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Urban malaria: primary caregivers' knowledge, attitudes, practices and predictors of malaria incidence in a cohort of Ugandan children

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Summary

OBJECTIVES To assess malaria-related knowledge, attitude and practices (KAP) among primary caregivers, to identify associations between primary caregivers' characteristics and positive KAP towards malaria, and to identify independent predictors of childhood malaria incidence in an urban setting.

METHODS Children aged 6 months to 5 years living in Kampala, Uganda were enrolled as part of a longitudinal study on antimalarial therapy. Primary caregivers of 307 children were interviewed and information was collected on demographics, malaria-related KAP, environmental and household factors. Malaria incidence was measured prospectively using passive surveillance.

RESULTS A total of 90% of respondents reported mosquitoes and/or malaria as the cause of fever. Caregivers reported that if their child had fever, 63% would go to a clinic or hospital as their first action and 97% as their first or second action. Only 38% knew that chloroquine was the recommended first-line treatment for malaria and 29% knew the correct dose. Preventive measures for malaria were reported in 45% of households but only 25% reported using bednets. Higher levels of education for the caregiver were associated with positive malaria-related KAP. Malaria incidence varied widely. The following were independent predictors of malaria incidence: (1) Children aged 24–41 months at enrolment had a higher incidence of malaria. (2) Reported bednet or chemoprophylaxis use reduced the incidence of malaria. (3) A child's place of residence was associated with incidence. (4) Children from households using open water sources had a higher incidence than those using closed sources.

CONCLUSION Primary caregivers were knowledgeable about malaria and used modern health care facilities but knew less about the proper administration of antimalarials and had limited use of preventive measures. Malaria incidence was associated with child's age at enrolment, geography, source of water and the use of preventive measures.

keywords malaria, urban, incidence, cohort, KAP, predictors

Introduction

Malaria remains one of the most serious global health problems. Annually there are 300–500 million cases and about 1 million deaths in children under the age of 5, 90% of which occur in sub-Saharan Africa (Teklehaimanot & Bosman 1999; Trigg & Wernsdorfer 1999). In Uganda malaria is the leading cause of childhood morbidity and mortality, responsible for an estimated 11–23% of all deaths in children under the age of 5 (Ugandan Ministry of Health, unpublished data). Despite the huge malaria burden in Africa, the use of control measures is currently limited. Proven effective options to reduce morbidity and mortality include early diagnosis combined with prompt, effective therapy, and malaria prevention through reduction of human–vector contact, emphasizing the use of insecticide-treated nets (ITNs). Surveys in Africa revealed that 80–90% of presumed malaria cases were treated at home (Thera *et al.* 2000; Fawole & Onadeko 2001; Nyamongo 2002). Frequently formal health care is sought only if initial treatment fails.

Caregivers' behaviour in response to signs of disease is influenced by several factors including: knowledge, attitudes and practices (KAP) towards malaria; accessibility and availability of health services; socio-economic factors, and perceptions of severity of the illness (Tarimo *et al.*

1998). Understanding the communities' perceptions (particularly the primary caregivers) of cause, symptom identification, and treatment of malaria is an important step towards developing strategies aimed at controlling the disease (Munguti 1998).

Sub-Saharan Africa has the highest rates of urbanization in the developing world (Brockerhoff & Brennan 1998). However, most studies assessing caregivers' KAP have been conducted in rural areas of sub-Saharan Africa. The rapidly growing low-income urban communities differ from rural populations demographically, in socio-economic and cultural composition, and in access to treatment (Tanner & Harpham 1995). A study conducted in coastal Kenya showed that because of the underlying differences between rural and urban areas, rural malaria prevention and control measures may have to be modified in urban environments (Molyneux *et al.* 1999).

Malaria incidence has been seen to vary from village to village and even from family to family in the same village (Ghebreyesus *et al.* 2000). Most epidemiological studies of malaria incidence have been carried out in relatively homogenous rural communities. In these settings, transmission levels and disease risk have generally been estimated at the population level. Few studies have prospectively looked at predictors of malaria incidence at the individual level.

