Malaria prevalence and health-seeking behaviour among communities of the lowlands and highlands of Gonja, Same District, north-eastern Tanzania

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Abstract: A malaria survey was carried out in the lowlands and highlands of Gonja in Same District, north-eastern Tanzania. Malaria parasitaemia prevalence was found to be 26.8% and 3.8% in the lowlands and highlands, respectively. In the lowlands *Plasmodium falciparum* accounted for 96.8%, whereas *P. malariae* and mixed infections of *P. falciparum+P. malariae* accounted for 1.8 and 1.4% of all infections respectively. Of the *Anopheles gambiae* collected in the lowlands 61.5% were parous and 4.8% were infected with malaria sporozoites. Malaria was the most important public health problem among the communities in Gonja accounting for 37.9% of all admissions at health care facilities. The population in the lowlands had better knowledge of the disease and its control measures than those in the highlands. Among the communities in the highlands malaria was associated with frequent movements to the lowlands. Efforts to provide health education to the people of Gonja should be strengthened to control malaria among the communities most at risk.

Introduction

Malaria is the leading public health problem in Tanzania (Ministry of Health, 2001). The country has widest areas of highest transmission (over 300 infective bites per person per year) in Africa (*1*). Most areas of the country have perennial and intense malaria transmission while others have intense but seasonal transmission. Only a few areas experience moderate or low transmission (*2*).

Malaria was the most important vector-borne disease in Same District before the robust Pare-Taveta Malaria Control Scheme was introduced in 1955 (*3*). Twenty years after the scheme was terminated, it was shown that neither the prevalence of morbidity nor the overall mortality rate had reached levels before the intervention. Treatment seeking behaviour was thought to be responsible for the delayed return of the high morbidity and mortality levels (*4*). Many changes have occurred since then, and a large rice irrigation scheme is in place in the lowlands attracting large numbers of employment while at the same time offering wide-spread breeding sites for mosquitoes. The level of malaria transmission is therefore probably higher than what it was before or during the scheme. This study was conducted in order to provide current information on the level of malaria transmission and its consequences in order to guide proper management and control of the disease in Gonja area of north-eastern Tanzania.

Materials and Methods

Study Site

The study was carried out in Gonja area (4°20'S, 38°00'E) of Same District, northeast Tanzania in August 2000. Two villages, Bombo in the highlands (1210 m above sea level) and Maore in the lowlands (500 m above sea level), were selected for the study. Topographically, the two areas lie in the lowland of the Mkomazi Valley (500-900m) and highlands of the Pare Mountains (1200 - 1800m), respectively. The average annual rainfall is 780 mm occurring mainly in February -May with short rains in November-January. There is some seasonal change in prevailing temperatures: January to March being the hottest, and June to July the coolest months.

Most people live for most part either on the mountains or on the lowland villages. There are also smaller numbers of people living either in the dry plains, herding their cattle, or growing rice in the swampy and irrigated areas of Maore and Ndungu. The study area was part of the former Pare-Taveta Malaria Control Scheme of 1954-1959.

Health care facilities are available for most of the inhabitants within a few kilometres of their homes. The Gonja Lutheran Hospital in the highlands of Bombo serves the area. There is one rural health centre at Ndungu and dispensaries are found at Vuje in the highlands and Mpirani and Maore in the lowlands.

Malariometric survey

Malariometric surveys were carried out in the villages of Bombo (in the highlands) and Maore (in the lowlands). In both the lowland and highland, schoolchildren were screened for malaria parasites. Schools involved were Dindimo, Putu, Mvaa and Mjema in the highlands and Maore, Mtundu, Mheza and Kalemani in the lowlands.

Thick and thin blood smears were collected from each individual from a finger prick. The blood smears were stained with 10% Giemsa and examined under microscope in order to identify malaria parasite species present. Malaria parasite count was made against 200 leukocytes. A slide was considered negative if no parasite was seen after scanning 200 microscopic fields under oil immersion with X100 objective. When gametocytes were present, they were counted against 500 leukocytes. Parasite rate, geometric mean of parasite density, gametocyte rates and density indices were then determined.

