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Prevalence and Risk Factors Associated with Malaria Infection among Patients Attending Selected Health Facilities in Hong, Adamawa State

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ABSTRACT
Malaria remains a major public health concern, having historically claimed the lives of millions, especially among children under five and pregnant women. It is a potentially fatal illness caused by parasites, transmitted to humans through the bites of infected female *Anopheles* mosquitoes.This research focuses on the prevalence of malaria among patients attending key health institutions in Hong (Federal Medical Center Hong, General Hospital and Honorable Hassan Burguma Maternity and Clinic Hong) through a community-based cross-sectional approach. The study randomly selected 300 individuals across three facilities: Federal Medical Center Hong, General Hospital Hong, and Honorable Hassan. Direct microscopy was employed in this study using parasitological standard procedures. The study utilized structured questionnaires to obtain information from participants.The study showed that 208 subjects were positive for Malaria Infection out of 300 sample, overall malaria prevalence of 69.33% recorded during this study. Prevalence of Malaria Infection was highly significant ($p<0.05$) observation have shown that the prevalence is very high, which implies that study area is high-risk of malaria Infection, it could be attributed to sleeping not under insecticide treated net (ITN), proximal to breeding site of mosquitoes (≤/km), Malaria infection concerning age, the age 21-30 years have the highest prevalence (16%) while range age 71 and above have the lowest prevalence (1.67%)..

Keywords:
Malaria,
Infection,
Health,
Mosquitoes.

INTRODUCTION

Malaria remains a major health concern in the tropics, especially in sub-saharan Africa, despite significant improvement in malaria control and management in recent decade (Hamid, 2024). Children under five years old and pregnant women remain especially vulnerable to malaria, which has historically contributed to millions of deaths globally (Adjei *et al*., 2022; Berhe *et al*., 2023). Malaria global public health burden with an estimated 229 million cases reported worldwide 2019, about 94% of the reported cases were recorded in Africa (Fikadu and Ashenati, 2023).

The word “malaria” derives from the Italian mala aria or “bad air” Tropical medical Bureau, (TMB, 2023). The organisms that cause human malaria are protozoans of the genus plasmodium, family *plasmodiidae*, (order *Haemosporidida, clasHaemosporide, phylumsporozoa*). They are obligate intracellular parasites such as *Plasmodium (p) falciparum*, causessevere type of malaria, *P. vivax*causes benign tertian malaria, *P. malariae*, causing quartan malaria, and *P.ovale* (Neal, 2024). *P. falciparum* is considered the most pathogenic of all and it is the most prevalent in Africa (WHO, 2017). It is both preventable and curable. Malaria, unlike contagious diseases such as the common cold or flu, is not transmitted directly between people. Instead, it is spread through the bites of infected female Anopheles mosquitoes. If diagnosis and treatment are delayed, malaria can become life-threatening. Plasmodium falciparum and Plasmodium vivax are among the most dangerous malaria parasites, transmitted by approximately 40 of the over 400 species within the Anopheles genus (Kaithamanakallam *et al*., 2025). In 2020, Nigeria accounted for the highest number of malaria cases (27%) and deaths (37%) worldwide (Chimezie, 2020), as reported in the 2021 World Malaria Report.

Nigeria bore the largest malaria burden in West Africa in 2020, making up 55.2% of cases. From 2017 and 2020, the case rate rose by 5.3%, increasing from 298 to 314 per 1,000 people at risk.Deaths increased 4.7% from 0.92 to 0.97 per 1000 of the population at risk

during that same period (WHO, 2021). While progress has been made in understanding malaria, gaps in research persist. The findings of this research are expected to offer valuable data on malaria prevalence in Hong, Adamawa State, which can guide health authorities in formulating targeted interventions and policies.