'Micro-environments' may exist for malaria with heterogeneous incidence within small geographic areas. This may especially be true for urban environments where mosquito breeding sites and protective measures may be widely distributed. The identification of predictors of malaria incidence could provide a useful means of identifying targets for intervention. In this study, we describe malaria-related KAP among primary caregivers; identify associations between caregivers' characteristics and positive KAP towards malaria; and identify independent predictors of childhood malaria incidence.

Materials and methods

Study site

The study was conducted in Kawempe division, one of five geopolitical divisions of Kampala, the capital city of Uganda. Kawempe is divided into 18 parishes and covers an area of approximately 3245 ha. The 1998 estimated population was 153 900 (24% under 5 years of age) with an annual growth rate of 4.5% (Kampala City Council, unpublished data). The division is largely an urban slum with high population density, unemployment rate, and rural–urban migration rates. Household incomes are derived mainly from formal and informal work within Kampala City. This community is comprised of a mixture of several Ugandan tribes but Luganda is the major local dialect. Kawempe division is home to Mulago Hospital, Uganda's tertiary referral hospital, two public health clinics and approximately 245 private clinics and drug shops. Malaria is meso-endemic in this area occurring throughout the year with two peaks during the rainy season (Ugandan Ministry of Health, unpublished data).

Recruitment of study subjects and follow-up

This study was part of a longitudinal randomized trial, described in full elsewhere (Dorsey *et al.* 2002). Between July and August 2000 community-based convenience sampling was used to identify interested parents/guardians of healthy children between the ages of 6 months and 5 years. Our goal was to recruit approximately equal numbers of participants from five randomly selected parishes within the Kawempe Division. All eligible children living in a single household were enrolled. A household was defined as a group of people living within one domicile who normally share meals together. Participants were followed for 1 year for all of their health care needs at our clinic in Mulago Hospital (which was open everyday). Only children from the primary cohort with a follow-up period of at least 6 weeks were included in this study. The study was ethically approved by, the Uganda National Council of Science and Technology and the Institutional Review Boards of the University of California, San Francisco and Makerere University, Kampala.

Primary caregiver and household survey

Primary caregivers of participants were interviewed at their homes using a standardized open-ended/semistructured questionnaire. A primary caregiver was defined as the person within the household who provided most of the child's day-to-day care, including ensuring that the child gets his/her meals, seeking health care in case of illness, cleaning, and schooling where applicable. Interviews took place between September and October 2000, and were conducted by trained research assistants in the caregivers' primary language. Where necessary, a translator was used. Information was collected regarding malaria-related KAP, demographics of the caregiver and child, measures of socio-economic status, and household/environmental characteristics. Several questions included specified prompts to facilitate data accuracy and comparability. To confirm household characteristics and preventive measure used, direct observation was used whenever possible.

Assessment of malaria incidence density

Immediately after enrolment, participants were randomly allocated to one of three regimens to be given for all future episodes of uncomplicated malaria diagnosed. Participants were followed for 1 year during which time parents/guardians were instructed to bring their child to our clinic whenever they required medical attention. Parents/guardians were discouraged from using outside care or administering medications not approved by study physicians. Each time a child presented with a new history of fever (previous 48 h) or temperature ≥38.0 °C tympanic, a thick blood smear was tested. Patients were diagnosed with malaria if they fulfilled any of the following criteria: (1) complicated malaria (defined as the presence of severe malaria or danger signs) and any parasitaemia, (2) temperature ≥38.0 °C tympanic and any parasitaemia, (3) history of fever (not documented) and ≥500 asexual parasites/μl. For all recurrent episodes of malaria, molecular genotyping was used to distinguish recrudescence (treatment failure) from new infections as described by Dorsey *et al.* (2002). In this study, malaria incidence was based only on episodes of malaria caused by new infections and did not include episodes due to recrudescence (treatment failure) to control for differing efficacy among the three treatment groups. Time at risk was defined as the duration of study participation minus 14 days after each episode of malaria, during which time patients were unlikely to be at risk for malaria as a result of new infections.

