Original Article

Low reliability of home-based diagnosis of malaria in a rural community in western Kenya

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Abstract

Introduction: Home-based management of malaria is promoted as a major strategy for improving prompt delivery of effective malaria treatment in Africa. This study aimed to determine the proportion of children who tested positive for malaria with routine light microscopy among those whose mothers had made a home-based diagnosis in a rural community in Western Kenya.

Methodology: This cross-sectional study was conducted at Bokoli location, Bungoma East District in November and December 2007. Mothers of children five years of age or under with malaria diagnosed by their mothers were interviewed (n = 96). Duplicate blood smears were collected, stained by field stain A (Methylene blue, Azure) and B (Eosin), and examined for malaria parasites using light microscopy.

Results: Only 30/96 (31.2%) specimens were positive for *Plasmodium falciparum*. Elevated temperature (70/96; 72.9%) in their children was the most commonly cited criterion for diagnosis of malaria by the mothers. In 57 of the 96 cases, information was given by the mothers regarding treatment during the current malaria episode; of these, 10 (17.5%) had received treatment for malaria, but six (60%) of these were parasite negative. This means that only 4/21 (19.0%) with positive smear microscopy received treatment. The most common anti-malaria drugs used were Fansidar (37.8%) and Metakelfin (29.7%).

Conclusion: The difficulty of diagnosing malaria accurately at home increases the urgent need for improved diagnostic tools that can be used at the community level in poor populations. Intervention measures are needed to increase the treatment rate to reduce reservoirs and malaria parasite transmission.

Key words: malaria; microscopy; home-based diagnosis; treatment

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Introduction

Malaria is one of the most severe public health problems. The World Health Organization recommends that anyone suspected of having malaria should receive diagnosis and treatment with an effective drug within 24 hours of the onset of symptoms [1].

Definitive diagnosis of malaria infection is still based on identifying plasmodia in blood films. In general, the screening of blood slides by microscopy is considered to be the gold standard. However, presumptive malaria treatment without laboratory diagnosis has been justified by the scarcity of clinical facilities and the high case fatality rate of malaria in high-prevalence areas. Severe malaria is associated with the delay of presentation at a health facility and late use of anti-malarial drugs [2,3]. Consequently, home treatment is acceptable when the patient does not have access to a health-care provider within that time period, as is the case for most patients in malaria-endemic areas [4,5].

Recent studies emphasized the difficulty in making a presumptive diagnosis of malaria and highlight the urgent need for improved diagnostic tools that can be used at the community and primary-care levels, especially in resource-poor settings [6,7]. Even though febrile illnesses are commonly treated at home, little attention is paid to the children's caretakers' diagnosis of malaria in the community against laboratory microscopy. The purpose of this study was to compare the results of routine malaria microscopy used at the health centre with the mothers' diagnosis of malaria in a rural community within Western Kenya.

Methodology

Study setting

The study was conducted in Bokoli location, Webuye division of Bungoma East District, Western Kenya. The area is located approximately 100 km north of Lake Victoria. The study site, Bokoli sub-location, which is predominantly rural, has 15 villages and lies within a malaria-endemic region. There is only one government health centre. The annual temperatures range from 21^{o}C to 25^{o}C and rainfall ranges from 1,600 mm to 2,000 mm. According to the latest census of 1999, the area has a population of about 6,200 within an area of 15.4 km^{2}. There are about 400 homesteads with 1,158 households. Approximately 2% (125) of the population is comprised of children five years of age or under. The majority of the residents practice subsistence farming; sugarcane is the main cash crop. According to the local health centre records, malaria is the main cause of patients presenting at the hospital, with a prevalence of approximately 30% by clinical diagnosis (according to Bokoli Health Centre medical records, 2006).

Study design

A community-based cross-sectional study was conducted in November and December 2007, using face-to-face interviewer-administered questionnaires for quantitative data collection.

The estimated sample size, based on the assumption that the prevalence of malaria in the study area is approximately 30%, was 90 individuals. The study site was selected by purposive sampling because of the high malaria prevalence. From every consecutive household, study subjects were selected randomly from mothers of children five years of age or under with malaria. Selection of the respondents continued until 96 respondents were secured. The disease was classified as malaria based on self-diagnosis according to the community members' own perception. Caretakers were interviewed regarding administered treatment.

