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# PREVENTION AND TREATMENT STRATEGIES USED FOR THE COMMUNITY MANAGEMENT OF CHILDHOOD FEVER IN KAMPALA, UGANDA

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*Abstract.* To assess malaria-related prevention and treatment strategies in an urban parish of Kampala, Uganda, a questionnaire was administered to 339 randomly selected primary caregivers of children 1–10 years of age. Our study population was relatively stable and well educated, with better access to health services than many in Africa. Ownership of an insecticide-treated net (ITN) was reported by 11% of households and was predicted only by greater household wealth (highest quartile versus lowest quartile: odds ratio [OR] 21.8; 95% confidence interval [CI], 2.74–173). Among women, 5% reported use of an ITN and 11% used intermittent preventive therapy (IPT) during their last pregnancy. Use of appropriate IPT during pregnancy was predicted only by completion of secondary education or higher (OR, 2.87; 95% CI, 1.13–7.21). Children of 123 (36%) caregivers had experienced an episode of fever in the past 2 weeks. Of these, 22% received an anti-malarial that could be considered "adequate" (combination therapy or quinine). Only 1% of febrile children received adequate treatment at the correct dose within 24 hours of onset of fever. The only independent predictor of treatment with an adequate anti-malarial was accessing a clinic or hospital as the first source of care. In this urban area, use of appropriate malaria control measures occurs uncommonly.

## INTRODUCTION

Malaria remains a leading cause of morbidity and mortality in Africa. Recent estimates indicate that the burden of disease is rising, with the median malaria-specific mortality among 13 countries in sub-Saharan Africa increasing from 7.8 to 10.2 per 1,000 children over the last 50 years.[1] The increase in disease burden is likely caused by the spread of drug resistance. Interventions shown to reduce malaria-related morbidity and mortality include use of insecticide treated bed nets (ITNs), use of intermittent preventive treatment (IPT) during pregnancy, and prompt treatment of clinical cases with effective anti-malarial drugs. These interventions currently represent the cornerstones of malaria control in Africa.[2] In an effort to tackle the growing malaria burden, African leaders attending the Roll Back Malaria summit in Abuja in 2000 committed to improve access to ITNs, IPT, and anti-malarial treatment. Specifically, they pledged that by 2005, 60% of those at risk for malaria (particularly children < 5 years of age and pregnant women) should benefit from protective measures including ITNs, 60% of all pregnant women at risk of malaria should have access to IPT, and 60% of malarial illness should be treated with affordable and appropriate treatment within 24 hours of onset of symptoms.[3]

Since the Abuja summit, efforts to increase access to effective prevention and treatment measures have been made throughout Africa. However, barriers to full implementation of control measures exist, including cost and availability of bed nets and new anti-malarial drugs and awareness and acceptability of new programs. In addition, defining appropriate treatment has become increasingly complex in the face of rising drug resistance and recent changes in anti-malarial drug policy in Africa. In Uganda, bed nets are currently available through commercial distributors, with additional delivery of subsidized ITNs to vulnerable groups such as children and pregnant women. ITN use in Uganda has been monitored with standardized national surveys,[4] but population-based data on demographic and socioeconomic factors associated with ITN use are limited. Efforts to scale up IPT during pregnancy began in 2002 with an intensive campaign to train health care workers and ensure consistent supply of sulfadoxine-pyrimethamine (SP).[5] However, no data on uptake of this policy are currently available. Uganda's anti-malarial drug policy has also been revised twice in the last 5 years, with the recommendation for first-line treatment of uncomplicated malaria changing from chloroquine to chloroquine + sulfadoxine-pyrimethamine (CQ+SP) in 2000, and more recently to artemether-lumefantrine (Coartem).[6] Coartem may also replace CQ+SP in the national home-based management of fever (HBMF) program, in which pre-packaged anti-malarial drugs are distributed by trained members of the community to presumptively treat childhood fever. To date, implementation of the new policy has been delayed by lack of availability of Coartem. Little is known about the current practice for management of malaria at the community level in the setting of changing approaches to prevention and anti-malarial treatment.

Urbanization also impacts malaria control in Africa. Sub-Saharan Africa currently has the highest rate of urbanization in the developing world,[7] with an estimated 200 million people (24.6% of the total African population) living in urban settings where they are at risk for malaria.[8] Rapidly growing urban communities differ from rural populations in that they are generally younger, more socioeconomically and culturally diverse, and have greater access to education and health care facilities.[9] Some studies have shown that use of preventive measures for malaria and treatment practices for fever may differ significantly between rural and urban areas, with greater uptake of bed nets and greater use of private sector pharmaceuticals in urban settings.[10,11] It is likely that interventions designed for rural settings may not be applicable in an urban context. Here, we examine current prevention and treatment practice in an urban area of Kampala, Uganda to identify predictors of adequate malaria-related prevention and treatment strategies that may guide future malaria control efforts in urban settings.

