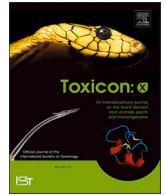


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## Dealing with snakebite in rural Cameroon: A qualitative investigation among victims and traditional healers

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## ABSTRACT

**Background:** Snakebite is a neglected tropical disease (NTD) affecting rural and remote populations globally, who are additionally burdened by poverty and the lack of effective healthcare systems. Delayed healthcare and use of traditional treatments are very frequent. The purpose of our study was to explore perceptions of snakes, impact of snakebite, and knowledge and opinions of different snakebite treatments with the aim of identifying opportunities for improving snakebite management.

**Methods:** This is a qualitative descriptive study based on semi-structured interviews with 21 snakebite victims and 4 traditional healers in 4 villages of Akonolinga health district, Center Region, Cameroon. Analysis focused on describing participants' perceptions of snakes, the impact of snakebite on the victims' lives, and their opinions of different treatment options.

**Results:** Respondents were fearful of snakes and knowledgeable about envenoming symptoms and treatments. The experience of snakebite led to increased vigilance and avoidance behaviours, which sometimes resulted in financial loss for the victims. A range of traditional treatments were described, including tourniquets, black-stone application and medicinal plant decoctions. However, opinions were ambivalent regarding their efficacy, depending especially on previous personal experiences. Still, traditional treatments were said to be more available and cheaper than hospital care, and in particular, than antivenom. Nevertheless, most victims preferred hospital treatment if the financial and transportation barriers were lifted. Both snakebite victims and traditional healers were of the opinion that collaboration between health services and traditional healers could help to improve snakebite management and outcomes.

**Conclusion:** Our study shows that snakebite victims are in favour of using antivenom for the treatment of snakebite and would welcome better access to it. However, its current unavailability and high cost pushes them to turn to traditional treatments. On the other hand, traditional healers are in favour of collaborating with health facilities. These results are very encouraging for the improvement of snakebite management in Cameroon along the lines of the WHO Snakebite Envenoming Strategy for Prevention and Control: ensuring access to safe and effective treatment, and increasing partnership and coordination between communities, traditional healers, and conventional caregivers.

**Abbreviations:** Neglected tropical disease, (NTD); World Health Organization, (WHO); Comité National d'Ethique de la Recherche sur la Santé Humaine, (CNERSH); Commission Cantonale d'Ethique de la Recherche scientifique, (CCER); Post-Traumatic Stress Disorder, (PTSD).

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## 1. Introduction

Snakebite is a major and underestimated cause of chronic disabilities, psychological trauma and premature death in many tropical countries where human activities and snake habitat overlap (Kasturiratne et al., 2008; Habib et al., 2015). Sub-Saharan Africa, East Asia and South America are regions that combine high density of dangerous snake species, difficult access to adequate health care, and scarce antivenom supply. As a result, their populations are the most exposed to snakebite envenoming in the world (Longbottom et al., 2018). Snakebite is estimated to cause between 81,000–138,000 annual deaths throughout the world (300 deaths per day), and over 400,000 permanent disabilities such as blindness, limb amputation or ankylosis (Gutiérrez et al., 2017).

Although antivenom is the only treatment recommended by the World Health Organization (WHO), its availability, affordability, efficacy, and quality are critically insufficient, especially on the sub-Saharan African market where only a small percentage of the needs for antivenom are met and where ineffective products are common (Brown, 2012; Warrell, 2008). A publication from Cameroon mentioned an alarming “quasi-absence” of antivenom in health facilities during the year 2015 (Tchoffo et al., 2019). In this context, even the most recent publications report that 60–90% (Sapkota et al., 2020; Igawe et al., 2020) of snakebite victims still rely on traditional treatment techniques such as incisions at the bite site, application of the black stone (a calcined animal bone or horn applied at the bite site and said to absorb the snake venom from the wound (Eteson, 1876)), or ingestion of medicinal herbs (Kularatne et al., 2014; Michael et al., 2011). These practices have been the subject of much research and are not currently recommended by WHO for snakebite treatment (Warrell, 2010). The black-stone is absorbent but unspecific to venom components (Chippaux et al., 2007a, 2007bbib\_Chippaux\_et\_al\_2007abib\_Chippaux\_et\_al\_2007b); tourniquets are often too tight and kept for days, causing ischemic damage to the distal limb (Bush and Kinlaw, 2015); and research on the local protective effect of medicinal plants has yet to demonstrate clinical efficacy (Félix-Silva et al., 2017; Trim et al., 2020).

