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IMPACT OF PREVENTIVE PRACTICES ON ANAEMIA DUE TO MALARIA AMONG CHILDREN ATTENDING OUT-PATIENT CLINIC IN SPECIALIST HOSPITAL YOLA, ADAMAWA STATE, NIGERIA

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ABSTRACT
The study focused on the impact of preventive practices on anaemia due to malaria among children. The study considered Out-Patients children who came to laboratory for malaria diagnostic test. Blood sample was examined using Giemsa stain for parasite detection and speciation. Informed consent was obtained and structured questionnaire were administered. Pack Cell Volume was used to screened for anaemia. A total of 310 children were sampled. Malaria anaemia in relation to types of net used, children that were anaemic with malaria used damage insecticide nets recorded highest and least among those using untreated insecticide net with 57.1% and 38.0% respectively ($p>0.05$). Malaria anaemia based on insecticide application, those used cover cloth (50.0%) against mosquito vector and are anaemic with malaria recorded highest while those applied house spray (25.0%) had the least. Malaria anaemia with regard to sleeping habit of the child at night, high proportion were seen in children that were anaemic with malaria sleeping outdoor (56.5%) while those sleeping indoor (36.9%) recorded least ($p>0.05$). Subjects that were anaemic with malaria and previously used Sulphonamides (51.4%) had highest prevalence ($p>0.05$). Children that were anaemic with malaria and period of last treatment of four months (58.2%) recorded highest while period of last treatment of one month (24.1%) had the least ($p>0.05$). Therefore, insecticide application using house spray, stayed indoor at night using mosquito nets had an impact on reducing the risk of anaemia due in Children

Keywords: House spray, Malaria anaemia, mosquito nets, Yola

INTRODUCTION

Malaria is a common disease with public health challenges (Bassey and Izah, 2017). On the African continent, where *Plasmodium falciparum* is the most prevalent human malaria parasite, anaemia is responsible for about half of the malaria-related deaths (Quintero *et al*., 2011). Anaemia remains one of the most difficult public health problems to manage in malaria endemic countries of Africa (Crawley, 2004). Furthermore, anaemia has negative consequences on cognitive development and physical growth of children from infancy to adolescence (Crawley, 2004). It also damages immune mechanisms, and is associated with increased morbidity rates (Balarajan *et al.* 2012).

The World Health Organization [WHO] estimation of the global prevalence of anaemia 1993-2005 suggested that between 31% and 90% of children in malaria-endemic areas of Africa suffers from anaemia (WHO, 2008). Anaemia is a common manifestation of the malaria infection and severe anemia can contribute to malaria mortality through hypoxia and cardiac failure (Memendez *et al*., 2000). Various *Plasmodium* species cause malaria, yet *P. falciparum* is the most critical for anaemia in children. Contrary to iron deficiency anaemia that develops slowly, *P. falciparum* causes severe and profound anaemia within 48 hours of the onset of the fever (WHO, 2008), with a significant risk of death (Menendez *et al*., 2000). In *P. falciparum* malaria, anaemia has a multifactorial origin ranging from increased removal of parasitized and un-parasitized red blood cells (phagocytosis, immune-mediated destruction, spleen sequestration) through cytokines-mediated dyserthropoiesis and bone marrow suppression to iron delocalization (Nweneka *et al*., 2010).

There are a number of other methods to reduce mosquito bites and slow the spread of malaria (Tusting *et al*., 2013). Some of these include the use of insecticides and destroying the breeding grounds of the vector, use of insecticide-treated bed nets, indoor residual spraying and targeted chemoprophylaxis (Okonko *et al*., 2010). Furthermore, improved sanitation, enlightenment could also reduce the prevalence of malaria. However, malaria parasites have developed defence against many antimalarial drugs. This response, known as drug resistance, makes the drugs less effective. In addition, the

Anopheles mosquitoes that transmit the disease have become resistance to many insecticides. Risk of malarial anaemia is largely determined by environmental factors such as elevation, temperature, and rainfall patterns, as these factors determine vector abundance and longevity as well as the rate of parasite development. These environmental factors can be combined to form a suitability index that determines overall risk of malaria transmission [United State Agency International Development (USAID), 2012]. The research was undertaken to determine the impact of preventive measures toward malaria anaemia in children.

