

Asymptomatic Malaria Parasitaemia - A Suitable Index for Evaluation of Malaria Vector Control Measures

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Summary

Orogade AA, Ogala WN, Aikhionbare HA. Asymptomatic Malaria Parasitaemia - A Suitable Index for Evaluation of Malaria Vector Control Measures. Nigerian Journal of Paediatrics 2002; 29: 23. To evaluate the impact of malaria vector control measures which form an integral part of the National guidelines for malaria control, 1224 and 940 healthy primary school children in Kaduna, were assessed for malaria parasitaemia at peak wet (maximal malaria transmission) and peak dry (minimal malaria transmission) seasons, respectively. Possible association between asymptomatic malaria parasitaemia (ASMP) and utilization of vector control measures were analysed. The overall ASMP prevalences were 22.5 per cent and 14.9 per cent at maximal and minimal transmission periods, respectively. Vector control measure utilization was strongly related and inversely associated with the rates of ASMP. The estimation of ASMP is therefore recommended for use as an index for evaluation of malaria vector control programmes.

Introduction

MALARIA is a major global problem and one of the five major childhood killers in tropical Africa, causing the death of one in every 20 of the under-fives in the region.¹ National guidelines on malaria control were adopted by the Federal Ministry of Health & Social Services (FMOHSS) through the National Malaria Vector Control Division (NMVCD) as an integral part of the Primary Health Care Scheme (PHS) in 1989.^{2,3} Vector control measures in particular, when fully implemented, should reduce the risk of transmission, morbidity and mortality of malaria as well as the prevalence of asymptomatic malaria parasitaemia (ASMP). The impact of these programmes has not been clearly evaluated since 1989. Both morbidity and mortality of malaria are difficult to assess due to the high prevalence of other infections especially viral, that mimic the clinical presentation of malaria⁴ and irregular or incomplete routine reports to FMOHSS through sentinel surveillance systems.¹ Levels of ASMP may therefore remain the most useful and easily

determined index, to assess the effectiveness of control measures.

A study was designed to determine the prevalence of ASMP among school-aged children at maximal and minimal transmission periods. In order to further characterise this, several factors were investigated. This paper focuses on the relationship between ASMP and malaria vector control utilization, to determine whether any association exists, thereby assessing the suitability of the former as an index for evaluating malaria vector control programmes

Subjects and Methods

A prospective cross-sectional study was carried out in 1996, among healthy primary school children living in Kaduna, to determine the prevalence and intensity of asymptomatic malaria parasitaemia. Kaduna is a cosmopolitan northern Nigerian city of over 1.5 million inhabitants⁵ living in three distinct types of government defined population density areas namely, low, medium and high. It has typical guinea savanna vegetation. The study was carried out during the months of March and April (peak of the dry season) and from July to August (peak of the wet season) which represent the minimal and the maximal transmission periods of malaria. Pilot studies were carried out in both wet and dry seasons to determine the estimated prevalence using weighted proportions⁶ and a sample size of 100 for each population density area. This estimated prevalence, P, calculated per season, was necessary as there was no known prevalence of asymptomatic malaria

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parasitaemia in the locality. It was used to determine appropriate sample size for each season (to ensure accuracy due to the known marked seasonal variation) using the cluster sampling technique formula corrected for random sampling.⁷ A total of 1224 and 940 children were studied in the

Table I
Prevalence of ASMP in Wet and Dry Seasons

Population Density	Sample size		Prevalence (%)		Z value	P value
	Wet	Dry	Wet	Dry		
Low	350	283	15.0	11.0	1.47	>0.05
Medium	396	313	23.0	15.0	2.67	<0.005
High	478	344	27.0	17.0	3.36	<0.001
Total	1224	940	22.5	14.9	4.23	<0.001

ASMP = Asymptomatic malaria parasitaemia

Table IIA
Effect of Use of Vector Control Measures on Malaria Parasitaemia in the Wet Season

Use of Vector Control Measures	Presence of Malaria Parasitaemia								
	Low Density Area			Medium Density Area			High Density Area		
	+	-	Total	+	-	Total	+	-	Total
Yes	53	297	350	14	86	100	1	19	20
No	-	-	-	78	218	296	129	329	458
χ^2							6.35		4.09
P value							<0.01		<0.05
Coefficient of association							-0.375		0.763

Table IIB
Effect of Use of Vector Control Measures on Malaria Parasitaemia in Dry Season

Use of Vector Control Measures	Presence of Malaria Parasitaemia								
	Low Density Area			Medium Density Area			High Density Area		
	+	-	Total	+	-	Total	+	-	Total
Yes	32	251	283	3	48	51	1	29	30
No	-	-	-	45	217	262	59	255	314
χ^2							4.19		4.54
P value							<0.05		<0.05
Coefficient of association							-0.537		-0.741

+ = Yes and - = No for presence of malaria parasitaemia

wet and dry seasons, respectively. Children were allocated by multi-stage stratified random sampling where the number allocated per stratum (density area) per season was derived by optimum allocation proportionate to the population standard deviation(s).⁶ With the allocation of children per stratum per season, four primary schools were chosen by simple random sampling from each stratum and children were also randomly selected to fill the allocations using random number tables. Those included in the study were children who had been resident for more than one year in areas where the schools were located, who were present in the school and had no symptoms attributable to malaria on the days of the investigator's visits, who had had no antimalarial drug therapy during the previous two weeks and who also had parental consent. Excluded were children whose parents did not give consent, those who had fever or other symptoms attributable to malaria on the day of the investigator's visit and those who had had antimalarial drug therapy during the previous two weeks, and those below five years or above 14 years at the last birthday.

