# THE RISK FACTORS FOR MALARIA IN UNDER-FIVES IN GINDIRI COMMUNITY OF MANGU LOCAL GOVERNMENT AREA, PLATEAU State

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**ABSTRACT**

**Background:** Malaria is responsible for 25 % of infant mortality and 30 % of under-5 mortality globally.In Nigeria, it is a huge public health problem with an estimated 300,000 children dying of the disease each yearwhich represents one in every four deaths in childhood. The aim of this study was to determine the prevalence of malaria in under-fives and the risk factors responsible for malaria in Gindiri, a rural community in the North-central part of Nigeria.

**Methods:** A cross-sectional descriptive study was conducted among 390 under-fives in Gindiri Community of Mangu LGA, Plateau State. Multi-stage sampling technique was used to select the under-fives. A semi-structured, interviewer administered questionnaire was used to collect quantitative data from the respondents. Data analysis was carried out using SPSS version 23.0.

**Results:** The prevalence of malaria by Rapid Diagnostic Test (RDT) was 34.9%, 74 (34.5%) were females and 62 (35.2%) were males. The use of torn windows/door screens was a major predictor for a positive RDT in under-fives. Majority (91.8%) of households possessed insecticide treated nets but none of them had ever been treated.

**Conclusion:** Understanding the household and environmental risk factors for malaria is vital in tackling the high burden of malaria in rural communities. The prevalence of malaria among the under-fives in Gindiri is still a public health problem.

**Keywords**: Malaria, Under-fives, household, environment, risk factors

## INTRODUCTION

Malaria has remained a life-threatening disease despite it being preventable and treatable.[1] By December 2015, there were 212 million cases of malaria and 429,000 deaths globally.[1] Out of this malaria burden, sub-Saharan Africa is home to 88 % of malaria cases and 90 % of malaria deaths.[1] It is also believed to contribute up to 25 % of infant mortality and 30 % of under-5 mortality globally.[2,3] Nigeria bears up to 29 % of the malarial disease burden in Africa and has remained a major public health problem especially for children under the age of five years even though it is preventable, treatable and curable.[2] An estimated 300,000 children die of the disease each year in Nigeria which represents one in every four deaths of childhood [2,3]. It is estimated that children under five years have as many as three or four episodes every year with associated impairment in physical and intellectual development in fatally afflicted children.[4,5] Despite the various malaria prevention and control measures put in place by the Nigerian government to curb the spread of malaria such as the provision of Rapid Diagnostic Tests (RDTs), distribution of antimalarial medicines and long-lasting insecticide treated nets (LLINs), the intensity of malaria attack remains constant throughout the year leading to a high mortality of the under-fives who are Nigeria's future. [3]

This study aimed to determine the prevalence of malaria in under-fives in Gindiri community, Mangu Local Government Area, Plateau State and to identify the factors in the household and environment which contribute to the burden of malaria in this community.

## METHODS

**Study Area**: Gindiri is a district in Mangu Local Government Area (LGA), one of the 17 LGAs of Plateau State, Nigeria. It is approximately 14 kilometres from Mangu town and 100 kilometers from Jos, the capital of Plateau State. It has two wards (Gindiri 1 and 2) with 1,734 households. Gindiri is an old missionary settlement and the headquarters of the Pyem Chiefdom with a population of 40,400.[6] Gindiri town is headed by the Sum Pyem. The indigenous tribe is Pyem; other tribes include Mwaghavul, Mupun, Bejim, Ngas with other settlers like Hausa, Fulani, Igbo, Yoruba etc. The major religions are Islam and Christianity and the major occupation is subsistence farming. There are several educational institutions in Gindiri such as the College of Education, Boys and Girls Secondary School, government colleges etc. It has two primary health care centres and a Comprehensive Health Centre (which is a rural outpost of the Jos University Teaching Hospital, JUTH). Other basic facilities such as pipe-borne water and electricity supply are also present in the town.[6]

**Study Population:** Child-parent/care giver pair made up of children aged 6 months to 5 years whose

parents/care givers gave verbal consent to be part of the study.

**Inclusion criteria:** Child-parent/care giver pair made up of children aged 6 months to 5 years whose parents/care givers (18 years-60 years) gave verbal consent.

