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Malaria prevalence, blood profile and risk factors for transmission in a peri-urban community, north-central, Nigeria

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Abstract

Malaria-related morbidity is a common occurrence in sub-Saharan Africa culminating in low productivity, and waste of valuable man-power. A cross-sectional study of a sub-urban community in Ilorin, north-central, Nigeria, was conducted. Malaria parasite detection and quantification was established using Giemsa-stained thick and thin blood films. Packed cell volume (PCV) was determined with hematocrit centrifuge and micro-hematocrit reader. Bio-data, socio-environmental and socio-demographic factors were obtained with pretested questionnaire. One thousand, one hundred and four (44.8% males and 55.2% females) inhabitants enrolled for the study with 63.86% harbouring varying degrees of *Plasmodium falciparum* parasitaemia. Specific point prevalence with respect to age groups were only significant ($p<0.05$) with age 6-10 and 26-30 respectively. 42.1% of the population were anaemic following established guidelines. More subjects concealed light infections with slightly higher mean anaemia in comparison to other groups. Education level, farming, proximity to stagnant water and sleeping outdoor was highly correlated with degree of infections ($p<0.001$). Five epidemiological factors predicted future malaria infections viz; outdoor sleepers (OR: 0.003, 95% CI: 0.001-0.006, $p<0.001$), domiciling within 50 metres of bushes (OR: 10.807, 95% CI: 8.067-14.479, $p<0.001$), use of insecticides (OR: 0.003, 95% CI: 0.001-0.004, $p<0.001$), proximity to stagnant water (OR: 0.516, 95% CI: 0.400-0.666, $p<0.001$) and drug efficacy (OR: 0.457, 95% CI: 0.354-0.590, $p<0.001$). Malaria still remains a public health debacle in Nigeria. Transmission largely depends on a complex interaction of the vector, physical, socio-economic, demographic and environmental factors, human biology and behaviour with malnutrition promoting anaemic outcomes.

Keywords: Anaemia; *Plasmodium falciparum*; predictions; Ile Apa.

Introduction

Malaria remains a global health problem despite concerted efforts towards complete eradication. The World Health Organization [1] in 2016 reported, that there were 212 million new cases of malaria worldwide in the year 2015 (i.e. range 148–304 million) with the WHO African Region accounting for most global cases (90%), the South-East Asia Region (7%) and the Eastern Mediterranean Region (2%). In 2015 alone, there was an estimated 429 000 malaria deaths (range 235 000-639 000). Statistics for these deaths followed this trend; African Region (92%), the south-east Asia region (6%) and the eastern Mediterranean region (2%). Concisely, between 2010 and 2015, malaria incidence rates fell by 21% and mortality rate fell by an estimated 29% globally, while in the Africa region, malaria mortality rates fell by an estimated 31%. Till date, children under 5 years still bear the brunt of malaria burden, infection and death, claiming the life of 1 child every 2 minutes [1]. In Nigeria, malaria is consistently a major public health challenge, accounting for more cases and death than any other country in the world [2]. It often present

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with a variety of syndromes, but anaemia remains the most prominent haematological manifestation [3]. Although, there are other causes of anaemia; such as poor nutrition, deficiencies of iron and other micronutrients, hookworm disease and schistosomiasis, malaria is considered to be the primary cause of severe anemia in at least 50% of people living in endemic regions [4]. Severe malarial anaemia affects 7.5-34% of the African children with an overall prevalence of 21.2% and case fatality rate of 8.4% [5]. Despite various control interventions; a main difficulty in achieving reduction in its incidence is that a combination of many diverse factors contributes to the maintenance of transmission and it is further compounded by socio-demographic and socio-economic factors [6]. A disproportionate distribution of malaria in endemic zones does occur with reported determinants of transmission [7], including; area of residence [8], overcrowding [9, 10], maternal education [10], knowledge about prevention of malaria [11, 12], and socio-economic factors [13], living close to swamps and forests, livestock roosting near habitation [14], household economic index [15]. The effective control of malaria in Nigerian communities will greatly depend on the acquisition of requisite knowledge of risk factors, modes of spread and the factors that enhance its prevention. It's in the light of the aforementioned that this study was carried out. The present study aims to establish key epidemiological factors that determine anaemia status and identify predictors of morbidity in the inhabitants of this community.