MATERIALS AND METHODS

Study Area

Hong LGA is located between latitudes 10^0 00' 00" N and 10^0 35' 00" N and longitudes 12^0 35' 00" E and 13^0 20' 00" E. It has a total land area 2,419.11 km2 is one of the 21 Local Government Areas of Adamawa State created in 1987 during the defunct Gongola State. The Hong local government area, situated in Adamawa state, is home to its main administrative center, Hong town, which is the largest settlement and falls under the third-order core urban settlement category. The local government area is divided into seven districts: hong, dugwaba, pella, kulinyi, hildi, gaya, and uba (local government area, 2016). The geographical information of the study area is depicted in figures 1 and 2 (Joshua *et al.*, 2017). Hong local government area witness two major seasons which are dry and the rainy seasons, it has an average temperature of 32 degrees centigrade while the average wind speeds in the area is 11km/h. the total recorded rainfall in Hong L.G.A is at an annual average of 800mm (Manpower, Nigeria, 2023). According to a 2022 projection, Hong has a population of 260,900 spread across an area of 2588 km², resulting in a population density of 100.81 people per km². Occupations of the Hong residents are farmers, civil servants and traders. The common crops cultivated in this area incudes groundnuts, maize, rice and vegetables. Their major sources of drinking water are boreholes, well and sachet water.

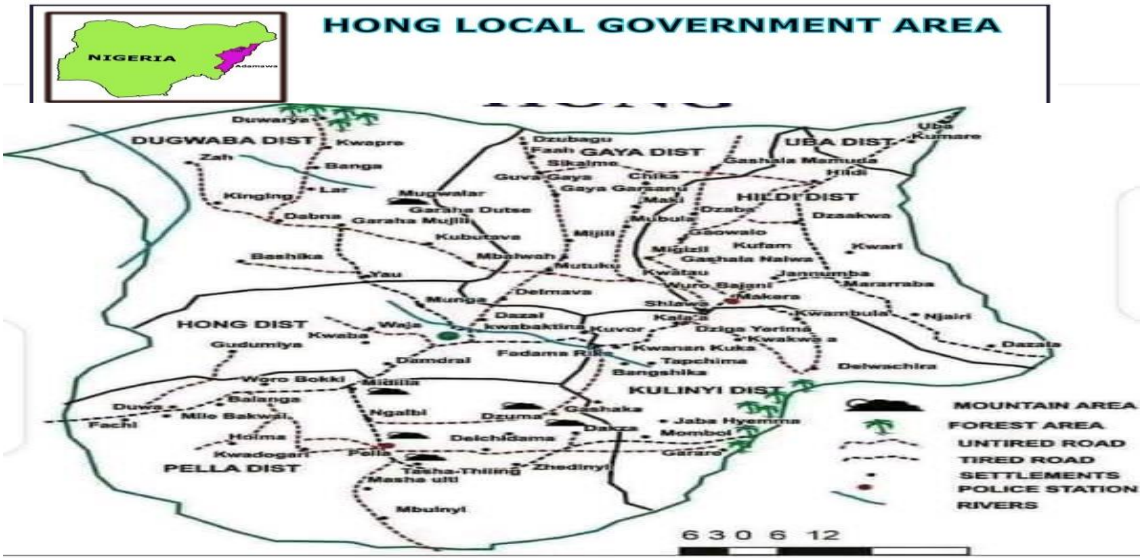

Figure 1. Map of Hong L.G.A Showing Study Area

Sample Size

The sample size was determined by using the formula for cross-sectional studies as described by Araoye, 2013.

$$N = \frac{Z^2PQ}{D^2} \quad (1)$$

where;

$N = DesiredSamplesize$

$Z = standardnormaldeviationat$ 95% $confidencelevelusuallysetat$ 1.96

$P = prevalencerate$ 55% by previous studies, of 300 participants examined, a total of 165(55%) were found positive of *plasmodium falciparum* with mean (S.D) parasite density of 1814.70 parasite/µL of blood. (Oluwaseun, 2021).

$D = is\ the\ allowable\ error\ which\ taken\ as$ 5%, $Q = 1 - p$

The sample size was computed using a previous malaria parasite prevalence of 55% (Oluwaseun A. 2021) at a confidence interval (Cl) of 95 percent and 5 percent margin of error following the formula of Oluwaseun, 2013 for calculating sample size. This give rise to total of 300 subjects that was recruited for this study.

