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Burden and Epidemiology of Snakebite Envenoming in Tanzania

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ABSTRACT

Background: Snakebite envenoming (SBE) is a pressing public health issue in tropical countries. However, there is a paucity of data regarding the burden and epidemiology of SBE in Tanzania, undermining advocacy and the implementation of necessary prevention and control measures.

Methods: From June to September 2022, both health facility-based and community-based survey was conducted to collect data of the snakebite incidents that occurred between 2017 and 2021 in five regions of Tanzania; Pwani, Manyara, Tabora, Katavi, and Ruvuma. Data were analysed using STATA and summarized by tables and narrative descriptions.

Results: A total of 869 snakebite incidents were registered, resulting in 18 deaths. The estimated annual incidence, and mortality rates were 105.6, and 2.2 per 100,000 people, respectively. Pwani and Tabora regions exhibited a higher proportion of cases, accounting for 26% (226) and 23.4% (203) respectively. Males constituted the majority of cases, representing 52.5% (456), and individuals aged 10 to 59 years were most affected, accounting for approximately 85% of cases. The incidents commonly occurred during agricultural activities (31.5% or 219 cases) and while walking on rural roads (32% or 221 cases). Furthermore, snakebites were more prevalent during the dry season (34% or 295 cases) and the rainy season (25% or 218 cases). Factors such as time of day, season, circumstances/activities, occupation, age, and education level were found to be significantly associated with snakebite incidents.

Conclusion: This study underscore the significant impact of SBE in Tanzania, affecting individuals of all age groups, particularly farmers. Urgent collaborative efforts are required to address and mitigate the consequences of SBE in the country.

KEYWORDS: Snakebite envenoming, burden, epidemiology, incidence, mortality, Tanzania

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INTRODUCTION

Snakebite envenoming (SBE) is a significant public health problem, particularly in resource-limited tropical and subtropical countries in South Asia, sub-Saharan Africa, Central and South America [1]. In 2017, World Health Organization (WHO) categorized SBE as one of the category A neglected tropical diseases (NTDs) due to its substantial impact on morbidity, mortality, disability, and its contribution to poverty [2,3]. Annually, approximately 4.5 to 5.4 million people worldwide experience snakebites, resulting in 1.8 to 2.7 million cases of clinical illness (envenomation) and 81,000 - 138,000 deaths [4]. However, the true burden of SBE is often underestimated due to an overreliance on hospital records, overlooking the fact that many victims do not seek medical care at health facilities but instead rely on traditional treatments, leads to uneven and inaccurate epidemiological information on the burden of SBE [5,6]. In an effort to mitigate the adverse effects of SBE, WHO established a goal in 2019 to reduce the number of deaths and cases of SBE by 50% by the year 2030 [7].

Typically, SBE affects rural agricultural workers, herders, fishermen, hunters, and working children in poor rural communities [8–10]. Morbidity and mortality are most common among young people, with children experiencing higher case fatality rates [11,12]. There are several species of snakes, but envenoming is primarily caused by venomous snakes belonging to four medically important families: Viperidae (such as vipers or adders), Elapidae (including cobras, kraits, and mambas), Colubridae (such as the African boomslang and vine snakes), and Atractaspididae (such as Macrelaps, e.g., Natal black snake) and Molevipers) [13–16]. Tanzania, located in sub-Saharan Africa, contains diverse ecological habitats that support thriving of various snake species. Previous studies have documented the presence of various snakes of medical importance [7,18]. However, there is generally limited data regarding the burden and epidemiology of SBE. Understanding the burden and epidemiology dynamics of snakebite is critical to understand the magnitude of the problem, identifying the high-risk populations, and understand the circumstances leading to snakebite incidents. These information are essential to inform resources allocation and targeted responses for SBE prevention and control in our settings. This study aimed to estimates the incidences and mortality rates of SBE, and characterize the epidemiological profile of SBE in Tanzania.

MATERIAL AND METHODS

Study design, duration, study area and settings

From June to September 2022, a cross-sectional survey was conducted to gather data on the burden and epidemiology of SBE in five regions of Tanzania: Tabora, Manyara, Pwani, Katavi, and Ruvuma. The distribution of regions across the geographical area of the country is shown in Figure 1. Data were collected in both health facilities and community settings.

