Malaria Parasitaemia and Household Use of Insecticide Treated Bed Nets: A Cross-sectional Survey of Under-fivesin Jos, Nigeria

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SUMMARY

Background: In spite of enormous investments in Malaria control programme, malaria is still a major cause of morbidity and mortality among under-fives.

Objective: The objective of this study was to determine malaria parasitaemia in under-fives and to relate it to household use of Insecticide Treated Bed Nets (ITBNs) in Jos - a malaria endemic setting.

Methodology: A cross-sectional study was carried out in a selected settlement in Jos North Local Government Area (LGA) in September 2007 towards the end of the rainy season. All households with children less than 5 years of age in the selected settlement were listed and then 150 of the households were selected using systematic sampling technique. In each selected household one under five was selected and where there were more than one under five only one was selected by balloting. The selected 150 under-fives were then studied using thumb prick blood smear to determine the presence of malaria parasite in their peripheral blood and a semi structured interviewer administered questionnaire to obtain information on household use of ITBNs in the community.

Result: Malaria parasitaemia was found in 57 (38.0%) of the children and the highest age specific prevalence of 46.4% was among the 36-47 months age group. The females were more (46.6%) infected than their male counterparts (29.9%) p=0.035. Eighty three (55.3%) mothers owned ITBNs but only 61(40.7%) used them for their children. Children who slept under ITBNs were less likely to have malaria parasites in their blood compared with those who did not (p=0.000..). Mothers' age and education were among other factors that positively influenced the use of ITBNs.

Conclusion: Malaria parasitaemia is high in this community and sleeping under ITBN has been found to significantly reduce the prevalence of parasitaemia in the children studied. It is therefore recommended that the ITBNs campaign should be intensified so that the ITBN use can cover all the under-fives.

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INTRODUCTION

Malaria eradication has eluded most tropical countries. As such this ancient disease has remained a huge public health problem in this part of the world with very devastating impacts on the vulnerable groups in the population. It kills more than 1 million persons every year in Africa.[1] Mortality and morbidity from malaria are highest in infants and in children under age[5]. Malaria morbidity accounts for 10 to 80% of childhood fevers, for approximately 30 to 35% of all presenting cases seen at dispensaries in the savanna region of sub-saharan Africa and for 10 to 30% of all infant and child deaths in the same region.[2]

It is only in later childhood and adulthood, after repeated exposure to the malaria parasite that some immunity is developed against the disease. [3] Although this acquired immunity protects against severe malaria and death it does not prevent the parasite from multiplying in the human host.[3] Consequently even apparently healthy children in malaria endemic regions may habour the parasite in their blood and these children may still suffer the long term sequalae of the disease such as cognitive impairment and stunting.[4,5,6] Among children who are febrile the proportion with the parasites in their blood may exceed 50%[4,7] while household surveys among apparently healthy children have reported parasitaemia levels of between 10-30%.[5] This has implication for diagnosis and case management as undue reliance on fever and body temperature elevation as opposed to parasitaemia may overlook many cases of malaria with the attendant dire health consequences for the victims.[6] In addition to its usefulness as evidence base for treatment, parasitaemia is also a measure of malaria endemicity.[8] For these reasons it is important to determine the level of parasitaemia in any locality. The burden of malaria differs among different segments of the community. For instance the frequency of fever episodes and the prevalence of parasitaemia vary between rural and urban areas.[4,9] This has been related to differences in community practices. Whereas in urban centres, episodes of fever are likely to be reported to public health centres for treatment, in rural areas treatments are started with traditional remedies at home and health centres are only consulted when the traditional remedies fail. [10, 11] Also poverty is an important factor in malaria and the rural poor are more likely to be ignorant of preventive measures, less likely to access prompt treatment and their children are more likely to be poorly nourished. In addition breeding sites for the mosquito vector are more abundant in the rural areas increasing the intensity of transmission.[12]

Several interventions have been implemented to reduce the burden of malaria. Pilot efforts in the past aimed at controlling the disease using dichloro-diphenyl-trichloroethane (DDT) against the vector and quinine for case treatment gave hope of possible disease eradication but subsequent implementation of the eradication strategies using DDT and chloroquine did not yield the desired results due to the development of resistance by the mosquito to the insecticide and the parasite to the drug. This led to its subsequent abandonment. [3, 13] The Current malaria control initiative is encapsulated in the Roll Back Malaria (RBM) Programme, a vital element of which is the use of insecticide treated Bed Nets (ITBN) [14, 15] Consistent and correct use of ITBNs along with prompt treatment of cases using artemisinin combination therapy (ACT) has been shown to reduce the episodes of clinical malaria. It is therefore possible to assess the effectiveness of ITBNs in reducing malaria in children by testing the peripheral blood of the users for the presence of malaria parasites. [15, 16] However the community effectiveness of ITBNs in reducing malaria parasitaemia depends on the coverage of the ITBNs in the community.