To improve snakebite management in communities in which traditional practices are common, WHO insists on the importance of gaining in-depth understanding of the local beliefs and perceptions of the issue (Gutiérrez et al., 2015). Qualitative research can contribute to achieving this goal by giving a voice to the front row actors of this issue, exploring their ideas, behaviours and concerns within the broader social context (Pope and Mays, 1995).

This paper reports on the qualitative research carried out as the second phase of the SNAKO project, conducted in the rural health district of Akonolinga, Center Region, Cameroon, between October 2016 and January 2017. The first phase of the SNAKO project was a cross-sectional, door-to-door multicluster survey (Alcoba et al., 2020), which revealed a very high snakebite incidence (665 bites per 100,000 inhabitants per year), 59% of which involved severe envenoming; unavailability of antivenom (only 5% of the needs met); and widespread use of traditional practices by victims and their families, traditional healers, but also by health professionals (black stone application 23%, bite site incision 36%). In addition, 71% of snakebite victims reported “subjective psychological trauma”, defined as conscious avoidance of specific places or activities related to the snakebite, and/or frequent nightmares about the event.

The qualitative phase of the SNAKO project, presented in this paper, was intended to complement the quantitative findings, exploring more thoroughly the experiences, practices and perceptions of snakebite victims and traditional healers regarding snakebite and their management. Specifically, we aimed to answer the following questions: (a) How do people perceive snakes? (b) What is the impact of snakebite on people's lives? (c) Which snakebite treatments do people know and use? (d) What are people's opinions regarding the advantages and disadvantages of different treatment options? And (e) What are healers' attitudes regarding collaboration with health centers?

Our aim was to give voice to snakebite victims and traditional healers in Akonolinga, Cameroon, in hopes of providing new insights into snakebite prevention and management.

## 2. Methods

### 2.1. Context

The Akonolinga health district is located in the Center region of Cameroon, with a population of 105,789 inhabitants in 2015. It has a sub-tropical climate with two rainy seasons per year (August to November; April to May). It is a rural region, with one of the main occupations being industrial or subsistence agriculture (Rapport régional de progr, 2011). A snake census conducted in this region shows the presence of neurotoxic cobras and mambas (*Naja* and *Dendroaspis* genera respectively), cytotoxic and hemotoxic vipers (*Bitis* and *Atheris* genera), and burrowing snakes (*Atractaspis* genus) (Chirio and Lebreton, 2007). Less harmful snakes include small colubridae and adders (*Crotaphopeltis* and *Causus*) (Chirio and Lebreton, 2007).

The Cameroon healthcare system is organised in health districts, each of which is subdivided into health areas. There are twelve health areas in the health district of Akonolinga. The district hospital, which is the referral health facility for the entire district, is located in the center of Akonolinga-city; each of the other health areas has a smaller health center facility, located between 18 and 78 km from the district hospital.

### 2.2. Participant selection

For this qualitative phase, we purposely selected four of the 20 villages of the Akonolinga health district which had been randomly selected for the SNAKO epidemiological survey. Selected villages (Edou, Akoua, Zalom, Mengang) had high snakebite incidence, high traditional healer consultation rates and/or the presence of a traditional healer.

All the snakebite victims of these villages which had been previously identified through the epidemiological survey, were invited to participate to the qualitative phase. Snakebite victims bitten before or after the research period of our epidemiological survey (July 1, 2015 to June 30, 2016) were not invited to participate. Adult family members were invited to represent under-aged victims (less than 21 years old).

In addition, from each of the four villages, we contacted the nearest traditional healer with experience in managing snakebite cases, based on villagers' indications (see Table 1). In order to gather different opinions and practices, we aimed at interviewing at least four traditional healers (one per village).

### 2.3. Data collection

Semi-structured interviews were conducted, either individually or in small groups of two to four participants (Table 1). For the participants' comfort, we interviewed male and female victims separately (Hennink, 2007). We developed two interview guides (one for victims, one for traditional healers), which were pre-tested and adapted after two pilot

**Table 1**

Detail of the participants in each of the 13 SNAKO interviews.

Villages	Number of interviews (number of participants/number of snakebite victims in this village)		
	Female victims	Male victims	Traditional healers
Edou	1 (n = 4/6)	1 (n = 2/7)	1 (n = 1)
Mengang	1 (n = 3/7)	1 (n = 2/3)	0
Akoua	1 (n = 1/2)	1 (n = 3/5)	1 (n = 1)
Zalom	1 (n = 4/7)	1 (n = 2/4)	2 <sup>a</sup> (n = 1 and n = 2)
Edjom	0	0	1 (n = 1)

<sup>a</sup> In Zalom, we interviewed Zalom's traditional healer individually (n = 1), and then Zalom's and Edjom's healers together as a group (n = 2).

discussions held with Akonolinga villagers in July 2016 (Table 2).

