The effect of free distribution of insecticide-treated nets on asymptomatic *Plasmodium* parasitemia in pregnant and nursing mothers in a rural Nigerian community

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Abstract

Introduction: Malaria is a major public health problem in Nigeria, with adverse outcomes on the poor, pregnant women and children living in rural communities. A major component of current intervention in roll back malaria (RBM) initiative is vector control and insecticide-treated nets (ITNs).

Aims and Objective: This research studied the impact of free distribution of ITNs on malaria parasitemia in a rural community in Nigeria.

Materials and Methods: This is a longitudinal survey involving 990 pregnant and nursing mothers who received free ITNs between February 2007 and September 2008. Blood samples were collected at contact, then every 2 months to check for malaria parasites using standard methods.

Result: There was a sustained but insignificant rise in asymptomatic malaria parasitemia post-distribution of ITNs.

Conclusion: We conclude that ITN intervention remains important in malaria prophylaxis but must be complemented with awareness campaigns and other vector control strategies.

Key words: Asymptomatic malaria parasitemia, free distribution, insecticide-treated nets, pregnant women

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Introduction

Malaria is a serious health burden of developing nations, including Nigeria.[1] It is very simple to diagnose and treat, yet it claims more lives than any other infectious disease in the world.[2] In Africa, it accounts for about one million deaths annually with more than 500 million people all over the world becoming severely ill with malaria every year.[3] The worst malaria situations occur in remote, rural areas and among the marginalized poor populations, ethnic minorities and forest dwellers.[4] Travelers from malaria-free regions to endemic areas are highly vulnerable and may suffer from severe malaria due to lack of immunity.

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Recent efforts to scale-up malaria control in endemic countries throughout the world has lead to increased support for communities and health systems, as combating malaria is a major component of the millennium development goals.[5] The aim of the roll back malaria (RBM) initiative was to significantly reduce malaria deaths by 2015. The need for such an effort is abundantly clear as malaria places a huge burden on sub-Saharan Africa, accounting for as much as 40% of public health expenditure, 30–50% of inpatient admissions and up to 50% of outpatient visits.[2] Thus the

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key emphases of RBM are: early detection and prompt treatment of cases of malaria, the detection and control of epidemics, vector control using bed nets treated with insecticide and the prevention and treatment of malaria in pregnancy.

Malaria in pregnancy is a major cause of morbidity and/or mortality in both the mother and her newborn baby. The situation is worse in first pregnancies as they are yet to develop immunity against Plasmodium falciparum, the major species that has been implicated. Uniquely, P. falciparum infested red cells sequestrate in the placenta, causing maternal anemia and intrauterine growth retardation or even fetal demise. The main objective of malaria vector control is to significantly reduce both the number and rate of parasite infection and clinical malaria by controlling the malaria-bearing mosquito and thereby interrupting and/or reducing transmission. Two main operational interventions for malaria vector control currently available are indoor spraying of long-acting insecticide and insecticide-treated nets (ITNs), which can be complemented with other local methods (e.g., larval control) in the context of integrated vector management (IVM). Almost a decade after the launch of RBM, and many years since its high-profile African summit in Abuja, it still appears that little has been done to ensure widespread availability of ITNs and effective drugs.[6] Although studies from Africa[7,8] have shown that treated nets reduce deaths from malaria in under 5 children and pregnant women, in most endemic countries less than 10% of the population sleep under such nets.[6] There is a consensus now that the scarcity of nets and drugs is costing lives.[9] This must be taken seriously as the commercialization of nets has militated against efforts to reduce the prevalence of asymptomatic malaria parasitemia.[10,11]

One major success of the RBM campaign is an impressive partnership with donor agencies which has increased availability of ITNs for free distribution to pregnant women and children under 5. This project thus represents the impact assessment of free distribution of ITN to pregnant and nursing mothers in a rural community in Nigeria, using asymptomatic malaria parasitemia as the main outcome measure.

