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Prevalence of Malaria in the Highlands of Obudu Cattle Ranch, Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Author IGU did the study design and wrote the protocol. Authors EIO, LLA and IGU did the statistical analysis and literature searches while analyses of study were by author SEE. All authors read and approved the final manuscript.

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ABSTRACT

Studies on highland malaria have been spurred by reports of rising incidence of the infection at altitudes where the malaria vector was not previously found. Preliminary studies were carried out in Obudu Cattle Ranch communities located at an altitude of 1,585 meters above sea level in the heart of the tropical rainforest of Cross River State of Nigeria; to determine the prevalence, knowledge, attitude and practice (KAP) of malaria. The study methodology included the use of questionnaires and secondary data. A four-year prevalence study using malaria data from 2008 to 2011 revealed high transmission rate of malaria on the highlands, with 324 reported cases and a high and fluctuating prevalence rates ranging from 39.61/1000 in 2008 to 68.87/1000 in 2009; and 82.29/1000 in 2010 to 49.1/1000 in 2011. Analysis of seasonal incidence showed higher incidence (68.5%) in the wet season with temperature range of 4°C – 10°C than the dry season with temperature range of 26°C – 32°C. Malaria incidence was significantly related with season and sex ($P < 0.05$). Children between the ages of 5 and 14 years were the most affected (33.64%); the under-fives constituted 24.69% while the aged, over 60 years of age, constituted 4.62% of total

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population infected. The study recorded high level of ignorance of disease etiology (62.5%); and negative attitude and practice of malaria treatment, with high preference for self medication (37.5%) and traditional medicine (12.5%).
While the study has documented prevalence of mountain malaria in the region, it has set the stage for in-depth inquiry into the role of climate change on malaria incidence and its implications to public health in Nigeria's most valued mountain resort.

Keywords: Mountain malaria; obudu cattle ranch; prevalence; knowledge; attitude and practice; seasonal incidence.

1. INTRODUCTION

In the midst of growing efforts at treatment and control, malaria is still a major threat to life and socioeconomic development, especially in Africa. Latest estimates show that 207 million cases were recorded globally in 2012 and about 627, 000 deaths, mostly among African Children [1]. Although malaria is endemic in the tropics, its transmission dynamics is greatly influenced by a mix of climatic and anthropogenic factors which influence vector ecology and also capable of enhancing transmission rates and patterns in certain areas. Environmental parameters such as rainfall, temperature and humidity, type and distribution of vegetation are vital in promoting vector proliferation and abundance [2-5]. Human attitude and practices also promote man-vector contact and disease prevalence in a community; e.g. housing patterns, environmental sanitation practices, urban drainage, population as well as unresponsive control system.

The role of temperature in the transmission dynamics is paramount owing to its influence on both vector and parasite biology. It affects population growth of mosquitoes and development of *Plasmodium* within the vector. Parasite extrinsic incubation period reduces as temperature rises and the feeding frequency and blood digestion rate of adult female mosquitoes increase in warmer temperatures, thus the proportion of infective vectors and transmission intensity increase respectively. While temperatures above 34°C generally impact negatively on vector and parasite survival, stable transmission of the falciparum malaria is supported by temperature above 10°C with a threshold at 18°C [6,4]. Studies have shown variation in extrinsic incubation period (EIP) across a range of diurnal temperature, which also influenced transmission intensities across the various locations [7]. Recent models show that daily temperature fluctuations influence EIP, which alters malaria transmission potential; with increase in the rate of parasite development under cooler conditions but decrease in parasite growth under warmer conditions [8,9]. Malaria is limited in highland areas because of low temperature. However, increasing incidence of malaria is being recorded in higher elevations in recent years. Such incidence in the East African highlands and Madagascar is assumed to be due to climate change [10] Increasing incidence has been recorded in the highlands of Columbia (50-2,700 meters) and Ethiopia (1,600-2,500 meters) where temperatures have been low, but have in recent years experienced higher temperatures as a result of global warming [11]. Variation of transmission with more malaria infection in a lowland than a highland area has also been reported in Tanzania [12].