Entomological survey

Mosquito collections were made using pyrethrum spray catch and light trap catch techniques. One room in each selected house was sprayed with pyrethrum during the morning hours, and after 10 minutes, the mosquitoes knocked down on the spread white cotton sheets were picked up and preserved in petri dishes lined with moist cotton wool and filter papers.

Mosquito collections were also made overnight with CDC light traps (John W. Hock Co., Gainesville, Florida, U.S.A.) operated in the main bedroom of 3 houses per village. Each trap was suspended on the head side, about 1.5 m above the floor and 0.5 m from a bed occupied by one adult sleeper under untreated mosquito net. The trap was switched on at 18:00 h and the room owner was asked to switch off the trap at 06:00 h the following morning. All collections were morphologically identified, sorted according to site of collection, house, date and species. Female *Anopheles* mosquitoes were grouped as unfed, fed, half-gravid and full gravid according to the external appearance of their stomach contents. The female *An. gambiae* were dissected and examined for parity and malaria sporozoites.

Malaria morbidity and mortality in health facilities

Malaria morbidity and mortality data from health care facilities were collected from outpatient and in-patient registers. Data were collected from Gonja Lutheran Hospital, Ndungu Health Centre and Maore and Vuje Dispensaries. In both, data were collected to cover a period of five years.

Knowledge, attitudes and practice

Information on malaria knowledge, attitude and practice was collected using semi-structured questionnaires. The study population was selected randomly covering a total number of 334 households. In every household visited, either the head of household or his/her spouse and in some cases any other mature (>18 years old) member of the respective household was interviewed. In addition, informal in-depth interviews were held with some elders and shopkeepers on their experience on malaria and its management and control.

Data analysis

Data were entered and analysed with Epi-Info 6.0 and STATA computer software. Student *t*-tests were used to evaluate difference between parasite means in schoolchildren in the lowlands and highlands. Chi-square was used to test the differences in knowledge between communities in the highlands and lowlands.

Results

A total of 213 and 818 schoolchildren (aged between 6 and 15 years old) were screened for malaria parasites in lowlands and highlands, respectively. The overall malaria parasite rate was higher in the lowlands of Maore (26.8%) than in the highlands of Bombo (3.8%) (Table 1). The mean malaria parasite densities in <10 year old schoolchildren were significantly higher in the lowlands than in the highlands (Figure 1). *Plasmodium falciparum* was the predominant species accounting for 96.8% of all malaria infections in lowlands. Infection by *P. malariae* accounted for 1.8% whereas mixed infection by *P. malariae+P. falciparum* accounted for 1.4%. *P. falciparum* was the only malaria species found in the highlands. The overall malaria gametocyte infection rates were 14.7% and 5.2% for lowlands and highlands, respectively.

Table 1: *Malaria parasite composition and P. falciparum prevalence and its geometric mean of parasite density in Gonja*

Species	Lowlands (%)	Highlands (%)
Plasmodium falciparum	96.8	100
Plasmodium malariae	1.8	0
P. falciparum + *P. malariae*	1.4	0
Prevalence of *P. falciparum*	26.8	3.8
Geometric mean of parasite density	3752	556*

* Geometric mean of parasite densities are significantly different at $P<0.01$

A total of 603 mosquitoes of which 90.2% were *Anopheles gambiae sensu lato* and 9.8% *Culex quinquefasciatus* were collected in the lowlands (Table 2). No mosquito was collected in the highlands. Malaria mosquito densities in the lowlands as calculated from spray catches were 18.6 *An. gambiae s.l.* per room. Of the *An. gambiae* collected 61.5% were parous and 4.8% were infected with malaria sporozoites. Breeding of *An. gambiae* was found to take place at some swampy places at Maore.