The aim of this study was to determine the level of malaria parasitaemia among children less than 5 years in the community and to relate it to the household use of ITBNs. It was also to find out other factors that influence parasitaemia and household use of ITBNs. Findings from the study may be used to advocate for improvement in the methods of ITBNs distribution so as to improve access to it in this and similar communities.

SUBJECTS AND METHODS

The Study was carried out between17th and 28th of September 2007 in Jos North Local Government Area (LGA) which is one of the 17 LGAs in Plateau State. It is very cosmopolitan and is one of the three LGAs that make up Jos. It is divided into 20 electoral wards. The target population for the study were children aged between 6 months and less than 5 years residing in Jos North Local Government Area. Children less than 6 months were excluded from the study because during this period maternal antibodies are present in their blood in enough quantities to protect them from malaria. This may confound the effect of ITBN use in this group of children. They were studied using a cross-sectional study design. The minimum sample size was calculated to be 150 children using the formula for cross sectional studies.[17]

N = Z^2PQ/D^2, where N= desired sample size

Z = standard normal deviate at 95% confidence level usually set at 1.96

P = proportion of under-fives found to have malaria parasites in their peripheral blood in a previous study (10.7% = 0.107) [5]

Q = 1-P = 1.0 - 0. 107= 0.893

D = degree of precision or acceptable error margin (5% or 0.05 for this study).

N = $(1.96)^2 \times 0.107 \times 0.893/(0.05)^2$

N = 146.83

This was rounded up to 150 children.

From among the 20 wards in Jos North LGA,Tudun Wada ward was selected. During an ongoing household survey of the LGA by the Department of Community Medicine, University of Jos, it had already been established that not all the households in the ward had children less than 5 years of age. Therefore all the households identified to have under five children were listed to form a sampling frame and a total of 550 households were listed. A sampling interval was determined by dividing the number of households by the sample size. This gave an interval of 3.7 rounded up to 4. The first household with a serial number less than 4 was randomly selected and then subsequently every 4th household was selected until the listed households were exhausted. By this method 150 households were selected for the study. One child was then selected from each household. Where there were more than one under five children in a household, they were given numbers and only one was selected by balloting. The researchers moved from house-to-house to select the children and then asked the mothers or care givers to bring them to the Primary Health Care (PHC) clinic located in the area. A semi-structured interviewer-administered questionnaire was then administered on the mothers or other care givers of the selected children to obtain information on the children's socio-demographic attributes, history of fever in the children and use of ITBNs at home. A thumb prick blood specimen was also obtained from each child to make thick and thin blood films to examine for malaria parasites in the children's peripheral blood.

Permission for the study was obtained from the Primary Health Care (PHC) Department of Jos North LGA as part of the preparation for the research. A detailed explanation of the purpose, nature and all the processes involved in the research was made to the parents and caregivers of the children. All the possible risks involved especially with regards to thumb pricks of the children for blood specimen were explained to the parents. They were informed that their participation along with their children was voluntary and that they were free to decline from participating or to withdraw from participating at any stage of the research. However they were assured that all efforts would be made to minimize harm and all children found with malaria parasites would be treated free. Only children whose parents gave informed verbal consent were recruited for the study. Ethical approval for the study was obtained from the Institutional Health Research Ethical Committee of the Jos University Teaching Hospital, Jos. All data collected on the field were entered into the computer and analyzed using Epi Info 2008 epidemiological software.[18]

RESULT

A total of 150 children aged between 6 and 59 months were studied. Table I shows the distribution of malaria parasitaemia by the children's age groups. Fifty seven (38.0%) children had malaria parasites in their peripheral blood and the age group 36-47 months had the highest age-specific prevalence with 13(46.4%) being positive for parastaemia. Children aged between 6 and 11 months had the lowest prevalence with 6 (28.6%) having parasites in their blood. However age did not have a statistically significant influence on malaria parasitaemia in the children (P = 0.93). A total of 83 (55.3%) mothers or caregivers owned ITBNs. However, Table II shows that only 61 (40.7%) of all the children slept under ITBNs. Whereas the highest age-specific usage of

14 (50.0%) was in the 36-47 months age bracket, the least of 8 (30.8%) was found in the 12-23 months age group. Again there was no statistically significant relationship between the children's age and their use of ITBNs (P = 0.94).

