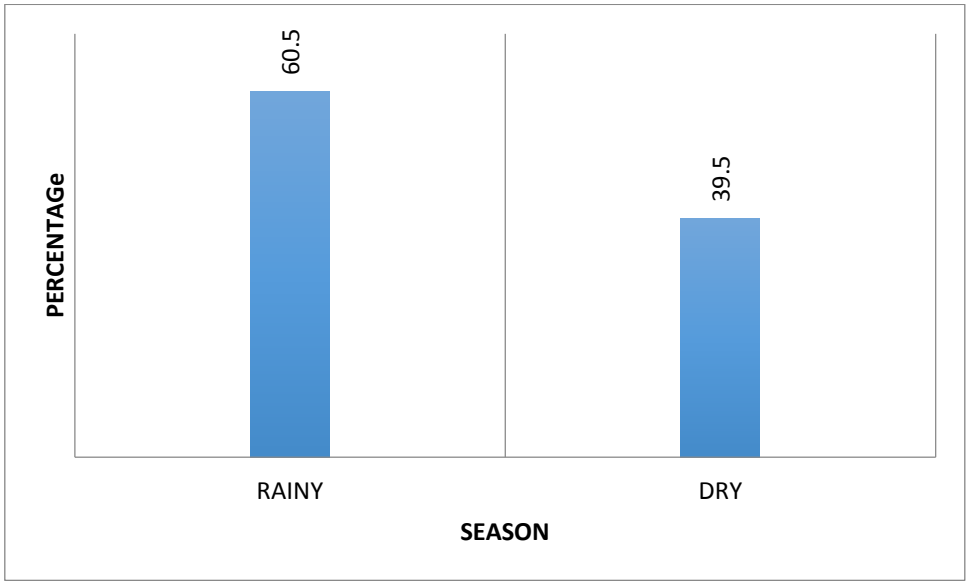

Figure 3: Seasonal distribution of snakebite incidence in the study area

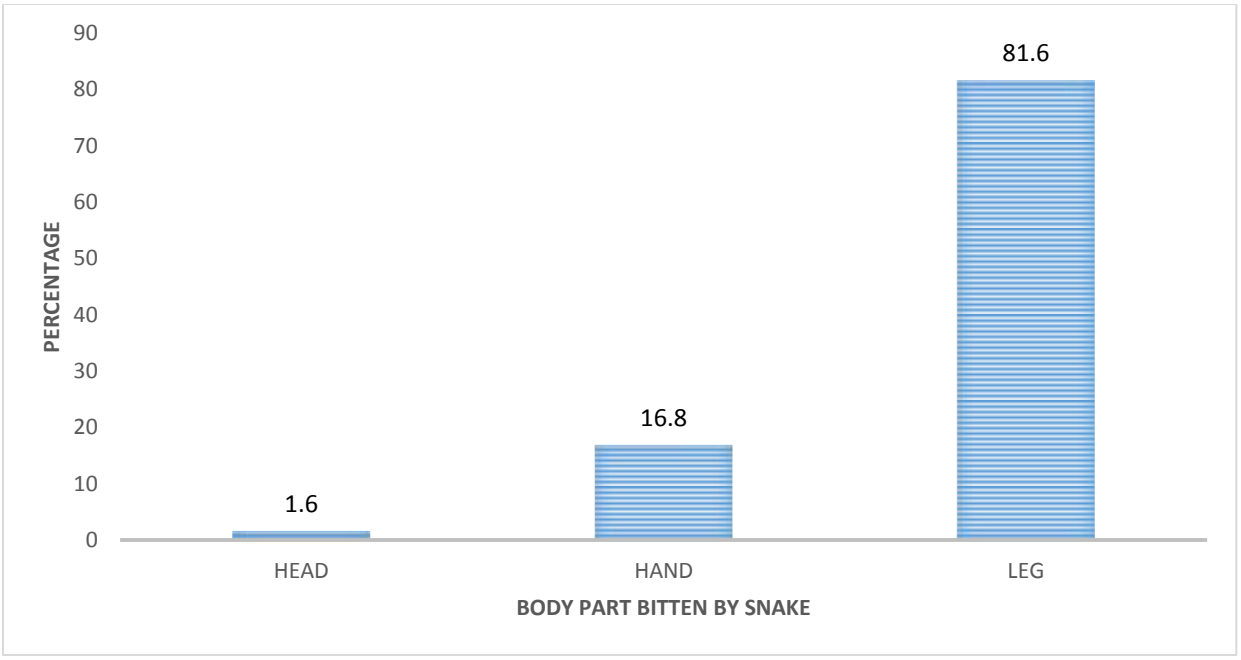

Figure 4: Distribution of respondents by body parts bitten

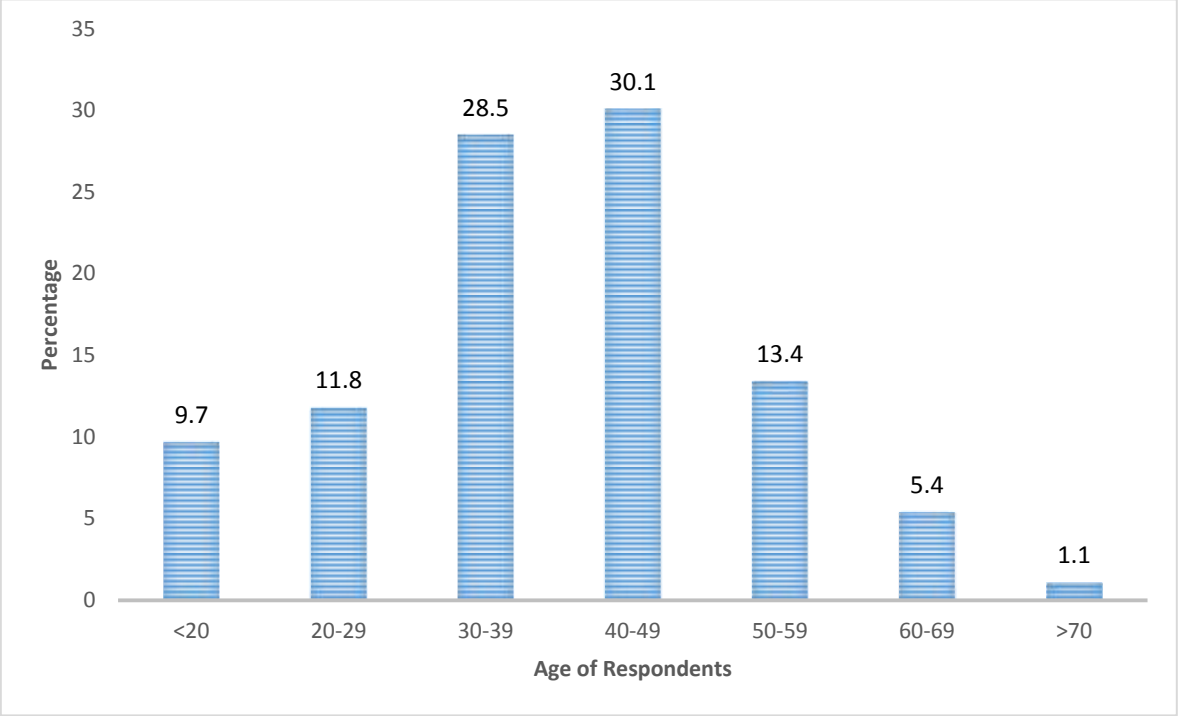

Figure 5: Age distribution of respondents bitten by snake in the study area

Table 1: Snake specie in the study area from 2011-2020

S/No	Snake specie	Scientific name	%
1	Attracstaspic spp	*Fevlina currori*	4.9
2	Cobra	*Naja nigricollis*	9.2
3	Green Mamba	*Dendroaspis viridis*	8.6
4	Puff adder	*Bitis arietans*	27.6
5	Viper	*Echis ocillatus*	22.7
6	Unidentified	-	27.0