Data collection and analysis

Mothers of children five years of age or under were interviewed by trained research assistants using a pre-tested semi-structured questionnaire to elicit responses regarding age, education level, malaria diagnosis and treatment. Mothers under 18 years of age and those who did not give consent to participate were not included in the study.

Thick and thin blood smears were prepared on slides in duplicate from finger pricks of children who had malaria according to their mothers' perception and taken to the Bokoli Health Centre for malaria parasite microscopy diagnosis. Participants with smear-positive results were referred to the health centre for treatment.

Data were entered into Statistical Package for Social Scientists (SPSS for Windows version 14, Washington, USA), checked for consistency, and analysed using descriptive statistics. Association between microscopy and home-based diagnosis was established using the chi-square test.

Laboratory processing of blood smears

For each study participant, two blood smears were prepared and transported to Bokoli Health Centre. The slides were stained at the health centre with field stain A (Methylene blue and Azure) and B (Eosin) according to routine procedures [8]. Thin blood smears were fixed in methanol before staining. A trained technician examined the smears for the presence of malaria parasites and identified the species based on the appearance of trophozoites and gametocytes. All slides were counter-checked by the principal investigator.

Ethical considerations

The research was approved by Maseno University, School of Graduate Studies, which serves as the Institutional Review Board. Permission to conduct the research was sought from the Medical Officer of Health, Bungoma East District, and the Local Administration. Informed verbal consent was sought from all the mothers 18 years of age and above to include their children in the study. Participants with smear-positive results were referred to the health centre for specific treatment.

Results

Of the 96 children included, the mean age was 25.6 months (range = 1 to 60 months; median = 25 months). In only 30/96 (31.2%) of the specimens, malaria parasites were detected by slide microscopy. In all cases, the parasite species identified was *P. falciparum*.

The ages of the children and respondents in comparison to the blood smear test results are shown in Table 1. There was a statistically non-significant trend for a decrease in malaria-positive cases by microscopy as the age of the children increased, after

which it was reversed upward to stabilize at about 30% (p = 0.51). There was no significant relationship between the mothers' age or education level and malaria diagnosis (p = 0.58 and 0.46, respectively).

Table 1. Child and maternal age against blood smear results

Variable	Number (%) of children's blood slides	
	Positive	**Total**
Age (months)		
1 – 12	14 (40%)	35
13 – 24	7 (26.9%)	26
25 – 36	1 (11.1%)	9
37 – 48	3 (30%)	10
49 – 60	5 (31.2%)	16
Total	**30 (31.2%)**	**96**
Age (yrs) of mothers		
19 - 24	6 (37.5%)	16
25 – 29	7 (36.8%)	19
30 – 34	5 (29.4%)	17
35 – 39	5 (38.5%)	13
≥ 40	6 (27.3%)	22
Total	**29 (33.3%)**	**87***
Mothers' education level		
No formal education	3 (33.3%)	9
Primary	20(35.7%)	56
Secondary	7 (22.5%)	31
Total	**30 (31.2%)**	**96**

* = 9 women did not give their ages.

The mothers' criteria for diagnosis of malaria in their children included, most commonly, elevated temperature (70/96; 72.9%). Other reasons for diagnosis given by 27.1% (26/96) of the mothers included loss of appetite, vomiting, crying, dullness, dizziness, diarrhoea and coughing.

Out of the 96 mothers interviewed, 37 (38.5%) indicated they used anti-malaria drugs whenever they suspected malaria in their children. However, mothers provided information about specific treatment in the current malaria episode in only 57 of the 96 cases. Of these, 10 (17.5%) had received treatment for malaria, but interestingly, six (60%) of these were negative for slide smear microscopy. This means that 4/21 (19.0%) with positive smear microscopy received treatment, and 17/21 (81.0%) did not (p = 0.05).

The most common anti-malaria drugs used were Fansidar (37.8%) and Metakelfin (29.7%). Malariaquine (16.2%), chloroquine (8.1%) and camoquine (5.4%) were less commonly used.