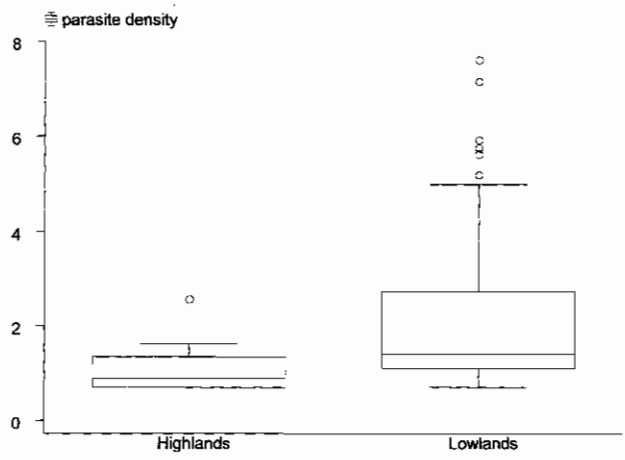

Figure 1: *Distribution of malaria parasite density in lowlands and highlands of Gonja*

Data collected from Gonja Lutheran Hospital and Ndungu Health Centre showed that malaria was the leading cause of health facility attendance for 1995-1999. Between 591 and 1457 cases of malaria per year were reported at Gonja Hospital during this period. More cases of malaria (72.6%) were observed in the > 5 year old group than in the < 5 year olds (27.4%).

Children under the age of 5 years contributed to 33% (29.3-38.6%) of all admissions at the hospital.41.2% (36.1-48.5%) of the < 5 years children and 34.4% (24.2-38.9%) of the > 5 years old individuals attending the hospital each year with history of malaria were admitted. Most of the malaria cases (60%) attended at Gonja Hospital were from the lowland villages of Maore, Mpirani and Ndungu. Malaria accounted for 25-53.8% of all causes of death at the hospital during the same period.

Table 2: *The number, parity and sporozoite rates of female Anopheles gambiae sl. collected by pyrethrum spray catch (PSC) and light trap techniques (LTC) in lowlands and highlands of Gonja*

Area	PSC	LTC	Parity (%)	Sporozoite (%)
Lowlands	280	264	61.5	4.8
Highlands	0	0	0	0

A total of 334 individuals were interviewed on their knowledge, attitudes and practice in relation to malaria. Of the respondents, 62% and 38% were from the lowlands and highlands, respectively.

A total of 292 (88%) of the study population ranked malaria as the most important health problem in both highland and lowlands. Fever, diarrhoea, convulsions, general body weakness, joint pain, headache, loss of appetite, vomiting and cough were mentioned as the most common symptoms of malaria. The frequency of knowledge on these symptoms, however, varied from lowland to highland areas although there was no significant difference in some of the symptoms mentioned between the two areas (Table 3).

The classification of the malaria problem was observed to be significantly different between the two areas. The higher proportion of the respondents in the lowlands classified malaria as the most serious problem compared to those in the highlands of Gonja ($P<0.01$). One hundred and ninety-one (57%) of the respondents perceived malaria as the most serious problem in the area. Some 4% of the respondents considered malaria not a serious problem while 39% perceived malaria is a "normal" problem. Most (85%) respondents in highlands associated malaria with the visits the make to the lowlands of Maore during market days, weddings and funeral ceremonies.