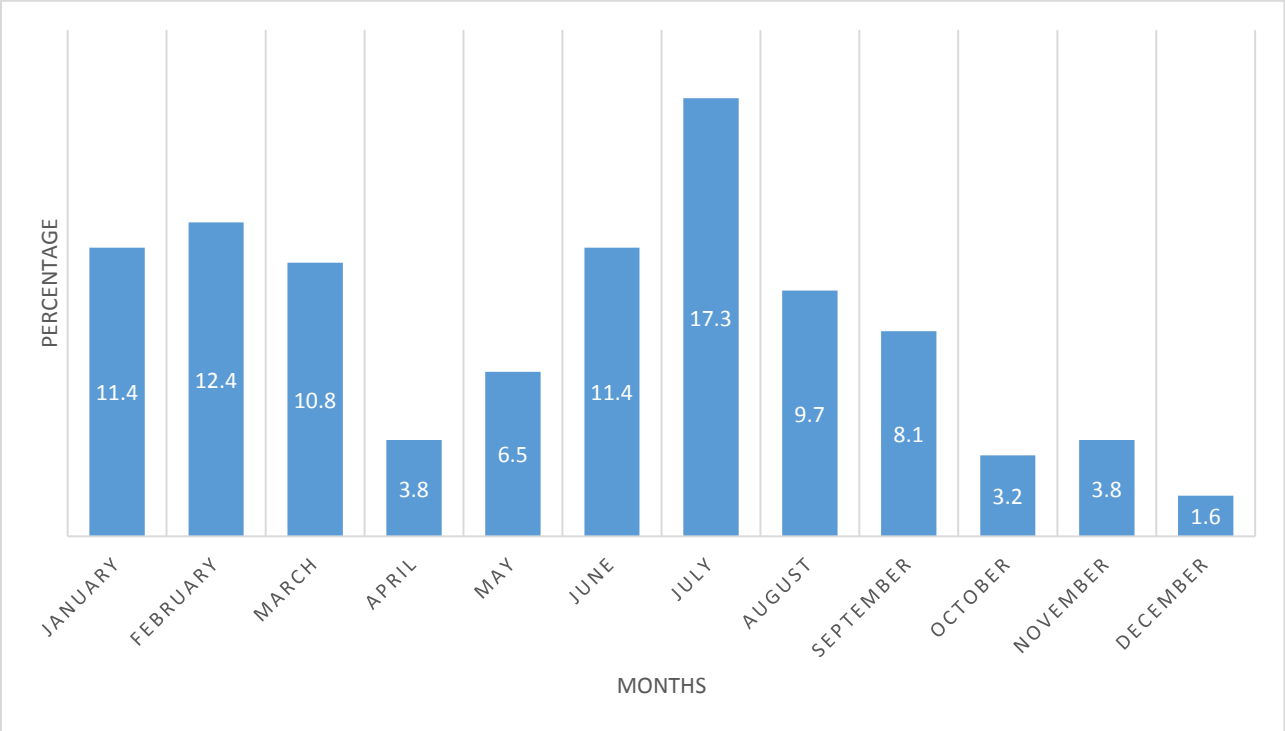

Figure 6: Distribution of snakebite victims by months in the study area

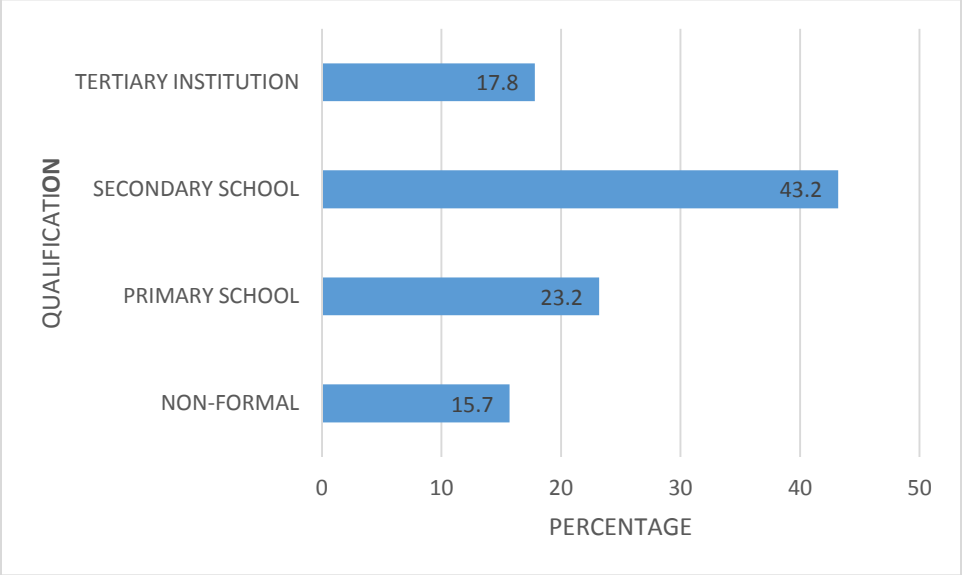

Figure 7: Educational status of the respondents in the study area

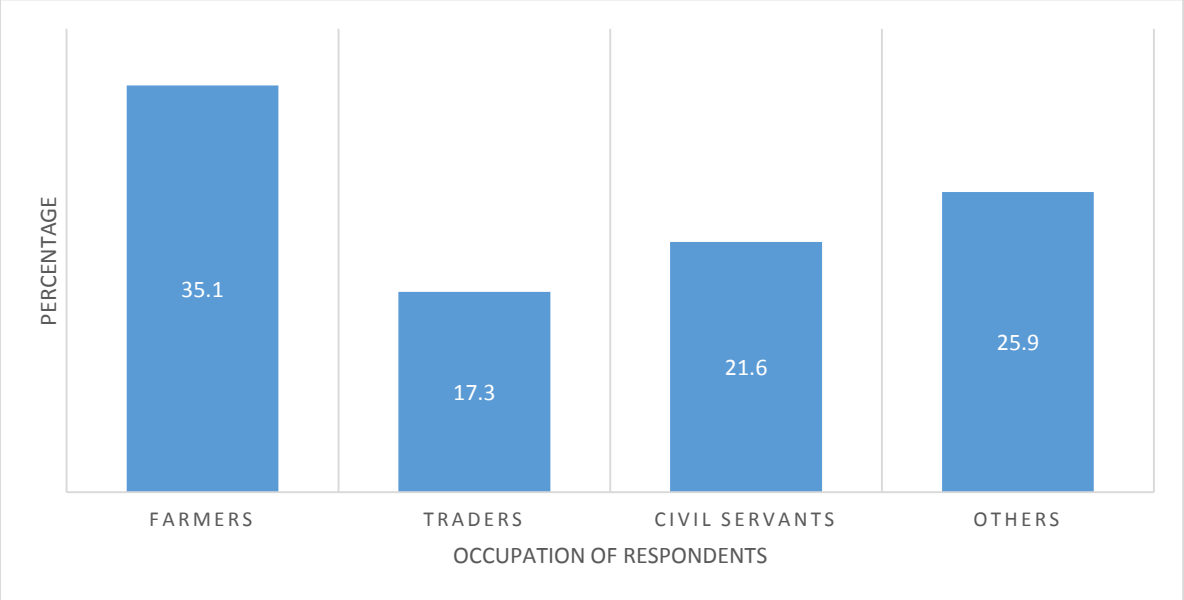

Figure 8: Occupation of respondents in the study area

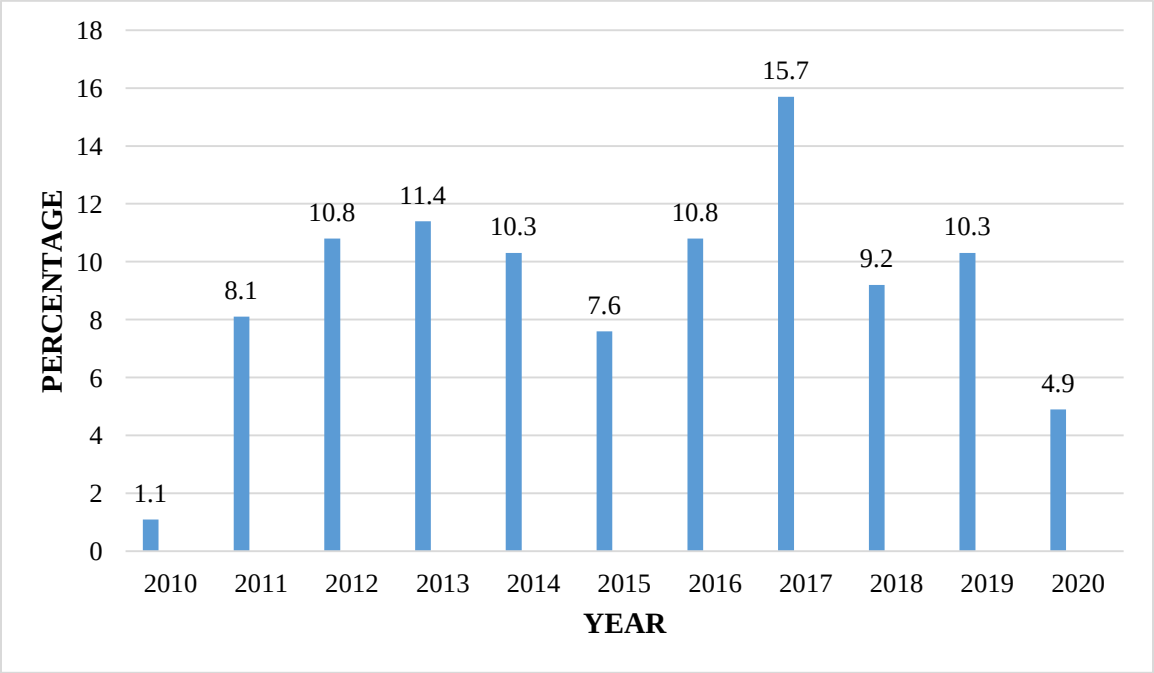

Figure 9: Distribution of snakebite victims by years in the study area

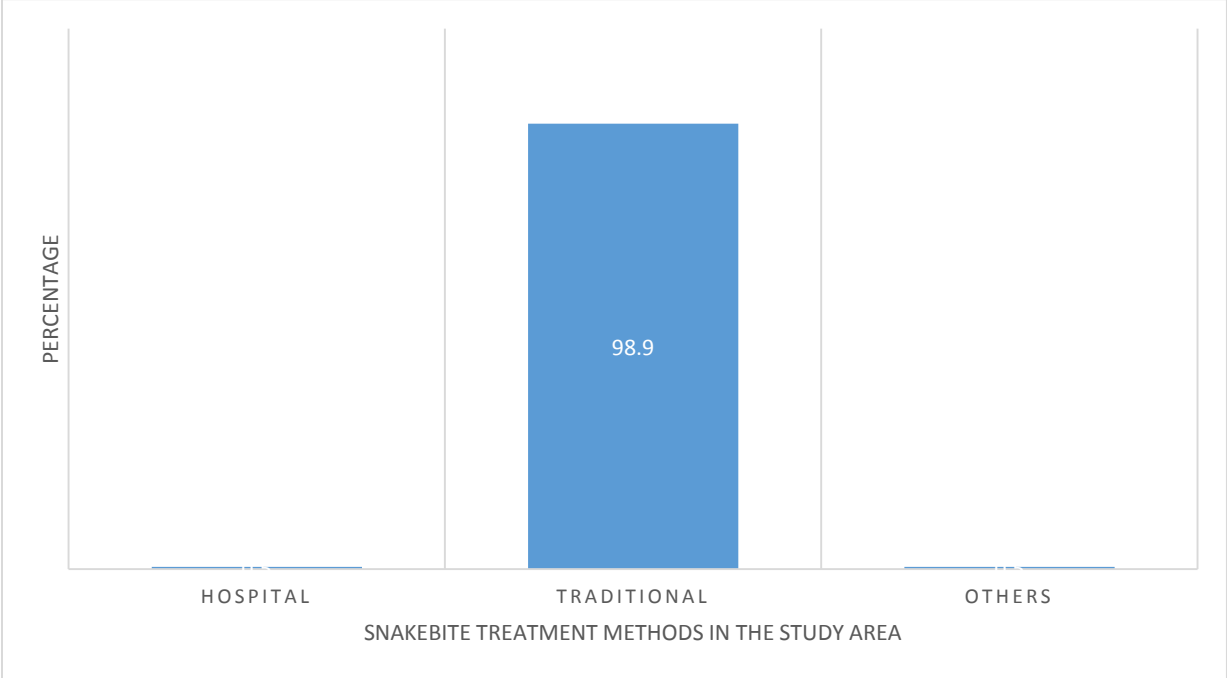

Figure 10: Snakebite treatments methods in the study area

DISCUSSION

Snakebite is now classified among the WHO Neglected Tropical Diseases (NTDs) needing an intervention because of its high waves (WHO, 2020). This requires an up to date mapping out of this neglected condition to

prompt better management. Snakebite incidence is relatively high in Agatu but with the low mortality rate among the people. Snakebites were more frequent among male than the female which could be due to the fact that the main exposure or risk factor to snakebites is farming and is mostly practiced by male. A similar result has