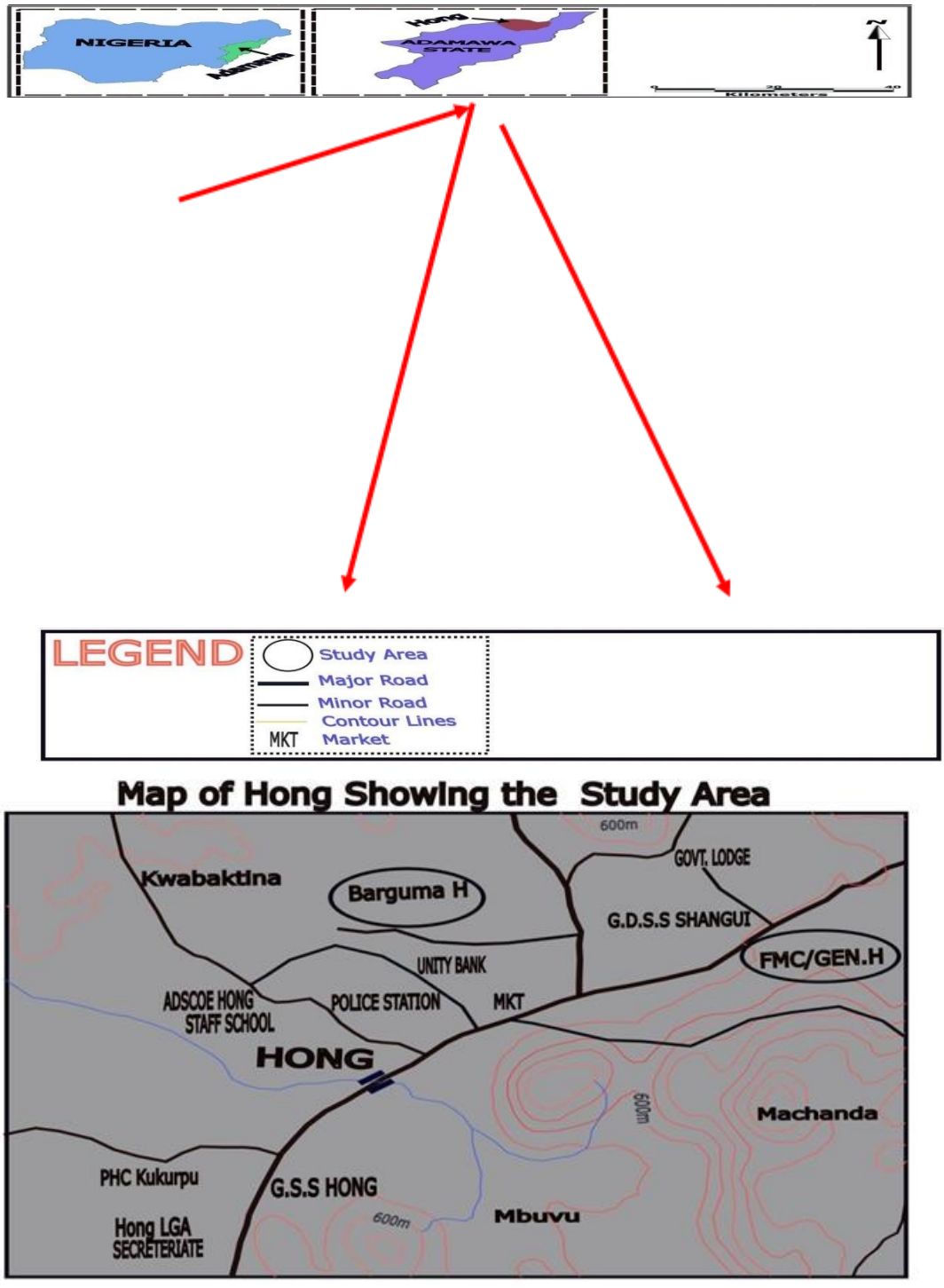

Figure 2. Map of Hong Local Government showing study Hospitals

Ethical Clearance

Introductory letter was obtained from the department of Zoology, Modibbo Adama University Yola and the letter and was taken to the State Ministry of Health, Yola. The introductory letter was taken to Chief Medical Director (CMD) Federal Medical Center Hong, Principal Medical Officer (PMO) General Hospital Hong, and Medical Doctor in charge (MDC) of Honorable Hassan Barguma Maternity Clinic Hong, and inform them prior to the commencement of the proposed study and also to sought for their permission. Ethical clearance with protocol number ADHREC.01/11/2023, Approval Number: ADHREC.07/11/2023/094 and the reference

number S/MOH/1131/1 was obtained from the Adamawa state ministry of Health Yola.

Sample Collection

With the assistance of a trained laboratory technologist, 3 mL blood samples were obtained intravenously from each participant. The collected blood was then transferred into ethylenediaminetetraacetic acid tubes to prevent coagulation. 300 structured questionnaires were administered to all participants to collect their data such as: Age, Sex, Educational level, Use of Insecticides Treated Net (ITN), proximity to breathing side for mosquitoes within $\leq$ 1km of the participant home. Those who were literate fill the questionnaires by them self's while does who could not write were assisted by trained interviewers to fill the questionnaires for them with confidential assurance and were retrieved instantly.

Laboratory Test Procedure

thick smear

A drop of blood was obtained from the EDTA container containing blood by using micro pipette and a drop of blood were dropped on a clean grease free slide. It was then spread to make a thick smear by using a spreader. The thick films were allowing to air dry. (Chesbrought, 2006).

Staining procedure

3& Giemsa Stain of PH 7.0 was poured on each blood smear and was allowed to stand for 20-40 minutes on a staining rack (Chesbrought, 2006).

The stains were then washed from the blood film by using buffered distilled water and the slide were allowed to air dry. (Chesbrought, 2006).

Examination of Blood Films for Malaria Parasites

a. Recognition of a malaria Parasites