Materials and methods

Description of the study-area

This study was carried out in a peri-urban community situated in Ilorin East at Ile Apa (8.4917'N; 4.5446' E). The community falls within the transitional climate zone with average daily temperature ranges between 26.28^{0}C and 31.95^{0}C. The dry season last from October to February while the rainy season begins towards the end of March and ends in October, with two peak periods in June and September. The annual mean rain fall is about 1,352.0 mm with relative humidity fluctuating between 75% and 76%.Atmospheric visibility is about 5.91 km [16]. The study-area lie in the forest savannah ecosystem. The following housing condition of the inhabitants was established, viz; mud bricks, non-cemented walls, corrugated iron roofing sheets, no asbestos on ceiling, bushy surroundings, puddles of stagnant water around habitation and proximity to slow flowing streams. The inhabitants were mostly farmers and traders.

Data and sample collection

A cross sectional study of a cohort of inhabitants was undertaken between November 2016 and May 2017. Participants were randomly selected from their respective habitations. Consenting donors from alternate houses in each street who had not taken antimalarial medications within the last three months prior to the present study were included, while those that had taken within the period were excluded. Minors were only recruited for the study after informed consent was obtained from their parents/guardians.

Ethical approval

The study protocol was approved by the University of Ilorin Ethical Approval Committee and the Kwara State Ministry of Health respectively. Advocacy visits were paid to the traditional ruler of the community before the study commenced. A pretested questionnaire was used to gather information relating to bio-data, socio-economic and socio-demography. Afterwards, peripheral blood samples obtained by finger prick were collected in EDTA bottles.

Laboratory procedure

All blood samples collected were investigated for malaria parasitaemia after the methods of Cheesbrough [17]. On the average, 200 microscopic fields were counted per slide and the average number of parasites counted per high power field (oil immersion, x1000) was multiplied by 500.

Estimation of packed cell volume (PCV)

Packed cell volume (PCV) of the volunteers were carried out according to the methods described by Dacie and Lewis [18]. Anaemia was defined as PCV<30%. Mild anaemia PCV 25-29%, moderate anaemia PCV 19-24% and severe anaemia PCV <18% and control anaemia PCV e" 40%.

Results

One thousand, one hundred and four (1,104) individuals participated in the study comprising 495 (44.8%) males and 609 (55.2%) females. 63.86% of this population were found to harbor varying degrees of *Plasmodium falciparum* parasitaemia with the following statistics; male: 336(30.4%) and female: 369 (33.4%). The participants were stratified into age groups to identify specific point prevalence (Table 1). It was observed that prevalence with respect to age groups were only significant ($p<0.05$) and comparable with age 6-10 and 26-30 respectively, while the remaining age groups were not significant ($p>0.05$). There was however a decline in malaria infections with respect to age in the study with the highest infection observed in age <5 years (120, 10.9%). Two hundred and thirteen (213, 19.3%) males and 252 (22.8%) females of the studied population were anaemic following WHO guidelines [19].

The infection intensity was stratified into categories and compared with their respective PCVs. This revealed that there were more subjects with light infections (276,

Table 1. Malaria prevalence and anaemia status of inhabitants of Ile Apa.

Characteristics	Variables	Malaria parasitaemia status			
Age group (yrs.)		No. Examined (%)	No. Infected (%)	Uninfected (%)	*p*-value
	<5	120 (10.9)	120 (100.0)		
	6-10	135 (12.2)	129 (11.7)	6 (0.5)	0.005
	11-15	126 (11.4)	105 (9.5)	21 (1.9)	0.093
	16-20	135 (12.1)	93 (8.4)	42 (3.8)	0.219
	21-25	123 (11.1)	66 (6)	57 (5.2)	0.238
	26-30	153 (13.9)	78 (7.1)	75 (6.8)	<0.001
	31-35	117 (10.6)	35 (3.3)	81 (7.3)	0.064
	36-40	75 (6.8)	30 (2.7)	45 (4.1)	0.004
	? 41	120 (10.9)	48 (4.3)	72 (6.5)	0.178
Sex	Male	495	336 (30.4%)		0.014
	Female	609	369 (33.4%)		
Anaemia status					0.581
	Male	495 (44.8)	213 (19.3)	282 (25.5)	
	Female	609 (55.2)	252 (22.8)	357 (32.3)	

Key: Anemia was defined as PCV<30%. Mild anemia PCV 25-29%, moderate anemia PCV 19-24% and severe anemia PCV <18% (control anemia was defined as Packed cell volume e" 40%).

25%) as compared to other groups and with slightly higher mean anaemia (1.5109±0.03014, 95% CI: 1.4515-1.5702). This difference is highly significant ($p<0.001$), (Table 2).

