Knowledge of malaria prevention among pregnant women and non-pregnant mothers of children aged under 5 years in Ibadan, South West Nigeria

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Abstract

Background: Adequate knowledge of malaria prevention and control can help in reducing the growing burden of malaria among vulnerable groups, particularly pregnant women and children aged under 5 years living in malaria endemic settings. Similar studies have been conducted but with less focus on these vulnerable groups. This study assessed knowledge of malaria prevention and control among the pregnant women and non-pregnant mothers of children aged under 5 years in Ibadan, Oyo State, South West Nigeria.

Methods: In this cross sectional study, data on socio-demographic, clinical and knowledge on malaria prevention was collected using interviewer administered questionnaires from consenting study participants attending Adeoyo maternity hospital between May and November 2016. Data was described using percentages and compared across the two maternal groups in the study population. Knowledge scoring from collected data was computed using the variables on causes, symptoms and prevention of malaria and thereafter dichotomised. Multivariate analyses were used to assess the interactive effect of socio demographic and clinical characteristics with malaria knowledge. Level of statistical significance was set at p < 0.05.

Results: Of the 1373 women in the study, 59.6% (818) were pregnant women while 40.4% (555) were mothers of children aged under 5 years. The respondents mean age was 29 years ± 5.2. A considerable proportion of both the pregnant women (n = 494, 60.4%) and the non-pregnant mothers of children aged under 5 years (n = 254, 45.8%) did not have correct knowledge on malaria prevention measures based on our assessment threshold (p < 0.001). Having a tertiary level education was associated with better knowledge on malaria (4.20 ± 1.18, F = 16.80, p < 0.001). Multivariate analyses showed that marital status, educational attainment, gravidity, and HIV status were significantly associated with knowledge of malaria prevention and control.

Conclusion: The findings indicate that socio-demographic factors such as marital and educational status greatly influence knowledge on malaria prevention and control measures. Key health stakeholders and authorities need to implement strategies and direct resources to improve the knowledge of mothers on malaria prevention and control. This would stem the tides of malaria related deaths among pregnant women and children aged under 5 years.

Keywords: Malaria prevention and control, Pregnant women, Non-pregnant mothers of children aged under 5 years
Background
Malaria is a major public health problem in ninety-one countries worldwide with sub-Saharan Africa bearing 80% of the disease burden [1]. Malaria remains endemic in Nigeria where the parasitic disease disproportionately affects children aged under 5 years and pregnant women compared to the rest of the population groups [2–6]. In pregnancy, malaria increases the risk of maternal anaemia, spontaneous abortions, stillbirths, premature deliveries, intra-uterine growth retardation and low birth weight babies, and these are all important causes of infant mortality [7]. Also, more than 70% of all malaria deaths occur in children aged under 5 years [4, 8]. The scope of malaria control is changing worldwide with more emphasis on community and individual participation. Health education can improve participation in malaria control, when such education is designed to address gaps in the knowledge, attitudes and practice of individuals in the communities [4, 9].

Nigeria has implemented three national malaria strategic plans (NMSP) till date, and is presently implementing a fourth NMSP (2014–2020). This fourth NMSP aims to achieve pre-elimination status and reduce malaria-related deaths to zero by 2020 [10]. Evidence from malaria knowledge, attitudes, and practices (KAP) studies reported that misconceptions on malaria transmission and risk factors still exist with adverse impact on malaria control programmes [11, 12]. Findings from a study conducted by Singh et al. in rural areas of Northern Nigeria revealed that although knowledge about malaria prevention measures was high (90%), it was poorly reflected in their practices (16%) [13]. Another study by Adebayo et al. [14] assessed the knowledge of malaria prevention among mothers of children aged under 5 years and pregnant women in a rural community in Southwest Nigeria. This latter study also found poor knowledge and utilization of malaria prevention measures among majority of the caregivers in the rural study area [14]. Considering the vulnerability of both children aged under 5 years and pregnant women to malaria [10, 15], this study aimed to determine the knowledge of malaria prevention and management among pregnant women and non-pregnant mothers of children aged under 5 years seeking health care at one of the main secondary maternity hospitals in Ibadan, Nigeria. Only few studies have assessed knowledge on malaria prevention among mothers in hospital-based setting. This study sought to fill this gap and provide new insights on the depth of knowledge gaps. The findings will help to improve implementation of integrated malaria control strategies. It will also be essential in establishing epidemiological and behavioural baseline indicators to evaluate and improve progress by malaria control programmes.

Methods
Ethics statement
Prior to data collection, ethical approval was obtained from the Oyo state ministry of health ethics committee (IRB AD13/479/1035) in Nigeria and from the biomedical research ethics committee (BREC- BE199/16) of the University of KwaZulu-Natal, South Africa. Study participants voluntarily signed written informed consent forms without any incentives. They consented because they believed their responses would contribute to increased effective control of malaria. The participants were also assured of confidentiality. The data collection tool was translated to both Yoruba, which is the dominant local language, and English language.