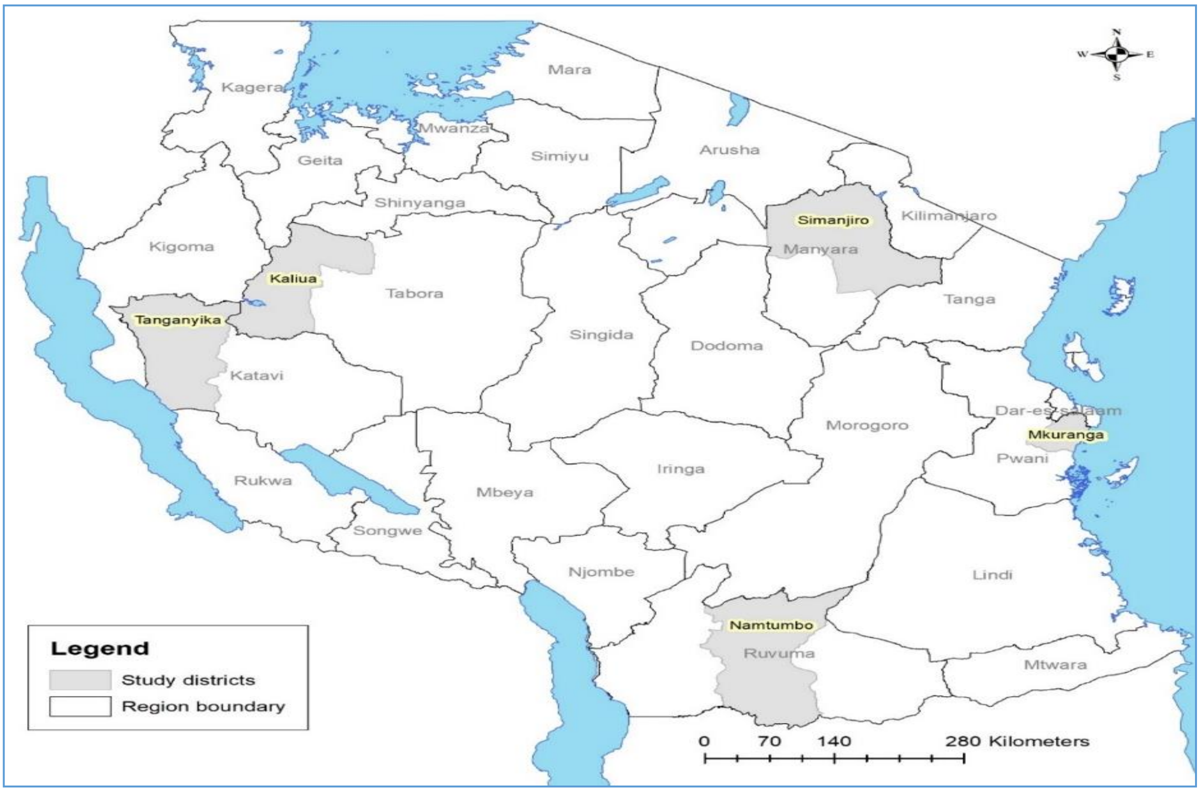

Figure 1: Tanzania map showing distribution of districts in respective regions where study was conducted

Study participants and data sources

The study participants involved individuals who had encountered snakebites. Inclusion criteria for the study included both males and females residing within the designated study area, who had experienced snakebites between January 2017 and December 2021, and provided consent for participation. Furthermore, medical records of snakebite cases from chosen health facilities within the study areas were also utilized as data source.

Sampling strategy and sample size

The sampling strategy employed a combination of purposive and probability sampling methods to select both the study areas and participants. The selection of study areas was based on previous report of snake endemicity (anecdotal reports), with the regions of Pwani, Manyara, Tabora, Katavi, and Ruvuma being purposively chosen. Likewise, within each region, one district was selected, namely Mkuranga, Simanjiro, Kaliua, Tanganyika, and Namtumbo, respectively. Random selection was then used to choose two wards within each district. From each ward, two villages were randomly selected, resulting in a total of four villages per district and 20 villages across all five districts as primary study sites. Additionally, one health facility was recruited from each ward, leading to a total of two health facilities per district and 10 health facilities across all study sites. The selection of the health facilities was based on their capacity to manage snakebite cases and possessing a reliable medical record system. Recruitment of the participants during community survey was based on their availability and willingness to participate in the study. Moreover, data from medical records in the selected health facilities were reviewed, as far as it was accessible. Overall, the study registered 695 snakebite victims within the community and reviewed 217 medical records of SBE cases in health facilities.