**Exclusion criteria:** Child-parent/care giver pair made up of children aged 6 months to 5 years who was currently on treatment for malaria during the period of the study.

**Study Design:** Cross-sectional community-based study.

**Sample size determination:** Based on the prevalence of malaria in under-fives in the Malaria Indicator Survey, 2015 for Plateau state 57.6% [7], a minimum sample size of 375 was calculated using the Leslie-Kish formula of $z^2pq/d^2$.[8] After correcting the sample size for a finite population using the formula $Nf=n/1+n/N$[8] (population of under-fives in Gindiri was 6277), the corrected sample size was 388. This was rounded up to 390.

**Sampling Technique:** The multistage sampling technique was used where Gindiri was purposively selected (the researchers were undergoing rural health posting). There are 2 wards in Gindiri (1 and 2), ward 2 was selected through a coin toss. A systematic sampling technique was used to select respondents. The total number of eligible households (1,734) was enumerated and listed. The sampling interval was then determined by dividing by the total number of households by the sample size (390) to give a sampling interval of 4. A bottle was spun at the centre of the community to determine the direction in which to start collecting the data. On entering an eligible household, if there was more than one eligible respondent, only one child-parent/care giver pair was interviewed.

**Instrument for Data collection:** A semi-structured, interviewer administered questionnaire was used to collect data from the respondents after obtaining informed consent from the care givers/guardians/household head. The questionnaire was adapted from the Malaria Indicator Survey[7]. The questionnaire was translated in Hausa, which is the main Language of the participants and back translated into English Language. Rapid Diagnostic Test (RDT) kits were used to test blood samples of eligible children for the presence of malaria parasite (antigen). A drop of blood was tested immediately with the CareStart™ Malaria HRP-2 (Pf)™ (Access Bio, Inc.) rapid diagnostic test, which is a qualitative test to detect histidine-rich protein II antigen of

*Plasmodium falciparum* (Pf) in human whole blood. A small amount of blood was collected on a pipette and placed in the 'S' well of the testing device. Two drops of the buffer solution were then placed into well 'A' and the setup was allowed to stand undisturbed for 20 minutes after which the results were read, interpreted, and recorded. Results were read as follows: if only one pink-coloured band appeared in the control window, test was interpreted as negative. In addition to the control band, if a distinct pink coloured band also appeared in the test window, test was interpreted as positive. Test was considered invalid/inconclusive if no bands appeared on the device. In that case, test was repeated with new device ensuring that the test procedure was followed accurately. Children whose malaria RDT results were positive were offered a full course of treatment as per the Nigeria national malaria treatment guidelines, provided they were not currently on treatment with artemisinin-based

combination therapy (ACT) and had not completed a full course of ACT during the preceding 2 weeks.[7] The CareStart™ Malaria HRP-2 (Pf)™ has a sensitivity of 98% and specificity of 97.5%. Blood collection samples were carried out by the researchers.

**Data collection:** Community health workers (CHWs) were trained in administering the questionnaire and inspecting the homes. Male and female CHWs who were known members of the community were recruited. Female CHWs were used in houses which did not permit entry of male CHWs, taking into consideration religious beliefs of household heads. They were then deployed and engaged in data collection alongside the lead researchers. The questionnaire was pretested in a different community (Gindiri ward 1) on selected households was carried out after obtaining permission from the district head of Gindiri village and informed consent from the head of households. Corrections and adjustments were made to the questionnaire before data collection in the study population was done.

**Data Analysis:** Data was collected, entered, cleaned and analyzed using Statistical Package for Social Sciences (SPSS) version 23.0 software. Chi-square test was used to test for associations between independent variables (socio-demographics, household and environmental risk factors). Logistic regression was then used to determine the predictors (risk factors) of RDT results in children under 5 years of age. A confidence level of 95% was used and p-values $\leq 0.05$ considered statistically significant.

**Ethical Approval:** Ethical approval to carry out the study was granted by the Health Research Committee, Jos University Teaching Hospital and informed consent obtained from parent/care giver of each participant.