Data management and statistical analysis

At the end of each field working day, the principal investigator of this study reviewed all questionnaires, and any inconsistencies or missing data were verified and/or completed in the field through re-interviews. All data were coded, entered and verified with double entry using the Epi-info 6.04. Associations between caregivers' characteristics and positive malaria related KAP were analysed using chi-squared test for categorical variables and 2-sample *t*-tests for continuous variables. Malaria incidence density was defined as the number of episodes of malaria because of new infections per time at risk. Predictor variables of interest included participant demographics, treatment group assignment, use of preventive measures, caregivers' demographics, primary source of water, household characteristics, and location of residence. Independent predictors of malaria incidence density were identified using a multivariate negative binomial regression model with backward selection. The final model included age at enrolment [a known risk factor for malaria incidence (Marsh & Snow 1999)] and all variables ($P < 0.05$) and two-way interaction terms ($P < 0.20$) significantly associated with the outcome. Statistical analysis was performed using both the SPSS and STATA statistical software.

Results

A total of 316 children living in 221 different households were enrolled in the primary longitudinal antimalarial drug efficacy study. Of these, 307 children (97%) from 218 households had at least 6 weeks of follow-up and were included in this study. Reasons for inadequate follow-up included permanent relocation outside the study area ($n = 6$), withdrawal of consent ($n = 2$), and missing more than three follow-up visits for malaria ($n = 1$).

Characteristics of the study subjects, primary care givers and households

Characteristics of the children, primary caregivers, and their household are presented in Table 1. Eighty-nine per cent of the caregivers were mothers to the respective children, 7% were grandmothers and 4% were fathers or other relatives. Seventy-two per cent of the caregivers reported that someone else was also involved in the decision making for their children's care (secondary caregiver). Most caregivers were young (age ≤26 years), had little formal education and were not earning a regular income. Households were approximately evenly distributed among five distinct areas with the exception of Kawempe I, where we were unable to recruit as many participants. Houses were primarily rented, constructed of mud/clay bricks or mud/wattle and characterized by crowded conditions (≥4 people sleeping in the same room).

Primary caregivers' knowledge, attitudes and practices

Malaria-related knowledge, attitudes and practices of the caregivers are summarized in Table 2. Mosquitoes or malaria were recognized as causes of fever by 90% of caregivers. Other perceived causes of fever included un-boiled water (36%) and respiratory illnesses (14%). Caregivers had a good understanding of how to recognize fever, with 89% reporting their child feeling hot. Caregivers were less sure how to recognize malaria; only 38% reporting their child feeling hot or having a fever. The recognition of severe malaria was similar to non-severe malaria with the exception that 20% recognized convulsions as a sign of severe disease. When asked what they would do if they thought their child had fever, most caregivers reported that they would seek care from formal health care facilities. Seeking care at a hospital or clinic

Table 1 Characteristics of children, primary caregivers and households

Group	Characteristic	Summary
Children ($n = 307$)	Gender (% female)	53%
	Mean age at enrolment (months)	30.6
	Median number of people sleeping in the same room as child (range)	4 (1–10)
Caregiver ($n = 218$)	Relationship to child	
	Mother	89%
	Grandmother	7%
	Other	4%
	Median age (years)	26
	Maximum educational level	
	Primary school or none	71%
	Secondary school or higher	29%
	Occupation	
	Unemployed/housewives	58%
	Unskilled/semiskilled traders	32%
	Skilled worker/professional	10%
Household ($n = 218$)	Parish	
	Kanyanya	25%
	Kawempe I	8%
	Makerere I & II	25%
	Makerere III	21%
	Mulago III	21%
	Family size	
	Median	5
	Range	2–27
	Median number of rooms (range)	1 (1–10)
	Primary source of water	
	Spring or well	51%
	Communal or house tap	49%
	Food grown at home	16%
	House rented	67%
	Construction of home	
	Mud or clay brick	68%
	Mud and wattle	21%
	Cement brick or concrete	10%