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## MATERIALS AND METHODS

**Description of study site.** The study was conducted in Mulago III parish in Kampala, Uganda. This parish is located near Mulago Hospital, Uganda's main public hospital and tertiary referral center. The parish covers an area of slightly less than 1 $km^2$, with a population density of 18,824 persons/$km^2$. The local economy is primarily dependent on petty commercial activities and small-scale farming. A large swamp extends along the northern border of the parish with poor drainage and frequent flooding during the rainy seasons. Malaria is considered meso-endemic in this region, occurring throughout the year with peaks during two rainy seasons (Ugandan Ministry of Health, unpublished data). Health facilities within the parish include nine private clinics offering consultation services and 16 drug shops (vendors that primarily sell commercially produced pharmaceuticals). Some medications can also be purchased at other shops and kiosks throughout the parish. Mulago Hospital is no more than 2 km from any subsection of the parish, and two full-service pharmacies are located adjacent to the hospital grounds.

**Selection of study subjects.** From July to October 2004, a census of Mulago III parish was conducted to provide a sampling frame of households with children 1–10 years of age for recruitment into a longitudinal study of anti-malarial combination therapy. The parish was systematically surveyed by study personnel, and each household was enumerated. Households were defined as any single permanent or semi-permanent structure acting as the primary residence for a person or group of people. After enumeration, study personnel asked an adult resident (18 years of age or older) from each household for verbal consent to participate in a brief demographic survey including information on number and age of all residents. A resident of a household was defined as a person who intended to sleep primarily at that location for the subsequent 6 months. If no adult resident was available, households were revisited up to four times to complete the census. The house was considered vacant if no residents were present at the household after four visits. Occupied households were mapped using Pathfinder Pocket Global Positioning System (GPS) Receivers (Trimble Navigation, Sunnyvale, CA) equipped with TerraSync 2.40 software (Trimble Navigation, Sunnyvale, CA) connected to handheld personal digital assistants (PDAs). A minimum of 12 satellite readings, taken from the door of the household, were averaged to obtain the final GPS reading (Easting, Northing, and Altitude) for each household in UTM units.

From a database of all households enumerated in the census, a random list of households with at least one child less than 10 years of age was generated. From November 2004 to April 2005, home visitors approached households for recruitment sequentially from the randomized list, using handheld GPS receivers to locate households by previously recorded coordinates. Households were assessed for the following selection criteria for each eligible child for recruitment into the longitudinal study of anti-malarial combination therapy: 1) age 1–10 years; 2) agreement to come to study clinic for any febrile episode or illness; 3) agreement to avoid medications administered outside the study; 4) agreement to remain in Kampala; 5) absence of known chronic disease or history of side effects to the study medications, and 6) written informed consent provided by parent or guardian.

Within 2 weeks of screening, a survey was administered at home to the primary caregiver for each household with at least one child meeting selection criteria. The primary caregiver was defined as the household resident claiming primary responsibility for the daily care of the child(ren) screened. The study was approved by the Institutional Review Boards at the University of California, San Francisco and Makerere University School of Medicine, and by the Ugandan National Council of Science and Technology.

**Household survey.** A questionnaire on primary caregiver and household demographics, socioeconomic characteristics, household assets, malaria-related prevention measures, and treatment strategies for childhood fever was developed, based on standardized survey instruments[12–14] and a pilot survey previously administered in Kampala by our study group.

Caregivers were interviewed in their primary language. Respondents were considered literate if they had completed secondary school or could read a sentence printed on a card in either English or Luganda.[12] Bed net ownership was confirmed by direct observation. Ownership of an ITN was assessed by asking about re-treatment and brand of net and observing the net purchased. A bed net was considered an ITN if the net was reported to have been treated with insecticide after purchase or based on the observed brand of the net. Malaria prevention strategies during pregnancy were assessed by asking female caregivers about measures taken during their most recent pregnancy. Knowledge of treatment strategies for fever was assessed by asking what the caregiver would do first if his or her child had fever. If giving paracetamol was the first response, the caregiver was asked what she/he would do next if the child did not improve. Illness histories were taken from any caregiver reporting an episode of fever in a child under her/his care in the 2 weeks before screening. If a caregiver reported febrile illness in more than one child under her/his care, the history of the child most recently ill was obtained. For each illness episode, details were documented on symptoms and perceived severity of the illness, duration, medications given, dosing intervals, where and at what stage of the illness treatment was sought, and expenditures on management of the illness. Based on World Health Organization guidelines for empirical management of fever, prompt treatment was defined as treatment within 24 hours of illness onset.[15]

**Data management and analysis.** Survey data were entered directly into an electronic data collection system using Visual CE 8.1 software (Syware, Cambridge, MA) on a handheld PDA. Home visitors were required to review and confirm the accuracy of data before completion of the interview. Analysis was performed using SPSS version 10.0 (SPSS, Chicago, IL) and STATA version 8.0 (STATA Corp., College Station, TX) statistical software programs.

Categorical variables were compared using the $\chi^2$ test or a non-parametric test for trend and continuous variables using a two-sample *t* test or a non-parametric test when appropriate. Infant and child mortality rates were estimated based on birth histories taken from female primary caregivers.[12] Independent predictors of positive malaria-related knowledge and prevention and treatment strategies were identified using multivariate logistic regression models. Based on current guidelines in Uganda, knowledge regarding positive treatment strategies was defined as preferred use of any combination therapy or quinine as a first treatment or a preference for taking the child directly to a clinic or hospital before treatment. Adequate treatment practice for fever in the previous 2 weeks was defined as use of a combination therapy or quinine as the first treatment, regardless of where the treatment was obtained. Predictor variables retained in all models included primary caregiver characteristics of age, sex, level of education, and number of children under care (or parity when considering prevention strategies during pregnancy), as well as an index of household wealth. The household wealth index was created using principal component analysis (PCA)[16,17] of data on household possessions, utilities, and housing construction. Households were ranked according to their distribution along the index, which was divided into quartiles and classified as an ordinal variable for use in logistic regression models. Additional variables that were assessed but only retained in the final models if they were of borderline significance ($P \leq 0.10$) included variables related to past experiences of primary caregivers with the hospitalization or death of children, and use of a clinic or hospital as the first point of care. In our final models, $P < 0.05$ was considered statistically significant.