In Table 3, a number of epidemiological variables were identified as probable risk factors for the spread of malaria infections in this study. The degree of infections was correlated with the identified risk factors and it was observed that the level of education was a determining factor for malaria infections ($p<0.005$). Surprisingly, gender was found to be statistically significant ($p=0.014$), more females carried higher varying degrees of parasitaemia as compared to males with a marginal statistical difference ($p=0.044$). Proximity to stagnant water also showed a major difference as those subjects who lived close to stagnant water were less infected compared to those who lived far from stagnant water. Subjects living within proximity to bush however did not show significance difference as compared to those who lived far from bush ($p=0.949$), but the degree of infections amongst the subjects indicated a high statistical difference ($p<0.001$). Subjects who sleep outside their habitation had very high infections as compared to those who sleeps indoor ($p<0.001$) and same variation was observed with intensity of infections.

Self-medication did not however help the subjects despite their abuse of drugs for malaria, many of them came up with varying degree of parasitaemia ($p=0.159$). A comparison between orthodox and traditional drugs did not help to abate infection status as a great number with orthodox drugs came up with malaria ($p<0.001$). The unemployed carried more infection when compared to those who are employed. Wage earners were less infected (138, 12.5%). However, students were slightly higher than wage earners. Family size was a determinant of malaria infections, as those subjects who lived in homes with more than six individuals carried more infections (435, 39.4%) than those who domiciled in homes with less than six individuals (270, 24.5%) except that more subjects had light infections. The use of insecticides showed a statistical difference ($p<0.001$). Those who claimed that they use insecticides at night had less malaria infections when compared to those who don't use. Subjects who took antimalarial drugs less than a month were less infected (177, 16.0%).

Table 2. Intensity of malaria infections with respect to packed cell volume.

Malaria Intensity	No. infected (%)	Packed Cell Volume Count	95% CI		*p*-value
		Mean ± S.E.M	Lower Bound	Upper Bound	
Light	276 (25)	1.5109±0.03014	1.4515	1.5702	<0.001
Moderate	231 (20.9)	1.2987±0.03018	1.2392	1.3582	
Heavy	195 (17.7)	1.2154±0.02951	1.1572	1.2736	

Key: Light = 1-13%, Moderate = 14-35%; Heavy = above 36%. Source: WHO, (2001). Anemia was defined as PCV<30%. Mild anemia PCV 25-29%, moderate anemia PCV 19-24% and severe anemia PCV <18% (control anemia was defined as Packed cell volume e" 40%).

Table 3. Prevalence and intensity of malaria with respect to demographic, social and environmental variables.

Factor	Prevalence of malaria with infection intensity						*p*-value
	No. examined	Malaria Positive	*p*-value	Intensity			
				Light	Moderate	Heavy	
Gender			0.014				0.044
Male	495	336 (30.4%)		123 (14.7%)	108 (9.8%)	102 (9.2%)	
Female	609	369 (33.4%)		153 (13.9%)	123 (11.1%)	93 (8.4%)	
Educational status			<0.001				<0.001
Completed pry school	210	162 (14.7%)		36 (3.3%)	93 (8.4%)	33 (3%)	
Completed sec school	642	300 (27.2%)		108 (9.8%)	45 (4.1%)	144 (13%)	
Illiterate	252	243 (22%)		132 (12%)	93 (8.4%)	18 (1.6%)	
Proximity to stagnant water			<0.001				<0.001
Yes	390	210 (19%)		87 (7.9%)	78 (7.1%)	45 (4.1%)	
No	714	495 (44.8%)		189 (17.1%)	153 (13.9%)	150 (13.6%)	
Proximity to bush			0.949				0.008
Yes	630	402 (36.6%)		147 (13.4%)	150 (13.7%)	102 (9.3%)	
No	468	297 (27%)		129 (11.7%)	75 (6.8%)	93 (8.5%)	
Sleep outdoor			<0.001				<0.001
Yes	633	624 (56.5%)		225 (20.4%)	216 (19.6%)	183 (16.6%)	
No	471	81 (7.3%)		51 (4.6%)	15 (1.4%)	12 (1.1%)	
Self-medication			0.159				<0.001
Yes	666	414 (37.5%0		228 (20.7%)	120 (10.9%)	66 (6%)	
No	438	291 (26.4%)		48 (4.3%)	111 (10.1%)	129 (11.7%)	
Drug efficacy			<0.001				<0.001
Orthodox	717	504 (45.7%)		201 (18.2%)	186 (16.8%)	114 (10.3%)	
Traditional	387	201 (18.2%)		75 (6.8%)	45 (4.1%)	81 (7.3%)	
Occupation			<0.001				<0.001
Wage earner	372	138 (12.5%)		69 (6.2%)		66 (6%)	
Unemployed	294	282 (25.5%)		159 (14.4%)	105 (9.5%)	18 (1.6%)	
Students	438	285 (25.8%)		48 (4.3%)	126 (11.4%)	111 (10.1%)	
Family size			<0.001				0.003
<6	378	270(24.5%)		105 (9.5%)	81 (7.3%)	81 (7.3%)	
>6	726	435 (39.4%)		171 (15.5%)	150(13.6%)	114 (10.3%)	
Distance from bush			<0.001				<0.001
>50m	738	600 (54.3%)		30 (2.7%)	51 (4.6%)	24 (2.2%)	
<50m	366	105 (9.5%)		246 (22.3%)	180 (16.3%)	171 (15.5%)	
Use of insecticide			<0.001				<0.001
Yes	402	27 (2.4%)		15 (1.4%)		9 (0.8%)	
No	702	678 (61.4%)		261 (23.6%)	231 (20.9%)	186 (16.8%)	
Last antimalarial used			<0.001				<0.001
<6 month	408	225 (20.4)		69 (6.2%)	30 (2.7%)	123 (11.1%)	
? 3 month	456	303 (27.4%)		177 (16%)	99 (9%)	27 (2.4%)	
<1 month	240	177 (16%)		30 (2.7%)	102 (9.2%)	45 (4.1%)	