Study design and setting
Using a cross-sectional study design, this survey was conducted between May and November 2016. The study recruitment site was the Adeoyo Maternity Hospital located in Ibadan North East-Oyo state, Nigeria. The elevation of the study area lies between 64 and 414 mm (Fig. 1). The study setting and site have been described in another publication [16]. The hospital is situated in the semi-urban community of Yemetu-Adeoyo in Ibadan. This facility is one of the oldest of its kind in Nigeria (opened in 1927) that provides both primary and secondary level maternal and child health care [17].

Study population and eligibility criteria
A multi stage sampling technique was employed with the aim of ensuring that the study population was representative of pregnant women and non-pregnant mothers of children aged under 5 years in the study area. The first stage involved identification of the geographical area and the second stage involved selection of the specific health facility from a list of facilities within the identified geographical area. In the third stage, participants were randomly selected from the selected health facility. The study population included consenting pregnant women and mothers of children under 5 years old attending the study site for health care. Mothers who were residents in Ibadan and regular attendees of the study site for health care were eligible to participate in the study. Criteria for inclusion into the study was that the women had to be either pregnant or have at least one child who is less than 5 years old.

Data collection
A semi-structured interviewer administered questionnaire was used to collect data from the consenting study participants. The variables and measurements collected included socio demographic data such as age, socio-economic status; clinical characteristics such as human
immunodeficiency virus (HIV) status, gravidity status, blood group; and questions assessing the participants’ awareness and extent of knowledge on malaria symptoms, prevention and management.

Data analysis
Overall knowledge score was computed by aggregating the knowledge related variables (1) awareness of malaria (2) knowledge of cause of malaria (3) knowledge of breeding sites for mosquito (4) knowledge of three or more symptoms of malaria (5) knowledge of when malaria mosquito feeds (correct knowledge when at night), and (6) knowledge of malaria prevention knowledge (which include chemoprophylaxis, insecticide treated nets (ITN) and environmental sanitation). The knowledge variables were recoded to binary level such that respondents with correct option in the knowledge variables were coded 1 while not having correct knowledge was coded 0. Knowledge score was computed as the sum of the six knowledge variables, with 0 as the least possible score and 6 as highest possible score. Increasing score indicated better malaria knowledge. Subsequently, the median of the composite score was used as the cut-off to classify knowledge level as either poor or good. Individuals who scored less than the median of knowledge score were categorized as having poor knowledge while scoring within the exact median cut off and above were classified as having good malaria knowledge.

Categorical variables were presented as numbers and percentages; numerical variables were presented as means and standard deviation to describe the study population by their socio demographic and clinical characteristics. To assess the level of relationship and interaction between malaria knowledge score and the respondents’ socio demographic and clinical characteristics, analytical statistics involving Chi square and analysis of variance was carried out. Multivariate linear analysis was further performed to determine predictors of malaria knowledge. Level of statistical significance was set at $p < 0.05$. Analyses were performed using Statistical Package for the Social Sciences software (SPSS) version 25, Chicago, IL.
Results
Table 1 presents results on the socio-demographic and clinical characteristics of the study respondents. Of the 1373 women in the study, 59.6% (818) were pregnant women whereas 40.4% (555) were non-pregnant mothers of children aged under 5 years. Mean age of respondents in the study was 29 years ± 5.2 years old. Mean age of the pregnant women in the study was 28.9 ± 5.21 while mean age of non-pregnant mothers of children aged under 5 years was 30.0 ± 5.14. The most predominant age group was 25–34 years of age (pregnant women: 71.3% vs non-pregnant mothers of children aged under 5 years: 66.8%). The most predominant socio economic class among both maternal groups were the lower upper class (60.4% for the pregnant women and 61.4% among non-pregnant mothers of children aged under 5 years). The most predominant genotype was 'AA' (pregnant women: 85.9% vs non-pregnant mothers of children aged under 5 years: 87%). Conversely, the predominant genotype was 'AA' (pregnant women: 70.4% vs non-pregnant mothers of children aged under 5 years: 65.9%) followed by 'AS' (pregnant women: 23.3% vs non-pregnant mothers of children aged under 5 years: 22%), 'AC' (pregnant women: 5% vs non-pregnant mothers of children aged under 5 years: 8.8%) and 'SS' (pregnant women: 1.2% vs non-pregnant mothers of children aged under 5 years: 3.2%).

