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EFFECT OF VITAMIN A SUPPLEMENTS ON MALARIA AND HELMINTHS INFECTIONS AMONG CHILDREN UNDER 5 YEARS IN MICHIKA LOCAL GOVERNMENT AREA, ADAMAWA STATE, NIGERIA

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Abstract

This study was conducted in Primary Health Care Facilities in Michika Local Government Area in Adamawa State of Nigeria between April and August 2021 to assess the effect of Vitamin A supplement (VAS) on malaria and helminths infection among children under 5 years with the aim to determine the prevalence and intensity of malaria and helminths infection. Blood and stool specimen was collected from each child to detect malaria and helminths parasite microscopically. Ethical approval was obtained from the Primary Health Care Department and the consent of the mother/caregiver was sought for and obtained. A total of 398 children were selected for the study. The result of

Introduction

Vitamin A is an essential nutrient crucial for growth, development, immune function, and vision in children (Tanumihardjo, 2011). Deficiency can lead to various eye conditions, including night blindness and permanent vision loss, as well as increased mortality risk from diseases like measles and diarrhea (Imdad, 2011). While vitamin A occurs naturally in animal-based foods and some plant sources, many children in developing countries struggle to meet their

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malaria infection showed that (32.2%) were positive for those that received VAS and (38.2%) were positive for those without vitamin A supplement. The result also showed that (13.6%) were positive for helminths among those that received VAS and (18.3%) among those without VAS. Intensity of malaria infection were also recorded which showed that (35.2%) had light infection (+) for malaria and (7.04%) had moderate infection (++) for those that received VAS. For those without VAS (17.6%) light infection (+) and (10.6%) moderate infection (++) for malaria infection. The intensity of helminths was also recorded which showed (8.8%) had light infection (+), (3.5%) had moderate infection (++) among those with VAS, while (13.1%) had light infection (+), (6.5%) had moderate infection (++) among those without VAS. There was significance different in malaria and helminths prevalance among children that received VAS and those who did not have VAS ($p<0.05$). Malaria and helminths infection have also assess by gender and age of the participants, which showed that female had higher malaria (51.07%) and helminth (54.3%) infections while male children (48.9%) malaria and (45.7%). Children aged 0-13 months had higher malaria (34.3%) and children aged 44-59 months had lower malaria (15.2%) The prevalence of malaria and helminths infections recorded among the children in the study area could be due to inability of mother/caregiver to bring their children regularly for immunization, or it might be as a result of this age group are more exposure to mosquito bite as they usually play outside at night.

Keywords: *Vitamin A Supplementation (VAS), Malaria Prevalence, Helminth Infection, Children under five years, Michika Local Government Area, Malaria Intensity, Helminth Intensity, Immunization Status*

requirements through diet alone. As such, vitamin A supplementation has become an important public health intervention, potentially offering protection against malaria and other infections (European Food Safety Authority, 2015).

Malaria remains a major public health concern in developing countries, causing significant morbidity and mortality, especially among young children. Annually, an estimated 300-500 million malaria infections occur, resulting in 1-2 million deaths, predominantly in children under five years of age (Portugal *et al.,* 2014). Despite prevention efforts like insecticide-treated nets (ITNs), new cases continue to emerge, highlighting the need to identify additional risk factors and interventions (Mathanga *et al.,* 2012).

Intestinal parasitic infections, particularly helminths, pose another serious health threat to children in developing countries. These infections are associated with anemia, growth stunting, and other physical and mental health problems. Globally, over one-sixth of the population is infected with intestinal helminths, with children being most vulnerable to clinical symptoms. The high prevalence in developing countries is largely attributed to poor sanitation, overcrowding, and inadequate hygiene practices (Campbell *et al.,* 2016).

The potential interaction between malaria and helminth infections is of particular concern, as their combined presence may exacerbate anemia risk through distinct mechanisms affecting hemoglobin levels (Machteld *et al.,* 2010). Given the widespread nature of these health challenges and the potential benefits of vitamin A supplementation, this study aims to investigate the effect of vitamin A supplements on malaria and helminth infections among children under 5 years in Michika Local Government Area, Adamawa State, Nigeria.