Key: Light = 1-13%, Moderate = 14-35%; Heavy = above 36%.

Table 4. Logistic regression analysis to predict future malaria infections with respect to epidemiological parameters of subjects in the study.

Risk Factors	No. exam.	Mal. pos. (%)	Overall Predicted %	OR*	95% CI		*p*-value
					Lower	Upper	
Sleep outdoor							<0.001
Yes	633	624 (56.5%)	91.8	0.003	0.001	0.006	
No	471	81 (7.3%)					
Distance from bush							<0.001
>50 m	738	600 (54.3%)	78.0	10.807	8.067	14.479	
<50 m	366	105 (9.5%)					
Use of insecticides							<0.001
Yes	402	27 (2.4%)	95.4	0.003	0.001	0.004	
No	702	678 (61.4%)					
Proximity to stagnant water							<0.001
Yes	705	495 (44.8%)	63.9	0.516	0.400	0.666	
No	399	210 (19.0%)					
Drug efficacy							<0.001
Orthodox	717	504 (45.7%)	63.9	0.457	0.354	0.590	
Traditional	387	201 (18.2%)					

*Odd Ratio. *p*-value significant at 0.05., No. exam =Number of subjects examined, Mal. pos. =Malaria positive, Overall predicted % assuming the null hypothesis.

Five epidemiological factors however was able to predict future malaria infections as observed in Table 4. The logistic regression analysis indicated that subjects who slept outside at night are likely to be three times prone to malaria attack (OR: 0.003, 95% CI: 0.001-0.006, $p<0.001$). Those who lived less than 50 metres from bushes are a thousand plus times likely to experience malaria when compared to those that live more than 50 metres. The Omnibus tests of model coefficients gave varying x^2 values on 1 degree of freedom at $p<0.001$ significant to give credence to the null hypothesis.

Discussion

Malaria prevalence remains high despite concerted efforts launched towards its control and eradication. This was ascertained by a high overall prevalence (63.86%) observed in the present circumstance. Both higher [20] and lower [21, 22] prevalence rates have been reported in other endemic zones before now. Children under five are said to be the most vulnerable to repeated episodes of malaria and they bear the highest burden. Our findings tended towards the same argument that these age-group suffer high malaria occurrence as it is in other regions [23, 24].

However, in some meso-endemic regions, older age-group (45-56 years) showed increased prevalence rate and served as a reservoir of infection for other age-groups [25]. The observed decline in prevalence with increasing age in our study could be attributed to development of protective immunity with repeated exposure to infection as earlier reported [26, 27]. Our findings revealed a significantly higher prevalence in females than males ($p<0.05$). This development is most likely due to large female enrolment during the visits. Same situation occurred in Kenya [28], but somewhat different in Abuja and Ondo in Nigeria, and Côte d'Ivoire [24, 29, 30].The ability of *Plasmodium* to damage both parasitized and non-parasitized red blood cells as well as decreased erythrocyte production by the bone marrow has been identified as contributory factors to malaria-related anaemia [31, 32]. Anemia simply connotes a reduction in haemoglobin (Hb) levels in relation to the age, gender, and physiological status of the individual within a defined geographical context. In attestation to earlier reports [33], this study revealed that anaemia was more in females than males. Furthermore, we observed that high parasite density significantly correlates with reduction in PCV as in other localities [21, 29, 34]. The association between malaria risk and environmental, socio-demographic, as well as behavioural variables has been variously explored [35-38]. We observed on the contrary that educational status of the subjects was not positively associated with malaria occurrence as a significantly higher prevalence was observed among those who completed secondary school (27.2%), compared to those who completed primary school (14.7%) and illiterates (22%), however, it contradicts other findings (39, 40). Favourable environment conditions for mosquito breeding and survival around homes; for instance, pools of water and vegetation, can promote disease spread as it is observed