## RESULTS

Of 582 households approached for recruitment into the study, 243 did not meet selection criteria. The most common reasons for exclusion of households were no children 1–10 years of age (118/582 [20%]), no provision of informed consent (14%), or household vacated or destroyed (5%). Primary caregivers from all 339 households that met selection criteria were successfully interviewed.

**Characteristics of primary caregivers and households.** Characteristics of primary caregivers and households are summarized in Table 1. Most caregivers were women and were responsible for the care of a median of 3 children (range, 1–16 children). Our study population was diverse in terms of tribe, religion, and occupation. Nearly one half of caregivers had completed secondary school, and 82% were literate. A total of 301/305 (99%) female caregivers reported having been pregnant, either currently or in the past. Of these, 162 (53%) were pregnant within the last 3 years. The proportion of women using a bed net during pregnancy increased over

TABLE 1
Primary caregiver and household characteristics ($n = 339$)

| Primary caregiver characteristics | | Household characteristics | |
|---|---|---|---|
| Mean age in years (SD, range) | 31.4 (9.2, 15–79) | Median number of residents (range) | 5 (2–15) |
| Female | 305 (90%) | Median number of rooms (range) | 1 (1–7) |
| Median no. of children under care | 3 (range 1–16) | Ownership of home | 81 (24%) |
| Tribe | | Median monthly rent in USD (range)† | $17 ($5–$139) |
| Baganda | 172 (51%) | Ownership of land | 173 (51%) |
| Banyorwanda | 29 (9%) | Source of drinking water | |
| Banyankole | 25 (7%) | Open spring or well | 151 (45%) |
| Basoga | 19 (6%) | Closed communal tap | 178 (53%) |
| Batoro | 18 (5%) | Private tap | 9 (3%) |
| Bakiga | 16 (5%) | Toilet facility | |
| Other | 60 (18%) | Uncovered pit latrine | 212 (63%) |
| Religion | | Covered pit latrine | 70 (21%) |
| Protestant | 110 (32%) | Ventilated pit latrine | 39 (12%) |
| Catholic | 109 (32%) | Flush toilet | 16 (5%) |
| Muslim | 73 (22%) | None | 2 (1%) |
| Other | 47 (14%) | House structure‡ | |
| Highest educational level completed | | Cement floor | 292 (86%) |
| None | 16 (5%) | Cement walls | 283 (83%) |
| Primary schooling | 160 (47%) | Metal roof | 333 (98%) |
| Secondary schooling | 154 (45%) | Electricity in home | 200 (59%) |
| University | 9 (3%) | Household possessions‡ | |
| Literate* | 276 (82%) | Radio | 267 (79%) |
| Job | | Telephone | 178 (53%) |
| Unemployed | 105 (31%) | Television | 133 (39%) |
| Sales and services | 153 (45%) | Refrigerator | 38 (11%) |
| Skilled or unskilled manual labor | 35 (10%) | Motorcycle | 20 (6%) |
| Other | 46 (14%) | Ownership of at least one bednet | 208 (61%) |
| Continuously employed | 187 (55%) | Ownership of at least one ITN | 37 (11%) |
| Residency in Kampala | | Use of other prevention measures‡ | |
| Entire life | 143 (42%) | Sprays/coils | 100 (30%) |
| Greater than 10 years | 70 (21%) | Closing doors/windows at night | 68 (20%) |
| 5–10 years | 79 (23%) | Covering water sources | 26 (8%) |
| Less than 5 years | 47 (14%) | Any chemoprophylaxis | 8 (2%) |
| | | Mesh window screens | 2 (1%) |

| Malaria prevention during pregnancy§ | | | |
|---|---|---|---|
| | Before 1995 ($n = 38$) | 1995–2001 ($n = 101$) | 2002 or later ($n = 162$) |
| Use of any bednet | 3 (8%) | 30 (30%) | 107 (66%) |
| Use of an ITN | 0 (0%) | 3 (3%) | 13 (8%) |
| Appropriate IPT¶ | 1 (3%) | 8 (8%) | 23 (14%) |

* Literacy defined as those who attended at least secondary school or can read a whole sentence.
† Exchange rate 1750 Uganda shillings = $1 US dollar.
‡ Not mutually exclusive.
§ Includes 301 women (21 currently pregnant and 280 previously pregnant women considering last pregnancy).
¶ Defined as two doses of sulfadoxine-pyrimethamine, one each during second and third trimester.

time, from 8% before 1995, to 30% in 1995–2001, and to 67% in 2002–2005 ($P < 0.001$). Use of appropriate IPT in pregnancy, defined according to current guidelines as two doses of SP, taken during the second and third trimester, changed less dramatically (3% before 1995, 8% in 1995–2001, 14% in 2002–2005; $P = 0.02$). Infant and child mortality rates in our population over a 5-year period from 2000 to 2004 were estimated as 46.8 and 15.5 per 1,000 live births, respectively.