MATERIALS AND METHODS

Study Area

This study was carried out at Specialist Hospital, Yola North Local Government Area of Adamawa State, Nigeria. The area has a tropical climate, marked by dry and rainy seasons (Adamawa State Diary, 2011). The rainy season commences from April and ends in October. Wettest months are August and September. The dry season starts in late November and ends in April (Adamawa State Diary, 2011). The vegetation in Yola and environs is secondary type due to human activities through construction, farming wood gathering for fuel and grazing, which have altered the natural vegetation (Akosim *et al*., 1999). Yola North LGA is the Administrative Centre of the State. Most indigenes of Yola are civil servants, farmers, fishermen/women, petty traders, poultry and livestock keepers.

Ethical Consideration

An Ethical Clearance was obtained from the Adamawa State Ministry of Health and permission of the management of Specialist Hospital Yola was sort. Before enrolment, informed consent forms were given to parents/guardians of the children and only those who accepted to allow their children to participate voluntarily were included in the study.

Study Design and Population

The study was hospital based and considered only Out-Patient children who came to laboratory for malaria confirmatory test from the months of July to November 2015. A total of 310 children were enrolled aged 6 months to 15 years. Questionnaire was designed to collect information on malaria prevention measures used.

Collection of Blood Sample

Blood samples were collected using finger prick and venepuncture techniques (Cheesbrough, 2006) alternatively with the assistance of Medical Laboratory Scientists.

Parasitological Examination

Thick and thin film was prepared (Cheesbrough, 2006) for the detection and speciation of malaria parasites respectively. Blood smear were read by experience Medical Laboratory Scientists.

Haematology

Packed Cell Volume (PCV) also referred to as haematocrit was used to screen for anaemia. To measure the PCV, either a plain capillary with mixed EDTA anticoagulated blood or a heparinized capillary with capillary blood was used. The technique outlined by Cheesbrough (2006) was utilized. The Haemoglobin levels to diagnose anaemia based on WHO criterion as adopted in 1968 is as follows:

- Children 6-59 months of age: non anaemia (11g/dl and above), mild anaemia (10-10.9g/dl), moderate anaemia (7-9.9g/dl) and severe anaemia (below 7g/dl).
- Children 5-11 years of age: non-anaemia (11.5 g/dl and above), mild anaemia (11-11.4g/dl), moderate anaemia (8-10.9g/dl) and severe anaemia (below 8g/dl).
- Children 12-14 years of age: non-anaemia (12g/dl and above), mild anaemia (11-11.9g/dl), moderate anaemia (8-10.9g/dl) and severe anaemia (below 8g/dl)
- Female 15 years of age: non-anaemia (12g/dl and above), mild anaemia (11-11.9g/dl), moderate anaemia (8-10.9g/dl) and severe anaemia (below 8g/dl).
- Male 15 years of age: non-anaemia (13g/dl and above), mild anaemia (11-12.9g/dl), moderate anaemia (8-10.9g/dl) and severe anaemia (below 8g/dl) as cited in WHO, (2011).

DATA ANALYSIS

Data collected were analysed using SPSS version 23 (SPSS Inc., Chicago, IL, USA). Data are presented as frequency distribution table (in percentage) andassociation between variables were determined using Pearson Chi square (χ^2) test ($P < 0.05$).

RESULTS

Table 1 shows the epidemiological characteristics of the children. The male 168 (54.2%) had the highest number of participants while the female 142 (45.8%) had the least. The age groups 6 months-4 years, 5-9 years were the first, second and third number of participants recruited in this study with 43.2%, 27.1%, and 26.1% respectively. While ≥15 years were the fourth (3.5%).

Table 2 highlights the prevalence of malaria anaemia in relation to the type of nets used. The highest prevalence was among those that were anaemic with malaria used damage net (57.1%). While the least was among those using un-treated net (38.0%). The analysis revealed that there was no significant difference between malaria anaemia and type of nets ($p>0.05$). Distribution of malaria anaemia in relation to insecticide application is shown in Table 3. Those children that used cover cloth to protect themselves against mosquito and anaemic with malaria were recorded with highest prevalence rate of 50.0%. while the least was among those that were anaemic with malaria and were applying house spray (25.0%). The analysis showed no significant difference between malaria anaemia and insecticide application ($p>0.05$). Table 4 depicts the distribution of malaria anaemia according to sleeping habit of the child at night. The proportion of malaria anaemia as seen in children that were anaemic with malaria increases with sleeping outdoor having the highest (56.5%) and the lowest was seen in those sleeping indoor having 36.9%. The analysis indicates insignificant

difference between malaria anaemia and sleeping habit of the child at night (p>0.05).