during the course of visits to the community. For instance, individuals who lived <50 m from bushes had significantly higher infection rate. Likewise, results obtained from logistic regression analysis revealed that those living <50m from bushes had a 90.7% reduced risk of malaria in comparison to those who lived afar (OR: 0.093, 95%CI: 0.069-0.124, p=0.001). In addition, proximity to stagnant water was not suggestive of increased malaria prevalence. This observation is a marked deviation from other documented reports (39-42) and may be as a result of occupational exposure, since members of the community are mostly farmers who might have been exposed to mosquito vectors during farming activities.

The percentage of malaria positives was significantly higher among those who sleep outdoors compared to those who sleep indoor. As such, sleeping indoor confers a 99.7% reduction in their odds of malaria (OR: 0.003, 95% CI: 0.001-0.006, p=0.001). Early reports also attributed the increased prevalence observed in outdoor sleepers to increased vector contact [43-46]. The problem of parasite resistance to drugs has been on the rise partly due to indiscriminate use of antimalarial drugs [47-49]. A substantial proportion of people in endemic communities still rely on presumptive diagnosis, not putting to cognizance the fact that there is an overlap of malaria symptoms with other diseases [50-52].

The study showed that malaria is more prevalent among those who practice self-medication compared to those who pass the time of accurate clinical diagnosis before drug usage. Students and unemployed had significantly higher prevalence of infection in contrast to wage earners. Several researchers [13, 53, 54] have identified the former as groups at higher risk of malaria infection, due to the adoption of inadequate preventive measures or non-compliance with the use of insecticide treated nets (ITNs), if at all available.

The use of insecticides, as one of the tools in malaria control programmes has to a certain extent, reduced man-vector contact and invariably malaria prevalence [55, 56]. From our study, it was deduced that infection rate reduced significantly among insecticide users (2.4%), compared to non-users (61.4%). Interestingly, insecticides non-users had a 3fold increase odd of malaria infection (OR: 0.03, 95% CI: 0.001-0.004, p=0.001).

Likewise, it revealed that households with higher family size (>6) was significantly associated with increased malaria risk. Similar to this was the report by Kateera *et al* [57]. The reason ascribed is that, the presence of multiple sleepers lead to production of larger volumes of mosquito attracting human emanations and hence the increased risk of transmission [44, 55]. As regards drug efficacy, a decreased prevalence was observed in participants who employ traditional methods of treatment (18.2%) compared to those who use synthetic drugs (45.7%). A logistic regression showed that those who use traditional methods had 54.3% reduced risk of malaria (OR: 0.457, 95% CI: 0.354-0.590, p=0.001). This implies that herbal remedy still hold strong potential in the development of antimalarial drugs. However, without proper investigation and isolation of the active principles of such plants, safety of usage would be of great concern.

Conclusion

This study has shown that malaria still thrives in many Nigerian communities and greatly impacts the health of the inhabitants. We also identified sleeping outdoors, self-medication, and use of orthodox medicine, increased family size, unemployment and non-use of insecticides as plausible risk factors that may cause increase in malaria prevalence in the community. The sanitary and hygienic nature of human surroundings will play a major role in abating cyclic infection-reinfection in most malaria endemic communities of sub-Sahara Africa and beyond, this is because transmission in any locality depends upon a complex interaction of the mosquito vector, the physical, socio-economic, environmental factors, human biology, demography and human behaviour. Malnutrition also plays a preponderant effect in malaria burden and it is often the case when rural populace work so hard but feed so little. However, it is pertinent to note that increasing parasitemia burden in non-immune individuals will certainly culminates in massive lysis and clearance of red blood cells with profound anemia outcome.