also been observed by (Silva *et al.,* 2020; Malik *et al.,* 2018; Omogbai *et al.,* 2002). Males are more likely to be bitten than females. They are more willing to incur risks and are therefore liable to have more frequent encounters with snakes.

Rainy season recorded the highest cases of snakebite 60.5% while dry season recorded 39.5%. Snakebite envenomation in rainy season coincided with dense vegetation cover and vigorous farming activities, a preferred habitat for snake camouflage and ambushed for their prey (Paramonte, 2007). The general epidemiological profile of the snakebite cases in our study indicated that the majority were bitten on lower limb which corresponds to what has been observed in other studies on snakebites envenomation (Silva *et al.,* 2020; Magalhães *et al.,* 2018). The intensity of exposure and bite frequency appear to be highest in active productive years of 40 - 49 while the lowest were >70 (Figure 5). The observed aged range is in agreement with the work of Silva *et al.,* (2020) and Tchoffo *et al.,* (2019). Puff adder had the highest bite rate of 27.6% while the least was Atracstaspis spp 4.9%. The monthly record of snakebite over a study period is high except December, November and October (Figure 6) which is significantly low which might be duo to reduce farming activities and fishing in Agatu. This result is in agreement with the work of Roriz *et al.,* (2018). Snakebites envenomation tended to occur more frequently during the rainy season which coincide with the period of reproductive activity (Malik *et al.,* 2018; Almeida-Santos and Salomão, 2002; Oliveira and Martins, 2001) and availability of their prey (Turci *et al.,* 2009; Martins and Oliveira, 1998). These snake densities are high particularly in grain agriculture which attracts the largest rodent and amphibian populations that are eaten by snakes (Mise *et al*., 2016). Flooding of rivers and streams drives snakes to seek drier places, increasing encounters with humans as certain human activities are also more frequent during this period (planting and harvesting of forest products and hunting) Feitosa *et al.,* 2015; Mota-da-Silva *et al.,* 2019).