Structured questionnaire was administered to the parents/caretakers, and was used to obtain personal data and other information with regard to the risk of malaria infection, control measures available and being utilized by the child. Thick and thin blood films obtained from each child, were stained with Giemsa and examined under oil immersion for malaria parasites. Intensity of parasitaemia was calculated using standard formula after Bruce-Chwatt.⁸

Ethical approval was obtained from the Ethical Committee of Ahmadu Bello University Teaching Hospital Complex, Zaria.

Statistical analysis

Prevalence of ASMP was calculated for both seasons using weighted proportions and compared by z test. Parasite density indices were determined. Relationship between utilization of vector control and ASMP was determined by chi squared test; P values < 0.05 were considered significant. Coefficients of association were also tested.

Results

Blood films were assessed for 1224 children during the wet season and 940 in the dry season. These children were fairly comparable in age and sex and were allocated appropriately to represent the population density areas as described above. *Plasmodium*

falciparum species was found in 96 per cent of the children during both seasons, *Plasmodium malariae* in 3.3 per cent (during the wet season) and 2.7 per cent (in the dry season) while *Plasmodium ovale* was identified in 0.7 per cent, in each season. The overall prevalence of ASMP was 22.5 per cent at the peak of the wet season and 14.9 per cent at the peak of the dry (Table I). This overall difference was highly significant ($P < 0.001$). In the low-density area however, the difference in the prevalence of ASMP between the wet and dry seasons was not significant ($P > 0.05$) unlike those of the medium and high-density areas which were highly significant. The parasite rates between high and low-density areas were also strikingly different in both seasons.

The types of vector control measures available and in use were house netting, mosquito (bed) net, insecticide sprays and repellents (topical and coil). Insecticide treated bed nets were not available locally for use at the time of the study. Use of at least, one control method on a regular basis (two to three times per week in cases where insecticide sprays and repellents were the only forms of control) was considered adequate. The presence of malaria parasitaemia as compared with usage of vector control measures is shown in Tables IIA/IIB.

Discussion

Asymptomatic malaria parasitaemia (ASMP) was found in 75 per cent of school-aged children in an earlier study from Malumfashi.⁹ Malaria parasite rate increases with age from 0-10 per cent in the first three months of life to between 80 and 90 per cent by one year of age and persists at this high level during childhood.¹⁰ In association with rising parasitaemia levels, immunity is gradually acquired,¹¹ and by school age, the antimalarial levels are high enough to confer sufficient antitoxic properties to neutralize parasite products and interfere with host acute response to malaria infection.¹² In effect, the school-aged child is heavily parasitized, but healthy and so has asymptomatic malaria parasitaemia.

The overall ASMP prevalence of 22.5 per cent in this study compares favourably with the 26.5 per cent obtained in a similar study in south-western Nigeria by Salako *et al*.³ and falls within the national average crude parasite rate (20 - 75 per cent) for this age group. A significant difference in the asymptomatic parasitaemic rates between wet and dry seasons is expected, due to differences in transmission rates; however, this was not found to be the case in the low

population density areas, where the rates were not significantly different. Prevalence and density of malaria parasitaemia are related to the extent of man-mosquito contact. Effective man-mosquito contacts are dependent on parasite and host factors (most of which were constant among the study population throughout the study), as well as the level of protection against the actual contact; the more the protection, the less the parasite rates and densities.

The use of vector control measures in this study was similar in both seasons; very high in low density population areas (100 per cent) as compared to extremely poor (4-25 per cent) in the medium and high density areas. The utilization of vector control measures in this study was found to be strongly related to the presence of ASMP with a negative correlation between them. Since the use of vector control measures was uniformly poor in the medium and high-density areas, the difference seen in their parasite densities would also be influenced by the seasonal variation in transmission. On the other hand, in the low-density areas, inspite of seasons, the low rates of parasitaemia constantly recorded corresponded to high usage of vector control measures. These findings are similar to those reported by workers in south-western Nigeria.^{4,14} The difference in usage of vector control measures was a reflection of the socioeconomic status of the families which is relatively high in low population density areas and vice versa; this in turn, determined their enlightenment and economic power to sustain prolonged use of these vector control measures.

It had been assumed that ASMP would only be of epidemiological interest,¹⁵ but as this study demonstrates, it is potentially an extremely useful tool for evaluating the utilization and implementation of malaria vector control programmes as well as monitoring their continued use. ASMP rate, as an index of malaria control, meets the standard of a basic indicator.¹⁶ It is valid, reliable, easily interpreted and detects changes within a reasonable time period. It is recommended that ASMP be used as an invaluable,

affordable guide in monitoring changes when malaria vector control programmes are fully implemented.

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