SHORT COMMUNICATION

Urban malaria in Dodoma and Iringa, Tanzania

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Summary: Cross sectional malaria parasitaemia and entomological surveys were carried out in urban Iringa and Dodoma in Tanzania. A total of 395 and 392 schoolchildren (age range= 6-15 years) were screened for malaria parasites in Iringa and Dodoma, respectively. *Plasmodium falciparum* was the predominant malaria parasite (Iringa= 100%, Dodoma= 97.8%). Malaria parasitaemia was observed in 14.9% and 12% of the schoolchildren in Iringa and Dodoma, respectively. The geometric mean parasite density for *P. falciparum* was higher (632 parasites/μl) in Iringa than in Dodoma (74.1 parasites/μl). The average spleen rates were 0.5% and 2% in Iringa and Dodoma, respectively. A slightly higher haemoglobin level was observed among schoolchildren in Dodoma (10.2g/dl) than in Iringa (9.5g/dl). Only a few *Anopheles gambiae* sensu lato were collected indoors in the two areas. On the average 47.3% and 80% of the children in Iringa and Dodoma, respectively were sleeping under mosquito nets. Although malaria endemicity in the two municipalities is low, unplanned rapid urbanisation is likely to change malaria epidemiology in Tanzania. Continuous malaria and mosquito density surveillance should therefore, form an in integral part of the malaria control strategies in urban areas. Communities should be continuously sensitised to use insecticide-treated mosquito nets and strengthen community-based environmental management to minimise malaria breeding sites.

Key words: urban, malaria, schoolchildren, Tanzania

Malaria is the primary cause of ill health in Africa South of Sahara, causing an enormous health and economic burden. It is estimated that malaria causes up to 500 million-illness episodes and over 1.2 million deaths annually worldwide. More than 90% of these illnesses and deaths occur in Africa South of Sahara, the great majority in children under the age of 5 years (Lopes *et al.*, 2006). In Tanzania, malaria is the leading communicable disease problem, affecting over 95% of the population.

A number of malaria epidemiological studies have been conducted in Tanzania, and mostly covering rural population of northeast and south-east Tanzania. There is a significant lack of knowledge on urban malaria in the country, except for Dar es Salaam and Tanga (Yamagata, 1996; Wang *et al.*, 2006). It is estimated that over 33% of the population in Tanzania live in urban areas (Mbogoro, 2002); this being two-folds the proportion lived in 1978. The rapid urbanization in many areas of the country brings about major changes in ecology, social structure and disease patterns. Such changes are likely to alter the frequency and transmission dynamics of malaria, with significant effects on disease-associated morbidity and mortality. It has been reported that uncontrolled urban population growth accompanied with poor housing and lack of sanitation and drainage of surface water can increase mosquito breeding places and human-vector contact (Keiser *et al.*, 2004). This increase in urban population calls for the attention by health authorities and requires up-scaled and adapted strategies for malaria control and other diseases (Yamagata, 1996; Caldas de Castro *et al.*, 2004).

Data on malaria parasitaemia and transmission in many urban areas of Tanzania is scanty. Such information are urgently required to provide rational basis for the design, implementation and monitoring of malaria control programmes. It was therefore, the objective of this study was to determine malaria prevalence and transmission in two municipalities of Iringa and Dodoma in Tanzania.

This study reports results of malariaometric and entomological surveys carried out in Iringa and Dodoma in March 2001. Iringa Municipality (7°49'S, 35°15'E) lies between 1560 and 2000 m. The area receives an annual rainfall of 750-1000 mm between December and April. The mean temperature is about 19°C and remains relatively low throughout

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the year. Chipogoro and Gangilonga areas and their respective primary schools were selected for the study. Dodoma Municipality (6º8'S, 35º45'E) lies at an average altitude of 1100m and receives an annual rainfall of 500mm, with most of the rain falling in November-April. Chinagali School in Chang'ombe-Kati and Mlimani School in Kilimani were selected for the malaria surveys. Gangilonga (Iringa) and Kilimani (Dodoma) were located in well-planned areas, with well built houses and good drainage systems. Chipogoro (Iringa) and Chango'mbe-Kati (Dodoma) were located in areas characterised by poor housing and lack of drainage systems.