Interviews were conducted in the Ewondo language by the members of the original SNAKO research team, composed of one doctor, two nurses and one physiotherapist, all Cameroonians. The team members took turns leading the discussions, audio-recording them, and taking notes. Interviews were audio recorded, and then translated and transcribed to French by the team members.

Interviews with snakebite victims took place in communal spaces in the villages, whereas traditional healer interviews took place in the healers' houses. Because most participants worked on the farms during the day, the interviews were held in the evenings after they had returned from work. Interviews lasted between 45 and 60 min.

#### 2.4. Ethical considerations

Ethical approval to conduct this study was obtained from the *Comité National d'Ethique de la Recherche sur la Santé Humaine* (CNERSH) in Cameroon (October 3, 2016, N°: 2016/10/815/CE/CNERSH/SP), and from the *Commission Cantonale d'Ethique de la Recherche scientifique* (CCER) in Switzerland (February 14, 2017, with permission to begin the study obtained on July 19, 2016).

The research team first met with village leaders to explain the objectives and methods of the study. All leaders were literate in French, and were provided with a written summary of the study (Appendix A). Once oral consent was given by the village leader, our investigators visited the snakebite victims in their homes to obtain their consent to participate in the second, qualitative phase of the SNAKO project. All victims who gave oral consent to participate were informed of the place and time of the interview. At the beginning of each interview, the interviewer re-explained the purpose of the study, provided an information sheet in French for each participant, and a consent form to be signed (Appendix B). The form was orally translated to Ewondo for illiterate and non-French speaking participants, who were then asked to mark the consent form. Given the small number of traditional healers in our study, we identify by them number only, in order to protect their anonymity.

#### 2.5. Analysis

We used a qualitative description methodology for our study (Bradshaw et al., 2017). This approach is characterized by low-inference description of the phenomena of interest, and staying close to the data. It is especially useful when the perspectives of those directly experiencing

**Table 2**  
Interview guides for the SNAKO interviews.

Interview guide for snakebite victims
When you hear the word « snake », what does it make you think of?
Tell us about the time you were bitten by a snake.
What impact did the snakebite have on your life (personal and professional)?
Which snakebite treatments do you know?
What are the advantages and disadvantages of being treated by a traditional healer?
What are the advantages and disadvantages of being treated in a health center?
What determines whether you go to a health center or a traditional healer?
Do you feel at risk for snakebites? What would help you feel safer?
What do you do to avoid snakebites?
Interview guide for traditional healers
When you hear the word « snake », what does it make you think of?
Do you often treat people who were bitten by a snake?
Do you feel confident treating snakebite victims or is it something difficult for you?
Which techniques do you use to treat snakebite victims?
What do you think is the best treatment for snakebite victims?
Did complications ever occur while you were treating snakebite victims? How did you react?
Why do you think that most snakebite victims come to you for treatment, rather than going to a health center?
Have you ever contacted a health center about a snakebite victim?
What do you think might be the advantages and disadvantages of collaborating with health centers on snakebite management?

the phenomenon of interest are needed, and where there is no need or attempt to “re-present the data in any other terms but their own” (Sandelowski, 2000). Qualitative description can be particularly useful in the context of health services research by “obtaining straight and largely unadorned (i.e., minimally theorized or otherwise transformed or spun) answers to questions of special relevance to practitioners and policy makers.” (Sandelowski, 2000).

We first applied a “template analysis” approach (Crabtree and Miller, 1992), whereby we coded text segments according to our five general research questions (perceptions of snake; impact of snakebite; knowledge of snakebite treatments; opinions of different treatments; possibility of collaboration between conventional health services and healers). Next, within each of these categories, we coded the range of ideas expressed, and grouped them into sub-categories as appropriate. Coding was checked and validated by Patricia Hudelson and Justin Eyong. The frequency with which certain ideas were mentioned, both within and across the different interviews, was also noted to help identify major and minor opinions.

Table 3 provides illustrative quotes of the main coding categories; Appendix C provides the detailed presentation of the coding scheme.