Table 2 Malaria related knowledge, attitudes and practices of primary caregivers ($n = 218$)

Variables	Frequency (%)
Knowledge	
Reported causes of fever	
Mosquito/malaria	90
Drinking unboiled water	36
Respiratory illnesses	14
How fever is recognized	
Child feels hot	89
Weakness/lethargy	36
Diarrhea	29
Anorexia	21
Vomiting	21
How malaria is recognized	
Child feels hot/fever	38
Does not know	24
Vomiting	17
Weakness/lethargy	15
Anorexia	15
How severe malaria is recognized	
Very high fever	37
Anorexia	26
Weakness/lethargy	25
Convulsions	20
Government-recommended treatment for malaria	
Unknown	51
Chloroquine	37
Acetaminophen	6
Attitudes	
Most important factor when deciding to seek formal care for child with fever	
Condition of child	48
Perceived cost	39
Time of day	6
Best treatment for malaria	
Chloroquine	51
Unknown	23
Acetaminophen	12
Quinine	5
Amodiaquine	5
Practices	
If child had fever, first action would be:	
Go to clinic	40
Self-treat at home/go to drug shop	36
Go to a hospital	23
Do nothing	1
If child had fever, first or second action would be to go to a hospital/clinic	97
Reported preventive measure	
Any	46
Bednets	25
Insecticides	8
Chemoprophylaxis	5

was reported by 63% of caregivers as their first action. Among those reporting self-treatment as their first action, the majority said they would administer acetaminophen (69%) or chloroquine (65%). Only 3% of caregivers reported that they would not seek care at a hospital or clinic if their child did not respond to their first action. No caregivers reported they would seek care from traditional healers. Results were similar if the question was rephrased to ask what they would do if they thought their child had malaria.

Knowledge regarding antimalarial therapy was generally limited. Only 37% of caregivers knew chloroquine was the government-recommended first-line treatment for malaria, 29% knew the correct dose of chloroquine, and 19% knew

that chloroquine is best administered orally. When asked what they thought was the best treatment for malaria, 51% reported chloroquine, with acetaminophen (12%) the next most common drug. Only 1% mentioned sulphadoxine/pyrimethamine (Uganda's second-line treatment at the time) and no one mentioned herbal medications. Reported use of preventive measures was also limited. Although 46% reported using some method to prevent malaria, only 25% reported using bednets. Seventy per cent of caregivers who were not using bednets felt that they were an effective means of preventing malaria but thought they could not afford them. We looked for significant associations between caregivers' and household characteristics and positive malaria-related KAP including the use of formal health care facilities, knowledge of proper malaria treatment, and the use of bednets. Caregivers with at least a secondary school education were more likely to know that chloroquine was the recommended treatment for malaria (RR = 1.8, $P = 0.004$), know the correct dose of chloroquine (RR = 1.8, $P = 0.004$) and use bednets (RR = 1.9, $P = 0.002$). Caregivers with a skilled occupation and households with more property ownership were more likely to use bednets (RR = 1.5, $P = 0.02$; RR = 1.3, $P = 0.001$, respectively). Caregivers' age or whether caregivers received help with the child's care were not associated with any positive malaria-related KAP.

Predictors of malaria incidence

Malaria incidence varied widely in our study population (Figure 1). No episodes of malaria were diagnosed in 123 of the 307 participants (40%). In the remaining 184 participants, 415 new episodes of malaria were diagnosed. The cumulative period of observation covered 93% of potential follow-up time and 282 participants (92%) completed the full 1-year of follow-up.