Malaria parasitaemia surveys were carried among schoolchildren. Each child was examined clinically and thick and thin blood smears were collected from a finger prick. The blood smears were stained with 10% Giemsa in phosphate buffer (pH 7.2) and examined under a microscope in order

per microlitre of blood, the number of parasites/µl was estimated by multiplying by a factor of 40 for asexual forms of malaria parasites.

In Iringa a total of 395 schoolchildren (age range=6-15 years), were screened for malaria parasites. *Plasmodium falciparum* accounted for 100% of the malaria parasites observed. The overall mean malaria prevalence rate was 14.9% (59/395)(Table 1). Parasite rate was significantly higher among schoolchildren in Ipogoro (19.5%) than Gangilonga (10.3%) (P<0.05). The geometric mean parasite densities were 491 and 773/µl in Ipogoro and Gangilonga, respectively. Gametocytes and spleen enlargement were observed in 0.5% of the children. The haemoglobin levels among schoolchildren in Iringa ranged between 9.3g/dl in Gangilonga and 9.7g/dl in Ipogoro. Among the schoolchildren, 47.3% (187/395) were using mosquito nets. Of these 64.2% were from Gangilonga and 35.8% were from Ipogoro.

Table 1: Malaria parasite and gametocyte rates, geometric mean parasite density (GMPD) spleen rate and haemoglobin level among children in Dodoma and Iringa

Municipality	Total children	Parasite rate %	Gametocyte (%)	GMPD Parasite/µl	Spleen rate (%)	Hb g/dl
Dodoma	392	12.0	0.76	74.5	2.0	10.2
Iringa	395	14.9	0.50	632	0.5	9.5

to identify any malaria parasite species present. Parasite rate, geometric mean parasite density, gametocyte rates and density indices were then determined. Haemoglobin levels was determined from a sample of 50 schoolchildren in each of the school. Each child screened for malaria parasite was asked whether he/she slept under a mosquito net the previous night.

Entomological surveys were conducted in the same areas where the malariometric surveys were done. Mosquito collections were made using pyrethrum spray catch technique between 06.00 and 09.00hr in 10 houses selected randomly. All mosquitoes collected were morphologically identified, sorted according to site of collection, house, date and species. Female *Anopheles gambiae* sensu lato and *An. funestus* were dissected to determine parity by observing the degree of coiling of ovarian tracheoles (Detinova & Gillies, 1964). Salivary glands of parous mosquitoes were examined for malaria parasites using standard dissection techniques (WHO, 1975).

All malariometric and entomological data were entered into EXCEL and Epi-Info 6 and analysed by STATA version 6 (Stata Corporation, USA). Sexual and asexual parasite rates and geometric mean parasite density were then calculated. Assuming an average of 8000 leukocytes

In Dodoma a total of 392 schoolchildren (age range= 6-15 years) were screened for malaria parasites of which 12% (47/392) were infected. *P. falciparum* accounted for 97.8% (46/47) of all species of malaria parasites observed. A mixed infection of *P. falciparum* + *P. malariae* was found in one (2.2%) child. The geometric mean of parasite density was slightly higher among schoolchildren in Mlimani (84 parasites/µl) than Chinangali (65 parasites/µl). Gametocytes were observed in 0.76% (3/392) of the children examined. The spleen rate among schoolchildren was slightly higher (3%) in Chinangali than Mlimani (1%). Similarly, the mean haemoglobin level was slightly higher in schoolchildren from Chinangali (10.5g/dl) than Mlimani (9.9g/dl). Twenty-six per cent and 32% of the children in Chinangali and Mlimani, respectively had haemoglobin levels below 10g/dl. On the average 80% of the children in Dodoma were sleeping under mosquito nets.

A total of 665 mosquitoes were collected in Iringa. Of these, 99.4% were *Culex quinquefasciatus* and *An. gambiae s.l + An. funestus* accounted for 0.6% of the mosquitoes collected. Only one *An. funestus* mosquito was collected at Ipogoro. In Dodoma, a total of 229 mosquitoes were collected, of which 171 (74.7%) were caught in Changombe-Kati and 58 (25.3%) in Kilimani. *Cx quinquefasciatus*

accounted for 98.7% and An. gambiae s.l. for 1.3% (3/229) of the total mosquito collection. All the An. gambiae mosquitoes were collected at Kilimani.