Households were typically composed of a single room, with a median of five residents per household. For households that did not own their home, median monthly rent was US$17. Ownership of at least one bed net was reported and confirmed by direct observation in 61% of households. However, only 11% of households owned an ITN, and of these, 31% reported they had not re-treated their net within the last 6 months. Fifty percent of households reported using prevention measures other than bed nets, including use of sprays or coils, closing doors, or windows at night, covering water sources, taking chemoprophylactic anti-malarial medications, or using mesh screens on windows.

**Factors associated with prevention strategies.** Multivariate logistic regression analysis was used to assess independent predictors of use of prevention strategies (Table 2). Younger caregivers and caregivers who had completed secondary education or higher were more likely to live in households with bed nets. Households falling into progressively higher quartiles of the wealth index were also increasingly likely to own bed nets. Household ITN ownership, however, was predicted only by greater household wealth (third quartile versus first quartile: OR, 8.1; 95% CI, 0.99–67; fourth quartile versus first quartile: OR, 21.8; 95% CI, 2.74–173). Among female caregivers, the strongest predictor of bed net use during pregnancy was the time at which the pregnancy occurred, with more recent pregnancy predicting use of a bed net. Use of appropriate IPT during pregnancy was predicted only by completion of secondary education or higher (OR, 2.87; 95% CI, 1.13–7.21). In contrast to bed net ownership, use of prevention strategies during pregnancy (bed nets or IPT) was not significantly associated with household wealth.

**Experience of primary caregivers with health facilities.** Our population of primary caregivers reported having used both private and public health facilities in the past: 52% had experienced hospitalization of a child under their care, 99% had taken a child to a clinic or hospital, and 84% had bought medicines from a drug shop or pharmacy. A total of 27% of caregivers reported that a child under their care had died. When asked about problems experienced accessing care at clinics or hospitals, the most frequent responses were: long wait time (34%), too expensive (27%), or problems with drugs (i.e., no drugs available, wrong drugs given, or the drugs were expired; 23%). Of those who had accessed drugs shops or pharmacies, the most common problems were that the drugs were too expensive (35%) and that the desired drugs were not available or were expired (14%).

**Knowledge of treatment strategies.** When primary caregivers were asked which strategy they preferred for initial management of fever in their child, the most common responses were give chloroquine or paracetamol followed by chloroquine (48%), take the child directly to a clinic or hospital for treatment (34%), and give quinine (5%). Fourteen of 339

TABLE 2
Multivariate predictors of positive malaria-related prevention strategies

| | Household prevention strategies ($n = 339$) | | | |
|---|---|---|---|---|
| | Own at least one bednet | | Own at least one ITN | |
| Predictor variables* | OR (95% CI) | *P* value | OR (95% CI) | *P* value |
| Age† | 0.86 (0.75–1.00) | 0.04 | 0.95 (0.75–1.22) | 0.71 |
| Female | 1.97 (0.89–4.36) | 0.10 | 0.86 (0.28–2.68) | 0.80 |
| Education level‡ | 2.24 (1.35–3.73) | 0.002 | 1.69 (0.73–3.90) | 0.22 |
| No. of children under care | 0.91 (0.81–1.03) | 0.13 | 1.14 (0.98–1.33) | 0.08 |
| Household asset index | | | | |
| < 25th percentile | 1.0 | – | 1.0 | – |
| 25th to 50th percentile | 1.39 (0.73–2.63) | 0.31 | 3.70 (0.40–34.2) | 0.25 |
| 50th to 75th percentile | 2.22 (1.14–4.31) | 0.02 | 8.14 (0.99–67.0) | 0.05 |
| > 75th percentile | 3.51 (1.66–7.39) | 0.001 | 21.8 (2.74–173) | 0.004 |

| | Prevention strategies during pregnancy ($n = 300$)§ | | | |
|---|---|---|---|---|
| | Use of bednet | | Use of IPT | |
| Predictor variables* | OR (95% CI) | *P* value | OR (94% CI) | *P* value |
| Age at last pregnancy† | 1.10 (0.80–1.53) | 0.56 | 1.42 (0.91–2.22) | 0.12 |
| Year of pregnancy | | | | |
| Before 1995 | 1.0 | | 1.0 | |
| 1995–2001 | 7.22 (1.60–32.5) | 0.01 | 2.18 (0.25–18.8) | 0.48 |
| 2002 or later | 35.1 (7.89–156) | <0.001 | 4.03 (0.50–32.3) | 0.19 |
| Education level‡ | 1.68 (0.95–2.98) | 0.08 | 2.87 (1.14–7.21) | 0.03 |
| Parity | 0.98 (0.81–1.18) | 0.84 | 0.75 (0.55–1.01) | 0.06 |
| Household asset index | | | | |
| < 25th percentile | 1.0 | – | 1.0 | – |
| 25th to 50th percentile | 1.12 (0.53–2.35) | 0.77 | 1.04 (0.29–3.65) | 0.96 |
| 50th to 75th percentile | 1.19 (0.56–2.52) | 0.65 | 1.15 (0.33–3.98) | 0.83 |
| > 75th percentile | 1.66 (0.73–3.74) | 0.33 | 1.35 (0.39–4.64) | 0.63 |

* Characteristics of the primary caregiver (with the exception of household asset index).
† Per 5 year increase.
‡ Secondary school or higher versus primary school or none.
§ One caregiver with missing parity data excluded from analysis.