**RESULTS**

Out of the 390 respondents (parents/care givers), 345 (88.5%) were females and 45 (11.5%) were males. Their ages ranged from 18-60 years with a mean age of 30.8±7.9 years. Majority (43%) of them fell into age-group of 28–37 years. Majority (93.1%) of the respondents were married and 36.7% had no formal education. Most (94.1%) of the respondents were Muslims and Pyem by tribe (83.1%). Majority (86.2%) of the respondents earned below the minimum monthly wage of ₦18,000 and 54.6% were traders (Table 1). Out of 390 children aged 6 to 59 months who were sampled, 214 (54.9%) were females and 176 (45.1%) were males. One hundred and thirty-six (34.9%) of the sampled population were positive for malaria using the RDT. Seventy-four (34.5%) were females while 62 (35.2%) were males. (Table 2). Out of the 290 children who had fever in the last 1 month, 108 (37.2%) tested positive for RDT. Those with fever in the last one month were 35 % less likely to test positive for malaria by RDT compared to those without fever. (Table 3). Table 4 shows that statistically significant association was observed between RDT results and torn window/door screens (p=0.004) and toilet facilities (p=0.044). Majority (91.8%) of households possess insecticide treated nets while a good number (67.2%) do not have window and door screens. Majority of the respondents (74.4%) had cracks on the walls of their houses, and 36.7% use pit latrine with slab. Over 50% of the households have overgrown grasses in their surroundings though 90.5% said they clear the grasses monthly. Majority of the households (77.7%) had stagnant water bodies and empty water sachets/containers were observed in 82.0% of households. Most (59.2%) use open dumping as a method of refuse disposal and 82.3% were observed

to have blocked drains. On logistics regression, the presence of torn window and door screens was twice more likely to be associated with positive RDT results than window/door screens that were not torn and this was statistically significant (OR=1.809, p=0.016, 95% CI=1.115-2.935) (Table 5).

## DISCUSSION

In this study, the prevalence of malaria in under-fives in Gindiri by RDT was 34.9 %. This prevalence was slightly higher than 32.2 % reported in Calabar[9] but lower than 37.5 % in Kano[10], 41 % in Plateau[11] and 57.6 % in the Malaria Indicator Survey (MIS), 2015.[7] This higher MIS prevalence may be attributed to the fact that it was state prevalence. The prevalence of children who tested positive for malaria on RDT in this study was similar in both males and females, with that of the males only being slightly higher than the females but this was not statistically significant. This was consistent with the Malaria Indicator Survey which also reported that there was little difference in malaria prevalence by sex of the child.[7] This was comparable to a study in Tudun-Wada locality of Plateau state[11] but was in contrast with studies which reported higher values of 77.4 % in females and 69.7 % for malesin Enugu[12] and 59.7 % (females) versus 61.2 % (males) in Kano.[10] Studies which found a higher prevalence in males explained the reason to be because male children may be biologically susceptible to infectious diseases compared to their female counterparts.[13] Studies which found a higher malaria prevalence in females were in those > 5years of age. This was because females were the ones who largely carried out household chores, staying up late into the night and up by dawn, hence getting more exposed to the early morning mosquito bites.[14] The use of RDT kits to test for malaria was a limitation in this study because RDTs might still read positive for malaria even after treatment. It is also not able to detect malaria if the parasite density is low. However, most RDTs have a sensitivity of 95 % at parasite densities of 200/μL of blood. They provide a useful guide to the presence of clinically significant malaria infection and complement microscopy-based diagnosis where such services are not available. RDTs are now recommended by World Health Organization (WHO) for timely diagnosis for malaria case management in all age groups, including children.[2] RDTs can expand malaria diagnostics to areas where good quality microscopy cannot be maintained such as in the community, in the home or by private providers.[2] In such settings, RDTs is considerably more cost-effective. It requires a short training period and provides an opportunity for improved fever case management at lower levels of the health system.[2]