The study also reveals that most of the victims (43.1%) were secondary school leavers while non formal education was the least (16.2%). Similar study was reported by Sapkota *et al*., (2020). Most of the snakebite victims in our study were farmers while the least were traders. Highlighting the occupation correlate of snakebite morbidity with agriculture (Mise *et al.,* 2019). Confirming these groups as those at higher risk in Agatu. The relatively greater degree of negativity towards snakes among farmers, civil servant and traders may be associated with a lack of knowledge about the role that snakes play in ecosystems, the risk of snakebite and proper preventative measures Deb Prasad et al., (2016). Most victims of snakebites victims sought care from a traditional healer as the first point of care while others went for Jerusalem stone and prayers. Few cases of snakebite were reported to health facilities.

CONCLUSION

Despite the high stable morbidity indicated, there is almost absence of fatality throughout the study period. There is a strong and institutionalized traditional snakebite treatment methods that need improvement. On a negative note, most of the respondents rejected orthodox medical treatment for snakebites. Intensive research on the locally available (currently unreported) snakebite management principle in Agatu Local Government area should be carried out, there is need to enlightened and educate communities in Agatu on snakes and snakebite risks and protective clothing such as boots, hand gloves and trouser should be worn when working.

REFERENCES

Abubakar B.S, Habib N.D, Yusuf P.O (2010). Randomised controlled double-blind non-inferiority trial of two antivenoms for saw-scaled or carpet viper (*Echisocellatus*) envenoming in Nigeria. Echi Tab Study Group. *PLoS Neglected Tropical Diseases,* 4(7):7-10.

Ada G, Mamman M, Magaji M.G, Yusuf P.O, Ameh M.P (2019) *In vitro* and *in vivo* Neutralizing Activity of *Uvaria chamae* (p. Beauv) Leaf and Stem Extracts against the Venom of *Bitis arietans*. Asian *Journal of Ethnopharmacology and Medicinal Foods*, 5(3): (01-09).

Ada G, Mamman M, Magaji, M.G.,Yusuf P. O, Ameh P. M, Akefe I .O. (2020). In Vitro and In Vivo Neutralizing Activity of Uvaria chamae Leaves Fractions on the Venom of Naja nigricollis in Albino Rat and Bovine Blood. *Recent Patents on Biotechnology*. 14, 1-17

Adeiza A.A, Minka N.S (2013). Ecological distribution of snakes and the prevalence of parasitic infestations and bacterial isolates from snakes captured within the guinea savannah zone of Nigeria. (PDF Download Available). Retrieved 12 January 2019.

Almeida-Santos, S.M.; Salomão, M.G. (2002). Reproduction in Neotropical pit vipers, with emphasis on species of the genus Bothrops. In: Schuett, G.W.; Hoggren, M.; Douglas, M.E.; Greene, H.W. (Org.). Biology of the Vipers. V.1. Eagle Mountain Publishing, Carmel, Indiana, p.445-462.

Altimari W (1998). Venomous Snakes: A Safety Guide for Reptile Keepers. Herpetoogical Circular 24: 26-30.

Arya V. (2004). Plants used in reptile bites with emphasis on Snakebite Vikrant. Sweta Kumari Mandi, Himachal Pradesh, India: Arya pp. 232-432.

Ayyanar M, Savarimuthu I. (2011). Ethnobotanical survey of medicinal plants commonly used by Kani tribals in Tirunelveli hills of Western Ghats, Indian. *Journal of Ethnopharmacology*, 134(3):851-64

Deb Prasad Pandey, Gita Subedi Pandey, Kamal Devkota and Matt Goode (2016). Public perceptions of snakes and snakebite management: implications for conservation and human health in southern Nepal. *Journal of Ethnobiology and Ethnomedicine*, 12:22

Feitosa, E.; Sampaio, V.; Sachett, J.; Castro, D.B.; Noronha, M.D.N.; Lozano, J.L.L. (2015). Snakebites as a largely neglected problem in the Brazilian Amazon: highlights of the epidemiological trends in the State of Amazonas. *Revista da Sociedade Brasileira de Medicina Tropical*, (48): 34-41.

Gbue S. (1999). My Achievements in 242 days in the office Agatu Local Government Area. Oshogbo Phabimson.