Knowledge about the causes, symptoms and prevention of malaria
Table 2 shows the distribution of variables related to knowledge about malaria disaggregated according to maternal grouping. There was a low proportion of respondents who were not aware of malaria, less than one-tenth among the pregnant women (7%) and even lower among non-pregnant mothers of children aged under 5 years (2.9%), and this was statistically significant, p < 0.05. Almost half proportion of both the pregnant and the non-pregnant mothers of children aged under 5 years did not have knowledge on the breeding sites of mosquitoes (47.1% vs 49.7%, respectively), however this finding was not significant (p > 0.05). Majority of the participants had low knowledge of malaria symptoms and was only able to identify a maximum of 2 or less symptoms of malaria (74% among pregnant mothers and 69% among non-pregnant mothers of children aged under 5 years), the difference in the proportion was on the edge of being statistically significant with p = 0.051. Across both maternal groups, about a third of the respondents reported insecticide treated nets (ITN) as common method of malaria prevention. Similarly, another one-third reported insecticide spray as common prevention methods for malaria. The proportion which reported the correct prevention knowledge for malaria to include ITN, environmental sanitation and chemotheraphy such as artemisinin-based combination therapy (ACT), were 39.6% among the pregnant women and 54.2% among non-pregnant mothers of children aged under 5 years, p < 0.001.

There was no significant difference in malaria knowledge score between pregnant women and non-pregnant mothers of children aged under 5 years in the study (Table 3). There was also no statistical difference in knowledge score between the age groupings of the respondents. Significantly, knowledge on malaria was higher among respondents who were of the lower middle class (4.10 ± 12.28) and lower upper class (4.10 ± 12.6) than the lower class (3.73 ± 16.6), F = 4.43, p < 0.001. Knowledge score was also highest among the never married women (4.31 ± 15.2, F = 30.2, p < 0.001) compared with the other like the married group (1.08 ± 12.6, F = 30.2, p < 0.001). Educational status of the mothers was also associated with knowledge of malaria as mothers who had secondary (4.07 ± 12.8) and tertiary education (4.20 ± 1.18) as their highest educational qualification showed significantly better knowledge about malaria than those with no formal education (3.38 ± 18.4) and primary education (3.8 ± 17.9), F = 16.80, p < 0.001. The clinical characteristics of the women such as gravidity status, HIV status, blood group and genotype showed significant relationship with malaria knowledge (Table 3). Women with more than a single child had better knowledge of malaria. Respondents whose HIV sero-status, was either positive (4.35 ± 0.88) or negative (4.14 ± 1.21) had higher mean knowledge score about malaria than those who did not know their HIV status (3.63 ± 1.71), p < 0.001.

Table 4 presents the post hoc analysis performed to show where the difference in mean for sub-groups
Table 1  Socio-demographic and clinical distribution by maternal group

| Maternal group                                                                 | Pregnant women N (%) | Non-pregnant mothers of children aged under 5 years N (%) | Total N (1373) |
|---------------------------------------------------------------------------------|----------------------|----------------------------------------------------------|---------------|
| **Age group**                                                                   |                      |                                                          |               |
| < 24                                                                            | 128 (15.6)           | 79 (14.2)                                                | 207           |
| 25–34                                                                           | 583 (71.3)           | 371 (66.8)                                               | 954           |
| 35+                                                                             | 107 (13.1)           | 105 (18.9)                                               | 212           |
| **Socio-economic status**                                                       |                      |                                                          |               |
| Lower class                                                                     | 140 (17.2)           | 62 (11.2)                                                | 202           |
| Lower middle class                                                              | 119 (14.6)           | 100 (18.0)                                               | 219           |
| Lower upper class                                                                | 492 (60.4)           | 341 (61.4)                                               | 833           |
| Upper class                                                                     | 63 (7.7)             | 52 (9.4)                                                 | 115           |
| **Marital status**                                                              |                      |                                                          |               |
| Never married                                                                   | 30 (3.7)             | 12 (2.2)                                                 | 42            |
| Married                                                                         | 731 (89.4)           | 530 (95.5)                                               | 1261          |
| Separated/widowed                                                               | 57 (7.0)             | 13 (2.3)                                                 | 70            |
| **Education**                                                                   |                      |                                                          |               |
| No formal education                                                              | 76 (9.3)             | 21 (3.8)                                                 | 97            |
| Primary                                                                         | 40 (4.9)             | 41 (7.4)                                                 | 81            |
| Secondary                                                                       | 384 (46.9)           | 325 (58.6)                                               | 709           |
| Tertiary                                                                        | 318 (38.9)           | 168 (30.3)                                               | 486           |
| **Religion**                                                                    |                      |                                                          |               |
| Christianity                                                                     | 338 (41.3)           | 229 (41.3)                                               | 567           |
| Islam                                                                           | 459 (56.1)           | 325 (58.6)                                               | 784           |
| Traditional worshiper                                                           | 21 (2.6)             | 1 (0.2)                                                  | 22            |
| **Status of residence**                                                         |                      |                                                          |               |
| Owned                                                                           | 209 (25.6)           | 118 (21.3)                                               | 327           |
| Not owned                                                                       | 597 (73.0)           | 414 (74.6)                                               | 1011          |
| Others                                                                          | 12 (1.5)             | 23 (4.1)                                                 | 35            |
| **Gravidity status**                                                            |                      |                                                          |               |
| Prime-gravid                                                                    | 275 (33.6)           | –                                                        | 275           |
| Multi-gravid                                                                    | 543 (66.4)           | 555 (100.0)                                              | 1098          |
| **Parity**                                                                       |                      |                                                          |               |
| No child                                                                        | 275 (33.6)           | –                                                        | 275           |
| One child                                                                       | 250 (30.6)           | 135 (24.3)                                               | 385           |
| Two Children                                                                    | 165 (20.2)           | 174 (31.4)                                               | 339           |
| Three or more children                                                          | 128 (15.6)           | 246 (44.3)                                               | 374           |
| **HIV status**                                                                  |                      |                                                          |               |
| Positive                                                                        | 12 (1.5)             | 8 (1.4)                                                  | 20            |
| Negative                                                                        | 603 (73.7)           | 442 (79.6)                                               | 1045          |
| Not known                                                                       | 203 (24.8)           | 105 (18.9)                                               | 308           |
| **Blood group**                                                                 |                      |                                                          |               |
| A                                                                                | 290 (35.5)           | 184 (33.3)                                               | 474           |
| B                                                                                | 133 (16.3)           | 131 (23.7)                                               | 264           |
| AB                                                                               | 51 (6.2)             | 66 (12.0)                                                | 117           |
| O                                                                                | 342 (41.9)           | 171 (31.0)                                               | 513           |
| **Genotype**                                                                    |                      |                                                          |               |
| AA                                                                               | 574 (70.4)           | 366 (65.9)                                               | 940           |
| AS                                                                               | 190 (23.3)           | 122 (22.0)                                               | 312           |
| AC                                                                               | 41 (5.0)             | 49 (8.8)                                                 | 90            |
| SS                                                                               | 10 (1.2)             | 18 (3.2)                                                 | 28            |
### Table 2 Respondents awareness and knowledge of malaria