MATERIALS AND METHODS

Description of the Study

This study was conducted in Michika Local Government Area (LGA) of Adamawa State, located in the Northern Senatorial zone of Adamawa State, Northeast Nigeria. Michika LGA lies within the northern axis of the state and is bordered by the Republic of Cameroon to the east, Madagali LGA to the north, and Askira/Uba LGA of Borno State to the west (Fig. 1).

Geographically, it is situated at latitude 10°37'N and longitude 13°23'E, within the tropical region characterized by a distinct dry and rainy season. The rainy season extends from April to October, with a mean annual rainfall of 700 mm, peaking in August and September. The dry season starts in November and ends in March, which coincides with the harmattan period when dust-laden northeast trade winds blow from the Sahara Desert, significantly affecting the climate. The primary occupation of the Michika population is farming, with major crops including maize, groundnut, beans, guinea corn, and rice. Michika has an estimated population of around 207,500 (NPC, 2016), and the major languages spoken are Higgi (Kamwe), Margi, and Hausa.

Research Design

The study adopted a cross-sectional survey design to analyze data from the target population at a single point in time.

Population and Sample Size

The target population for the study consisted of 28,057 children attending primary health care facilities in Michika LGA, specifically children between the ages of 0-59 months. Data were collected on vitamin A supplementation based on the child's immunization card to assess its effect on malaria and helminth infections, both currently and retrospectively.

A total of 8 primary health care facilities were selected from each ward for the study. These included: Michika 1, Michika 2, Minkisi/Wuro Ngiki, Moda Dlaka Ghenjawa, Tumbaragabili, Munkavachita, Madzi, and Jigalambu ward. Systematic random sampling was employed to select children attending these facilities. The sample size for this research was determined to be 398 children under 5 years of age, calculated using the Taro Yamane formula (Yamane, 1973) with a 95% confidence level:

$n=N1+N(e)2n = \frac{N}{1 + N(e)^2}n=1+N(e)2N$

where:

n = required sample size

N = population size
e = margin of error

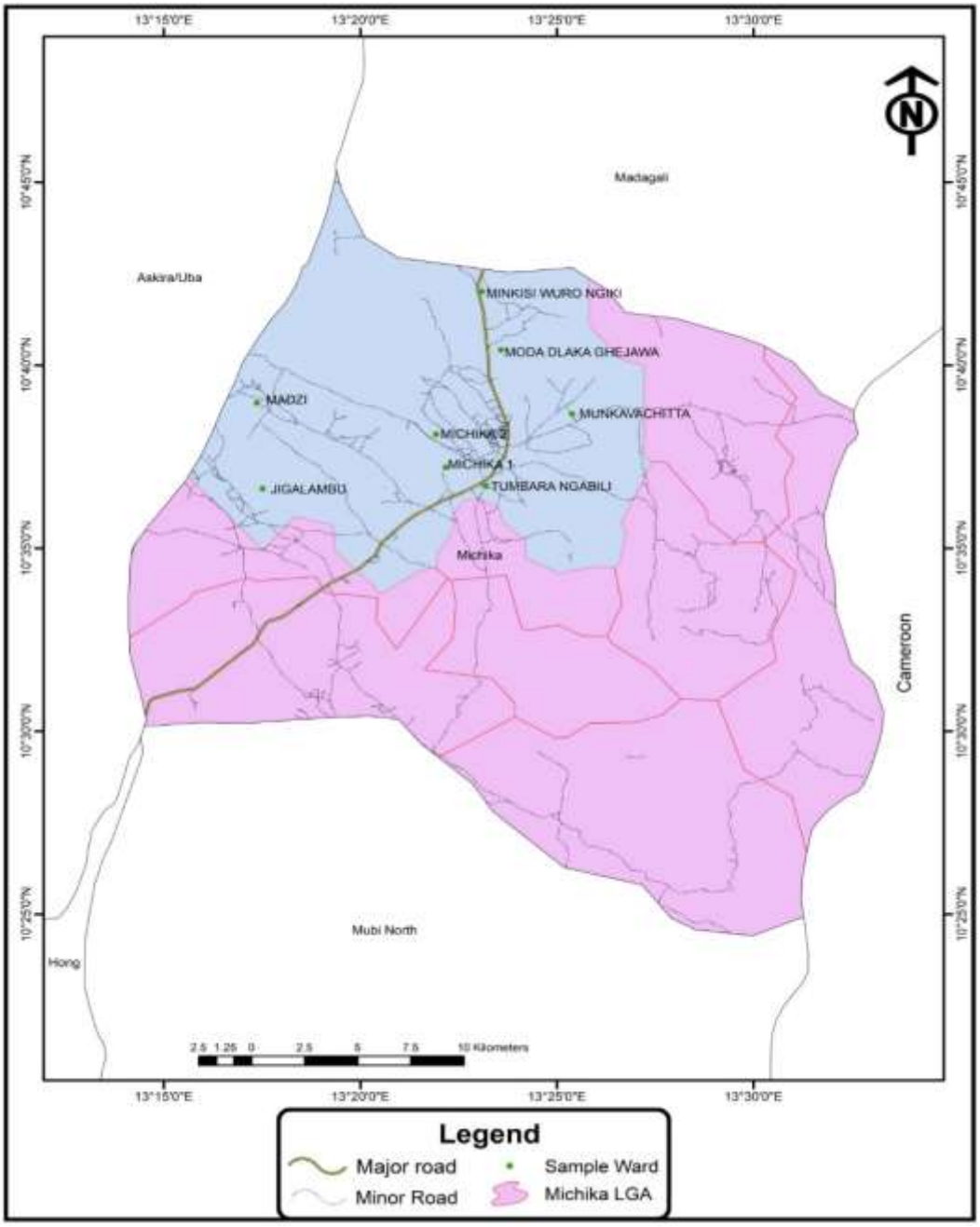

Fig.1 Map of Michika LGA Showing Study Area
Source: @ GIS Laboratory, Geography Department MAU, Yola 2022

Data Collection

A structured questionnaire was administered to the mothers/caregivers of each of the 398 children to collect data on the child's sex, age, and vitamin A status, as well as the mother's occupation, type of toilet used, and level of education. The child's immunization card was required from the mother/caregiver to verify immunization status, which was recorded on the corresponding questionnaire. Informed consent was obtained from each mother/caregiver, detailing the process. Blood samples were collected from each child by a trained laboratory technician using sterile bottles to test for malaria parasites, and fresh stool samples were collected using pre-coded specimen bottles for laboratory testing of helminth eggs and intensity.

Blood Collection

The finger or heel of each child was massaged and swabbed with cotton wool soaked in 70% alcohol or methylated spirit to sterilize the area. The mother/caregiver was asked to open a sterile lancet to ensure its safety and cleanliness before it was used to puncture the finger or heel. The researcher wore rubber gloves as a preventive measure during blood collection. The blood collected was used to prepare thick and thin blood films for malaria detection, following standard laboratory procedures (Cheesbrough, 2005).

Malaria Parasite Determination

Thick and thin blood films were prepared and stained with Giemsa stain diluted to a 1 in 10 ratio for 45 minutes. The slides were examined under a microscope using oil immersion objectives to detect the presence of parasites.

Procedure for Thin Blood Film Preparation

A drop of blood was placed on a clean, grease-free slide, at least 1 cm away from the edge. A spreader was placed at a 45° angle to the blood drop and

drawn forward gently to create a thin smear, which was then air-dried, fixed, and stained (Cheesbrough, 2005).

Procedure for Thick Blood Film Preparation

A drop of blood was placed at the center of a clean, grease-free slide and spread gently using a spreader to create a thick smear. The film was allowed to air dry without fixing (Cheesbrough, 2005).

Staining Method

The thin film was fixed with absolute alcohol for 1-2 minutes, then covered with Giemsa stain diluted in a 1 in 10 ratio with buffered pH 7.2 water or immersed in a staining rack for 25-30 minutes. The slide was differentiated using phosphate buffer saline or clean water, cleaned, and allowed to air dry. The thick film was stained similarly but without fixing (Cheesbrough, 2005).

Stool Collection and Helminths Diagnosis

A specimen bottle was provided to each mother/caregiver for early morning stool collection from the child. The stool samples were examined macroscopically and prepared for microscopic examination using the formol-ether concentration method described by Allen and Ridley. The Formalin-Ether sedimentation technique was used for stool examination, following standardized protocols to ensure accuracy and reliability (Cheesbrough, 2005).