The distribution of malaria anaemia in relation to anti-malaria drug previously used for treatment is highlight in Table 5. The result depicted that subjects that were anaemic with malaria and were previously used Sulphonamides (51.4%) had the highest. Those that were anaemic with malaria and were previously used no drugs (35.2%) had the least The difference between malaria anaemia and anti-malaria drug previously used for treatment was statistically no significant (p>0.05). Distribution of malaria anaemia in children based on the period of last treatment is shown in Table 6. Those children that were anaemic with malaria and the period of last treatment of four months (58.2%) recorded highest. While those that were anaemic with malaria with the period of last treatment of one month (24.1%) had the least. The analysis showed no significant difference between malaria anaemia and period of last treatment (p>0.05).

Table 1: Epidemiological Characteristics of children in relation to Gender and Age

Epidemiological Characteristics	No. (%) Subjects
Gender	
Male	168 (54.2)
Female	142 (45.8)
Total	310 (100.0)
Age Group	
6 Months-4 Years	134 (43.2)
5-9 Years	84 (27.1)
10-14 Years	81 (26.1)
≥15	11 (3.5)
Total	310 (100.0)

Table 2: Distribution of Malaria Anaemia in Relation to Types of Nets Used

Type of Nets	No. Examined	Malaria Anaemia				
		No. (%) Non Anaemic	No. (%) Mild Anaemia	No. (%) Moderate Anaemia	No. (%) Severe Anaemia	No. (%) Anaemic with Malaria
Insecticide treated net (ITNs)	64	7 (10.9)	3 (4.7)	21 (32.8)	2 (3.1)	26 (40.6)
Not treated net	71	3 (4.2)	2 (2.8)	16 (22.5)	9 (12.7)	27 (38.0)
Damaged net	7	0 (0.0)	1 (14.3)	2 (28.6)	1 (14.3)	4 (57.1)
Screen door/window	132	13 (9.8)	11 (8.3)	25 (18.9)	16 (12.1)	52 (39.4)
None	36	6 (16.7)	5 (13.9)	7 (19.4)	7 (19.4)	19 (52.8)
Total	310	29 (9.4)	22 (7.1)	71 (22.9)	35 (11.3)	128 (41.3)

$\chi^2_{cal} = 17.123$

Table 3: Distribution of Malaria Anaemia in relation to Insecticide Application

Insecticide application	No. Examined	Malaria Anaemia				
		No. (%) Non Anaemic	No. (%) Mild Anaemia	No. (%) Moderate Anaemia	No. (%) Severe Anaemia	No. (%) Anaemic with Malaria
Room spray	143	14 (9.8)	11 (7.7)	36 (25.2)	15 (10.5)	62 (43.4)
House spray	8	0 (0.0)	0 (0.0)	1 (12.5)	1 (12.5)	2 (25.0)
Burning coil/Mosquito repellent	115	10 (8.7)	7 (6.1)	25 (21.7)	14 (12.2)	46 (40.0)
Cover cloth	18	2 (11.1)	3 (16.7)	5 (27.8)	1 (5.6)	9 (50.0)
None	26	3 (11.5)	1 (3.8)	4 (15.4)	4 (15.4)	9 (34.6)
Total	310	29 (9.4)	22 (7.1)	71 (22.9)	35 (11.3)	126 (41.3)

$\chi^2_{cal} = 16.154$

Table 4: Distribution of Malaria Anaemia in relation to Sleeping Habit of the Child at Night

Sleeping habit	No. Examined	Malaria Anaemia				
		No. (%) Non Anaemia	No. (%) Mild Anaemia	No. (%) Moderate Anaemia	No. (%) Severe Anaemia	No. (%) Anaemic with Malaria
Sleeping indoor	168	17 (10.1)	12 (7.1)	37 (22.0)	13 (7.7)	62 (36.9)
Sleeping outdoor	23	2 (8.7)	1 (4.3)	7 (30.4)	5 (21.7)	13 (56.5)
Resting outdoor	119	10 (8.4)	9 (7.6)	27 (22.7)	17 (14.3)	53 (44.5)
Total	310	29 (9.4)	22 (7.1)	71 (22.9)	35 (11.3)	128 (41.3)

$\chi^2_{cal} = 14.306$

Table 5: Distribution of Malaria Anaemia in relation to Anti-Malaria Drug Previously Used for Treatment