Table 3: *Knowledge of malaria symptoms according to respondents in the lowlands and highlands of Gonja*

Symptoms	Gonja-Maore	Gonja-Bombo	Test statistic
Body temperature	Yes: 134 (64%) No: 75 (36%)	Yes: 92 (73%) No: 34 (27%)	χ^2_1=2.8, *p*-value= 0.09
Convulsion	Yes: 9 (4%) No: 200 (96%)	Yes: 7 (6%) No: 119 (94%)	χ^2_1=0.3, *p*-value= 0.60
Diarrhoea	Yes: 77(37%) No: 132 (63%)	Yes: 21 (16%) No: 105 (84%)	χ^2_1=15.4, *p*-value<0.01
General body malaise	Yes: 124 (59%) No: 85 (41%)	Yes: 78 (62%) No: 48 (38%)	χ^2_1=0.2, *p*-value= 0.60
Joint pain	Yes: 155 (74%) No: 54 (26%)	Yes: 77 (61%) No: 49 (39%)	χ^2_1=6.3, *p*-value= 0.01
Headache	Yes: 158 (76%) No: 51 (24%)	Yes: 98 (78%) No: 28 (22%)	χ^2_1=12.8, *p*-value<0.01
Cough	Yes: 57 (27%) No: 152 (73%)	Yes: 13 (10%) No: 113 (90%)	χ^2_1=13.6, *p*-value<0.01
Jaundice	Yes: 13 (6%) No: 195 (94%)	Yes: 11 (9%) No: 115 (91%)	χ^2_1=0.7, *p*-value<0.4
Loss of appetite	Yes: 109 (52%) No: 100 (48%)	Yes: 75 (60%) No: 51 (40%)	χ^2_1=1.7, *p*-value<0.2
Vomiting	Yes: 37 (18%) No: 170 (82%)	Yes: 15 (12%) No: 108 (88%)	χ^2_1=1.9, *p*-value<0.2

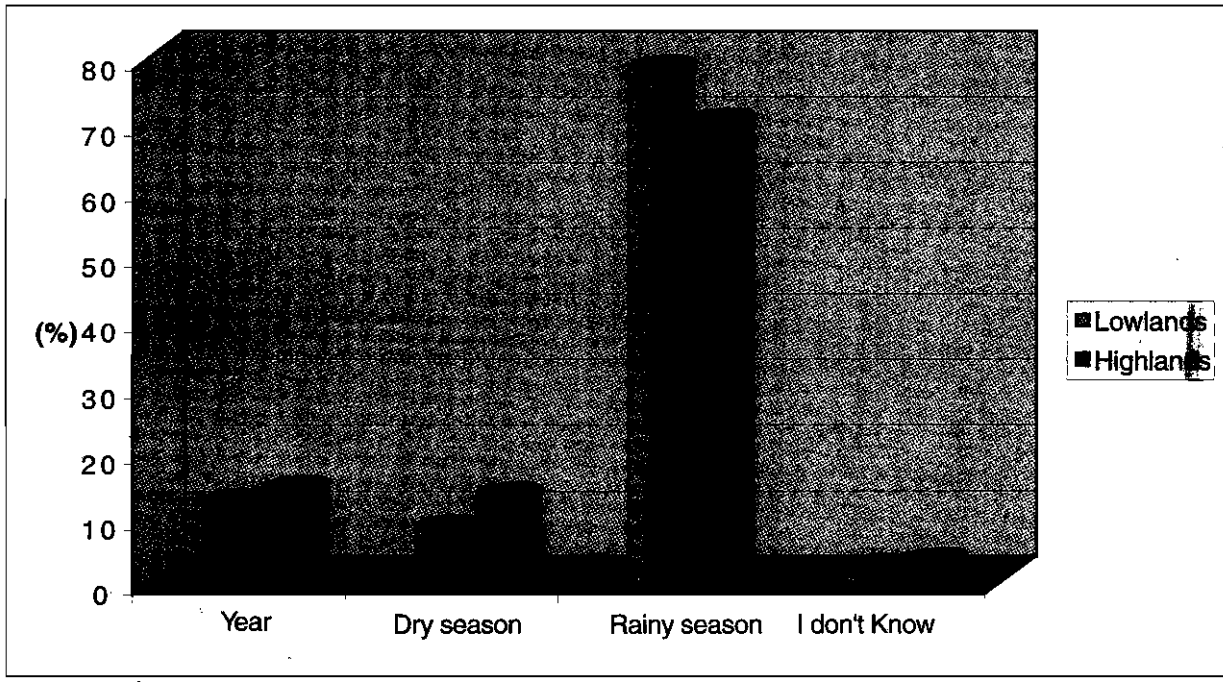

Figure 2: *The season when most malaria cases occur according to the responses of the communities in Gonja*