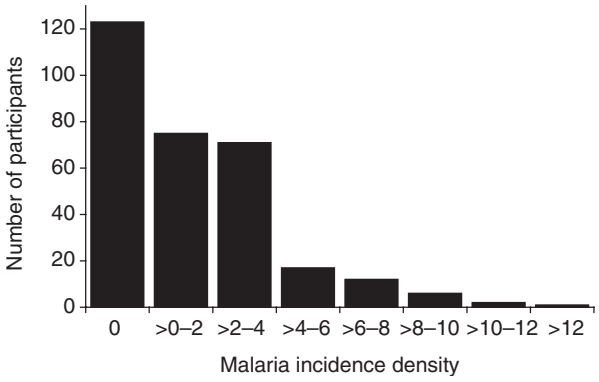

Figure 1 Malaria incidence density equals the total number of new episodes of malaria (after correction by genotyping) per person years of time at risk.

We explored potential predictor variables using univariate and multivariate analysis. Potential predictors of malaria incidence included age, gender, birth-order, primary water source, parish of residence, number of people sleeping in the same room as the child, number of people sleeping in the same house, malaria preventive measures, age of caregiver, educational level of caregiver, growing one's own food, renting/owning a house, make of walls, cooking in house, number of rooms in the house, household property (a marker of economic status), and primary caregivers' occupation. Of the 18 factors modelled four showed significant associations with malaria incidence (Table 3).

The child's age at enrolment was found to be a significant predictor of incidence of malaria, being highest in children aged 24–41 months at enrolment. The primary water source for the household was also significantly associated with the incidence of malaria. Children from households using open water sources (spring or well) had almost twice the rate of malaria compared with children from houses using closed water sources (communal or household tap). Children who did not use a bednet and/or chemoprophylaxis had more than twice the rate of malaria than those who did. Malaria incidence varied widely between the five geographically distinct parishes. The parish with the highest incidence had more than triple the rate of malaria relative to the parish with the lowest incidence.

Discussion

Understanding the epidemiology of malaria in an urban setting is important given the changing demographics in sub-Saharan Africa. In this study we saw that primary caregivers were knowledgeable about the cause and symptoms of malaria and used modern health care facilities but were less knowledgeable about its correct management. Malaria was very common but incidence varied widely and was predicted by easily identifiable risk factors.

A high percentage of the caregivers were knowledgeable about malaria and/or mosquitoes as a cause of fever. Indeed, in the local dialect the word *omusujja* means fever caused by mosquitoes. These findings contrast with previous studies in rural areas, which showed that people's knowledge about malaria as a cause of fever was low (Agyepong & Manderson 1994). This relatively higher level of knowledge in an urban area was also seen in Colombia (Nieto *et al.* 1999) and Malawi (Ziba *et al.* 1994) probably because of caregivers having higher levels of education, greater access to media-information, and

Table 3 Predictors of malaria incidence

Predictor variable	Incidence density*	Univariate IRR†	Multivariate adjusted IRR†	95% CI	*P*-value
Age group at enrolment (months)					
42–59‡	1.38	1.0	1.0	–	–
24–41	1.91	1.4	1.4	1.0–1.9	0.02
6–23	1.36	0.8	1.1	0.8–1.5	0.51
Primary water source					
Communal or house tap‡	1.05	1.0	1.0	–	–
Open spring or well	1.97	1.6	1.9	1.1–2.3	0.009
Use of preventive measures					
Chemoprophylaxis or bednet‡	1.04	1.0	1.0	–	–
None	1.75	1.7	2.2	1.4–3.4	<0.001
Residence					
Makerere I + II‡	0.70	1.0	1.0	–	–
Kanyana	1.96	3.0	2.5	1.4–4.3	0.001
Kawempe I	2.40	3.3	3.6	2.1–6.0	<0.001
Makerere III	2.02	2.9	2.9	1.7–4.9	<0.001
Mulago III§	1.33	1.9	–	–	–
Preventive measures used	–	–	3.3	1.6–7.0	<0.001
Preventive measures not used	–	–	3.7	1.4–3.4	<0.001

* New episodes of malaria per person year at risk.
† Incidence rate ratio.
‡ Reference group.
§ Adjusted IRR stratified based on significant interaction with use of preventive measures.

contact with modern health services than their rural counterparts (Tarimo *et al.* 1998; Molyneux *et al.* 1999).