(4%) caregivers stated that they would give an anti-malarial combination therapy (CQ+SP, AQ+SP, or quinine + another anti-malarial). Younger caregivers and caregivers who had never had a child hospitalized in the past were significantly more likely to name a positive strategy in response to fever, defined as quinine, combination therapy, or taking the child to a clinic or hospital (Table 3). Only 17% of caregivers correctly identified the government-recommended first-line treatment of uncomplicated malaria (CQ+SP). Other common responses included don't know (36%), chloroquine (17%), and SP (11%). None of the predictors in our model were associated with knowledge of government-recommended therapy (Table 3).

**Actions taken for fever in the previous 2 weeks.** *Treatment source and costs.* Of 339 primary caregivers interviewed, 132 (39%) reported an episode of fever in a child under their care in the preceding 2 weeks. The median duration of the illness was 4–7 days, and primary caregivers spent a median of 2 days caring for their child rather than performing their usual activities (range, 0–21 days). The sequence of actions taken by primary caregivers in response to fever is outlined in Figure 1. Almost all episodes (98%) were treated, and commercially produced pharmaceuticals were used in 97% of cases. Only one caregiver reported using herbs, and no caregivers reported visiting a traditional healer. Most caregivers sought treatment outside the home as their first course of action (89%). Of those who first sought treatment outside the home, 96% obtained treatment in the private sector (61% bought medicines at a private vendor, defined as a general shop, drug shop, or pharmacy, and 35% took the child to a private clinic). Only five (4%) caregivers took their child to a public hospital. Caregivers who perceived their child's illness as severe were more likely than those who did not to take their child to a clinic or hospital as their first action (47% versus 20%, $P = 0.001$) and were more likely to obtain adequate treatment of their child (31% versus 12%, $P = 0.009$). However, caregiver perception of severity did not significantly impact on promptness of treatment. Treatment within 24 hours was sought by 17% of caregivers who thought their child's illness was severe versus 29% of those who did not ($P = 0.12$).

In 47 (36%) cases, the child failed to improve after the first action, and the caregiver went on to take a second action. Second actions were more frequent among those who first treated the child at home (50%) or who bought medicines from a private vendor (42%) than among those who first took their child to a private clinic (27%). None of the children first taken to a public hospital were subsequently treated at another source. Considering both first and second actions, 51% of children received care at a clinic or hospital. The median expenditure on management of febrile illness was US$1.43 (range, $0–$27). Summing costs across all episodes, US$0.79 of each dollar spent went to medicines, $0.05 to clinic fees, $0.08 to transport, and $0.08 to special food and drink required by the sick child. The median expenditure for those who first sought treatment at a clinic or hospital (US$4.00; range, 0–US$27) was significantly higher than for those who

TABLE 3
Multivariate predictors of positive knowledge and practice of treatment for malaria

| | Knowledge of treatment strategies for fever in children ($n = 339$) | | | |
|---|---|---|---|---|
| | Knowledge of positive treatment strategy† | | Knowledge of government recommended first-line drug‡ | |
| Predictor variables* | OR (95% CI) | *P* value | OR (95% CI) | *P* value |
| Age§ | 0.79 (0.68–0.92) | 0.002 | 1.03 (0.86–1.22) | 0.78 |
| Female | 1.91 (0.84–4.33) | 0.12 | 0.55 (0.23–1.30) | 0.17 |
| Education level¶ | 0.88 (0.54–1.44) | 0.61 | 1.21 (0.64–2.29) | 0.57 |
| No. of children under care | 0.97 (0.86–1.09) | 0.56 | 0.89 (0.76–1.05) | 0.18 |
| Hospitalized child** | 0.60 (0.38–0.96) | 0.03 | 1.12 (0.61–2.04) | 0.72 |
| Household asset index | | | | |
| < 25th percentile | 1.0 | – | 1.0 | – |
| 25th to 50th percentile | 0.54 (0.28–1.04) | 0.07 | 0.71 (0.30–1.70) | 0.45 |
| 50th to 75th percentile | 1.10 (0.57–2.09) | 0.78 | 1.08 (0.47–2.46) | 0.86 |
| > 75th percentile | 1.44 (0.72–2.88) | 0.30 | 1.08 (0.46–2.56) | 0.86 |