Materials and Methods

Study population

The study was done in Imo state, South East Nigeria, between February 2007 and September 2008. Imo State is located at sea level with average annual temperature of between 23.1°C and 31°C with a rainfall of 1520-2030mm. There are two major seasons, rainy season (April-October) and dry season (November-February). The state has a mixed rural and urban population with majority being Igbos, with a projected population of 3.9 million out of which about 48% are females. It is a hyper-endemic area and malaria is predominantly caused by P falciparum. Most of the drainage system had been blocked by indiscriminate dumping of refuse. The study community is Nkwerre, in Nkwerre Local Government Area (LGA) of Imo state and has a projected population of 100,000. The RBM program of Imo State Ministry of Health received thousands of ITNs from the Federal Government supported by Global Fund as part of vector control program of RBM. The nets were for free distribution to pregnant women, nursing mothers and children under 5.

The LGA received 9000 units of ITNs which were distributed with the collaboration of NGOs and members of staff of both the local government and the State Ministry of Health. The nets were rectangular and made from 100% polyethylene material measuring 180 cm (W) x 190 cm (L) x150 cm (H). They were pre-treated with permethrin 2% w/w by manufacturer (A to Z Textile Mills Ltd, Tanzania).

Study design

This is a longitudinal study involving 990 pregnant and nursing mothers, aged 18 – 39 years. After obtaining ethical clearance from the relevant body, as well as oral informed consent of the participants, apparently healthy women attending antenatal, postnatal and immunization clinics in all the health centers located in the LGA were randomly recruited by means of a lucky dip of yes or no. Subjects who have symptoms indicating malaria, for example fever and headache, weakness, anorexia and joint/muscle pains were excluded from the study. They were advised not to use any other form of malaria prophylaxis, and to report for treatment when ever symptoms develop. All the subjects were of low socioeconomic group and had never used ITN. They were thought how to treat the nets and how to use them. During follow-up, we tried to find out from the women whether and how they treated the nets and also how often and for how long. What type of bed they used and the time and hours spent inside the nets. Those who developed symptoms indicating malaria, for example fever, headache, weakness, anorexia and joint/muscle pains were treated and dropped from the study. Axillary temperature was taken to exclude fever and temperature of less than 37.5°C was considered as normal.

Laboratory methods

Peripheral blood samples were collected into ethylenediaminetetraacetic acid sample bottles using sterile needles and syringes, after cleaning the volar surface of the arm with cotton wool moistened with methylated spirit. Blood specimen from each subject was collected at the time of receiving the bed-nets and every 2 months for 6 months. Some of the patients who could not come to the health center after the initial sample collection were followed to their homes for sample collection. Standard thin and thick blood smears were made from each of these samples. Blood films were stained with Geimsa at a pH of 7.2 and then examined under the microscope using ×100 objective lens in each case. Identification of species was done using the thin blood smear. Quality control was ensured by using freshly reconstituted and filtered Geimsa stains. The microscopist is very experienced and spent about 15 minutes to 1 h on each thick and thin film, respectively. Comparison was made with both known positive and negative thin films. After testing the 990 subjects, those who tested positive were given intermittent preventive therapy and free ITNs.

Statistical analysis

This was done using SPSS for Windows version 15 statistical software. A descriptive analysis of the collected data was performed. Base line characteristics were recorded and odds ratios calculated. Test for significance was done using χ^2 statistics. The level of significance was set at $P \leq 0.05$.

Results

Out of the 990 subjects recruited, 470 tested positive with the prevalence of asymptomatic malaria parasitemia of 47.5%. Out of the 520 who tested negative for malaria parasite, 515 reported in the 2nd month, 501 in the 3rd month and 490 in the 6th month. Table 1 represents some sociodemographic characteristics of the recruited subjects. Majority of subjects (58%) were farmers, followed by petty traders (18.8%). Pregnant mothers constituted 70% while majority (54.1%) had only primary school education.

Table 1: Sociodemographic characteristics of the recruited subjects

Variables	Pregnant	Nursing mothers	Total (N/%)
Occupation (N/%)			
Farmers	380 (38.4)	194 (19.6)	574 (58.0)
Housewives	98 (9.9)	20 (2.0)	118 (11.9)
Civil servant	100 (10.1)	12 (1.2)	112 (11.3)
Traders	116 (11.7)	70 (7.1)	186 (18.8)
Total	694 (70)	296 (30)	990 (100)
Level of education (N/%)			
Below primary	188 (19.0)	81 (8.0)	267 (27.0)
Primary	410 (41.4)	126 (12.7)	536 (54.1)
Secondary	94 (9.5)	84 8.5)	178 (18.0)
Tertiary	2 (0.2)	7 (0.7)	9 (0.9)
Total	694 (70)	296 (30)	990 (100)

Table 2 shows the prevalence of malaria parasitemia before and after distribution of the nets. It was 8.5% at 2 months and increased to 10.1% at 4 months (odds ratio 0.85, 95% CI; 0.61-1.2). Furthermore it increased to10.6% at 6 months (odds ratio 0.95, 95% CI; 0.68--1.34).These were, however, not statistically significant (χ^2 =0.632, P=0.73).