It was reported by 72% of the respondents in the lowlands and 66% in the highlands that all age-groups were at risk of getting malaria. Some 78% and 70% of the respondents from lowland and highland areas respectively said that malaria was a common disease during the rains (Figure 2). Ninety percent of the respondents knew that malaria is transmitted through a mosquito bite. However, the rest of the respondents said that malaria is transmitted through contaminated water and is due to climatic changes.

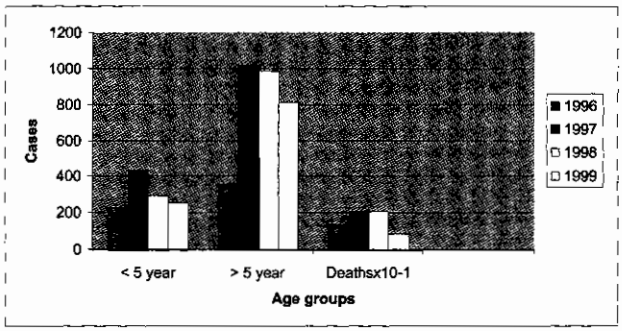

Figure 3: *Number of cases and deaths at Gonja Lutheran Hospital, 1996-1999*

The people of Gonja treated malaria using both modern and traditional medicine. Traditional herbs used to treat and prevent malaria in the area included *Mzangaze, Mkwazu* and *Sivi. Mshukwe* was the most commonly used mosquito repellent. Most people preferred traditional medicine than modern medicine because of their inability to afford health services charges.

Moreover, antimalarial drug failure was mentioned to be common in area, causing the community to lose faith in the ability of chloroquine in treating malaria cases.

Most respondents in the lowlands considered the use of mosquito nets as the main strategy through which malaria can be prevented. The utilisation of mosquito nets was higher in the lowlands than highlands. A higher proportion of the highland population preferred to use antimalarial drugs such as chloroquine and sulfadoxine-pyrimethamine for chemoprophylaxis.

Discussion

Results obtained from this survey indicate that malaria transmission in Same district is significantly higher in the lowlands than in the highlands. Earliest studies in the Mkomazi area have also showed that malaria parasite rate was found to be higher in the lowlands of Gonja (*13*) affecting more children than adults.

Malaria prevalence in the lowlands found in this study was higher than that (1-20%) observed soon after the indoor spraying of dieldrin in 1955. In the present study the lower parasite rates were found during the cool and dry period of the year when malaria transmission is expected to be low.

The higher prevalence of *P. falciparum* and lower prevalence of *P. malariae* observed in this area was as expected in most endemic areas of Tanzania (*6*). *P. falciparum* was the predominant malaria parasite, with *P. malariae* and *P. vivax* obtaining significant proportions only in the areas of heaviest transmission in the area before the robust malaria control programme of 1950s (*3*). Interestingly, only *P. falciparum* was observed in the highlands where malaria transmission is low.

In Gonja, *An. gambiae s.l.* was the most predominant mosquito species in the lowland villages. The high (4.8%) sporozoite rate in *An. gambiae* observed in this study is probably due to a small sample of the dissected mosquitoes collected in the area. However, this indicates that even during a dry and cool season of the year malaria transmission is still maintained by a smaller population of the mosquitoes available. Surveys conducted in the same area in 1954-1955 showed that mosquito catches in the area mainly consisted of *An. gambiae* and *An. funestus* (*14*). Thereafter, *An. funestus* disappeared almost completely (following dieldrin spraying) (*17*). The absence of *An. funestus* during this survey could not be explained. Nonetheless, the absence of permanent water bodies in the area due to poor rainfall since 1999 may be a contributing factor to the absence of this species. Poor rainfall is also likely to be another reason for the lower densities of *An. gambiae* observed in our study. Although during our study malaria vectors were not observed in the highlands, the presence of malaria parasites in schoolchildren suggests the possibility of some transmission in the area.