A high percentage of households in this study possessed at least one insecticide-treated net (ITN). This was higher than 55.3 % in Jos[15], 53.8 % in Benin[16]; 71.5 % in Calabar[9], 78.2 % in Kano[10] and 78 %[7] in the MIS 2015. The proportion of households who had at least one ITN has risen far above the reported proportion of 42 % obtained in 2010[17], 8 % in 2008[18] and 2 % in 2003[19]. Household ITN ownership is said to have substantially increased nationwide over the years. This increase in household net ownership can be attributed to the Long-Lasting Insecticide Treated Nets mass distribution campaign supported by the Global Fund, World Bank, UK Department for International Development (DFID), Support for the National Malaria Control Programme (SuNMaP), President's Malaria Initiative (PMI)/USAID, and MDG funds through the government of Nigeria. The nets were given at no cost most of the time, via Primary Health Centres.[7]Results from this study showed that there

was no statistically significant relationship between ITN use by households and the RDT results. This contrasted with a study carried out in Kano which found that not using ITNs increased participants' odds for malaria by 1.57 times (95 % CI = 1.10, 2.24) when compared to those who used them.[10]The results from the Gindiri study can be explained by the fact that most of the nets were torn and none of the bed nets had been treated with insecticide as was observed during the house inspection. It could also be due to inconsistent or inappropriate use of the nets or possible exposure of the child to mosquito bites during the day or evening.[20]

In this study, majority of the children under the age of 5 years slept under a net the night before the study. This was considerably higher than 25.4 % in Calabar[9]and 48.3 % in Kano[10].The finding from this study agrees with the sustained increase in net utilization in the NMIS surveys. The percentage of children under age five who slept under ITNs has increased steadily and substantially from 6 % in 2003[19], to 12 % in 2008[18] and to 26.7 % in 2010 by National Malaria Indicator Survey.[17] The findings from this study concerning children sleeping under an ITN could also have been due to response bias. Since the surveyed households were only asked whether the child slept under ITN the night before, our ITN measure does not mean that the child had been protected by ITN on continuous basis. In this study, only a handful of the houses sampled ever had indoor residual spraying (IRS) carried out. The findings were similar to the 1 % of households reported having IRS in the 12 months before the MIS survey. The Federal Ministry of Health has included indoor residual spraying (IRS) as one of the preventive strategies against malaria in Nigeria. The IRS implementation programme in the country is relatively new and is not deployed in all states of the federation.[7] This study found that the presence of torn window and door screens was more likely to be associated with positive RDT results than window and door screens that were not torn. The presence of holes/tears on windows and doors encourages the entry of mosquitoes into the house and exposes inhabitants to malaria.The presence of open pit as a toilet facility was also less likely to be associated with positive RDT results than other toilet facilities. These findings were statistically significant. This was similar to studies carried out in Cameroon and Enugu where the toilet facility was not a significant risk factor.[21,22] But this was not the case in Kano where those living in houses with pits or ground dug latrines were 1.7 times more likely to be infected with malaria than were those who have toilets in their houses with a pour/flush system.[10]The findings in Gindiri could be explained by the fact that most of the respondents practiced open defaecation far away from their households and the open pits were not used as toilets. The presence of cracks in the wall was also not associated with a higher malaria prevalence in this study which differed from a study in Cameroon which showed a relationship between cracks on the wall and malaria prevalence.[21]Cracks in the wall have been shown to encourage the entry of mosquitoes into the house.[16,20]Also, overgrown grasses, presence of empty water sachets and methods of refuse disposal were not associated with a higher malaria prevalence in children. This differed from the studies in Cameroon and Enugu which showed a strong relationship between bushes and malaria prevalence.[21,22] This could probably be explained by the fact that the study was conducted in the dry season and not the rainy season which encourages the breeding of mosquitoes.[13,20]

## CONCLUSION

Findings from this study, revealed that the

prevalence of malaria among the under-fives is still high in Gindiri, Mangu LGA. It demonstrated that the presence of torn window and door screens was a major predictor of a positive RDT test in under-fives. Education should be intensified on the proper handling and use of mosquito nets. It was also demonstrated that none of the ITNs had been treated long after purchase. The re-treatment of ITNs should be encouraged. A reduction in the burden of malaria can be achieved through the regular and proper use of ITNs, environmental sanitation and retreating nets. Communities should be educated on the role of household and environmental factors in the spread of malaria.