Discussion

The prevalence of asymptomatic malaria parasitemia in this study was 47.5%. This result show that malaria parasite remains an endemic health burden for rural African communities with recorded prevalence above rates reported for females in an urban Nigerian community[12] and 6.5% reported in blood donors in Sudan.[13] The finding that a majority of our subjects were farmers may be implicative especially as other studies from Nigeria[10,12] have reported higher prevalence of malaria parasitemia among farmers than the general population. Furthermore, over 70% did not complete 12 years of formal education. This is not surprising as the poorly educated, rural and marginalized populations are more prone to malaria attack.

There is no doubt that ITN has a capacity to reduce mosquito bites and malaria prevalence but our study showed a non significant increase in prevalence of malaria after 6 months use in a rural agrarian Nigerian community. The reasons are most likely related to sustained exposure to mosquito bites partly due to occupation and other poverty/environmental-related factors. These factors include poor housing and overcrowding which make the use of nets very uncomfortable. This increases the average night-time spent outside the ITNs, thus increasing exposure to mosquito bites. In the presence of poorly ventilated houses and very poor electricity supply in the study community the time spent under the ITNs is most likely reduced.

Majority of houses in the study community were surrounded by farmlands with thick bushes and poor waste management. These factors will inadvertently contribute additional breeding sites for mosquitoes which transmit the malaria parasite. Furthermore it has been reported that environmental modification measures are difficult to implement in overcrowded periurban areas,[14] and this would even be more difficult in a rural community. Our

Table 2: Impact of insecticide-treated net on prevalence of malaria parasitemia

	M0 (N/%)	M2 (N/%)	M4 (N/%)	M6 (N/%)
No. of subjects	990 (100)	515 (100)	501 (100)	490 (100)
No. positive for mp	470 (47.5)	44 (8.5)	51 (10.1)	52 (10.6)
No. negative for mp	520 (52.5)	471(91.5)	450 (89.9)	438 (89.4)

Cross-tabulation, $\chi 2$= 0.632, P=0.73 (M0-M6 = 0-6 months).

finding is consistent with post-Tsunami reports from Sri Lanka[15] that despite distribution of mosquito nets, a large population is relatively exposed to mosquito bites due to various factors which include inadequate housing. Vector control in rural Nigerian community can thus be said to be poor despite provision of ITNs, due to the lack of clean environments and inherent incapability of poor populations to complement net intervention with insecticide spraying. There are also no efforts to reduce mosquito breeding sites due to poor awareness and literacy level of the residents.

Study was done in rural community, thus it was difficult to follow-up the women to ascertain how the ITNs were used. Another factor that may have affected our results is the compliance of the subjects. The number of recruited subjects that presented for additional investigations decreased each month and this may constitute an important group that may affect the findings. Comparison with matched control who did not benefit from the use of ITN would have been more appropriate and will be taken care of in further studies.

Finally, in other to achieve set targets, effort should include incorporating other vector control measures in the context of integrated vector control. The rural areas will benefit from efforts at larva control and reduction of breeding sites like bushes near living homes. This will require complementing awareness campaigns on need for effective vector control. Any effort to reduce poverty as well as improvement in housing and electricity in Nigeria will invariably reduce the malaria burden. This will go a long way in reducing maternal and perinatal morbidity and mortality

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Authors contributions.

1) USBA was involved in the conception and design of the study, the analysis and interpretation of data, revising the article for intellectual content, writing up the article and giving final approval of the version to be sent for publication.
2) UIN was involved in the conception and design of the study, the analysis and interpretation of data, revising the article for intellectual content and giving final approval of the version to be sent for publication.
3) PNA was involved in the, analysis and interpretation of data, revising the article for intellectual content and giving final approval of the version to be sent for publication.
4) TUN performed the microscopy to identify the malaria parasites,was also involved in the analysis and interpretation of data, revising the article for intellectual content and giving final approval of the version to be sent for publication.

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