References

1. WHO. Fact Sheet: World Malaria Report 2016. Geneva: 2016 13th December, 2016. Report.
2. Nigeria U. Nigeria Malaria Report. United Nations House, Abuja, Nigeria: 2010.
3. Erhabor, O., Adias, T. C., Hart, M. L. 2010. Effects of falciparum malaria on the indices of anaemia among pregnant women in the Niger delta of Nigeria. *J. Clinc. Med. Res., 2:* 35-41.
4. Jasbir, K. S. and Kiersten, B. J. 2009. Reduction in the burden of malaria anemia in Benin: Confirmation of an anti-vector approach at national level. *International Journal of Tropical Medicine, 4(3):* 104-11.
5. Taylor, T., Olola, C., Valim, C., Agbenyega, .T, Kremsner, P., Krishna, S. *et al*. 2006. Standardized data collection for multi-center clinical studies of severe malaria in African children: establishing the SMAC network. *Transactions of the Royal Society of Tropical Medicine and Hygiene, 100(7):* 615-22.
6. Sharma, R. K., Singh, M. P., Saha, K. B., Bharti, P. K., Jain, V., Singh, P. P. *et al* 2015. Socio-economic and household risk factors of malaria in tribal areas of Madhya Pradesh, central India. *The Indian Journal of Medical Research, 141(5):* 567-75.
7. De Silva, P. M., Marshall, J. M. 2012. Factors contributing to urban malaria transmission in sub-Saharan Africa: A systematic review. *Journal of Tropical Medicine*, 10.

8. Graves, P. M., Richards, F. O., Ngondi, J., Emerson, P. M., Shargie, E. B., Endeshaw, T. *et al* 2009. Individual, household and environmental risk factors for malaria infection in Amhara, Oromia and SNNP regions of Ethiopia. *Transactions of the Royal Society of Tropical Medicine and Hygiene, 103(12):* 1211-20.
9. Ghebreyesus, T. A., Haile, M., Witten, K. H., Getachew, A., Yohannes, M., Lindsay, S. W. *et al* 2000. Household risk factors for malaria among children in the Ethiopian highlands. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, *94(1):* 17-21.
10. Kateera, F., Mens, P. F., Hakizimana, E., Ingabire, C. M., Muragijemariya, L., Karinda, P. *et al* 2015. Malaria parasite carriage and risk determinants in a rural population: A malariometric survey in Rwanda. *Malaria Journal*, *14:* 16.
11. Coleman, M., Coleman, M., Mabaso, M. L., Mabuza, A. M., Kok, G., Coetzee, M. *et al* Household and microeconomic factors associated with malaria in Mpumalanga, South Africa. *Transactions of the Royal Society of Tropical Medicine and Hygiene, 104(2):* 143-7.
12. Okebe, J., Mwesigwa, J., Kama, E. L., Ceesay, S. J., Njie, F., Correa, S. *et al* 2014. A comparative case control study of the determinants of clinical malaria in The Gambia. *Malaria Journal*, *13:* 306.
13. Sonko, S. T., Jaiteh, M., Jafali, J., Jarju, L. B., D'Alessandro, U., Camara, A. *et al* 2014. Does socio-economic status explain the differentials in malaria parasite prevalence? Evidence from The Gambia. *Malaria Journal*, *13(1):* 449.
14. Ernst, K. C., Adoka, S. O., Kowuor, D. O., Wilson, M. L. and John, C. C. 2006. Malaria hotspot areas in a highland Kenya site are consistent in epidemic and non-epidemic years and are associated with ecological factors. *Malaria Journal*, *5:* 78.
15. Koram, K. A., Bennett, S., Adiamah, J. H. and Greenwood, B.M. 1995. Socio-economic risk factors for malaria in a peri-urban area of The Gambia. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, *89(2):* 146-50.
16. Alaaya, B. A., Adetimirin, O. I. and Alagbe, A. O. 2013. Investigation of ground water reservoir in ASA and Ilorin West Local Government of Kwara State using geographic information system. *GIS, Mapping Technology and GeoSpatial Implementations*, *6694:* 1-17.
17. Monica, C. 2006. *District Laboratory Practice in Tropical Countries.* New York: Cambridge Press, Part 1 (*2nd edition*), pp. 249-58.