Morbidity data from health care facilities in the area show a seasonal trend in the incidence of the disease, with a highest peak between May and July. Previous studies in the area have shown that maximum transmission occurs during the first 4 5 months of the year (*3*).

Children < 5 year old were at a higher risk of contracting malaria than adults. Moreover, about half of those reporting to hospital with malaria were

always admitted suggesting delay in seeking health care. Previous surveys in the area have shown that deaths in children < 5 years of age were most frequent during the malaria season (*16*) and an association between mortality and malaria transmission among the older children has not been established in the area.

Communities from the highlands of Gonja associate malaria with their frequent visits to the lowlands attending markets, wedding and funeral ceremonies. This suggests that most malaria infections in the highlands are therefore acquired in the lowlands. The fact that most cases of malaria attended at Gonja Hospital in the highlands originate from the lowlands has also been reported in previous studies (*16*). However, the possibility of transmission taking place in the fringes of some river tributaries and water collections during the rainy season in the highland villages cannot be ignored.

The experience of self-medication practices and awareness about the growing problem of drug resistance in the area constitute important information that requires urgent attention. It is advisable that laboratory confirmation of malaria is important given the symptomatic overlap of malaria and other conditions (*8*).

Since the absence of malaria parasites in a blood smear does not necessarily exclude completely the presence of malaria, it is further recognised that laboratory tests are essential and necessary to ascertain diagnosis and limit overuse of drugs so as to avoid the development of antimalarial drug resistance.

Factors behind the widespread preference for self-medication and traditional medicine in Gonja may be attributed to the high cost of treatment services. The former is likely to have contributed much to antimalarial drug failure reported by some communities. Since drug stores and normal retail shops are sources of antimalarial drugs in Same District (*9*), shopkeepers should therefore be provided with information about prompt recognition and appropriate use of antimalarial drugs and encouraged to pass it on to their customers (*10*). Continuous monitoring of antimalarial drug efficacy should also be emphasised for timely actions.

As expected, the knowledge of the disease and its control measures were better known by the population in the lowlands than in the highlands. Likewise, the utilisation of mosquito nets, either treated with insecticide or not, in the control of malaria mosquitoes was commonest in the lowlands too. Most studies in Sub-Saharan Africa have revealed that the use of insecticide-treated nets significantly reduce the risks of morbidity and mortality due to malaria in childhood and during pregnancy (*11, 12*).

In conclusion, the prevalence of malaria in Gonja area of South-Same district varies with altitude, with higher transmission in the lowlands than highlands. Frequent movements to the lowlands expose the highland population to malaria infection. It is also evident that malaria threat is well perceived and known among the population in the lowlands. The gap in terms of malaria knowledge and prevention practice due to limited information about the disease and its vectors and protective measures leaves many people unprotected. Health education and net utilisation should therefore, be promoted in this area. It is important that sensitization of the community and promotion of mosquito net usage be emphasised to provide sustainable malaria control in this area.

Acknowledgements

The field and technical assistance of Mayunga Maega, Abdallah Telaki, Donald Mwanjelukwa, Aza Kimambo, Charles Sevuri, Eugene Stephen, Zamoyoni Kabanda, and Charles Kejo is highly acknowledged. We are grateful to the Same District Commissioner, District Education Officer and District Medical Officer for facilitating this study. The investigators also wish to acknowledge the co-operation of the villagers of Bombo and Maore who made the accomplishment of the study possible. This study received financial support from the UNDP/ World Bank/WHO Special Programme for Research and Training on Tropical Diseases.

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