| | First medicines given for fever in the previous 2 weeks ($n = 123$) | | | |
|---|---|---|---|---|
| | Any antimalarial drug†† | | Adequate therapy‡‡ | |
| Predictor variables* | OR (95% CI) | *P* value | OR (95% CI) | *P* value |
| Age§ | 1.12 (0.83–1.51) | 0.47 | 1.00 (0.70–1.42) | 0.99 |
| Female | 1.38 (0.26–7.21) | 0.70 | 1.00 (0.12–8.52) | 1.00 |
| Education level¶ | 1.17 (0.46–3.00) | 0.75 | 0.50 (0.12–2.00) | 0.32 |
| No. of children under care | 1.16 (0.93–1.45) | 0.19 | 1.03 (0.76–1.41) | 0.84 |
| Household asset index | | | | |
| < 25th percentile | 1.0 | – | 1.0 | – |
| 25th to 50th percentile | 1.48 (0.47–4.63) | 0.50 | 1.28 (0.22–7.24) | 0.78 |
| 50th to 75th percentile | 2.92 (0.85–10.04) | 0.09 | 4.73 (0.76–29.34) | 0.10 |
| > 75th percentile | 1.01 (0.25–4.16) | 0.99 | 2.69 (0.35–20.48) | 0.34 |
| Clinic as first point of care | 19.5 (4.19–90.82) | <0.001 | 40.9 (10.3–162.6) | <0.001 |

* Characteristics of the primary caregiver (except household asset index and clinic as first point of care).
† Positive treatment strategy as combination therapy, quinine, or going directly to clinic/hospital.
‡ Chloroquine + sulfadoxine-pyrimethamine (CQ + SP) at the time of this study.
§ Per 5-year increase.
¶ Secondary school or higher *vs* primary school or none.
** A child under the care of primary caregiver has been hospitalized in the past.
†† Antimalarial drugs defined as CQ, SP, amodiaquine (AQ), quinine, artemisinin, or combination of these.
‡‡ Adequate therapy defined as quinine, CQ + SP, AQ + SP, or quinine + another antimalarial.

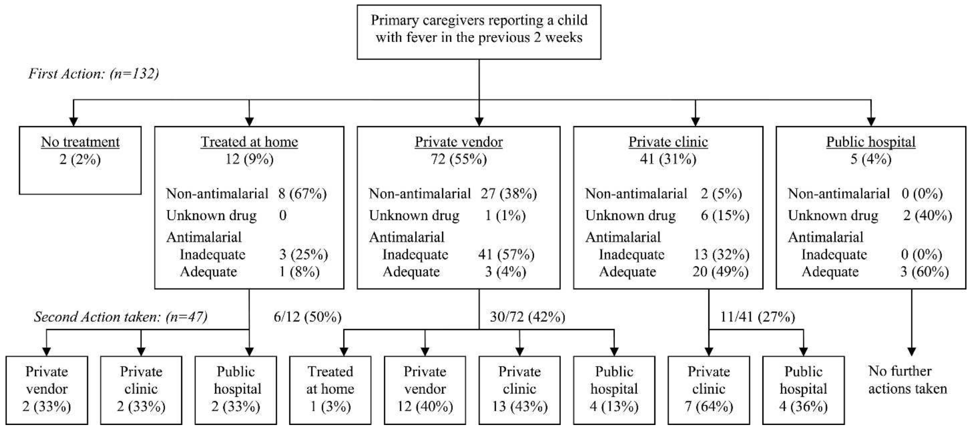


FIGURE 1. First and second actions taken by primary caregivers reporting a child with fever in the previous 2 weeks. Private vendors include general shops, drug shops, and pharmacies. Non–anti-malarials include paracetamol, aspirin, antihistamines, vitamins, herbs, and non–anti-malarial antibiotics. Inadequate anti-malarial defined as chloroquine (CQ), sulfadoxine-pyrimethamine (SP), or amodiaquine (AQ) monotherapy. Adequate anti-malarial defined as quinine monotherapy or combination therapy (CQ+SP, AQ+SP, quinine + another anti-malarial).

treated at home or bought medicines from a drug shop (US$0.83; range, 0–US$15; $P < 0.001$).

*Drugs used and factors associated with adequate treatment.* Drugs given with the first action are summarized in Figure 2. Medicines unknown to the primary caregiver were given in 9 (7%) cases, all but one of which was obtained at a clinic or hospital. Including only episodes in which the primary caregiver knew what medicines were given ($N = 123$), 68% of febrile episodes were treated with an anti-malarial medication. Of these, 45% received a correct dose. The most common first medication given for fever was chloroquine (34%), followed by paracetamol (25%). The first action included treatment with an antibiotic in only 11% of cases. Adequate anti-malarials, defined as combination therapy or quinine, accounted for 22% of known treatments, of which 15% were administered in the correct dose. Of the 27 children given an adequate anti-malarial, 6 (22%) went on to seek a second action compared with 39/96 (41%) of those who were not initially treated with an adequate anti-malarial ($P = 0.08$). Treatment with CQ+SP, the current government recommended first-line therapy, accounted for only 8% of first actions. Treatment with an adequate anti-malarial was significantly more likely when the child was taken to a clinic or hospital than when the caregiver treated the child at home or bought medicines from a private vendor (61% versus 5%, $P < 0.001$). By multivariate analysis, accessing a clinic or hospital as the first source of care was the only independent predictor of treatment with an anti-malarial drug or of treatment with an adequate anti-malarial (Table 3).