By reason of dominant variations in environmental indices influencing transmission, the spatial distribution of malaria infections and its transmission are obviously non-uniform, even in endemic areas [13,14]. While malaria is endemic in Nigeria, with a high transmission rate of above 1 case per 1000 population [15], variations in incidence due to varying environmental factors across the country must necessarily guide control efforts. This study recognized the potential influence of the highland environment on malaria transmission and its implication on disease endemicity and thus set out to determine the profile of malaria and factors influencing its prevalence in the Obudu Cattle Ranch area, Nigeria's frontline tourists' highland.

2. MATERIALS AND METHODS

2.1 Study Area

Obudu Cattle Ranch is located on the Obudu Plateau in Obanliku local government area, North-East of Cross River State of Nigeria. The State has an average temperature of 29°C and experiences two alternating seasons; the wet (May-October) and dry (November-April). The entire Ranch area includes seven villages

namely Kajukwu, Ukwamu, Okpayanga, Abayiule, Anape, Kigol and Keyi; with the Obudu Mountain Resort, an international tourists' location. Although it falls within the tropical climatic conditions of the State, it has a temperature of 26°C – 32°C between November and January (during the dry season) and lowest temperature range of 4°C – 10°C between June and September (during the wet Season). It has an altitude of 1,585 meters above sea level [16]. Total population of the study area was projected from the 1991 National Population Census figure of 888 people.

2.2 Data Collection and Analysis

Two sets of data were collected for the study, namely, data on knowledge, attitude and practice (KAP) of the people on malaria, and secondary data on reported malaria cases. The former was collected using questionnaires designed to suit individuals from 13 years and above, with 37 items (36 close-ended and 1 open-ended questions). A total number of 80 respondents were involved in the questionnaire study; 50% of respondents were between the age bracket of 18 and 24 years; 37.5% under ages 29 to 39 years; 7.5% under the ages 40 to 50 years, and 5% under the ages 51 years and above. Data on reported malaria cases in the area over a period of four [4] years, 2008 to 2011, were retrieved from medical records at the Obudu Cattle Ranch health unit, under which catchment area the seven villages fall. Data were analyzed using descriptive and non-parametric statistics.

2.3 Limitations of the Study

The KAP study was limited by the actual small size of community population, size of the age group of respondents selected (that is those capable of responding to questions (13 yrs and above), as well as unwillingness and non-availability of the natives who are predominantly farmers, to participate in the study. Also this study did not identify the species of malaria parasites in the area as it was a preliminary investigation of prevalence of the disease. However, it served as a basis for further studies that will address these needs.

3. RESULTS

3.1 Yearly Malaria Incidence

A total of 324 reported cases of malaria were recorded for the four year period, 2008 to 2011. These consisted of 163 (50.3%) males and 161 (49.7%) females.

Highest cases of malaria (34.6%) was recorded in 2010 with prevalence rate of 82.29/1000 population and lowest cases (16.0%) were recorded in 2008 with prevalence rate of 39.61/1000. The males had more malaria cases (50.3%) than the females (49.7%), (Table 1.).

3.2 Malaria Incidence with Age

The highest number of reported malaria cases were amongst children between the ages of 5 and 14 years (33.64%, n = 109) while the aged, 60 years and above, contributed the lowest (4.62%, n=15). Children under 5 years of age contributed 24.69%, (n=80), (Fig. 1).

3.3 Seasonal Incidence of Malaria

A total number of 102 cases, representing 31.5% of the total reported cases occurred in the dry season, while 222 cases (68.5%) were reported in the wet season, (Table 2). Varying incidence rates were observed in the years within the period.