18. Lewis, S., Bain, B., Bates, I. 2006. *Dacie and Lewis Practical Haematology. 10th ed.* Churchill Livingstone, 736pp.
19. World Health Organization. WHO Guidelines for the anaemia and malaria treatment. http//whqliddocwhoint/publication/2010/9789241547925_engpdf; accessed June 12, 2016.
20. Olasehinde, G., Ajayi, A., Taiwo, S., Adekeye, B. and Adeyeba, O. 2010. Prevalence and management of falciparium malaria among infants and children in Ota, Ogun State, south-western Nigeria. *African Journal of Clinical and Experimental Microbiology*, *11(3):* 159-63.
21. Oseghale, F., Okogun, G., Akhile, A. and Omolumen, L. 2012. Relationship between malaria parasitaemia and packed cell volume among primary school pupils in Ekpoma. *International Journal of Basic, Applied and Innovative Research*, *1(4):* 111-5.
22. Elechi, H., Rabasa, A., Muhammad, F., Garba, M., Abubakar, G. and Umoru, M. 2015. Prevalence and pattern of malaria parasitaemia among under-five febrile children attending paediatric out-patient clinic at University of Maiduguri Teaching Hospital, Maiduguri. *Nigerian Journal of Paediatrics, 42(4):* 319-24.
23. Christopher, J., Lisa, C., Stephen, S., Kathryn, G., Kyle, J., Diana, H. *et al* 2012. Global malaria mortality between 1980 and 2010: A systematic analysis. *Lancet*, *379(9814):* 413-31.
24. Nmadu, P., Peter, E., Alexander, P., Koggie, A. and Maikenti, J. T2015. The prevalence of malaria in children between the ages 2-15 visiting Gwarinpa General Hospital Life Camp, Abuja, Nigeria. *Journal of Health Science, 5(3):* 47-51.
25. Aina, O., Agomo, C., Olukosi, Y., Okoh, H., Iwalokun, B., Egbuna, K. *et al* 2013. Malariometric survey of Ibeshe Community in Ikorodu, Lagos State: Dry season. *Malaria Research and Treatment*, 1-7.
26. Playfair, J. H., Taverne, J., Bate, C.A. and de Souza, J. B. 1990. The malaria vaccine: Anti-parasite or anti-disease? *Immunology Today*, *11(1):* 25-7.
27. World Health Organization. World Malaria Report 2015 Available at http://wwwwhoint/malaria/publications/world-malaria-report-2015/en/.
28. Jenkins, R., Omollo, R., Ongecha, M., Sifuna, P., Othieno, C., Ongeri, L. *et al* 2015. Prevalence of malaria parasites in adults and its determinants in malaria endemic area of Kisumu County, Kenya. *Malaria Journal, 14:* 263.
29. Fowowe, A. 2013. Malaria: A major cause of anaemia among under 5 children on hospital bed in State Specialist Hospital, Ondo, Ondo State, Nigeria. *Mal. Journal*, *11(4):* 15-94.
30. Bassa, F., Ouattara, M., Silué, K., Adiossan, L., Baikoro, N., Koné, S. *et al* 2016. Epidemiology of malaria in the Taabo health and demographic surveillance system, south-central Côte d'Ivoire. *Malaria Journal, 16(9):* 1-11.
31. Haldar, K. and Mohandas, N. 2009. Malaria, erythrocytic infection, and anemia. Hematology American Society of Hematology Education Program, 87-93.
32. Suwanarusk, R., Cooke, B., Dondorp, A., Silamut, K., Sattabongkot, J. and White, N. 2004. The deformability of red blood cells parasitized by Plasmodium falciparum and P. vivax. *Journal of Infectious Disease*, *189:* 190-4.
33. Akinbo, F., Omoregie, R., Mordi, R. and Okaka, C. 2009. Prevalence of malaria and anemia among young children in a tertiary hospital in Benin City, Edo State, Nigeria. *Fooyin Journal of Health Science, 1(2):* 81-4.
34. Adesina, K., Balogun, O., Babatunde, A., Sanni, M., Fadeyi, A. and Aderibigbe, S. 2009. Impact of malaria parasitaemia on haematologic parameters in pregnant women at Booking in Ilorin, Nigeria. *Trends in Medical Research*, *4:* 84-90.
35. Mafiana, C. F. and Ojo, D. A. 2005. Epidemilogical study