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## CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

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**TABLES**

**Table 1: Socio-demographic data of respondents (n=390)**

| Variables | Frequency (%) |
|---|---|
| **Age (years)** | |
| 18 – 27 | 153 (39.2) |
| 28 – 37 | 168 (43.1) |
| 38 – 47 | 50 (12.8) |
| 48 – 57 | 14 (3.6) |
| ≥58 | 5 (1.3) |
| Mean age 30.8±7.9 | |
| **Sex** | |
| Male | 45 (11.5) |
| Female | 345 (88.5) |
| **Marital Status** | |
| Married | 363 (93.1) |
| Not Married | 27 (6.9) |
| **Educational Status** | |
| Tertiary | 20 (5.1) |
| Secondary | 107 (27.4) |
| Primary | 120 (30.8) |
| None | 143 (36.7) |
| **Religion** | |
| Islam | 367 (94.1) |
| Christianity | 23 (5.9) |
| **Ethnicity** | |
| Pyem | 324 (83.1) |
| Others** | 66 (16.9) |
| Occupation | |
| Trader | 213 (54.6) |
| Civil servant | 25 (6.4) |
| Farmer | 35 (8.9) |
| Housewife | 117 (30) |
| **Monthly income** | |
| ≤minimum wage | 336 (86.2) |
| >minimum wage | 54 (13.8) |

*** Bejim, Berom, Bogom, Fulani, Hausa, Kadung, Mupun, Mushere, Rumada, Siddi and Sikdawa.; Minimum wage:* ₦18000

**Table 2: Result of Rapid Diagnostic Test (RDT) in under-fives (n=390)**

| | RDT Result | | | |
|---|---|---|---|---|
| **Sex** | **Positive (%)** | **Negative (%)** | **$X^2$** | **P value** |
| Male | 62 (35.2) | 114 (64.8) | 0.007 | 0.935 |
| Female | 74 (34.5) | 140 (65.4) | | |

**Table 3: Relationship between fever and RDT results (n=390)**

| | Result of RDT | | | | | | |
|---|---|---|---|---|---|---|---|
| **Variable** | **Positive (%)** | **Negative (%)** | **$X^2$** | **P value** | **OR** | **95% CI** | |
| | | | | | | **Lower** | **Upper** |
| **Fever in the last 1 month** | | | | | | | |
| Yes | 108 (37.2) | 182 (62.7) | 2.796 | 0.094 | 0.655 | 0.399 | 1.077 |
| No | 28 (0.28) | 72 (0.72) | | | | | |

**Table 4: Association between RDT results, Household and Environmental factors (n=390)**

| | RDT results | | | |
|---|---|---|---|---|
| **Risk factor** | **Positive (%)** | **Negative (%)** | **$X^2$** | **p** |
| **Age group (years)** | | | | |
| 18 – 27 | 47 (30.7) | 106 (69.3) | 5.223 | 0.265 |
| 28 – 37 | 61 (36.3) | 107 (63.7) | | |
| 38 – 47 | 23 (46.0) | 27 (54.0) | | |
| 48 – 57 | 3 (21.4) | 11 (78.6) | | |
| ≥58 | 2 (40.0) | 3 (60.0) | | |
| **Sex** | | | | |
| Male | 21 (46.7) | 24 (53.3) | 3.116 | 0.078 |
| Female | 115(33.3) | 230 (66.7) | | |
| **Marital status** | | | | |
| Married | 124 (34.2) | 239 (65.8) | 1.170 | 0.279 |
| Not Married | 12 (44.4) | 15 (55.6) | | |
| **Educational status** | | | | |
| Tertiary | 6 (30.0) | 14 (60.0) | 4.790 | 0.188 |
| Secondary | 29 (27.1) | 78 (72.9) | | |
| Primary | 44 (36.7) | 76 (63.3) | | |
| None | 57 (39.9) | 86 (60.1) | | |