Data Analysis

Data collected were analyzed using multiple analytical techniques. Descriptive statistics (percentages) were used to analyze the prevalence of malaria and helminth infections among children. IBM SPSS software version 27 and Chi-square ($\chi 2$) tests were used to examine the association between Vitamin A supplementation and malaria and helminth infections,

the intensity of these infections, and the age and sex of the children, with a significance level set at $p > 0.05$.

RESULTS

Description of the Study Subjects Screened

Data was collected from 8 wards (primary health care facilities) which were Michika 1, Michika 2, Minkisi wuro Ngiki, Moda Dlaka, Jigalambu, Tumbara Ngabili, Madzi, Munkavachita (Table 1). Samples were collected among children between the ages 0- 59 months. The result of this study showed that 398 children participated in the study from the 8 primary health care facilities with Michika 2 having the highest participation of 15.6% while Michika 1 13.8%, Minkisi wuro Ngiki 13.6%, Madzi 13.3%, Moda Dlaka 12.6%, Jigalambu and Tumbara Ngabili 11.5%, and Munkavachita had the lowest of 8.4% participants. Out of the 398 participants, female had the highest participation of 53.01% while the male had 46.3%. Participants between the age group 0- 13 months had the higher participation of 36.7% while participants between the age group 44- 59months had the lower participation of 12.7%.

Prevalence of Malaria and Helminths Infection among Children under 5 years

The result of this study showed that 398 children participated in the study ages 0-59 months (Table 2). The overall prevalence rate of infected with malaria and helminths parasite was 70.3% for malaria only, 31.9% for helminths only, and 23.4% for co-infection only. In relation to age the result for malaria only was 0- 13 months 34.3%, 14- 28 months 30%, 29- 43 months 20.7% and 44- 59 months 15.4%.The result for helminths according to age was 0-13 months 20.5%, 14- 28 months 22.05%, 29- 43 months 25.9% and 44- 59 months 31.5%. The result according to sex revealed that, females have the higher infection 51.07% for malaria and 54.3% for helminths while males had 48.9 % for malaria and 45.7% for helminths.

Vitamin A supplement, Malaria and Helminths Infection among the Participants

The result revealed that children without vitamin A supplement had higher malaria infection (38.2%), with Plasmodium falcifarum, while those that received vitamin A supplement had lower malaria infection 32% (Table 3). Then the null hypothesis is rejected, and thus there was significant association between malaria infection among children that received vitamin A supplement ($\chi 2 = 33.1063$, df =1, 3.8414 $p< 0.05$).

Table 1. Description of the Study Subjects Screened

Wards (Health facilities)	Age (months)				Total (%)	Sex	
	0-13	14- 28	29- 43	44-59		Male	Female
Michika 1 (Michika town)	17	11	23	4	55(13.8)	22	23
Michika 2 (Maternity)	31	17	3	11	62 (15.6)	31	31
Minkisi/wuro Ngiki (Minkisi)	17	13	17	7	54 (13.6)	25	29
Moda/Dlaka (Moda PHC)	23	14	6	7	50 (12.6)	27	23
Jigalambu (Jigalambu PHC)	15	18	8	5	46 (11.5)	24	22
T/gabili (Kwabapale PHC)	13	13	15	5	46 (11.5)	20	26
Madzi (Watu PHC)	20	16	9	8	53 (13.3)	24	29
Munkavachita (Nkafa PHC)	10	15	4	3	32 (8.04)	14	18
No. in sample	146	117	85	50	398	187	211
	36.70%	29.40%	21.40%	12.70%	100%	46.90%	53.01%

Table 2: Prevalence of Malaria and Helminths Infection among Children under 5 Years Screened during the Study

Age (months)	No. Examined (%)	Number Infected (%)		Malaria+Helminths (%)
		Malaria.	Helminthes	
0-13	146(36.7)	96(34.3)	26(20.5)	19(20.4)
14-28	117(29.4)	84(30)	28(22.05)	14(15.05)
29-43	85(21.3)	58(20.7)	33 (25.9)	28(30.1)
44-59	50 (12.6)	43(15.4)	40(31.5)	32(34.4)
Total	398(100)	280(100)	127(100)	93(100)
Gender				
Male	187(46.9)	137 (48.9)	58(45.7)	45 (48.4)
Female	211 (53.01)	143 (51.07)	69 (54.3)	48 (51.6)
Total	398 (100)	280 (100)	127 (100)	93(100)

Table 3: Association Between Vitamin A Supplement with Malaria among children in the study area.