We present the history of fever in the under-fives within the 72 hours preceding data collection in Table III. Forty six (30.7%) of all children had had fever within this period. However the 12-23 months age group had the highest (38.5%) proportion of children with fever compared to the 48-59 months age group who had the lowest of 25.0%. Again age did not influence fever experience by the children (P = 0.78). Thirty three (42.9%) male children used ITBNs compared to the 28 (38.4%) female children who used ITBNs. The difference was not statistically significant (p=0.78). Also 34 (46.6%) of the female children had malaria parasitaemia compared to the 23 (29.9%) male children who were found with malaria parasitaemia. This difference was statistically significant (P=0.035). Twenty six (17.3%) of the children did not use any malaria preventive method at all. Table IV shows that 24 (42.1 %) mothers aged 31-40 years used ITBNs for their children while Table V shows that 17(28.3%) of mothers with only primary education used ITNs for their children compared to the 11 (64.7%) mothers with tertiary education who did so. This difference was found to be statistically significant (P = 0.025). Twenty two (47.8%) of the 46 children who had fever were positive for malaria parasites while 35 (33.7%) of the 104 children without fever were positive for malaria parasites. The association between fever and presence of malaria parasites was not statistically significant (p=0.09).

We tested the relationship between the subjects' use of ITBNs and the presence of malaria parasites in their blood. The result is presented in Table VI. This table shows that out of the 61(40.7%) subjects who slept under ITBNs 11(7.3%) had malaria parasites while 46 (30.7%) of the 89 subjects who did not sleep under ITBNs had malaria parasites. This relationship was statistically significant (p = 0.000…)

Table 1: Age distribution of the under-fives and the presence of malaria parasites.

	Malaria parasites		
Age (months)	**present (%)**	**absent (%)**	**Total**
6-11	6 (28.6)	15 (71.4)	21
12-23	9 (34.6)	17 (65.4)	26
24-35	14 (35.9)	25 (64.1)	39
36-47	13 (46.4)	15 (53.6)	28
48-59	15 (41.7)	21 (58.3)	36
Total	57 (38.0)	93 (62.0)	150

$\chi^2 = 2.04$ P = 0.93

Table 2: Age distribution of subjects in relation to the use of ITBNs

	Uses ITN		
Age (months)	**Yes (%)**	**No (%)**	**Total**
6-11	7 (33.3)	14 (66.7)	21
12-23	8 (30.8)	18 (69.2)	26
24-35	16 (41.0)	23 (59.0)	39
36-47	14 (50.0)	14 (50.0)	28
48-59	16 (44.4)	20 (55.6)	36
Total	61 (40.7)	89 (59.3)	150

$\chi^2 = 0.76$ P = 0.94

Table 3: Age distribution of subjects in relation to the experience of fever in the last 72 hours

History of fever			
Age (months)	**fever (%)**	**no fever**	**Total**
6-11	6 (28.6)	15 (71.4)	21
12-23	10 (38.5)	16 (61.5)	26
24-35	11 (28.2)	28 (71.8)	39
36-47	10 (35.7)	18 (64.3)	28
48-59	9 (25.0)	27 (75.0)	36
Total	**46 (30.7)**	**104 (69.3)**	**150**

$\div^2 = 0.78$ P = 0.78

Table 4: Mothers' age in relation to the use of ITN for the child Uses ITBNs

Age (years)	**Yes (%)**	**No (%)**	**Total**
15-20	5 (33.3)	10 (77.7)	15
21-30	28 (41.8)	39 (58.2)	67
31-40	24 (42.1)	33 (57.9)	57
41-50	4 (36.4)	7 (63.6)	11
Total	61 (40.7)	89 (59.3)	150

$\div^2 = 0.50$ P = 0.81

Table 5: Mothers' educational level in relation to the use of ITBNs

	Uses ITN		
Level of education	**Yes (%)**	**no (%)**	**Total**
Illiterate	6 (35.3)	11 (64.7)	17
Primary	17 (28.3)	43 (71.7)	60
Secondary	27 (48.2)	29 (51.8)	56
Tertiary	11 (64.7)	6 (35.3)	17
Total	**61 (40.7)**	**89 (59.3)**	**150**