### 3. Results

#### 3.1. Participants' characteristics

A total of twelve out of 22 female snakebite victims, and nine out of 19 male snakebite victims participated in this study, either in individual or in small-group interviews (Table 1). Unfortunately, several victims declined our invitation to participate due to their on-going farm work. In addition, one female victim from Akoua was excluded from the study because she was drunk at the time of the interview. One female participant in Edou spoke on behalf of her 14 year-old son who had been bitten, and one male deaf victim participated with the help of a sign language interpreter in Akoua.

In Akoua and Zalom, both traditional healers that we contacted agreed to individual interviews. As there were no traditional healers with snakebite experience in Mengang, we interviewed a healer in the nearby village of Edjom. In Edou, there were two traditional healers with snakebite experience, but one was absent at the moment of the study. In total, we interviewed four traditional healers, one per village. Two healers agreed to be interviewed a second time together (healers of Zalom and Edjom), in order to compare practices and opinions.

All participants were adult community members and permanent inhabitants of the study villages.

#### 3.2. How do people perceive snakes?

Study participants were almost unanimously fearful of snakes. They were seen not only as a lethal threat, but for some respondents they also evoked negative biblical images.

“When I see a snake, it is fear, death, danger.” (Akoua man).

“The word snake makes us think of death because when it bites you, if you have nowhere to go to cure yourself quickly, it is death.” (Edou woman).

“When God created the skies and the earth, he cursed the earth and it was because of the snake, because it is an evil spirit.” (Edou man).

Snakes were said to be omnipresent in the farms, forests, paths and even houses, and respondents said they would either flee from or kill a snake before it had a chance to bite anyone. A few respondents noted that the danger and aggressiveness of snakes depended on the species, the season of the year and human behavior.

“Sometimes when you meet the snake, it flees. The one that bit me was slow. The other ones, the green mambas, the najas, they flee each time we meet them.” (Akoua man).

“There are different snake species like the viper, the *Oviet*, that are docile. It can even happen that you step on them without being bitten.

**Table 3**  
Main coding categories and illustrative quotes.

Main categories	Example of codes and illustrative quotes
Perceptions of snakes	<p><b>Fear:</b> “It makes me think of an enemy, meaning I fear it. It is terrible. I am afraid even if it is small.” Male victim, Mengang</p> <p><b>Understanding snake behavior:</b> “Snakes sometimes flee from humans first. [...] It is not so simple that when [the snake] sees you it jumps to bite you! [...] All day long, especially during the dry season, the green mamba we see it lying on the road, in the grass, we see it everywhere. If you don't step on it ...” Male victim, Akoua</p>
Impact of snakebite	<p><b>Hypervigilance:</b> “Even if it is a rope that brushes against my foot, I think only of the snake.” Female victim, Mengang</p> <p><b>Use of self-protection measures:</b> “Since I was bitten by a snake, I saved five thousand francs to buy myself a pair of boots that I wear to go to the farm.” Female victim, Zalom</p>
Snakebite treatment strategies	<p><b>Tourniquet:</b> “I tore my dress apart and used it as a tourniquet.” Female victim, Edou</p> <p><b>Plant ingestion:</b> “I eat [the plants] myself first. After, I give them to you. You can swallow the juice and spit out the residue, or swallow both.” Traditional healer n°2</p>
Perceptions of treatment options	<p><b>Perceptions of traditional treatment for snakebite:</b> “I was satisfied with the way I was treated traditionally. I thought something could happen afterwards, but I have had no problem since.” Male victim, Mengang</p> <p>“I do not mention traditional treatments, I do not believe very much in them. Especially in these kinds of situations. I believe in traditional medicine for other things.” Male victim, Zalom</p> <p>“The traditional healer is for when there is really no health center near. Then, you can go a traditional healer.” Male victim, Mengang</p> <p><b>Perceptions of hospital treatment for snakebite:</b> “It would be best that we bring you to the hospital because it is the doctor who knows best the degree of envenoming and the appropriate medication.” Female victim, Edou</p> <p>“I want to know the benefits of the hospital. [...] When I have the money, I go!” Female victim, Akoua</p> <p>“If the government made antivenoms available in our health facilities, we would be reassured.” Female victim, Mengang</p> <p><b>Barriers to hospital treatment for snakebite:</b> “It can happen that the snake bites you [...] far away from the traditional healer. When [you get] there, there is already envenoming, the treatment does not work.” Female victim, Edou</p> <p>“My husband and I have no money and no-one who can take us to the hospital.” Female victim, Akoua</p> <p>“If you do not have money, once you reach the hospital the nurse will not treat you. The venom will spread in your body.” Female victim, Zalom</p>
Attitudes about collaboration	<p>“Why not? Can you refuse to enter in a useful collaboration? When you treat someone and he survives, is it not useful?” Traditional healer n°1</p>

[...] But the others like the green mambas, the najas, those are dreadful during the dry season in the village.” (Mengang woman).