Gutierrez J.M, Warreil D.A, David J.W, (2013). The need for full intergration of snake bite envenoming within a global strategy to combat the neglected tropical diseases: The way forward *PLoS Neglected Tropical Disease.* 7(6): e2162

Gutierrez J.M, Warreil D.A, David J.W. (2013). The need for full integration of snake bite envenoming within a global strategy to combat the neglected tropical diseases: The way forward *PLoS Neglected Tropical Disease.* 7(6): e2162.

Gutiérrez, J.M.; Calvete, J.J.; Habib, A.G.; Harrison, R.A.; Williams, D.J.; Warrell, D.A. (2017). Snakebite envenoming. *Nature Reviews Disease Primers, (3)*, 1–21.

Habib A.G, Gebi U.I, Onyemelukwe G.C. (2001): Snake bite in Nigeria. *African*

journal of medical science September; 30 (3):171-8

Habib A.G, Musa B.M, Iliyasu G, Hamza M, Kuznik A, Chippaux J.P (2020) Challenges and prospects of snake antivenom supply in sub-Saharan Africa. *PLoS Neglected Tropical Disease* 14(8)

Habib A.G. (2013) Public health aspects of snakebite care in West Africa: perspectives from Nigeria. *Journal of Venomous Animals and Toxins Including Tropical Diseases;* 19(1): 27.

Habib, A.G.; Kuznik, A.; Hamza, M.; Abdullahi, M.I.; Chedi, B.A.; Chippaux, J.-P.; Warrell, D.A.(2015). Snakebite is Under Appreciated: Appraisal of Burden from West Africa. *PLoS Neglected Tropical Diseased.9*.

Hansson E, Cuadra S, Oudin A, de Jong K, Stroh E, Toren K, and Albin M. (2010): Mapping snakebite epidemiology in Nicaragua- pitfalls and possible solutions. *PLOS; Journal of Neglected Tropical Diseases Published*: Harrison R.A, Hargreaves A, Wagstaff S.C, Faragher B, Lalloo D.G. (2009). Snake envenoming: a disease of poverty. *PLoS neglected tropical diseases. 3(12).*

Harrison, R.A.; Hargreaves, A.; Wagstaff, S.C.; Faragher, B.; Lalloo, D.G. (2009). Snake envenoming: A disease of poverty. *PLoS; Neglected Tropical Diseases*

Igawe, P. B., Muhammad, J. O., Nwokoro, U. U., Abubakar, J. D., Isah, S. I., Aketemo, U., Balogun, M. S., & Nguku, P. (2020). Snakebite outbreak and associated risk factors in Donga, Taraba State, Nigeria, June, 2016. *The Pan African medical journal*, *37*, 82.

Isbister G.K. and Silva, A. (2018). Addressing the global challenge of snake envenoming. *Lancet*392 619 - 620

Kasturiratne A, Wickremasinghe A.R, de Silva N, Gunawardena N.K, Pathmeswaran A (2008). Estimating the global burden of snakebite: A literature analysis and modelling based on regional estimates of envenoming and deaths. PLoS Medicine 5(11):e218.

Kasturiratne A, Wickremasinghe A.R, de Silva N, Gunawardena N.K, Pathmeswaran A, Premaratna R,. (2008).The global burden of snakebite: a literature analysis and modelling based on regional estimates of envenoming and deaths. PLoS Medicine. 5(11):e218.

Longbottom J, Shearer F.M, Devine M, Alcoba G, Chappuis F, Weiss D.J, Ray S.E, Ray N, Warrell D.A, Ruiz de Castañeda R, Williams D.J, Hay S.I, Pigott D.M.(2018). Vulnerability to snakebite envenoming: a global mapping of hotspots. *Lancet.* Aug 25; 392(10148): 673-684.

Magalhães, S.F.V.; Peixoto, H.M.; Moura, N.; Monteiro, W.M.; Oliveira, M.R.F. (2019). Snakebite envenomation in the Brazilian Amazon: a descriptive study. *Transactions of the Royal Society of Tropical Medicine and Hygiene, 113: 143–151.*

Malik, R., Bukie, J. O., Oigocho, J. J. (2018). Assessment of Snake Bite in Some Selected Communities in Benue State, Nigeria. *Proceedings of 6th NSCB Biodiversity Conference; Uniuyo 2018 (61-64 pp)*

McDiarmid R.W, Campbell J.A, Toure T (1999). Snake Species of the World: A Taxonomic and Geographic Reference, Volume 1. Herpetologists' League.

Mise Yakari, Lira-da-Silva Rejane and Carvalho Fernando (2016). Agriculture and Snakebite in Bahia, Brazil. An ecological study. Vl 23.