Data collection procedures

Data from selected health facilities and communities were collected by trained data collectors. In a health facility setting, patient's medical records registers that were used from January 2017 to December 2021 were identified and retrieved. Each register was independently reviewed by two data collectors to identify and record snakebite diagnosis. The case report form (CRF-1) was used to record demographic and clinical information of the SBE cases. The CRF-1 captured various information including sex, age, occupation, residence, dates of the snakebite incidence, circumstance/ activity related to the bite, time the SBE victim arrived at the health facility, site of the bite, first aid given, vital signs, presented symptoms, developed complications, treatment given, time spent at a health facility, and the treatment outcomes. During the community survey, data were obtained through face-to-face interviews using CRF-2. Before data collection, advocacy meetings with regional and district neglected tropical diseases (NTD) coordinators, community leaders, religious leaders, community health workers, traditional healers, and influential community members in the study sites were held, and they were used for community sensitization and the invitation of potential participants. The interview was carried out in a prearranged area, particularly at a health facility or village office. On the day of data collection, participants were briefed about the purpose of the study and invited to take part. Informed consent was obtained prior to the recruitment of the participants. CRF-2 was used to capture information during the interview, including age, gender, residence, occupation, circumstance, or activity that led to snakebite, the part bitten by a snake, symptoms of SBE, a place where the victim sought immediate care, type of treatment given, complications that developed, and treatment outcomes.

Ethical issues consideration

The study was approved by the National Health Research Ethics Committee (NatHREC) and granted certificate number NIMR/RQ/R.8a/Vol.IX/4986. Additional approval was obtained from the respective region, district, community, and health facility authorities and administrators. All participants provided their informed consent before the interview. In addition, interviews were conducted in the area and office with optimal privacy. The names of the participants were recorded to prevent any duplication of SBE cases recorded during the community survey and medical record review at health facilities, however, in this article data are presented anonymously.

Data management and statistical analysis

Open Data Kit (ODK) software installed on Android tablets was used to collect data. ODK-captured data were exported to MS Excel files for cleaning and quality checks before analysis. Descriptive and inferential statistics were performed using STATA software. Results were summarized using frequency tables and descriptive narratives. Annual incidence and mortality rates were calculated by dividing the number of bites or deaths by the population of the area and were expressed per 100,000 people. The population used to calculate these rates was based on enumeration population data obtained from the respective village at the time of data collection. Factors associated with snakebite incidence were established using Poisson regression.

RESULTS

Demographic and snakebite incident characteristics

In total, 869 snakebite incidents were recorded in the study sites. However, 652 (75.03%) of these incidents were recorded during the community survey. The number of snakebite incidents during the five-year period (217-2021) was relatively high in 2021 and 2017, consisting of 242 (27.5%) and 217 (24.97%) incidents. Regionally, Pwani (Mkuranga) and Tabora (Kaliua) recorded the highest snakebite incidents, with 226 (26%), and 203 (23.4%) cases, respectively. Males accounted for the majority of bites, 456 (52.47%). Almost all age groups were affected by snakebites, with a particularly high percentage among those aged 30 - 39 years (20.14%), 20 - 29 years (18.64%), and 40 - 49 years (18.41%). The majority of the snakebite victims (435 (56.57%)) had primary education levels. Farmers, herders, and students experienced more bites, accounting for 57.1%, 12.6%, and 9.1%, respectively. The main circumstances or activities in which the majority of victims encountered snakebites were walking along rural roads (31.8%) and engaging in agricultural activities (31.5%). Snakebites were more common in the morning hours 223 (34.20%), noon to evening hours 169 (25.92%), and at night hours 207 (31.75%). Snakebites occurred predominantly during the cold and dry season 295 (33.95%) and the long rainy season 218 (25.09%). The majority of the victims, specifically 510 (71.53%), were bitten on their legs, while a small number, 9 (1.26%), had snake spit in their eyes. The majority of victims were able to provide a description of the snake responsible for the bite based solely on its appearance, with black snakes being identified by 164 victims (23.77%), followed by grey snakes identified by 32 victims (4.64%), and green snakes identified by 31 victims (4.49%). However, some victims were able to identify the responsible snake by its local name, with puff adders being identified by 145 victims (21.01%), cobras by 103 victims (14.93%), and black mambas by 18 victims (2.61%). (Table 1).