|                                         | Pregnant women n (% | Non-pregnant mothers of children aged under five years n (%) | Total N (1373) | Chi square value | p value |
|-----------------------------------------|---------------------|--------------------------------------------------------------|----------------|------------------|---------|
| **Awareness about malaria**             |                     |                                                              |                |                  |         |
| Yes                                     | 759 (93.0)          | 539 (97.1)                                                   | 1298           | 11.028           | 0.001   |
| No                                      | 57 (7.0)            | 16 (2.9)                                                     | 73             |                  |         |
| **Causes of malaria**                   |                     |                                                              |                |                  |         |
| Mosquito                                | 697 (85.2)          | 480 (86.5)                                                   | 1177           | 12.312           | 0.031   |
| Contaminated food                       | 8 (1.0)             | 8 (1.4)                                                      | 16             |                  |         |
| Living in dirty environment             | 34 (4.2)            | 32 (5.8)                                                     | 66             |                  |         |
| Too much sunlight or heat               | 4 (0.5)             | 5 (0.9)                                                      | 9              |                  |         |
| Don't know                              | 66 (8.1)            | 22 (4.0)                                                     | 88             |                  |         |
| Stress                                  | 9 (1.1)             | 8 (1.4)                                                      | 17             |                  |         |
| **Correct knowledge on cause of malaria**|                      |                                                              |                |                  |         |
| Mosquito bites                          | 697 (85.2)          | 480 (86.5)                                                   | 1177           | 0.442            | 0.506   |
| Causes not mosquito bites               | 121 (14.8)          | 75 (13.5)                                                    | 196            |                  |         |
| **Breeding sites of mosquitoes**        |                     |                                                              |                |                  |         |
| Stagnant water                          | 433 (52.9)          | 279 (50.3)                                                   | 712            | 0.940            | 0.332   |
| Other sites/factors not related to breeding sites | 385 (47.1)     | 276 (49.7)                                                   | 661            |                  |         |
| **Symptoms of malaria**                 |                     |                                                              |                |                  |         |
| Cold                                    | 281 (34.5)          | 254 (45.8)                                                   | 535            | 18.122           | 0.000   |
| Fever                                   | 369 (45.1)          | 265 (47.7)                                                   | 634            | 0.926            | 0.336   |
| Headache                                | 350 (42.8)          | 330 (59.5)                                                   | 680            | 36.767           | 0.000   |
| Vomiting                                | 75 (9.2)            | 57 (10.3)                                                    | 132            | 0.462            | 0.497   |
| Weakness                                | 167 (20.4)          | 69 (12.4)                                                    | 236            | 14.805           | 0.000   |
| Dizziness                               | 36 (4.4)            | 25 (4.5)                                                     | 61             | 0.008            | 0.927   |
| Nausea                                  | 6 (0.7)             | 6 (1.1)                                                      | 12             | 0.461            | 0.497   |
| Loss of appetite                        | 42 (5.1)            | 31 (5.6)                                                     | 73             | 0.134            | 0.714   |
| Bitter mouth taste                      | 56 (6.8)            | 38 (6.8)                                                     | 94             | 0.000            | 0.999   |
| Convulsion                              | 7 (0.9)             | 9 (1.6)                                                      | 16             | 1.684            | 0.194   |
| Diarrhoea                               | 6 (0.7)             | 7 (1.3)                                                      | 13             | 0.982            | 0.332   |
| Joint pain                              | 54 (6.6)            | 47 (8.5)                                                     | 101            | 1.691            | 0.193   |
| Coloured/yellowed eye                   | 10 (1.1)            | 5 (0.9)                                                      | 15             | 0.316            | 0.574   |
| Coloured/yellowed urine                 | 6 (0.7)             | 1 (0.2)                                                      | 7              | 0.316            | 0.574   |
| **Knowledge on symptoms of malaria**    |                     |                                                              |                |                  |         |
| 0–2 correct symptoms                    | 525 (74.0)          | 358 (69.0)                                                   | 883            | 3.812            | 0.051   |
| Three correct symptoms or more          | 184 (26.0)          | 161 (31.0)                                                   | 345            |                  |         |
| **When does mosquitoes feed**           |                     |                                                              |                |                  |         |
| Wrong knowledge as other times          | 300 (36.7)          | 240 (43.2)                                                   | 540            | 5.979            | 0.014   |
| Correct knowledge as night              | 518 (63.3)          | 315 (56.8)                                                   | 833            |                  |         |
| **Malaria preventive methods**          |                     |                                                              |                |                  |         |
| Insecticide spray                       | 305 (37.3)          | 205 (36.9)                                                   | 510            | 55.885           | 0.000   |
| Chemoprophylaxis                        | 15 (1.8)            | 11 (2.0)                                                     | 26             |                  |         |
| Any bed net                             | 44 (5.4)            | 8 (1.4)                                                      | 52             |                  |         |
| Insecticide-treated nets                | 289 (35.3)          | 274 (49.4)                                                   | 563            |                  |         |
| Drinking traditional concoction         | 5 (0.6)             | 1 (0.2)                                                      | 6              |                  |         |
| Keeping environment neat and clean      | 20 (2.4)            | 16 (2.9)                                                     | 36             |                  |         |
| Others                                  | 140 (17.1)          | 40 (7.2)                                                     | 180            |                  |         |
significantly associated with knowledge score in Table 3 occurred. The post hoc analysis also shows significant association between selected socio-demographic and clinical characteristics with patients’ knowledge on malaria (Table 4). There was significant association between socio-economic status of the women in the study and their malaria knowledge score. The significant differences were between the lower class and the lower middle class; also between lower class and lower upper class. There was also significant difference between: women who had primary education compared to women who had secondary and tertiary education; women who had secondary education compared to women who had no formal and primary education.