of Malaria Parasitaemia; 29th Ann. Conf. and Gen. Meeting Abstract (Abeokuta), Ogun State, Nigeria. Microbes as agents of sustainable development, by Nigeria Society for Microbiology (NSM), 50.

36. Pemunta, N. V. 2013. The social epidemiology and burden of malaria in Bali Nyonga, North-west Cameroon. *Health, Culture and Society*, *4(1):* 69.
37. Chandy, C. J., David, K., Dickens, O., Kacey, C., Kim, A. L., Mark, L. W. *et al* 2009 Environmental, socio-demographic and behavioural determinants of malaria risk in the Western Kenyan highlands: A case-control study. *Trop Med Int Health, 14(10):* 1258-65.
38. Agarwal, A. K., Joshi, H. S., Mahmood, S. E., Singh, A. and Sharma, M. 2015. Epidemiological profile of anaemia among rural school going adolescents of District Bareilly, India. *Intl. J. Com. Med., 6(4):* 504-7.
39. Babamale, O. and Ugbomoiko, U. 2016. Status of malaria infection in peri-urban community of north-central region of Nigeria. *Journal of Bacteriology and Parasitology, 7(1):* 1-6.
40. Ernst, K., Lindblade, K., Koech, D., Sumba, P., Kuwuor, D., John, C. *et al* 2009. Environmental, socio-demographic and behavioural determinants of malaria risk in the western Kenyan highlands: A case-control study. *Tropical Medicine and International Health, 14(10):* 1258-65.
41. Nkuo-Akenji, T., Ntonifor, N., Ndukum, M., Kimbi, H., Abongwa, E., Nkwescheu, A. *et al* 2006. Environmental factors affecting malaria parasite prevalence in rural Bolifamba, South-west Cameroon. *African Journal of Health Science*, *13:* 40-6.
42. Ernst, K., Adoka, S., Kowuor, D., Wilson, M. and John, C. 2006. Malaria hotspot areas in a highland Kenya site are consistent in epidemic and non-epidemic years and are associated with ecological factors. *Malaria Journal*, *5:* 78
43. Gryseels, C., Peeters Grietens, K., Dierickx, S., Xuan, X. N., Uk, S., Bannister-Tyrrell, M. *et al* 2015. High mobility and low use of malaria preventive measures among the Jarai male youth along the Cambodia-Vietnam border. *The American Journal of Tropical Medicine and Hygiene*, *93(4):* 810-8.
44. Gore-Langton, G. R., Mungai, J., Alenwi, N., Abagira, A., Bicknell, O. M., Harrison, R. E. *et al* 2015. Investigating a non-mesh mosquito net among outdoor sleeping nomadic communities in Kenya. *The American Journal of Tropical Medicine and Hygiene*, *93(5):* 1002-9.
45. Mnyone, L. L., Lyimo, I. N., Lwetoijera, D. W., Mpingwa, M. W., Nchimbi, N., Hancock, P. A. *et al* 2012. Exploiting the behaviour of wild malaria vectors to achieve high infection with fungal biocontrol agents. *Malaria Journal*, *11(1):* 87.
46. Ijumba, J. N., Mosha, F. W. and Lindsay, S. W. 2002. Malaria transmission risk variations derived from different agricultural practices in an irrigated area of northern Tanzania. *Medical and Veterinary Entomology, 16(1):* 28-38.
47. White, N. J. 2004. Antimalarial drug resistance. *Journal of Clinical Investigation*, *113(8):* 1084-92.
48. Cui, L., Mharakurwa, S., Ndiaye, D., Rathod, P. K. and Rosenthal, P. J. 2015. Antimalarial drug resistance: Literature review and activities and findings of the ICEMR network. *The American Journal of Tropical Medicine and Hygiene, 93(3 Suppl):* 57-68.
49. Bloland, P. B. 2001. Drug resistance in malaria. Geneva: World Health Organization, Department of Communicable Disease Surveillance and Response.
50. Faure, E. 2014. Malarial pathocoenosis: Beneficial and deleterious interactions between malaria and other human diseases. *Frontiers in Physiology*, *5:* 441.
51. Valle, D., Millar, J. and Amratia, P. 2016. Spatial heterogeneity can undermine the effectiveness of country-wide test and treat policy for malaria: A case study from Burkina Faso. *Malaria Journal*, *15(1):* 513.
52. Simon, G. G. 2016. Impacts of neglected tropical disease on incidence and progression of HIV/AIDS, tuberculosis, and malaria: Scientific links. *International Journal of Infectious Diseases*, *42(Supplement C):* 54-7.
53. de Castro, M. C. and Fisher, M. G. 2012. Is malaria illness among young children a cause or a consequence of low socioeconomic status? evidence from the United Republic of Tanzania. *Malar J., 11:* 161.
54. Tusting, L. S., Willey, B., Lucas, H., Thompson, J., Kafy, H. T., Smith. R. *et al* 2013. Socioeconomic development as an intervention against malaria: A systematic review and meta-analysis. *Lancet*., *382(9896):* 963-72.
55. Takken, A. and Knols, B. 1999. Odor-mediated behaviour of Afro-tropical malaria mosquitoes. *Annu Rev Entomology*, *44:* 131-57.
56. Bhattarai, A., Ali, A. S., Kachur, S. P., Mårtensson, A., Abbas, A. K., Khatib, R. *et al* 2007. Impact of Artemisinin-based combination therapy and insecticide-treated nets on malaria burden in Zanzibar. *PLOS Medicine*, *4(11):* e309.
57. Kateera, F., Mens, P., Hakizimana, E., Ingabire, C., Muragijemariya, L., Karinda, P. *et al* 2015. Malaria parasite carriage and risk determinants in a rural population: a malariometric survey in Rwanda. *Malaria Journal*, *14(16):* 1-11.

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