Table 1: Demographic and snakebite incident characteristics

Characteristics	Frequency (n)	Percent (%)
Types of survey		
Health facility-based	217	24.97
Community-based	652	75.03
Year of incidence (N = 869)		
2017	217	24.97
2018	114	13.12
2019	138	15.88
2020	158	18.18
2021	242	27.85
Region (Surveyed district) (N=869)		
Katavi (Tanganyika)	128	14.73
Manyara (Simanjiro)	159	18.3
Pwani (Mkuranga)	226	26.01
Ruvuma (Namtumbo)	153	17.61
Tabora (Kaliua)	203	23.36
Gender (N=869)		
Male	456	52.47
Female	413	47.53
Age group (in years) (N = 869)		
<10 years	24	2.76
10 - 19 years	128	14.73
20 - 29 years	162	18.64
30 - 39 years	175	20.14
40 - 49 years	160	18.41
50 - 59 years	112	12.89
≥60 years	108	12.43
Level of education (N=769) *		
No formal education	223	29
Primary education	435	56.57
Secondary education	103	13.39
College/University education	8	1.04
Occupation (N=771) *		
Unemployed	35	4.54
Peasant/Farmer	440	57.07
House wife	45	5.84
Student	97	12.58
Employed	14	1.82
Entrepreneur	65	8.43
Animal keeper	70	9.08
Traditional Healer	5	0.65
Circumstance/activity (N= 695) *		
Walking on the rural road	221	31.8
Agriculture-related activity	219	31.51
Herding related activity	65	9.35
Collecting firewood	43	6.19
While sleeping	43	6.19
At home environment	101	14.53

Characteristics	Frequency (n)	Percent (%)
Playing in grass field	3	0.43
Time bitten (N = 652) *		
Early morning (4:00-6:59)	26	3.99
Morning (7:00-11:59)	223	34.2
Noon to Evening (12:00-18:59)	169	25.92
Night (19:00-23:59)	207	31.75
Midnight (24:00-3:59)	27	4.14
Incident season (N =869)		
Short dry season (Jan-Feb)	172	19.79
Long rain season (March-May)	218	25.09
Cold and dry season (Jun-Sep)	295	33.95
Short rain season (Oct-Dec)	184	21.17
Part bitten (N=713) *		
Leg	510	71.53
Feet	76	10.66
Hand	43	6.03
Arm	65	9.12
Eye spitting	9	1.26
Other parts	10	1.4
Associated Injury (N = 673) *		
Dislocation of leg	45	6.69
Dislocation of arm	3	0.45
Bruises	623	92.57
Head injury	2	0.3
Snake type (N= 690) *		
Puff adder	145	21.01
Cobra	103	14.93
Black mamba	18	2.61
Black snake	164	23.77
Brown snake	31	4.49
Green snake	32	4.64
Grey snake	33	4.78
Red snake	18	2.61
White snake	12	1.74
Yellow snake	4	0.58
Not seen snake	130	18.84

*** N is not equal to 869 due to missing data from data obtained at health facilities**.

Snakebite incidence and mortality rates

The overall annual incidence and mortality rates of snakebite were estimated as 105.60 and 2.19 per 100,000 people, respectively. Pwani (Mkuranga) and Katavi (Tanganyika) exhibited higher and lower snakebite incidence rates, with 296.84 and 51.85 bites per year per 100,000 population, respectively. Conversely, Manyara (Simanjiro) and Pwani (Mkuranga) had mortality rates of 8 and 3.9 deaths per 100,000 population, respectively. No deaths were registered in Katavi (Tanganyika) or Ruvuma (Namtumbo) (Table 2).