Only traditional healers mentioned the mystical nature of certain snakes, to explain the occasional inefficacy of their treatments.

“I can deliver my treatment. If it is a simple snake, you will heal. But if it is a mystical snake, I can do nothing.” (traditional healer n°2).

“Later someone came to tell me that the death was due to mystical things and to the sorcery that [the victim] had done near Akonolinga. We had told [the victim] to go put back the things he had stolen in Akonolinga. He did not put them back. This is why he was killed.” (traditional healer n°3).

### 3.3. What is the impact of snakebite on people's lives?

After being bitten by a snake, fear led victims to develop different

strategies in the hope of avoiding future bites. Some victims were so afraid to return to the farms where they were bitten that they hired relatives or other villagers to work for them.

“I am a farmworker, but since [the snakebite], I work in sales. [...] My daughter works [in the farm] now and I work with the money.” (participant's identity withheld to respect confidentiality).

“I cannot bear to harvest peanuts or even to clean the peanut field anymore. When I have a peanut field [to harvest], I call people, I give them money to harvest for me.” (participant's identity withheld to respect confidentiality).

Other strategies included paying more attention to where they stepped or put their hands while working in the farm, wearing protective clothing, cutting high grass along paths and farms, and avoiding going out at night.

“I cover my entire body to the point which, if [the snake] wants to bite me, he grabs my clothes before touching me [laughs].” (Edou woman).

“It scares me when the path to my farm is covered with grass. It scares me because it seems like I could be bitten again by a snake. It is better when the path to my farm is clean.” (Zalom woman).

“I do not trust holes. Now, when I get my small salary, I buy beef. And most of all, I avoid rat holes.” (Mengang man, bitten while chasing rats for food).

One participant mentioned that as a result of his experience, he tries to teach his children to be more careful as well:

“He tells his kids that the first thing is to pay attention to snakes. Sometimes he asks them not to go in the bush.” (sign language interpreter, speaking for Akoua man).

Most of these avoidance strategies came at a financial cost (to buy clothing or footwear, hire employees, buy meat), which is why they were mostly temporary solutions.

Respondents also described mental consequences of snakebite. Added to the anxiety of being bitten again, some were afraid they might develop delayed complications from the snake venom (even years after treatment), while other described invasive flash-backs of the bite, hypersensitivity to similar stimuli, and avoidance of the place or activity associated with the snakebite experience.

“I do not know if the venom is still in my body. Something may happen today and have complications later. The damage can be delayed ... Who will know it, especially after many years?” (Mengang woman).

“Nothing has ever traumatized me so much. When I go in the forest, if something brushes by me, I think only of the bite, I am scared.” (Edou woman).

“I never forgot the place where I was bitten. Every time I go there, I think of this horrible scene. I see the scene again.” (Zalom man).

Finally, some snakebite victims mentioned long-term physical consequences of snakebite such as chronic pain, tingling, hyposensitivity and scarring at the bite site.

“Sometimes it hurts when I put this foot on the ground. [The snake] really bit me. Sometimes I have acute pain and at the same time, I see blurry.” (Edou woman).

### 3.4. Which snakebite treatments do people know and use?

Study participants knew about snakebite treatments through personal experience and from relatives, traditional healers, churches, and schools. Biomedical snakebite treatments they knew of were antivenom, corticosteroids, antibiotics, and unspecified pills and injections. In comparison, participants knew of a much greater variety of traditional snakebite treatments. The most frequently mentioned treatment was the tourniquet; others included application of the black-stone or medicinal plant concoctions to draw out the poison, ingestion of herbal infusions to either purge or counteract the effects of the poison, and wound incisions and compressions to drain the venom.

“You pick tree barks and you boil them. Then you put your machete in the fire. When it is hot and red, you take the potion and pour it on the

machete, tilting it over the wound that you had enlarged beforehand with incisions.” (traditional healer n°3).

“He brought the leaves, he put them on the wound, he tied them, but we did not apply the black-stone first because for him, it was the leaves who played this role, not the black-stone. And this thing, the leaf application, it sucked the venom like the black-stone. I felt the veins moving fiercely inside, it was painful.” (Mengang man).

“I incise with a clean blade. I incise until there is a small bleeding so that I can apply my remedies on the wound.” (traditional healer n°2).