Mota-da-Silva, A.; Monteiro, W.M.; Bernarde, P.S. (2019). Popular names for bushmaster (Lachesis muta) and lancehead (Bothrops atrox) snakes in the Alto Juruá region: repercussion to clinical-epidemiological diagnosis and surveillance. *Revista da Sociedade*

Brasileira de Medicina Tropical, 52: e-20180140.

Nasidi A. (2007). Snakebite as a Serious Public Health Problem for Nigeria and Africa. Presentation to WHO Consultative Meeting on Rabies and Envenomings: by Director, Special Duties, Federal Ministry of Health, Project – Coordinator EchiTAb Study Group, UK/Nigeria

Oliveira, M.E.; Martins, M. (2001). When and where to find a pitviper: activity patterns and habitat use of the lance head, *Bothrops atrox,* in central Amazonia, Brazil. *Herpetological Natural History, 8: 101-110.*

Omogbai E.K, Nworgu Z.A, Imhafidon M.A, Ikpeme A.A, Ojo D.O, Nwako C.N. (2002): Snake bites in Nigeria: A study of the prevalence and treatment in Benin City. *Tropical Journal Pharmaceutical Research; 1:39-44.*

Paramonte B. (2007). Snakebites in Nigeria. University of the Sciences Philadelphia, 600 South 43rd Street, Philadelphia, Pennsylvania, 19104 - 4495, USA. *Medical Journal of Therapeutics Africa*, 1(3): 222

Potet J, Smith J, McIver L. (2019). Reviewing evidence of the clinical effectiveness of commercially available antivenoms in sub-Saharan Africa identifies the need for a multi- centre, multiantivenom clinical trial. *PLoS Negleted Tropical Diseases. 13(6)*

Potet J, Smith J, McIver L. (2019). Reviewing evidence of the clinical effectiveness of commercially available antivenoms in sub-Saharan Africa identifies the need for a multi-centre, multiantivenom clinical trial.*PLoS Negleted Tropical Diseases. 13(6)*

Roriz, K.R.P.S.; Zaqueo, K.D.; Setubal, S.S.; Katsuragawa, T.H.; Silva, R.R.D.; Fernandes, C.F.C. (2018). Epidemiological study of snakebite cases in Brazilian Western Amazonia. *Revista da Sociedade Brasileira de Medicina Tropical, 51: 338-346.*

Sapkota S, Pandey DP, Dhakal GP, Gurung DB (2020) Knowledge of health workers on snakes and snakebite management and treatment seeking behavior of snakebite victims in Bhutan. *PLoS Negleted Tropical Diseases.* 14(11).

Shehu A, Magaji M.G, Yau J, Abubakar A (2017). Ethnobotanical survey of medicinal plants used for the management of depression by Hausa tribes of Kaduna State, Nigeria. *Journal of Medicinal Plants, Research* 11(36):562-567.

Silva, A.M.; Colombini, M. Moura-da-Silva, A.M.; Souza, R.D., Monteiro, W.M.; Bernarde, P.S. (2020). Epidemiological and clinical aspects of snakebites in the upper Juruá River region, Western Brazilian Amazonia. *Acta Amazonica* 50: 90-99.

Tchoffo, D., Kamgno, J., Kekeunou, S. (2019). High snakebite underreporting rate in the Centre Region of Cameroon: an observational study. *BMC Public Health* 19**,** 1040 (2019).

Theakston R.D.G, Laing G.D, Freire L, (2003).Treatment of Snakebites by Bothrops Species and *Lachesis mula* in Ecuador: Laboratory Screening of Candidates Antivenoms. Transaction of Royal Society of Tropical Medicine and Hygiene.

Turci, L.C.B.; Albuquerque, S.; Bernarde, P.S.; Miranda, D.B. 2009. Uso do hábitat, atividade e comportamento de Bothriopsis bilineatus e de Bothrops atrox (Serpentes: Viperidae) na floresta do Rio Moa, Acre, Brasil. Biota Neotropica, 9: 197-206.

Wiewel A.S., Adams, A.A.Y and Rodda G.H. (2009). Distribution, density, and biomass of introduced small mammals in the southern Mariana Islands. *Journal of specific Science* 63(2):205-222.

Williams, D.J., Faiz, M. A., Abela-Ridder, B., Ainsworth, S., Bulfone, T. C., Nickerson, Andrea D., Habib, A G., Junghanss, T., Fan, H. W., Turner, M., Harrison, R. A., Warrell D.A. (2017). Strategy for a globally coordinated response to a priority neglected tropical disease: Snakebite envenoming. *PLOS; Neglected Tropical Diseases.*

World Health Organization (2017).The Case for Snakebite Envenoming Recommendation for the Adoption of an Additional Disease as a Neglected Tropical Disease.