Table 1. Prevalence of malaria in the ranch communities (2008-2011)

Period	Male	% infection (male)	Female	% infection (female)	Total	% Total	Population of study area*	Prevalence rate
2008	30	57.69	22	42.31	52	16.0	1,311	39.61
2009	53	57.61	39	42.39	92	28.40	1,336	68.87
2010	50	44.64	62	55.36	112	34.60	1,361	82.29
2011	30	44.12	38	55.89	68	21.0	1,385	49.1
Total	163	50.3	161	49.7	324		5393	

** Projected population for respective years from national census figures*

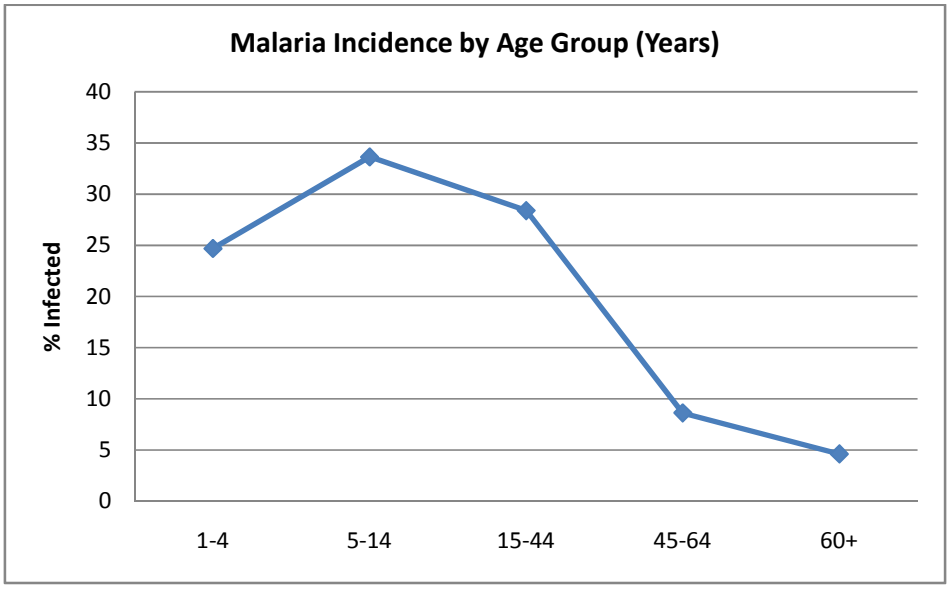

Fig. 1. Malaria Incidence by age group (years), (2008-2011)

Table 2. Seasonal incidence of malaria

Year	Dry season		Wet season		Total	Population
	No. of cases (%)	Prevalence rate/1000	No. of cases (%)	Prevalence rate/1000		
2008	6 (10.90)	5.9	49 (89.1)	22.1	55	1,311
2009	36 (43.90)	35.3	46 (56.1)	20.7	82	1,336
2010	55 (49.54)	55.9	56 (50.5)	25.2	111	1,361
2011	5 (6.58)	4.9	71 (93.4)	31.10	76	1,385
Total	102		222		324	5,393

3.4 Knowledge of Malaria

Most (62.5%) of the 80 respondents who participated in the study did not know the cause of malaria; 30 (37.5%) could assert that malaria was caused by mosquito bite, while others believed it was caused by bad water (25%) or bad weather (25%), and yet others were completely bereft of idea in that regard (12.5%), (Table 3).

Table 3. Knowledge of cause of malaria

Cause	Number (%) of respondents
Bad water	20 (25.0)
Mosquitoes	30 (37.5)
Bad weather	20 (25.0)
No idea	10 (12.5)
Total	80 (100)

3.5 Attitude and Practice of Malaria Treatment

The dominant attitude and practice of malaria treatment amongst the people was seeking medical attention in health centre (50%). Other practices were self medication using drugs procured from vendors (37.5%), and traditional medicine (herbs) (12.5%); (Table 4).

Table 4. Attitude and practice of malaria treatment

Treatment option	Number (%) of respondents
Medical (Health centre)	40 (50.0)
Self medication	30 (37.5)
Traditional medicine	10 (12.5)
No treatment	0
Total	80 (100)