“When the venom has reached the heart, I give [the victim] these herbs which have the capacity to throw out the venom. If the treatment works, it will cause diarrhea and vomiting.” (traditional healer n°2).

“When the snake bit you and the venom is in your heart and that it makes you vomit, I peel the tree bark, I knead it in fresh water and make you drink it. It will stop the vomiting.” (traditional healer n°1).

Less frequently mentioned traditional treatments included drinking one’s own urine, drinking unsweetened milk, burning the bite wound with matches, having sexual intercourse, and massaging the wound with warm water. In addition, some of the traditional healers used prayer and ritual healing.

“Before doing anything else, I ask God his power by praying him to bring his power on the treatments that I use.” (traditional healer n°3).

“When you arrive in my house, you lay on the ground in my living room. Then I step over your lying body nine times while asking you “What bit you?” and you answer “The snake!”, “What bit you?“, “The snake!“, and so on, nine times.” (traditional healer n°1).

### 3.5. What are people’s opinions regarding the advantages and disadvantages of different treatment options?

Most respondents said hospital treatment, with antivenom, was the ideal snakebite treatment. They expressed great trust in hospital treatment because they believed it specifically targeted the snake venom, as opposed to traditional treatments which were described as unspecific. Victims said that health professionals could determine (sometimes with the help of machines) the degree of poisoning and the adequate treatment to give, whereas traditional healers mostly worked on “assumptions”.

“When you go the hospital, the treatment is faster and more efficient than the traditional treatment.” (Zalom woman).

“It is better if we bring you to the hospital because it is the doctor who knows better the degree of envenomation and the appropriate drugs.” (Edou woman).

“The hospital is efficient because it has the machines that detect the disease in the body.” (Edou man).

“The traditional healer relieves [the pain], but the hospital is effective [against snake poison].” (Edou man).

“We are not sure when we go to the traditional healers ... We are not sure.” (Mengang man).

“[With the healer] we often have the impression that the venom is not completely neutralized.” (Zalom man).

However, respondents complained about the major access barriers to hospital care such as physical distance and lack of transportation, high treatment cost and antivenom unavailability. The participants insisted on telling us that these barriers are applicable to any health issue in their district, not just for snakebite cases.

“One needs motorcycles, bicycles, why not cars, to get to the hospital in case of snakebite. [...] If you are at Sololo and the bridge has collapsed, what will you do?” (Zalom woman).

“The time to bring the patient to the hospital, he can die on the way.” (traditional healer n°4).

“If you are poor, know that you are dead. That is the center of the problem, that is what kills us. You can have the will to go, but money is the problem.” (Edou man).

“The antivenom, it must be available at the hospital. Otherwise, what will I seek for in the hospital?” (Zalom woman).

In contrast, traditional healers were described as rapidly accessible, and with available and affordable treatments. This made them either the primary caregiver, for those who trusted mainly traditional medicine, or the default caregivers in case of financial or geographical inaccessibility of hospital treatment.

“I don’t think I will go spend 2’000 francs when I can go to a place where, as soon as I arrive, I receive the treatment and I can thank [the healer].” (Akoua man).

“The healer always has his forest, the plants are always inside.” (Edou woman).

“If you don’t have the means, you cannot go to the hospital. [...] You stay here being treated by the healer.” (Zalom woman).

“The traditional healer is for when really there is no health center nearby. Then, you can go to the traditional healer.” (Mengang man).

“If the snake bites me and all the conditions are met (money, transportation), as soon as I am bitten I will take the road to the hospital [...]. But in the opposite case, I will go to the traditional healer.” (Edou woman).

Apart from the many practical advantages of traditional medicine, trust in its efficacy was expressed but in a more ambivalent way than for hospital treatment. Almost all of the groups said, in turn, that traditional treatments were both effective and non-effective, depending on the type of health issue faced, the community validation of the healer, and previous personal experiences with traditional medicine. Only in one village (Akoua) were the participants exclusively supportive of traditional treatments for snakebite.

“[This healer] really cures because up until now, there has been no cases of death among the people he treated.” (Akoua man).

“As I was treated, traditionally, I was satisfied. I thought something would happen after but I have had no problem since. [...] I did not know that it was effective.” (Mengang man).

“I believe in traditional medicine for other things. For example if at night, I cannot fulfill my conjugal obligations, I will run to my relative. The treatment he will give me, if I lick it once, the effect is immediate. I do not believe in the traditional treatment of snakebite.” (Zalom man).