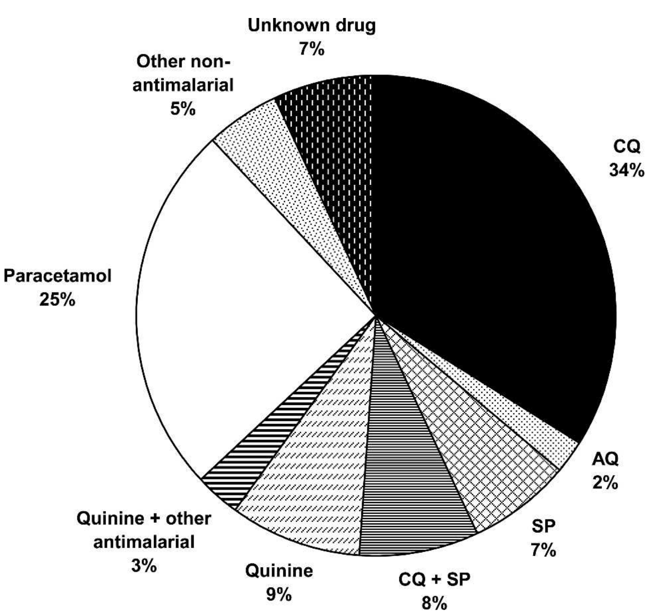


FIGURE 2. Medications given as first action in response to fever ($N = 132$). CQ, chloroquine; AQ, amodiaquine; SP, sulfadoxine-pyrimethamine.

*Promptness of treatment and time to anti-malarial treatment.* Seventy percent of caregivers reported no delay in seeking treatment. However, only 21% of caregivers obtained any treatment of their child within 24 hours. Children first treated at home or with medicines from a private vendor were no more likely to receive prompt treatment with an anti-malarial than those taken directly to a clinic or hospital (13% versus 21%, $P = 0.27$). The median time to anti-malarial treatment was 1–3 days after onset of fever, with 19% treated within 24 hours, 65% treated within 1–3 days from onset of fever, 14% within 4–7 days, and 2% after > 7 days. Overall, 19 of 123 fevers (15%) were treated with an anti-malarial within 24 hours. However, only six (5%) treatments included prompt treatment with an adequate anti-malarial, and only one (1%) included prompt treatment with an adequate anti-malarial given in the correct dose.

## DISCUSSION

In this study, we investigated malaria-related prevention and treatment practices in an urban African setting. We found that few households owned ITNs, and only 8% of women reported using an ITN during pregnancy within the last 3 years. Household wealth was strongly associated with bed net and ITN ownership, but did not seem to predict use of prevention measures during pregnancy. Services outside of the formal health sector were used commonly, with many caregivers obtaining treatment from private vendors. Notably, we found that prompt treatment with adequate anti-malarial drugs occurred rarely. Despite recent changes in drug policy in Uganda and the availability of a variety of anti-malarial drugs in Kampala, chloroquine remained the most common treatment of childhood fever. Only 5% of fevers were treated with an adequate anti-malarial regimen within 24 hours of illness onset. Adequate treatment was more likely to be obtained from a clinic or hospital; treatment given at home or obtained from a private vendor was frequently inadequate. Even in this urban area, with close proximity to an array of health services, we are still far from meeting the malaria control targets set by African leaders at Abuja in 2000.

One of the strengths of this study was the use of probability sampling to generate a representative group of primary caregivers from our target population. In general, our study site is likely to differ from other urban areas as it is located within Uganda's largest and most developed city. Comparing the demographics of our study population to urban populations described in the Uganda Demographic and Health Survey (DHS) conducted in 2000–2001, there were notable differences. Child mortality rates were considerably lower in our population (15.5% versus 48.7%).[4] The proportion of primary caregivers completing at least secondary school was comparable with that reported for urban Ugandan women; however, literacy was slightly higher (82% versus 76%). Based on a number of factors (including employment, access to electricity, quality of housing material, and ownership of mobile phones), our study population was somewhat more wealthy than other urban households. In addition, our study population had much greater access to education and amenities than the majority of the Ugandan population living in rural areas.[4]

Bed net ownership was relatively common in our study population, but use of ITNs and IPT was far below target levels. Compared with other urban households, twice as many households in our population owned bed nets (61% versus 33%) and use of bed nets during pregnancy was five times higher among women reporting pregnancies in the last three years (66% versus 13%).[4] However, despite unexpectedly high levels of bed net ownership, use of ITNs remained low (11% of households and 8% of pregnant women), consistent with other observations in sub-Saharan Africa.[11] In addition, use of any IPT (including CQ and/or SP) during pregnancy in our study population was less common than previously reported for urban populations in Uganda, even after the implementation of the national IPT program in 2002 (25% versus 38%). However, among women using IPT in the last 3 years, SP dosed once in the second trimester and once in third trimester accounted for a larger proportion of all IPT in our population than in the DHS (56% versus 4%), possibly reflecting the recent changes in IPT recommendations.

In our multivariate analysis, we evaluated for predictors associated with use of malaria prevention measures. We found that younger age, higher education level, and increased household wealth were associated with ownership of bed nets, but that only wealth, as measured by our household wealth index, predicted ownership of ITNs. An association between wealth and bed net ownership has been previously documented.[18–22] This is not unexpected, given that the cost of a single ITN may approximate 1 week's wages for some households.[22] The association between bed net ownership and higher education has also been shown elsewhere.[18,22] Interestingly, wealth was not a predictor of use of prevention measures during pregnancy. The year of pregnancy was the strongest predictor of bed net use in pregnancy, whereas higher education level was the only independent predictor of use of IPT. Not surprisingly, use of bed nets and IPT during pregnancy was more common in recent years, corresponding to efforts to scale-up ITNs and IPT in Uganda.