In the multivariate linear regression analysis to examine the predictors of malaria knowledge, socio-demographic factors including marital status, education, gravidity status and the clinical factor HIV status remained significant with malaria knowledge (Table 5).

**Discussion**

Nigeria contributes the highest morbidity and mortality rates to the global burden of malaria, accounting for 25% of the global malaria cases and about 24% of global malaria-related deaths [1]. Thus, the initiative to study maternal knowledge on malaria prevention was essential in understanding the extent and impact of malaria programmatic efforts in malaria control. Women serve as role models for their families in raising awareness and participating in malaria prevention and control [18]. They are also responsible for home-based management of malaria for themselves when pregnant and among children aged under 5 years in the home [19]. In this study, findings revealed obstacles to effective malaria control despite high awareness of malaria as an illness which has been previously reported in studies conducted in South Western Nigeria [20], Northern Central Nigerian [21] and as confirmed in this study (93% among pregnant women and 97% among mothers of young children). There were knowledge gaps on; breeding sites for the vectors that transmit malaria, symptoms of malaria and malaria prevention measures. According to Killeen [22], level of knowledge on mosquito behavioural pattern (biting and resting times) and breeding sites has been associated with the severity of malaria. Killeen further explains that elimination of malaria from most endemic regions of the tropics requires vector control strategies that address residual transmission by deliberately targeting the mosquito behaviours which enable it [22].

In relation to the knowledge on malaria symptoms and preventive measures by respondents in this study, about 60% of pregnant women and 46% of non-pregnant mothers of young children did not have correct knowledge on malaria prevention. Further, there were 26% of pregnant mothers and 31% of the non-pregnant mothers of young children who correctly reported more than 3 clinical symptoms of malaria. Similar studies conducted in rural South West Nigeria [14], North Central Nigeria [9] and Burkina Faso [18] also showed low knowledge on malaria prevention measures. Conversely, the study by Singh et al. showed that high knowledge about malaria symptoms and prevention measures (90%) however; this knowledge was poorly reflected in practice (16%) [13]. Misconceptions about causes of malaria in this study although reported by few respondents include living in dirty environment, eating contaminated food, stress, and exposure to sunlight. Some studies in Nigeria and parts of Africa have also reported spurious causes of malaria such as staying for long in the sun and drinking bad water among other misconceptions on malaria [11, 21, 23, 24]. Overlapping knowledge on malaria causes, key symptoms, and prevention was observed between pregnant women and the non-pregnant mothers of children aged under 5 years in this study. In some aspects of malaria prevention, higher proportion of pregnant women was less knowledgeable about malaria, compared with the mothers of young children and vice versa. However, the differences in malaria knowledge on preventive measures between the maternal groups were not significant from the analysis of variance performed.