### 3.6. What are healers’ attitudes regarding collaboration with health centers?

Healers were all in favour of cooperating with health centers, arguing that they all had the same objective: the victims’ survival and well-being. Healers described how they already collaborated with health services, referring patients to hospitals, accepting patients which were sent to them from health centers, and sharing knowledge regarding snakebite treatments with health center staff.

“I send him to the health center because I was afraid of the risks related to the viper’s bite and especially the envenomation. [...] I often tell my patients that if you feel bad, do not hesitate to go to the health center.” (traditional healer n°4).

“I am used to sending cases to the hospital after having applied my remedies. Because I tell myself that if there is a complication, it is the hospital that will examine it well.” (traditional healer n°3).

“The entire limb was swollen at the point which the health center declared to be incompetent [...]. So they called me and I said I could try as well.” (traditional healer n°3).

“Centers should know that in case of failure or difficulties, they can refer cases to us.” (traditional healer n°3).

“You can have a remedy that I do not have, and I, one that you do not know. We show them to one another.” (traditional healer n°1).

However, collaboration was not always possible, and some healers experienced contempt and disregard from health professionals.

“Before, health centers could not even bear traditional healers. [...] If I am facing an understanding nurse, I can ask him to allow me to give remedies to his patient to relieve his pain. With other nurses, [the patient] has to take it secretly. They do not like collaboration.” (traditional healer n°3).



#### 4. Discussion

Villagers of the Akonolinga health district are afraid of snakes because of the potential lethality of their bites. Only traditional healers said to believe in the mystical powers of certain snakes, even though we would have expected some mystical interpretations coming from the victims as well, based on reports on African traditional religion (Peter, 2015).

The terror associated with the event of a snakebite induces psychological symptoms suggestive of Post-Traumatic Stress Disorder (PTSD), leading to interruption of farm work and consequent exposure of new, non-bitten individuals, to these high-risk activities. These are not new findings as they concur with previously published papers from Costa Rica (Arias-Rodríguez and Gutiérrez, 2020), Sri Lanka (Williams et al., 2011; Wijesinghe et al., 2015), and Nigeria (Muhammed et al., 2017). In these studies, depression was found in 25% (Muhammed et al., 2017) to 54% (Williams et al., 2011) of snakebite victims, and PTSD in 19% of them (Williams et al., 2011), when interviewed 12–48 months after the bite. Up to 10% of the victims stopped working after the snakebite in Sri Lanka (Williams et al., 2011), and our findings suggest the fear of another snakebite, in the context of possible PTSD, is a strong motivator of this behavior. Early, as well as long-term, psychological support to snakebite victims seems therefore essential to avoid these psychiatric complications and their economic consequences, as previously attempted in Sri Lanka with encouraging results (Wijesinghe et al., 2015).

Another interesting finding regarding the consequences of snakebite, is the fact that the bites appeared to be triggers for applying prevention strategies, such as wearing protective clothing and footwear. This behavior should be the focus of prevention campaigns, so as to transform this secondary prevention into primary prevention.

We were somewhat surprised that many respondents said their use of traditional treatments was motivated primarily by the lack of access to health services and antivenom, and by the doubt expressed by respondents concerning the efficacy of traditional treatments. Other studies have suggested that belief in traditional medicine can be a barrier to use of conventional medicine (Schioldann et al., 2018), but we did not find this. It is possible that respondents were reluctant to admit to a preference for traditional medicine when speaking to researchers they associated with conventional medicine, but we do not think this is likely because many respondents thought traditional medicine was effective for other health problems.

There are few qualitative research studies on the snakebite issue, and their results often resemble quantitative data (circumstances of snakebites, induced disabilities, social-demographical information about snakebite victims), as a consequence of narrow research questions, and individual interviews, which do not bring out as much diversity and nuances of opinions as group interviews do. There is one group-discussion based qualitative research which was conducted in Myanmar in 2018, and whose results are relevant for a comparison with ours as they focused on the reasons for traditional healer consultation in case of snakebite (Schioldann et al., 2018). As opposed to our research, few snakebite victims were interviewed, rather non-bitten village inhabitants, interviewed in large groups. However, like our participants, the participants lived in a low-resource and rural environment. Results were similar to ours concerning the reported financial and geographical issues of antivenom treatment. However, one of the major opinions reported in Myanmar was that the participants would seek traditional treatment even if antivenom was available, because of their faith in the efficacy of traditional practices. This was not a major opinion among the participants of our study, maybe because of (i) the trauma of the bite (not experienced by most of the villagers of the study in Myanmar), (ii) the medical background of our investigators (possibly influencing our participants to express more positive opinions about conventional care), or (iii) the lesser religious status of the traditional healers on Akonolinga (the healers in Myanmar were Buddhist monks, in a Buddhist region). These differences underscore the limitations of qualitative research, as

the results obtained are the reflection of a specific culture and social organization, and therefore cannot be generalized to other geographical and cultural regions.