Like in many other places in Tanzania, *P. falciparum* was the predominant species of malaria in Iringa and Dodoma (Mboera, 2000). The mean malaria prevalence rates of 12-14.9%, indicate that the two urban areas are characterised by low malaria transmission. Similar findings have been reported in Iringa town during the 1960s (Clyde, 1967). Higher malaria parasite rates among children have been reported in nearby Iringa Rural district (Lemnge, 1990; Njunwa, 2000; Mboera *et al.*, 2001) and Dodoma Rural district (Clyde, 1967; Irare & Lemnge, 1988; Wakibara *et al.*, 1997).

In Iringa, a significantly higher malaria parasitaemia was observed among schoolchildren in Ipogoro than Gangilonga. However, the difference in parasitaemia between the two study locations in Dodoma was not significant. Some studies have already reported a high degree of heterogeneity in malaria burden in urban environments. It has been observed in Dar es Salaam, that the malaria prevalence rates among schoolchildren were higher as one move from the central to peripheral zones of the city (Yamagata, 1996). This can be explained by the fact that, the peripheral areas, which are usually, with poor drainage, provides much ample breeding sites than the central well-planned parts of towns. Moreover, it has been established that urban malaria prevalence rates show large variation, ranging from as low as 1% in city centres to more that 90% in suburbs. These variations may be attributed to various factors including weather, house locations proximal to wetlands, urban agricultural practices as well as infrastructure, including drainage and type of housing.

The low parasite rates observed in Dodoma could be explained by ecological and climatic difference between the two areas. Dodoma is located in the central plateau characterised by low (500mm) precipitations. Iringa is in the south-western highlands receiving on average >850mm of rainfall per year. Moreover, findings from this study indicate that there was relatively high mosquito net coverage in Dodoma than in Iringa. However, it could not be established whether or not the nets were treated with insecticides.

In both Iringa and Dodoma, a proportion of schoolchildren were found to have mild to moderate anaemia. Anaemia is a major health problem in Tanzania, especially among young children. The 2004-05 Tanzania Demographic and Health Survey showed that 72% of the children had some level of anaemia. One-fourth of children had mild anaemia, 43% had moderate anaemia, and 4% had severe anaemia (TDHS, 2005). According to

TDHS (2005) the prevalence of anaemia in children in Dodoma is 26.1% (mild) and 37.8% (moderate) whereas in Iringa it was 25.1% (mild) and 21.5% (moderate). Previous studies have reported anaemia in 33.8% and 21.3% of the pupils examined at Kikombo and Mlezi (in the suburbs of Dodoma), respectively (Irare & Lemnge, 1988).

Although the number of *Anopheles gambiae* s.l. during the study period was low, the species is likely to play a major role in malaria transmission in two municipalities. It is likely that few breeding sites for *An. gambiae* were available at the time of survey and that malaria transmission in the two areas is seasonal, depending on climate. Dodoma region is known for its unstable malaria, a characteristic of semi-arid zones (Mboera, 2004). Iringa at >1560 is also likely to experience seasonal unstable malaria. It has long been known that, in these areas, any change in temperature, relative humidity or rainfall can have a major impact on malaria transmission and possibly leading to epidemics. Constant monitoring of malaria incidence, and mosquito abundance and increased sporozoite rate is therefore, important for early detection of malaria outbreaks.

Rapid urbanisation is likely to change malaria epidemiology in Tanzania. Currently, over one-third of the population lives in urban areas, which are mostly characterised by poor infrastructure and poverty. The increase in malaria incidence at health care facilities and the established malaria endemicity as shown in this study, calls for initiation of effective malaria strategies that are appropriate in urban settings. Continuous malaria and mosquito density surveillance should form an in integral part of the malaria control strategies in such areas. Communities should be continuously sensitised to use insecticide-treated mosquito nets to protect themselves against malaria. Moreover, community-based environmental management to minimise malaria breeding in urban areas should be strengthened.

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