Table 2: Snakebite incidence and mortality rates by study area

Region (Surveyed district)	Population surveyed	No. of SBE cases in 5 yrs.		Total cases	No. of SBE deaths in 5 yrs.		Total deaths	Incidence rate / yr. / 100 000	Mortality rate / yr. / 100 000
		Community records	Health facility records		Community records	Health facility records			
Katavi (Tanganyika)	49372	113	15	128	0	0	0	51.85	0
Manyara (Simanjiro)	24087	116	43	159	6	4	10	132.02	8.3
Pwani (Mkuranga)	15227	119	107	226	2	1	3	296.84	3.94
Ruvuma (Namtumbo)	51026	113	40	153	0	0	0	59.97	0
Tabora (Kaliua)	24868	191	12	203	5	0	5	163.26	4.02
Total	**164580**	**652**	**217**	**869**	**13**	**5**	**18**	**105.6**	**2.19**

Factors associated with snakebite incidents

The factors that were found to have a significant association with snakebite included the timing and season of snakebite incidents, the circumstances surrounding the bites, the occupation, age, and education level of the participants. The analysis shows snakebite victims were more likely to be bitten during the morning, noon, and midnight hours compared to the early morning. Moreover, snakebite incidents occurred twice as frequently during the cold and dry seasons (June-September) in comparison to the short rainy season (October-December). Regarding occupation, individuals engaged in agriculture-related activities were five times more vulnerable to snakebites than those who were sleeping at home. Similarly, farmers experienced snakebite incidents 21 times more frequently than unemployed victims. The risk of snakebites for individuals aged 20 years and older was more than 13 times higher than for those under 10 years old. Furthermore, individuals with no college or university education were at least 11 times more likely to be bitten by snakes (Table 3).

Table 3: Factors associated with snakebite

Factor	Incidence Rate Ratio (95% CI)	P-value
Incidence time		
Early morning (04:00-06:59)	ref	-
Morning (07:00-11:59)	8.58 (5.71 - 12.87)	**<0.001**
Noon to Evening (12:00-18:59)	6.50 (4.3 - 9.82)	**<0.001**
Night (19:00-5:59)	7.96 (5.3 - 11.97)	0.891
Midnight (24:00-03:59)	1.04 (0.61 - 1.78)	<**0.001**
Incidence season		
Short dry season (Jan-Feb)	1.25 (0.98 - 1.6)	0.072
Long rain season (March-May)	1.39 (1.09 - 1.77)	**0.007**
Cold and dry season (Jun-Sep)	2.03 (1.62 - 2.53)	<**0.001**
Short rain season (Oct-Dec)	ref	-
Circumstance/activity		
While sleeping	ref	-
Walking on the rural road	4.88 (3.52 - 6.78)	**<0.001**
Agriculture-related activity	4.77 (3.43 - 6.62)	**<0.001**
Herding related activity	1.37 (0.93 - 2.03)	0.115
Collecting firewood	0.79 (0.5 - 1.24)	0.306
At home environment	2.35 (1.64 - 3.36)	**<0.001**
Occupation		
Unemployed	ref	-
Peasant/Farmer	21.74 (13.72 - 34.43)	**<0.001**
House wife	2.00 (1.15 - 3.47)	**0.014**

Student	2.37 (1.39 - 4.05)	**0.002**
Employed	0.63 (0.31 - 1.3)	0.213
Entrepreneur	3.21 (1.92 - 5.37)	**<0.001**
Animal keeper	3.21 (1.92 - 5.37)	**<0.001**
Traditional Healer	0.16 (0.05 - 0.53)	**0.003**
Age group (in years)		
<10	ref	-
10 -19	9.57 (4.39 - 20.85)	**<0.001**
20 –29	16.43 (7.66 - 35.23)	**<0.001**
20 – 39	19.71 (9.23 - 42.13)	**<0.001**
40 – 49	19 (8.89 - 40.63)	**<0.001**
50 – 59	14.14 (6.57 - 30.44)	**<0.001**
60 and above	13.29 (6.16 - 28.64)	**<0.001**
Level of education		
No formal education	34.17 (15.17 - 76.94)	**<0.001**
Primary education	62 (27.68 - 138.89)	**<0.001**
Secondary education	11.5 (4.99 - 26.48)	**<0.001**
College/University education	ref	-