| | | | | |
|---|---|---|---|---|
| **Religion** | | | | |
| Islam | 129 (35.1) | 238 (64.9) | 0.212 | 0.645 |
| Christianity | 7 (30.4) | 16 (69.6) | | |
| **Ethnicity** | | | | |
| Pyem | 116 (35.8) | 208 (64.2) | 0.730 | 0.393 |
| Others | 20 (30.3) | 46 (69.7) | | |
| **Occupation** | | | | |
| Trader | 70 (32.9) | 143 (67.1) | 6.399 | 0.094 |
| Civil servant | 8 (32.0) | 17 (68.0) | | |
| Farmer | 19 (54.3) | 16 (45.7) | | |
| Housewife | 39 (33.3) | 78 (66.7) | | |
| **Monthly income** | | | | |
| ≤ minimum wage | 117 (34.8) | 219 (65.2) | 0.003 | 0.958 |
| >minimum wage | 19 (35.2) | 35 (64.8) | | |
| **Ownership of ITN** | | | | |
| Yes | 120 (33.5) | 238 (66.5) | 3.513 | 0.061 |
| No | 16 (50.0) | 16 (50.0) | | |
| **Treated ITN** | | | | |
| Yes | 16 (50.0) | 16 (50.0) | 3.513 | 0.061 |
| No | 120 (33.5) | 238 (66.5) | | |
| **TornWindow/Door Screen** | | | | |
| Yes | 32 (25.0) | 96 (75.0) | 8.176 | 0.004 |
| No | 104 (39.7) | 158 (60.3) | | |
| **Cracks in the wall** | | | | |
| Yes | 106 (34.5) | 184 (63.5) | 1.405 | 0.236 |
| No | 30 (30.0) | 70 (70.0) | | |
| **Toilet facilities** | | | | |
| Flush to pit latrine | 19 (34.5) | 36 (65.5) | 11.399 | 0.044 |
| Flush to septic tank | 9 (22.5) | 31 (77.5) | | |
| Open pit | 30 (27.0) | 81 (73.0) | | |
| Pit latrine with slab | 63 (44.0) | 80 (66.0) | | |
| VIP | 5 (31.3) | 11 (68.9) | | |
| None/Bush/Field | 10 (40.0) | 15 (60.0) | | |
| **Overgrown grasses** | | | | |
| Yes | 67 (35.8) | 120 (64.2) | 0.145 | 0.703 |
| No | 69 (34.0) | 134 (66.0) | | |
| **Stagnant water bodies** | | | | |
| Yes | 110 (36.3) | 193 (63.9) | 1.226 | 0.268 |
| No | 26 (29.9) | 61 (70.1) | | |
| **Empty water sachets** | | | | |
| Yes | 109 (34.0) | 211 (66.0) | 0.514 | 0.473 |
| No | 27 (38.6) | 43 (61.4) | | |

| | | | | |
|---|---|---|---|---|
| **Refuse Disposal Method** | | | | |
| Composting | 16 (50.0) | 16 (50.0) | 4.59 | 0.205 |
| Incineration | 10 (43.5) | 13 (56.5) | | |
| Landfills | 34 (32.7) | 70 (67.3) | | |
| Open Dumping | 76 (32.9) | 155 (67.1) | | |
| **Blocked Drains** | | | | |
| Yes | 112 (35.2) | 206 (64.8) | 0.092 | 0.762 |
| No | 24 (33.3) | 48 (66.4) | | |

**Table 5: Predictors of RDT results**

| | RDT results | | | | 95% CI | |
|---|---|---|---|---|---|---|
| | **Positive (%)** | **Negative (%)** | **p** | **OR** | **Lower** | **Upper** |
| **TornWindow/ Door Screen** | | | | | | |
| Yes | 32 (25.0) | 96 (75.0) | **0.016** | 1.809 | 1.115 | 2.935 |
| No | 104 (39.7) | 158 (60.3) | Reference | | | |
| **Toilet facilities** | | | | | | |
| Flush to pit latrine | 19 (34.5) | 36 (65.5) | 0.173 | 0.465 | 0.154 | 1.400 |
| Flush to septic tank | 9 (22.5) | 31 (77.5) | 0.811 | 0.900 | 0.379 | 2.138 |
| Open pit | 30 (27.0) | 81 (73.0) | 0.055 | 0.444 | 0.194 | 1.018 |
| Pit latrine with slab | 63 (44.0) | 80 (66.0) | 0.336 | 0.630 | 0.246 | 1.614 |
| VIP | 5 (31.3) | 11 (68.9) | 0.612 | 0.714 | 0.194 | 2.632 |
| None/Bush/Field | 10 (40.0) | 15 (60.0) | Reference | | | |