Prompt treatment of malaria with effective anti-malarials is one of the key strategies for malaria control in Africa. Because barriers to obtaining care within the formal health sector may be substantial and laboratory-confirmed diagnoses are often lacking, presumptive treatment of febrile children with anti-malarials has been widely advocated in malaria-endemic areas.[15] In Africa, treatment of fever at home is common, either as primary management of fever or before seeking care from a health facility, frequently using drugs purchased from private vendors.[10,23–26] Our results confirm the importance of private vendors as an initial source of care for childhood fever in Kampala, with 55% of all febrile episodes treated initially with drugs bought at a shop or pharmacy. Use of anti-malarials as first-line treatment of childhood fever in our population (68%) was similar (or higher) to that reported from other urban settings in Ghana, Malawi, and Uganda.[27–29] However, we found that defining appropriate therapy was challenging, given rapidly changing recommendations for first-line treatment of malaria and widespread drug resistance. This was not an issue in previous studies, conducted when chloroquine was still considered the drug of choice for uncomplicated malaria. Recently, studies from Kenya and Malawi, which studied treatment practices after change in national drug policy from chloroquine to SP, found a gap between the proportion of fevers treated with any anti-malarial and those treated with the recommended regimen.[28,30] In our study, only 32% of anti-malarial treatments given for initial management of fever in children were considered adequate. CQ+SP, the recommended first-line therapy adopted in 2002, was poorly used, accounting for only 13% of anti-malarial treatments. Although a wide variety of anti-malarials are available in Kampala, we found that chloroquine remained the most commonly used drug for fever, with chloroquine monotherapy accounting for 54% of treatments. Combination regimens other than CQ + SP were used rarely. As drug policies evolve and more anti-malarial drugs become available, the gap between policy and practice is likely to widen.

Prompt treatment with adequate anti-malarials, defined by the WHO as treatment administered within 24 hours of the onset of illness, occurred rarely in our population. Initial treatment was most commonly given 1–3 days after the onset of fever. Only 15% of febrile episodes were treated with an anti-malarial drug within 24 hours, and only 5% were treated with an adequate regimen within 24 hours. Caregivers in our population were no more likely to obtain prompt anti-malarial treatment of their child if they first sought care outside the formal health sector than if they first took their child to a clinic or hospital. This is in contrast to findings from rural Africa, where distance to health care facilities likely has a significant impact on access to care.[31,32] Although the time from initial presentation to development of severe malaria or death may be short,[24,33–36] the evidence base for recommending treatment of fevers within 24 hours is limited, and the role that time to treatment plays in determining disease outcome remains unclear. In our study, many caregivers did not perceive waiting for over 24 hours before seeking treatment as a delay. If the goal of achieving prompt treatment is to be met, this perception will need to be changed.

Our results showed a significant difference in the likelihood of adequate treatment based on the first source of care. Caregivers who first sought care at a clinic or hospital were much more likely to obtain adequate treatment of their child than those who sought care outside the formal health sector (61% versus 5%). In our multivariate model, seeking care first at a clinic or hospital was the only independent predictor of adequate treatment. Treatment obtained from private vendors was no more likely to be adequate than treatment given at home by the caregiver. These data suggest that, in a setting where most treatments are obtained outside of the formal health sector, it may be difficult to provide appropriate anti-malarial therapy. Promoting health facility–based treatment in urban areas is an option, although this approach poses several challenges. In our study, the cost of care obtained from a clinic or hospital was four times as expensive as that of other alternatives and may be far more expensive than home-based approaches. However, we also found that wealth was not associated with adequate treatment in our multivariate analysis, suggesting that cost may not deter caregivers from obtaining appropriate treatment. Additional barriers to formal health facility care, including long waiting times, drug availability, and poor prescribing behaviors, must also be addressed. Alternatively, drug-dispensing practices at private vendors could be strengthened through regulation or by providing additional training to shop attendants, an approach that has been shown to be successful in rural Kenya.[37]

This study had several potential limitations. We assessed treatment of malaria based on reports by caregivers, which could be subject to recall bias. Caregivers may also have been misinformed as to what medicines they received at private vendors or formal health facilities. Comparing data collected during our census with our experience during subject recruitment, we found Mulago III parish to be a highly mobile urban population, with residents frequently moving within Kampala or to rural areas. Our sample could have been biased toward households with more permanent living arrangements. Despite these potential limitations, our results are fairly consistent with data from other studies done in urban African settings, suggesting that our sample was representative of this large and growing segment of the population.

Malaria control targets are not being met in our study population, a relatively well-educated urban community in Uganda with easily accessible health care services. In particular, prompt treatment of febrile illness with appropriate anti-malarials was seldom accomplished. Our results suggest potential approaches to improving current practices. Strategies to make bed nets and ITNs more affordable and education emphasizing the value of prevention practices may improve appropriate use of ITNs and IPT. Encouraging health facility–based care, or alternatively, building capacity for delivery of treatment through private vendors, could optimize prompt, effective anti-malarial treatment. Well-designed randomized trials comparing home-based versus clinic-based management of fever, in both urban and rural settings, should provide valuable insight into the effectiveness of these strategies.

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