DISCUSSION

This study provides data on the incidence, mortality, and risk factors associated with snakebite in Tanzania. The findings are crucial for understanding the burden and epidemiological characteristics of snakebite, enabling the development of effective preventive and control measures in our context. Our estimates indicate an annual incidence rate of 106 snakebites and a mortality rate of 3 deaths per 100,000 people. Considering Tanzania's population of 61,741,120 [19], this translates to approximately 6,572 snakebites and 186 deaths annually. However, it is important to note that the incidence rates varied significantly across different regions, with Pwani region exhibiting a high rate of 297 bites per 100,000 people and Katavi region demonstrating a lower rate of 52 bites per 100,000 people. Similarly, Manyara region displayed a higher mortality rate of 8.3 deaths compared to the overall mortality rate of 2.2 deaths per year per 100,000 people. These variations in the burden of snakebite have been observed in other regions such as South-East Asia [20–22], West Africa [23,24], East Africa [5,26], and can be attributed to factors such as study design, location, snake density, and methodology employed for burden estimation. Furthermore, unreported deaths in Katavi (Tanganyika) and Ruvuma (Namtumbo) could be a result of a variety of reasons that discourage participation and willingness to report deaths during the survey, including lack of awareness, limited access to survey areas, and cultural or religious beliefs.

The study findings indicate that a majority of snakebite victims (85%), were between the ages of 10 and 59. Notably, individuals aged 20 and above faced a significantly higher risk of snakebite, more than 13 times higher compared to those under 10 years old. This age group primarily consists of teenagers and adults who are typical workforce. The increased risk of snakebite within this age group aligns with previous research conducted in Asia [27]. This sub-group is actively involved in activities such as agricultural work, herding, fetching water, gathering firewood, or building materials, therefore increasing the risk of snakebite. On the other hand, children under the age of 10 accounted for only 3% of snakebite victims in this study. However, it is well-documented that snakebite morbidity, severity, and fatality are also prevalent among children [28,29]. These findings highlight the importance of prioritizing interventions for snakebite prevention and control among both the older age group and the youngest age group.

Our data indicates that farmers, students, and herders are most affected by snakebite incidents. Specifically, our study found that farmers experience snakebite incidents 22 times more frequently than unemployed individuals, aligning with previous research that identifies snakebite as an occupational disease [8,27,30–32]. The high occurrence of snakebites among agricultural workers and herders suggests a lack of protective equipment during agricultural and grazing activities. Wearing appropriate footwear such as shoes, gumboots, and heavy-duty gloves while working in agricultural fields or searching for pastures for livestock could significantly reduce the risk of snakebites. Additionally, the incidence of snakebites among students can be attributed, in part, to walking barefoot and playing in grassy areas.

The majority of snakebite victims were bitten while participating in outdoor activities or walking along the rural road, highlighting the growing overlap between human and snake habitats due to increased human activities like plantation, grazing, and village expansion. This exposes individuals to snakebites during their daily routines. Our findings also revealed that 15% of victims were bitten within their home compounds, while 6% were bitten while sleeping. Several factors contribute to these occurrences. Firstly, rural settlements are often surrounded by bushes, providing favourable snake habitats. Secondly, poorly constructed rural houses with thatched roofs, mud floors, and inadequate doors and windows make it easier for snakes to enter, increasing the risk of snakebites, especially during sleep or when there is insufficient indoor lighting. Additionally, storing grains in bedrooms in rural communities inadvertently provides shelter for snakes, as they are attracted to their prey, such as rodents or lizards, further increasing the risk of snakebites. Similar findings have been documented in other studies [21,33,34].

We observed that snakebites are most likely to occur during the morning, noon, and at night. In the morning, bites are more likely to happen as individuals venture out for work or engage in activities that put them at risk of snakebites, such as clearing fields, harvesting, herding, and collecting firewood. During noon, snakebites are also probable as snakes tend to search for water, increasing the chances of encountering humans. Similarly, during noon, individuals often seek shade under trees, making them predisposed to snakebites from snakes concealed in those trees. Furthermore, snakebites that occur in the evening and at night are likely to happen on roadsides or at home, as snakes are less visible in low light conditions and are more active during nocturnal hunting. The occurrence of snakebites at different times of the day has also been documented in other studies [35–38].