Anti-Malaria Drug	No. Examined	Malaria Anaemia				
		No. (%) Non Anaemia	No. (%) Mild Anaemia	No. (%) Moderate Anaemia	No. (%) Severe Anaemia	No. (%) Anaemic with Malaria
Quinolines	30	4 (13.3)	3 (10.0)	9 (30.0)	0 (0.0)	12 (40.0)
Sulphonamides	35	3 (8.6)	5 (14.3)	6 (17.1)	7 (20.0)	18 (51.4)
Artemisin combination therapy (ACT)	166	17 (10.2)	12 (7.2)	41 (24.7)	17 (10.2)	70 (42.2)
Local herbs	8	2 (25.0)	0 (0.0)	2 (25.0)	1 (12.5)	3 (37.5)
No drugs	71	3 (4.2)	2 (2.8)	13 (18.3)	10 (14.1)	25 (35.2)
Total	310	29 9.4)	22 (7.1)	71 (22.9)	35 (11.3)	128 (41.3)

$\chi^2_{cal} = 12.930$

Table 6: Distribution of Malaria Anaemia in Relation to Period of Last Treatment

Period of last treatment	No. Examined	Malaria Anaemia				
		No. (%) Non Anaemia	No. (%) Mild Anaemia	No. (%) Moderate Anaemia	No. (%) Severe Anaemia	No. (%) Anaemic with Malaria
One month	54	7 (13.0)	1 (1.9)	6 (11.1)	6 (11.1)	13 (24.1)
Two months	41	2 (4.9)	3 (7.3)	9 (22.0)	6 (14.6)	18 (43.9)
Three months	40	5 (12.5)	5 (12.5)	10 (25.0)	4 (10.0)	19 (47.5)
Four months	29	2 (6.9)	6 (20.7)	10 (34.5)	1 (3.4)	17 (58.2)
Five months and above	96	12 (12.5)	6 (6.2)	25 (26.0)	11 (11.5)	42 (43.8)
Never treated malaria	50	1 (2.0)	1 (2.0)	11 (22.0)	7 (14.0)	19 (38.0)
Total	310	29 (9.4)	22 (7.1)	71 (22.9)	35 (11.3)	128 (41.3)

$\chi^2_{cal} = 20.151$

DISCUSSION

Malaria species found in this study was *P. falciparum.* Barriers apply to malaria vector to prevent transmission could be largely depending on the consistent usage during dusk and dawn. This could be probably explained as seen among the user of untreated net (Table 2) could have resulted to this difference. Insecticide application on malaria vector's breeding ground and its environs as in the case of house spray (Table 3) have a long run effect not only reducing mosquito vector and transmission but on other complication of malaria such as anaemia Sleeping outdoor as well as resting at night couples with anopheles feeding behaviour at night might prompt malaria infection hence anaemia. In this study, a significant reduction in malaria anaemia was recorded among those sleeping indoor (36.9%). Others findings suggest that some mosquito populations avoid contact with ITNs by either feeding predominantly outdoors or in the early part of the evening when individuals are not under nets (Pates and Curtis 2005; Geissbuhler et al., 2007; Govella et al., 2010), hence the high proportion of anaemia with malaria among those sleeping outdoors and resting outdoor. Such behavioural habit of sleeping outside and resting outdoors might result due to the high temperature and humidity of Yola. However, ITNs represent a powerful tool for preventing malaria transmitted by mosquitoes residing indoors at night (Lengeler, 2004; Govella et al., 2010).

Etusium (2013) point out that the pattern of exposure to malaria infection, the types of treatment and degree of compliance with the antimalarial regimen, local drug resistance pattern and an individual's age and genetic makeup all tend to influence the severity of disease. These could probably have explained why antimalarial drug previously used for treatment (sulphonamides) were anaemic with malaria recorded high. Emerging resistance in malaria regimen using ACT has been observed in Laos (Briggs, 2014; Ashly et al, 2014). Studies have demonstrated that asymptomatic malaria can cause haemostatic imbalance and lower haemoglobin level in children (Kurtzhals *et al*., 1999), thus contributing to mild to moderate anaemia (Price *et al*., 2001; Umar *et al*., 2007), hence those with period of last treatment of four months having subsequent episode of malaria observed to have mild anaemia and moderate anaemia having highest result, resulted to significant increase in anaemic with malaria in this study.

CONCLUSION

Despite the used of different preventive measures by the parents/guardians of the children, there was high prevalence of anaemia due to malaria among the study subjects, moderate anaemia is the most prevalent in terms of anaemia classification, followed by mild anaemia, then severe anaemia was low. However, insecticide application using house spray, staying indoor at night using mosquito nets had an impact on reducing the risk of malaria anaemia in children.

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