$\div^2 = 9.39$ P = 0.025

Table 6: Relationship between the subjects' use of ITBN and parasitaemia

	Presence of mps		
Uses ITBN	**Yes (%)**	**No (%)**	**Total (%)**
Yes	11 (7.3)	50 (33.4)	61 (40.7)
No	46 (30.7)	43 (28.6)	89 (59.3)
Total	57 (38.0)	93 (62)	150 (100.0)

$\div^2 = 17.4$ P= 0.000…

DISCUSSION

This community-based survey aimed to determine the prevalence of malaria parasitaemia in under-fives in relation to household use of ITBNs. As many as 38.0% of the children surveyed had malaria parasites detected in their peripheral blood. For a community survey among an apparently healthy population, this level of parasitaemia was quite high. It was higher than the 8.1% found in North Mara, Tanzania, the 10.7% found in a household survey of healthy children elsewhere in Tanzania and the 27.5% in other parts of Nigeria.[5, 19,20] It was also higher than though closer to the 32% documented among HIV/AIDS patients in Jos. [21] It was however lower than the 50.9% recorded in Equatorial Guinea [4] and the 56.9% documented earlier among children in Jos. [7] Our study was located in an urban site and it has been documented that malaria prevalence is higher in the rural compared to the urban centres. [4, 9] Compared to our finding, the Guinean study had prevalences of 58.8% and 44%

for rural and urban areas respectively, both of which are higher than our finding. Seasonal variations affect malaria transmission even in areas of endemic malaria. Our study was conducted towards the end of the rainy season which is the peak period of transmission in this sub region. This probably accounted for the relatively high prevalence recorded in our study. The Jos Plateau is a highland where transmission is expected to be lower than that obtained in the low lands. Other studies that recorded higher prevalences took place in low lands and valleys. These areas have more intense transmission of malaria. Of particular interest is the 63% prevalence documented in a study among children less than 2 years in the Kilombero valley of Tanzania. [22]

Although others found statistically significant associations between the age of children and parasitaemia [7, 22] our study did not establish any. It is possible that our age intervals were too small to bring this association to the fore. Also other studies found higher prevalences in males [7, 23] but the present study found significantly higher prevalences of parasitaemia among female children compared with their male counter parts. This was explained partly by a higher use of Insecticide Treated bed Nets (ITBNs) among the male children. It will be interesting to explore further, using qualitative methods, to determine if indeed ITBNs are used more for male than for female children or it was an isolated finding. If it is an entrenched practice it will be interesting to know what socio-cultural reasons inform the practice.

As part of the Roll Back Malaria programme, intensive awareness campaigns have been carried out in several communities in Jos and its environs in the media on the use of ITBNs. These are accompanied by the distribution of free ITBNs. Distribution of free ITBNs tends to improve ownership and utilization of these nets in the community. [16, 23, 24] In this study 40% of the children slept under ITBNs although 55.3% of their mothers own the nets. The disparity between ownership and use is attributable to the extra motivation that mothers need to have before using the nets. This level of use falls within the range found in Tanzania [22] but it represents a quantum leap from the 1.7% average recorded across Nigeria in 2005. [25] This is most likely due to the on going campaigns and ITBN distribution. It is still lower than the 58.0% documented in Ethiopia in 2008. [24] Ownership and use of ITBN vary very widely in sub Saharan Africa, influenced by several factors. Some of these factors have been reported to include level of education, wealth index, family size, religion and residence among others. [12] In our study mother's education was significantly associated with the child's use of ITBN. This is understandable as educated mothers tend to be more aware of health protective and promotive measures. They also have better health-seeking behaviour. [11] Within the 72 hours preceding data collection a third of the under-fives had an episode of fever. This is indeed very high. Among the children who had fever 47.8 % had malaria parasitaemia while 33.7% of those who had no fever were positive for malaria parasites. This agrees with other studies in the savanna region of sub Saharan Africa and The Gambia as well as in PHC Centres in Jos, Nigeria. [7, 9, 23] Curiously the association between fever and parasitaemia were not statistically significant. Similar studies elsewhere have also demonstrated the absence of a direct relationship between fever and parasitaemia. [6] This is probably because not all cases of parasitaemia manifest with fever and not all cases of fever can be attributed to malaria. It is important to rule out concomitant bacterial infection because this can be a cause of persistent fever even after the malaria has been treated. Reports have indicated that this is more common than it is generally realized by clinicians. [26]

CONCLUSION

With parasitaemia prevalence of 38.0% malaria is still a major public health problem among under-fives in this environment. The use of ITBNs was found to significantly reduce the prevalence of parasitaemia among the surveyed population. The campaigns for its ownership and use should be intensified at the levels of the household and the community.

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