Finally, we are encouraged by the fact the traditional healers in our study were all favorable to a strengthened collaboration with health centers. This could be done, for example, through regular encounters to share experiences and difficulties, and provide information about antivenom availability. In Nepal, traditional healers were successfully included in a training program to deliver first aid in case of snakebite, and organize rapid transportation to the nearest antivenom-dispensing health center (Sharma et al., 2013).

Our study explored the snake-bite related beliefs and practices of both snakebite victims and traditional healers. To our knowledge, ours is the first qualitative snakebite study to include interviews with traditional healer interviews, and these allowed us to explore their knowledge of and attitudes towards both traditional and conventional snakebite treatments.

Nonetheless, the interviews were conducted by local health professionals, and it is possible that participants were less forthcoming about their traditional beliefs and practices than they might have been with non-medical interviewers. As a result, we may have missed some opinions and practices. Moreover, it is possible that the traditional healers who agreed to participate in our study were more open to collaboration with conventional structures than traditional healers elsewhere. More remote healers or healers who declined participation, may have held different opinions. Finally, coding and analysis of the transcripts was initially done by the Swiss researchers, who may have misinterpreted certain responses of participants. However, in order to reduce this particular source of bias, Cameroonian team members were asked to clarify the meaning of respondents' answers, confirm the coding scheme, and review the final analysis of the transcripts.

#### 5. Conclusion

Snakebite can lead to serious psychological distress and avoidance practices with potentially negative consequences. Recourse to traditional healers and their treatments in the event of snakebite is a logical strategy in the face of scarce and costly access to antivenom. Our study suggests that snakebite victims and traditional healers would welcome greater access to antivenom, as well as a strengthened partnership between traditional and conventional health systems.

In 2017, the World Health Organization created a Snakebite Envenoming Working Group with the aim of developing a strategic road map on snakebites, with four key objectives: empowering and engaging affected communities, ensuring availability of safe and effective treatment, strengthening health systems to deliver treatment, and increasing partnerships and coordination (Minghui et al., 2019; WHO | Snakebite envenomin, 2018). Our study results suggest that collaboration with traditional healers may contribute to these goals.

#### 6. Author contributions

Conceptualization: Manon Chuat, Gabriel Alcoba, Justin Eyong, Franck Wanda, Armand Nkwescheu, Eric Comte. Data curation: Manon Chuat, Gabriel Alcoba, Justin Eyong, Franck Wanda. Formal analysis: Manon Chuat, Patricia Hudelson, Justin Eyong. Funding acquisition: Gabriel Alcoba, François Chappuis. Methodology: Manon Chuat, Gabriel Alcoba, Patricia Hudelson, Justin Eyong. Project administration: François Chappuis, Franck Wanda. Supervision: François Chappuis, Franck Wanda. Investigation: Justin Eyong, Franck Wanda. Validation: Gabriel Alcoba, François Chappuis, Patricia Hudelson. Writing – original draft preparation: Manon Chuat. Writing – review and editing: all authors.

#### Ethical considerations

Ethical approval to conduct this study was obtained from the *Comité*

National d'Éthique de la Recherche sur la Santé Humaine (CNERSH) in Cameroon (October 3, 2016, N°: 2016/10/815/CE/CNERSH/SP), and from the *Commission Cantonale d'Éthique de la Recherche scientifique* (CCER) in Switzerland (February 14, 2017, with permission to begin the study obtained on July 19, 2016).

The research team first met with village leaders to explain the objectives and methods of the study. All leaders were literate in French, and were provided with a written summary of the study (Appendix A). Once oral consent was given by the village leader, our investigators visited the snakebite victims in their homes to obtain their consent to participate in the second, qualitative phase of the SNAKO project. All victims who gave oral consent to participate were informed of the place and time of the interview. At the beginning of each interview, the interviewer re-explained the purpose of the study, provided an information sheet in French for each participant, and a consent form to be signed (Appendix B). The form was orally translated to Ewondo for illiterate and non-French speaking participants, who were then asked to mark the consent form. Given the small number of traditional healers in our study, we identify by them number only, in order to protect their anonymity.

### Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.toxcx.2021.100072>.

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