Level of knowledge on malaria was associated with; socio-demographic factors such as marital status, education and clinical factors like gravidity and HIV status of the mothers. Good malaria knowledge was associated with higher level of educational status of the women. In previous studies, educational status has been linked

| Table 2 (continued) | Pregnant women n (%) | Non-pregnant mothers of children aged under five years n (%) | Total N (1373) | Chi square value | p value |
|---------------------|----------------------|-------------------------------------------------------------|---------------|-----------------|---------|
| Malaria prevention knowledge | Has correct knowledge on chemotherapy, insecticide-treated nets and environmental sanitation | 324 (39.6) | 301 (54.2) | 625 | 28.520 | 0.000 |
|                      | Does not have correct knowledge | 494 (60.4) | 254 (45.8) | 748 |         |         |
with good health awareness and health-seeking behaviour for the child [23, 25], and also improved knowledge on malaria and prevention among mothers [9, 18, 26]. Such association according to Fana et al. stresses the role education could have on the overall success in malaria control programmers in a region [26]. Another important finding was that respondents who knew their HIV status had a good knowledge of malaria compared with those who did not know their HIV status. Further, those who were HIV positive had better malaria knowledge when compared with both those were HIV negative and those who did not know their HIV status. The high knowledge of malaria among HIV positive respondents in the study might be due to the awareness of the high risk of acquiring opportunistic infections. For instance, knowledge of HIV status as reported by the study respondents reflects a higher awareness of their health status. This agrees with finding from study in Uganda by Katrak et al. where a sixfold lower risk of infection with malaria parasites among HIV-infected participants with an undetectable viral load was seen when compared to HIV-uninfected participants [27]. Possible explanation could be because individuals who knew their HIV status tend to have good health-seeking behaviour and knowledge on malaria compared with those who do not know their HIV status.

Although the study investigated the knowledge of malaria prevention and control, and sought to find the socio-demographic and some clinical factors associated with malaria knowledge this study did not investigate the programmatic factors that may influence the knowledge of the respondents on malaria and would like to recommend this for future studies. Limitations of this study include recall bias on account of information provided by the respondents. Since the study population was hospital-based, another bias related to the limitation of this study is selection bias because this hospital based study population could have been more knowledgeable than similar population if recruited from the community. Though these limitations, this study has implications for control programmes given the findings, which highlights the knowledge gaps requiring urgent interventions targeted at mothers.

**Conclusion**

This study has demonstrated that pregnant women and mothers of children under 5 years are aware of malaria, but still lack comprehensive knowledge about the disease. Many mothers know some important symptoms of malaria such as fever, cold and headache. There was also some level of misconception about malaria, which needs to be totally debunked by intensifying education about malaria among mothers who are either pregnant and or caring for young ones who are more vulnerable to malaria disease. Education as a socio-demographic factor was an important predictor knowledge of malaria among mothers and so government policies should be geared towards improving citizens

| Table 3 | Association between selected socio-demographic and clinical characteristics with respondents’ knowledge on malaria |
|----------|-------------------------------------------------------------------------------------------------|
|          | Mean | Standard deviation | Number | F-statistic | p value |
| Maternal grouping | | | | | |
| Pregnant women | 3.80 | 0.47 | 292 | 2.48<sup>a</sup> | 0.116 |
| Mothers of under-five | 3.87 | 0.50 | 171 | | |
| Age group | | | | | |
| < 24 | 4.12 | 1.27 | 207 | 1.506 | 0.222 |
| 25–34 | 3.98 | 1.41 | 954 | | |
| 35+ | 4.13 | 1.16 | 212 | | |
| Socio-economic status | | | | | |
| Lower class | 3.73 | 1.66 | 202 | 4.431 | 0.004 |
| Lower middle class | 4.10 | 1.28 | 219 | | |
| Lower upper class | 4.10 | 1.26 | 833 | | |
| Upper class | 3.95 | 1.38 | 115 | | |
| Marital status | | | | | |
| Never married | 4.31 | 1.52 | 42 | 30.725 | 0.000 |
| Married | 4.08 | 1.26 | 1261 | | |
| Separated/widowed | 2.83 | 2.13 | 70 | | |
| Education | | | | | |
| No formal education | 3.38 | 1.84 | 97 | 16.808 | 0.000 |
| Primary | 3.38 | 1.79 | 81 | | |
| Secondary | 4.07 | 1.28 | 709 | | |
| Tertiary | 4.20 | 1.18 | 486 | | |
| Gravidity status | | | | | |
| Prime-gravida | 3.45 | 1.74 | 275 | 64.18<sup>a</sup> | 0.000 |
| Multigravida | 4.17 | 1.20 | 1098 | | |
| HIV status | | | | | |
| Positive | 4.35 | 0.88 | 20 | 17.691 | 0.000 |
| Negative | 4.14 | 1.21 | 1045 | | |
| Not known | 3.63 | 1.71 | 308 | | |
| Blood group | | | | | |
| A | 4.04 | 1.37 | 474 | 7.294 | 0.000 |
| B | 3.70 | 1.56 | 264 | | |
| AB | 4.06 | 1.26 | 117 | | |
| O | 4.17 | 1.21 | 513 | | |
| Genotype | | | | | |
| AA | 4.10 | 1.26 | 940 | 2.9 | 0.034 |
| AS | 3.86 | 1.60 | 312 | | |
| AC | 3.89 | 1.35 | 90 | | |
| SS | 3.86 | 1.24 | 28 | | |