4. DISCUSSION

4.1 Malaria Prevalence in the Ranch Communities

This study has documented the prevalence and high transmission rate of malaria in the highland communities of Obudu Cattle Ranch, located in the heart of the tropical rainforest of Cross River State, corroborating a previous malaria GIS study that provided a general thematic map of the entire State, [17]. Out of 324 cases of malaria reported at the health unit within the study period, 2008 to 2011, the highest number of cases was recorded in 2010, with the highest prevalence rate of 82.29/1000 population. Prevalence rate rose from 39.61/1000 in 2008 to 68.87/1000 and 82.29/1000 in 2009 and 2010, respectively; but dropped to 49.1/1000 in 2011, signifying reduction in the number of new cases of malaria by 2011. This would suggest an improvement in control efforts or positive attitude of the people against the disease. However, judging from the high level of ignorance recorded in the KAP study and the negative attitude and practice of malaria treatment, e.g. the preference for self medication and traditional medicine, it is possible that it was only the rate of clinic attendance (reported cases) that may have dropped but not necessarily the incidence of the disease. The observed high transmission rate of mountain malaria in Obudu Cattle Ranch adds to the growing literature on the increasing transmission of malaria in highland areas in the tropics; especially in the highlands of Africa, where recent outbreaks are attributed to climate change [18,7,19,11].

It was also observed that children between the ages of 5 and 14 years were the most affected population group within the study period (33.64%), those below the age of 5 years formed 24.69% of the total population infected, while the least affected group was the aged, 60 years and above. While this finding does not align with known view that malaria burden is most on children below 5 years of age and the aged [20,21]; it is explicable that since this study relied on reported malaria cases at the health unit, it is possible that many cases amongst the under-fives and the aged may not have been reported within the period.

Malaria infection was more amongst the male members of the communities (50.3%) than females (49.7%). The relationship between infection and sex was found to be statistically significant, (P<0.05). Males were more infected, probably because they were more exposed to the vector than women due to occupational needs that warrant the males to work longer hours outdoors more than women e.g. in the farms. However, the result may have also been influenced by the pattern of clinic attendance and reporting of illness.

The relationship between malaria incidence and season shows that a higher incidence of the disease was recorded in the wet season; this was shown to be statistically significant (P<0.05). This is to be expected because during the wet season high rainfall and availability of stagnant water in human surroundings promote the breeding of the mosquito vector and thus enhance high transmission, hence high malaria incidence. It has been noted that transmission of malaria is influenced by climate and geography, and often coincides with the rainy season; and continued presence of water and constant temperature throughout the period favour the breeding of mosquitoes [2,3,6,4,22].

4.2 Knowledge, Attitude and Practice of Malaria in the Ranch Communities

Studies on the knowledge, attitude and practice of the people showed that majority of the people did not know the cause of malaria as only 37.5% of respondents could mention mosquito as the cause of the disease. Knowledge of the disease is an important aspect in control. The high level of ignorance recorded in this study could contribute to high prevalence of the disease in the area as natives remain off-guard to the presence and abundance of the vector.

The study also revealed that while 50% of the people seek medical attention at the clinic for malaria and other ailments, 50% apply other measures to help themselves, such as self medication (37.5%) and use of traditional medicine (12.5%); indicating a considerably poor health-seeking behavior in general and wrong approach to the management of malaria in particular, in the population. Self medication involves indiscriminate use of drugs obtained without prescription from drug vendors or patent medicine dealers in the area for symptoms thought to be those of malaria. The practice exposes the people largely to the inherent dangers associated with drug abuse and failed treatment with composite implication on the epidemiology and immunity to the infection amongst the population. This and the reliance on

traditional medicine for malaria treatment suggest that the communities may not be properly informed about malaria. Paucity of knowledge and non-conforming practices may prevent effective treatment and control of the disease in the area.

5. CONCLUSION

The study revealed high prevalence of malaria at the highland communities and paucity of basic knowledge of malaria amongst the people, which probably informed wrong attitude and practice of malaria treatment. This finding agrees with current reports of incidence of mountain malaria, especially in African highlands. However, determining the trend of incidence in the highland of Obudu Cattle Ranch would require further and in-depth retrospective study, as well as prospective longitudinal studies in order to assess the influence of climate change on the transmission pattern. Meanwhile an intensive control programme should be introduced on the mountain. Such programme should contain mass education and vector control strategies as priority, to control increasing incidence of the disease in the tourists' zone.

ETHICAL ISSUES

Ethical permission to conduct the study was sought and obtained from the Department of Medical Services of the Obudu Mountain Resort. Informed consent of respondents was obtained after due consultations with administrative hierarchy of the communities.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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