Vitamin A supplements	Number Examined	Number Positive	(%)Prevalence
Received vitamin A	230	128	32.2
Not received vitamin A	168	152	38.2
Total	398	280	70.4

($\chi^2 = 33.1063$,df=1,3.8414 p>0.05)

It was also observed that children without vitamin A supplement had higher helminths infection of 19.6%, while those that received vitamin A supplement had lower helminths infection of 12.3% (Table 4). Hence the null hypothesis, was rejected and thus conclude that there was significant association between helminths infection among children that received vitamin A supplement ($\chi 2 = 28.20541$, df =1, 3.8414 p>0.05).

Vitamin A Supplement, Intensity of Malaria and Helminths infection among the Participants.

The result revealed that children who received vitamin A supplement had 35.2% mild intensity and 7.04% moderate intensity for malaria (Table 5). Those without vitamin A supplement had 17.6% mild intensity and 10.6% had moderate intensity. There was no significant association between intensity of malaria infection among children that received vitamin A supplement ($\chi 2 = 17.1974$, df =1, 9.4877 p>0.05).

Participants with vitamin A supplement had 8.8% mild intensity with helminths and 3.5% moderate intensity with helminths. While those without vitamin A supplement had 13.1% mild intensity with helminths and 6.5% for moderate intensity with helminths (Table 6), The null hypothesis is thus rejected and concluded that there was significant association between intensity of helminths infection among children that received vitamin A supplement ($\chi 2 = 28.51266$, df =3, 5.9914 p< 0.05).

Table 4: Association between Vitamin A Supplement with Helminths Infection among children under five years in the study area.

VitaminA Supplement	Number Examined	Number Positive	Helminths (%) Prevalence
Received vitamin A	230	49	12.3
Not received vitamin A	168	78	19.6
Total	**398**	**127**	**31.9**

($\chi^2 = 28.20541$, df=1, 3.8414, p> 0.05)

Table 5: Relationship Between Intensity of Malaria among Children Under 5 years

Vitamin A	No. examined	Malaria			
		Single (+) Infection	Double (++) Infection	Single (+) Infection (%)	Double (++) Infection (%)
Received V.A.	230	140	28	35.2	7.04
Not Received V. A.	168	70	42	17.6	10.6
Total	**398**	**210**	**70**	**52.8**	**17.6**

(χ^2 Cal = 17.1974, P-value = 0.000, χ^2 tab (df = 1) = 5.9914)

Table 6: Relationship Between Intensity of Helminths among Children Under 5 years

Vitamin A	no. examined	Malaria			
		Single (+)Infection	Double (++) Infection	Single (+) Infection (%)	Double (++) Infection (%)
Received V.A.	230	35	14	8.8	3.5
Not Received V. A.	168	52	26	13.1	6.5
Total	**398**	**87**	**40**	**21.9**	**10.0**

(χ^2 Cal = 28.51266, P-value = 0.000, χ^2 tab (df = 2) = 5.9914)

DISCUSSION

Prevalence of Malaria and Helminths Infection among Children under 5 years

The overall prevalence rate of infection with malaria parasite in the present study was higher than that of the study done in Malawi by Zgambo (2017). This could be due to the difference in malaria control and prevention programs implemented. It might also be due to geographical variation. For intestinal helminths it was also observed that some of the children were positive, this could be as a result of poor hygienic practice. There is co-infection of malaria and intestinal helminth. Similar study was conducted by Lemaitre (2014) which reported that helminths infection favours protection because it reduces the Plasmodium parasite density. This high rate of infection could be as a result of their exposure to the vector in their environment. A report by Mwangi *et al.* (2016) coincide with the present study that infection with helminths increases susceptibility to malaria infection. Nacher (2008) disagree with the present findings that individuals infected by helminth infections are more likely to develop clinical Plasmodium falciparum malaria than helminth free individuals. A study carry out in Geneva, Switzerland by WHO, (2017) also disagree with the present study, the distribution patterns of malaria parasites (Plasmodium spp.) and helminths agree, making malaria-intestinal parasite co-infections very common occurrences in most malaria endemic countries. Brooker (2017) in Magu District, North-Western Tanzania, also reported that Ascaris lumbricoides infection was found to have a positive association with malaria infection and malaria parasite density. In relation to age, children ages 0-13 months had the higher prevalence of malaria infection. This result is in agreement with that of Oduro *et al.,* (2022) this could possibly be attributed to an inconsistent or inappropriate use of the nets or perhaps a child may exposed to mosquito bites during other times of the day or evening when the net was not in use. It could also be these areas are suitable for the breeding of mosquitoes around their homes while children aged 44-59 months had the lower malaria infection. Also, children