Discussion

The current data show that mothers correctly diagnosed malaria in their children in only about one-third of the cases. In addition, specific treatment rates were extremely low. A review of records at the same health centre revealed that approximately 30% of patients diagnosed with clinical malaria by the health-care providers were slide smear-positive, meaning that the accuracy of the health-care providers' diagnosis is similar to that of the mothers. In fact, presumptive diagnosis has been previously demonstrated in many settings to be highly inaccurate [6,7,9,10]. However, in many malaria-endemic countries, clinical diagnosis is more often the only determining factor for treatment, as laboratory techniques to confirm the clinical suspicion are considered to be expensive, labor-intensive, or not sensitive enough [11]. Fever is the clinical hallmark of uncomplicated malaria [12, 13], and empiric treatment of fever with antimalarials is widely advocated and practiced in Africa.

On the other hand, the potential benefits of malaria microscopy are currently not realized because of the poor quality of routine testing [6,14]. For example, Giemsa stain microscopy in selected district health laboratories in Kenya had a low sensitivity and specificity - 69% and 62% respectively [14]. Other studies elsewhere have shown that Giemsa stain is more sensitive than field stain A and B, with suboptimal performance being attributed to the high workload and poor supervision of laboratory technicians [15]. However, Giemsa field stain is currently being used widely in Kenya as the sole diagnostic test for malaria and thus may miss a considerable number of cases, leading to misdiagnosis and inappropriate treatment decisions. Clearly, more sensitive and easy-to-use tests of low cost are necessary to ascertain the actual prevalence of malaria in the study area [11,16].

Ideally, all persons who are sick with malaria should be treated promptly with effective antimalarials [17]. Apart from alleviating suffering, treatment eliminates essential components of the parasite cycle, thus interrupting transmission. Early initiation of malaria treatment largely depends on good laboratory-confirmed diagnosis and access to health care. In this study, many (80%) cases with smear-positive microscopy tests had not received any treatment. In Uganda, 96.2% of patients with a routine positive slide result, and 47.6% of those with a negative result, were treated for malaria [6].

Misdiagnosis of malaria contributes to a vicious cycle of increasing ill health and deepening poverty. In the light of the changing drug policies of many African countries, including Kenya, where the expensive artemisinin combination therapy drugs are prescribed as first-line treatment, a good laboratory confirmation will also have its impact on economics [18,19]. Rapid diagnostic testing (RDT) is a valuable tool for diagnosis and can shorten the interval for starting treatment, particularly where microscopy may not be feasible due to resource and distance limitations [11,20]. Molecular tests are more sensitive but expensive and difficult to implement in rural areas. Much better direct evidence is needed about why and how misdiagnosis affects the disease outcome among the poor and vulnerable.

In the current study, the quality of home-based diagnosis compared with slide microscopy decreased with the age of children up to 36 months, and then it was reversed. It is not clear if this diagnosis was based on prior experience by the mothers. Although home-based diagnosis was independent of maternal age and level of education, the latter may improve care by increasing the likelihood of seeking treatment from a health facility early for better management [21].

Following recognition that Sulphadoxine/sulphalene-pyrimethamine (SP) was failing, there was a rapid technical appraisal of available data. Replacement options resulted in a decision in 2004 to adopt artemether-lumefantrine (AL) as the recommended first-line therapy in Kenya [22,23]. Despite this, in the current study, the most common drug used was Fansidar.

Although the home management of malaria has been shown to be an effective strategy for reducing childhood mortality from malaria, there is still a further need to educate and train not only the mothers and caretakers, but also the health-care professionals [10]. The common practice of prescribing antimalarials for all episodes of fever in regions where malaria is endemic is likely to lead to both overtreatment of malaria and underdiagnosis of other treatable causes of fever [24,25]. A study in Mali demonstrated that for children aged 0-5 years in a high-transmission area of sub-Saharan Africa, the use of RDT was not cost-effective, as compared to presumptive treatment of malaria with an artemisinin-combination therapy [26]. However, the hidden cost of drug resistance associated with inappropriate treatment may be substantial. The major risk of a presumptive treatment strategy is an increase in drug resistance, but a benefit may be a reduction in malaria rates as evident in other parts of Africa [13].

We conclude that further research is required to guide treatment decisions. Meanwhile, health systems need strengthening at the community level, so that affordable, rapid and accurate diagnosis for effective treatment is available. A shift from presumptive to parasitological diagnosis should encompass substantial strengthening of microscopy testing for malaria parasites to reduce inappropriate exposure of poor rural communities to antimalaria drugs.

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