<sup>a</sup> t-test
Table 4 Post Hoc analysis for significant association between socio-demographic and clinical characteristics with knowledge on malaria score

| (I) Socio-economic status | (J) Socio-economic status | Mean difference \((I - J)\) | Sig. | 95% confidence interval Lower bound | Upper bound |
|--------------------------|--------------------------|---------------------------|------|------------------------------------|-------------|
| Lower class              | Lower middleclass        | −0.3678*                  | 0.026| −0.7041                            | −0.0314     |
|                          | Lower upper class        | −0.3682*                  | 0.003| −0.6386                            | −0.0978     |
| Upper class              |                          | −0.2152                   | 0.516| −0.6179                            | 0.1876      |
| Lower middleclass        | Lower class              | 0.3678*                   | 0.026| 0.0314                             | 0.7041      |
|                          | Lower upper class        | −0.0004                   | 1    | −0.2622                            | 0.2614      |
| Upper class              |                          | 0.1526                    | 0.756| −0.2444                            | 0.5497      |
| Lower upper class        | Lower class              | 0.3682*                   | 0.003| 0.0978                             | 0.6386      |
| Upper class              | Lower middleclass        | 0.0004                    | 1    | −0.2614                            | 0.2622      |
|                          | Upper class              | 0.153                     | 0.66 | −0.19                              | 0.4960      |
| Upper class              | Lower class              | 0.2152                    | 0.516| −0.1876                            | 0.6179      |
|                          | Lower middleclass        | −0.1526                   | 0.756| −0.5497                            | 0.2444      |
| Upper class              | Lower upper class        | 0.153                     | 0.66 | −0.496                             | 0.1900      |
| (I) Marital status       | (J) Marital status       |                           |      |                                    |             |
| Never married            | Married                  | 0.2263                    | 0.521| −0.2614                            | 0.7139      |
|                          | Separated/widowed        | 1.4810*                   | 0    | 0.8742                             | 2.0877      |
| Married                  | Never married            | −0.2263                   | 0.521| −0.7139                            | 0.2614      |
|                          | Separated/widowed        | 1.2547*                   | 0    | 0.873                              | 1.6364      |
| Separated/widowed        | Never married            | −1.4810*                  | 0    | −2.0877                            | −0.8742     |
|                          | Married                  | −1.2547*                  | 0    | −1.6364                            | −0.8730     |
| (I) Education            | (J) Education            |                           |      |                                    |             |
| No formal education      | Primary                  | −0.0013                   | 1    | −0.5164                            | 0.5139      |
|                          | Secondary                | −0.6905*                  | 0    | −1.061                             | −0.3200     |
|                          | Tertiary                 | −0.8140*                  | 0    | −1.1946                            | −0.4334     |
| Primary                  | No formal education      | 0.0013                    | 1    | −0.5139                            | 0.5164      |
|                          | Secondary                | −0.6892*                  | 0    | −1.0906                            | −0.2878     |
|                          | Tertiary                 | −0.8128*                  | 0    | −1.2235                            | −0.4020     |
| Secondary                | No formal education      | 0.6905*                   | 0    | 0.32                               | 1.0610      |
|                          | Primary                  | 0.6892*                   | 0    | 0.2878                             | 1.0906      |
|                          | Tertiary                 | −0.1235                   | 0.392| −0.3251                            | 0.0780      |
| Tertiary                 | No formal education      | 0.8140*                   | 0    | 0.4334                             | 1.1946      |
|                          | Primary                  | 0.8128*                   | 0    | 0.402                              | 1.2235      |
|                          | Secondary                | 0.1235                    | 0.392| −0.078                             | 0.3251      |
| (I) HIV status           | (J) HIV status           |                           |      |                                    |             |
| Positive                 | Negative                 | 0.2132                    | 0.76 | −0.4951                            | 0.9214      |
|                          | Not known                | 0.7201                    | 0.052| −0.0038                            | 1.4441      |
| Negative                 | Positive                 | −0.2132                   | 0.76 | −0.9214                            | 0.4951      |
|                          | Not known                | 0.5070*                   | 0    | 0.3036                             | 0.7104      |
| Not known                | Positive                 | −0.7201                   | 0.052| −1.4441                            | 0.0038      |
|                          | Negative                 | −0.5070                   | 0    | −0.7104                            | −0.3036     |
| (I) Blood group          | (J) Blood group          |                           |      |                                    |             |
| A                        | B                        | 0.3389*                   | 0.006| 0.0731                             | 0.6047      |
|                          | AB                       | −0.024                    | 0.998| −0.3813                            | 0.3333      |
|                          | O                        | −0.1357                   | 0.389| −0.3562                            | 0.0848      |
| B                        | A                        | −0.3389*                  | 0.006| −0.6047                            | −0.0731     |
|                          | AB                       | −0.3629                   | 0.072| −0.7473                            | 0.0215      |
|                          | O                        | −0.4746*                  | 0    | −0.7367                            | −0.2124     |
educational statuses in order to reduce the burden of the disease in the country, especially among the most vulnerable population. Mothers need to be educated about the importance of a better health-seeking behaviour and awareness about their health status. Nigeria’s malaria strategic plan should ensure that the knowledge cleft on malaria prevention and treatment needs to be addressed. This insight will help the policy makers to implement continuous strategic intervention including health awareness and educational programs to attain 2030 malaria goals.