aged 44-59 months had higher helminths infection, while children ages 0-13 months had lower helminths infection. The result according to gender revealed that, female children had higher malaria infection and intestinal helminths, while male children had lower malaria infection and intestinal helminths. This study disagrees with the finding conducted in Ethopia by Ayele (2012) the distribution of malaria prevalence being almost the same for both males and females.

Vitamin A Supplement, Malaria and Helminths Infection

The result showed that children without vitamin A supplement had a higher malaria infection compared to those who received vitamin A supplement. Similar work conducted by Awor *et al.,* (2021) disagrees with the present study; vitamin A supplementation in children had no impact on malaria prevention and mortality. And coincide with the work of Shankar (2017) vitamin A supplement decrease the severity of malaria infection in children ages 6 months to 5 years, thus there is significant association in rate of infection.

The result of the study showed that children who received vitamin A supplement had lower intestinal helminths compared to those without vitamin A supplement. The present study agrees with that of Beaton *et al.* (2017) vitamin A supplement have beneficial effects on infant mortality and overall infectious disease and morbidity. This could be as result of vitamin A supplement have a distinct effects on the innate and adaptive responses that are important in protection against parasite infection, thus there is significant association between helminths infection and children that received vitamin A supplement.

Vitamin A Supplement, Intensity of Malaria and Helminths Infection among the Participants.

The result of the study showed that children that received vitamin A supplement had moderate intensity of malaria, compare to those without vitamin A supplement who had mild intensity of malaria. The present study

agrees with the work of Naus *et al* (2015) which shows a negative association between malaria parasite intensity. Thus there is no significant association between intensity of malaria infection among children that received vitamin A supplement. This might be the children are yet to develop immunity against the parasite.

From the result of this study it showed that children without vitamin A supplement are more prone to intestinal helminths than those that received vitamin A supplement, thus there is association between intestinal helminths and vitamin A supplement. Low intensity of intestinal helminths parasite have been identified in the study area this might be the environment is not suitable for harboring the parasites or because of constant deworming of the children.

Conclusion

Vitamin A supplementation was associated with lower prevalence of malaria and helminth infections among children under 5 years in this Nigerian setting. The findings support the potential protective role of vitamin A against these infections and underscore the importance of supplementation programs targeting young children in endemic areas. Further research is needed to elucidate the mechanisms of protection and optimal supplementation strategies.

Recommendations

The results of this study suggest that the following recommendations be made in other to improve the intake of vitamin A supplement among children under five. Regularly immunization of the children was averagely low in the study area. Intensified efforts should be made in Michika Local Government area in orientating mothers/caregivers on the need for regular vitamin A supplementation intake so that the status of most children can be improved.

The results of this study suggest that the following recommendations should be made to improve the vitamin A supplementation of their children in other to reduce malaria and helminths infection.

1. There is need for creating awareness among mother/caregiver on the important of vitamin A supplement for children aged 0-59 months.
2. There is need for government to supply vitamin A supplement promptly to all the primary health care facilities across the state.
3. Survey should be made by primary health care provider at interval so that government will know the vitamin A supplement status of the children and how to plan for improvement.
4. Free insecticide treated bed nets (ITNs/) should be made available to mothers/caregiver and teach them how to use it so that infection with malaria could be controlled among children.
5. There is public health education campaign for mothers/caregiver and health care provider should create awareness that may lead to reduction of vectors of malaria infection and control of the disease especially in young children
6. World Health Organization should also be strict to vitamin A supplementation administration as that of malaria.

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