Unlike in other studies where children were largely managed at home (Kengeya-Kayondo *et al.* 1994; Mwenesi *et al.* 1995), caregivers in this study were highly receptive to the use of modern health care facilities for the treatment of malaria. Ninety-seven per cent would go to a hospital or clinic as their first or second action if their child was thought to have fever. Although home treatment with antimalarials is an accepted practice, the knowledge of proper administration of antimalarials in our study was limited. Only 29% of caregivers knew the correct dose of chloroquine, the drug recommended for the treatment of uncomplicated malaria at the time (Uganda recently changed from chloroquine to a combination of chloroquine and sulphadoxine-pyrimethamine). Malaria control depends heavily on prompt, effective treatment and not knowing the correct dose may be a barrier to effective case management. Given these results, in an urban setting, public health interventions for promoting proper antimalarial treatment may best be focused on the training and supplying of formal health facilities where care is most frequently sought. Such a strategy might also limit the improper use of self-administered antimalarials which has become increasingly important with the spread of drug resistance and the move to more complicated regimens like combination therapy.

Several studies have found that malaria transmission may vary greatly between and within communities in rural (Bjorkman *et al.* 1985; Cattani *et al.* 1986) and periurban environments (Thompson *et al.* 1997). However, few studies have looked at risk factors and variability of the incidence of symptomatic malaria. In this study, we collected highly sensitive and specific data on the incidence of symptomatic malaria using a prospective design covering 1 year of follow-up. Given our high rate of compliance, it is unlikely that many cases of malaria were missed and the use of genotyping improved our ability to distinguish new infections from recrudescence while removing any confounding effects of treatment.

Our results show that children in the middle age group (24–41 months) had the highest incidence of malaria, consistent with longitudinal data from endemic areas where incidence peaks in the first few years of life and then gradually declines as immunity increases (Marsh & Snow 1999; Rogier *et al.* 1999). We also found that children who used bednets had a lower incidence of malaria. The individual variation in the use of bednets was also shown to be a major cause of variations in the incidence of malaria in The Gambia (Bradley *et al.* 1986). Studies in Africa have shown that the burden of malaria in the community can be reduced by the use of bednets (Binka *et al.* 1996; Nevill *et al.* 1996); however, it is unclear if this efficacy can be translated into effectiveness. In our study only 25% of

caregivers reported use of bednets, although an additional 53% were aware of their effectiveness in prevention of malaria but could not afford them. Another survey conducted in Uganda showed that only 22% of households had a bednet and the high cost of nets was the main reason for non-use (Commercial Marketing Strategies 2001, unpublished data). These results emphasize cost as an important barrier to bednet use and indicate the need to make bednets more accessible and affordable.

Few studies have examined the impact of geographic distribution and the environment on the risk of malaria in micro-environments. Proximity to a micro-dam was shown to be a risk factor for malaria in rural Ethiopia (Ghebreyesus *et al.* 2000). In a periurban area of Mozambique, individuals living within 200 m of malaria breeding sites were at much higher risk than those living 500 m or more away (Thompson *et al.* 1997). In our study malaria incidence varied significantly across different small geographic areas and was independently associated with the use of open water sources, which could have been potential mosquito breeding sites. These results suggest that malaria risk may not be homogenous within communities with high population density. The identification of groups of people at higher risk and the environmental factors associated with these risks (i.e. mosquito breeding sites) may provide an opportunity for targeted interventions in prevention and vector control.

Urban malaria is an important public health issue in Africa and knowledge of unique characteristics in this growing population may be important for planning targeted malaria control interventions. In contrast to rural settings, we found caregivers to be knowledgeable about the cause and symptoms of malaria in their children and to be highly receptive to the use of modern health facilities. Malaria incidence was heterogeneous and could be predicted by a few easily identifiable risk factors.

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