### Abbreviations

- ACT: artemisinin-based combination therapy
- BREC: biomedical research ethics committee
- GTS: global technical strategy
- HIV: human immunodeficiency virus
- IDI: in-depth interviews
- IPT: intermittent preventive treatment
- IPTp: intermittent preventive treatment of malaria in pregnancy
- ITN: insecticide treated nets
- IVM: integrated vector management
- KAP: knowledge, attitudes, and practices
- LLIN: long-lasting insecticide-treated nets
- NMSP: national malaria strategic plans
- SPSS: statistical package for social sciences
- WHO: World Health Organization

### Table 4 (continued)

| (I) Genotype | (J) Genotype | Mean difference (I − J) | Sig. | 95% confidence interval Lower bound | Upper bound |
|--------------|--------------|-------------------------|------|-------------------------------------|-------------|
| AB A         |              | 0.024                   | 0.998| −0.3333                             | 0.3813      |
| B            |              | 0.3629                  | 0.072| −0.0215                             | 0.7473      |
| O            |              | −0.1117                 | 0.85 | −0.4663                             | 0.2429      |
| O A          |              | 0.1357                  | 0.389| −0.0848                             | 0.3562      |
| B            |              | 0.4746*                 | 0    | 0.2124                              | 0.7367      |
| AB           |              | 0.1117                  | 0.85 | −0.2429                             | 0.4663      |

### Table 5 Multivariate linear model of factors associated with knowledge of malaria

|             | Unstandardized regression coefficient (95% CI) | 95% CI | Standard error | Standardized coefficient | t-statistic |
|-------------|-----------------------------------------------|-------|----------------|--------------------------|-------------|
|             | Lower bound | Upper bound                                  |       |               |             |             |
| Age         | −0.004     | −0.018                                      | 0.009 | 0.007        | −0.02       | −0.60       |
| Wealth status | 0.03     | −0.051                                      | 0.117 | 0.04        | 0.02        | 0.77        |
| Marital status | −0.47   | −0.724                                      | −0.205 | 0.13       | −0.10       | −3.51***    |
| Education   | 0.16       | 0.072                                       | 0.252 | 0.05        | 0.10        | 3.52***     |
| Gravidity status | 0.67   | 0.474                                       | 0.859 | 0.10       | 0.20        | 6.80***     |
| HIV status  | −0.32      | −0.478                                      | −0.16 | 0.08       | −0.10       | −3.93***    |
| Blood group | 0.04       | −0.014                                      | 0.092 | 0.03        | 0.04        | 1.44        |
| Genotype    | −0.08      | −0.175                                      | 0.022 | 0.05       | −0.04       | −1.52       |
| Maternal grouping | −0.14 | −0.291                                      | 0.017 | 0.08        | −0.05       | −1.75       |

$R^2 = 0.050$, $F$ for change in $R^2 = 2.328$, $p = 0.011$, *$p < .05$, **$p < 0.01$, ***$p < 0.001$
Authors’ contributions
KEO and JMT conceptualized the idea and designed the study. Data collection, cleaning and analysis was conducted by KEO. Interpretation of results was done by KEO, JMT, EO, STY. KEO wrote the initial draft of the manuscript. All authors read and approved the final manuscript.

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Competing interests
The authors declare that they have no competing interests.

Availability of data and materials
The dataset produced by the current study is available from the corresponding author upon request.

Consent for publication
Not applicable.

Ethical approval and consent to participate
The study was approved by the Oyo state ministry of health ethics committee (IJRRC AD13/479/1035) in Nigeria and the biomedical research ethics committee (BREC: BE 199/16), University of Kwa-Zulu Natal, South Africa. Signed informed consent was obtained from the respondents enrolled in the study. The participants were assured of the confidentiality of their information. They were pre-informed that the study findings will be presented at stakeholders meetings, conferences and finally published which could positively influence effective malaria control policy and its implementation in the future.

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