Similar to previous studies [21,38], we observed that snakebite incidents were more prevalent during both the rainy season (25.09%) and the dry season (33.95%). It is worth noting that during the dry season, when prey is scarce, people may have been more exposed to snakebites as snakes actively search for food and water. This finding aligns with ecological studies that demonstrated an increase in snake activity during the dry season, coinciding with a decrease in surface water levels (55, 56). However, the higher occurrence of snakebites during the rainy season could be attributed to increased field and agricultural activities during this period, coinciding with snakes bleeding season, or increased bushes.

Emilie *et. al* [27], established that 60% – 80% of snakebites occur on the foot, ankle, or leg. Our current study replicated these findings, with 81% of all bites occurring on the lower limbs. It is likely that bites occurring while walking or engaging in agricultural activities primarily affect the lower limbs. This observation can be attributed to the absence of protective footwear such as shoes or gumboots when working on farms. In many cases, victims unintentionally step on snakes while working in fields or walking on rural roads, which are often covered in grass. Nevertheless, it is important to note that snakebites on the upper limbs, trunk, head, or neck region are also common [41]. These bites typically occur when victims are sleeping on the floor or in bed. Nocturnal snakes that enter houses in search of prey are often responsible for these incidents.

In our study, we observed snakebites caused by various snake species. The appearance of the snake was primarily used to identify the specific species, although some individuals used local names. Black snakes were commonly recognized as the most aggressive specie. Specifically, snakes referred to as "Swila" (cobras), "Koboko" (black mambas), and "Kipili/moma" (puff adders) were frequently identified by their Swahili names. Swila was described as venomous and capable of spitting venom, while Koboko was considered highly dangerous and potentially fatal due to its quick-acting bite. Kipili/Moma, on the other hand, was described as relatively calm and non-aggressive, but still poisonous, with occasional cases leading to gangrene and amputation. It is important to note that the low mortality rate observed in our study suggests that many victims may have experienced "dry bites" or were bitten by non-venomous snakes. Previous studies has documented presence of poisonous and non-poisonous snakes species in Tanzania including black mambas, black-necked spitting cobras, Egyptian cobras, puff adders, brown house snakes, green mambas, and olive grass snakes [14, 17].

The strengths of this study includes its design approach in collecting data from both the community and health facilities, as well as wide geographic representation from various zones in Tanzania. However, it is important to acknowledge certain limitations. Firstly, data collection within the community did not encompass every household but instead relied on potential participants voluntarily presenting themselves at a specific location for enrolment. This approach may have resulted in the missing of some events (incidents/deaths), thereby potentially underreporting the true burden of snakebite. Secondly, in addition to incomplete documentation, some health facilities failed retrieving files of snakebite victims. Thirdly, the use of village population enumeration data from the 2012 census may have influenced our estimates by inaccurately reflecting the current population dynamics and demographic changes within the community. Future research should strive to address these limitations for a more robust and generalized data.

CONCLUSION

Snakebite envenoming poses a significant public health challenge in Tanzania, leading to substantial morbidity and mortality. This condition affects both children and adults, with a higher prevalence among males. Furthermore, SBE is prevalent during both the dry and rainy seasons, and it presents as an occupational hazard, particularly impacting farmers. These findings underscore the need for immediate and collaborative actions from various stakeholders to prioritize and implement measures aimed at reducing the burden of SBE in Tanzania.

Conflict of interest

Authors declare no conflict of interest about this publication.

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inclusion in order to promote health equity for all individuals and communities.

Author's contribution

EPK, LEM, and NGM designed the study, collected data, and wrote the manuscript. GPM helped with study design, data collection, and data analysis. FBM analysed the data and assisted in writing the manuscript. HTN, YJM, and DRJ collected data and assisted in writing the manuscript. PMM, JEC, and AML assisted in writing and reviewing the manuscript. All authors have read the final draft and approved it for publication.

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