Malaria parasites exhibit a characteristic staining pattern with Giemsa stain in both thick and thin blood films. Accurate identification of the parasite's distinct features, particularly in thin blood films, is essential for diagnosis (Sinha & Gupta, 2023).Malaria parasites develop through many stages, however, in all stages the same parts of the parasites will stain the same color. Chromatin part of the parasite nucleus is usually round in shape and stained deep red. The cytoplasm can appear in different shapes, such as rings or irregular forms, and it always stains blue (Cheesbrough, 2006).

Examining the Thick Film

The examination of each blood film was done in a systematic way as follows: X100 objectives (with oil immersion) was used, start looking form the edge of the middle of the film, examine the blood film, following the pattern of movement show one by one field systematically, combine the examination for 100 good fields to determine whether the blood film is positive or negative for malaria, if doubtful diagnosis, more fields should be examine, or a second smear requested, at the end of the examination, record the result on the label request form and in the record book. (SMRU, 2002). During this study microscopic examination under oil immersion x100 objective was used as described by cheesbrough (1998) and the number of asexual malaria parasite found on the slide was counting per 200 leucocytes WHO, (2000).

Data Analysis

The data was generated on prevalence and was analyzed using Statistical Package for Social Sciences (SPSS) version 22.0 window versions. The statistical significance of variables was estimated using chi-square test.

RESULTS AND DISCUSSION

The overall prevalence of malaria infection among patients attending health facilities in Hong was 208 (69.3%) with the breakdown of 15.7%, 21.0% and 32.7% for Federal Medical Center Hong, General Hospital Hong and Hon. Hassan Barguma maternity and clinic respectively (Table 1); the malaria infection is highly prevalence in this study area since P 0.05 among the 300 subject tested for malaria.

Prevalence of malaria infections in relation to age: Age 21-30 has the highest prevalence, 48(16. 0%), while Age 71-80 has the lowest prevalence, 5(1.7%), in terms of gender, female gender has the highest prevalence, 130(43.3%), while male is 78(26.0%). In terms of use of insecticide-treated nets (ITN) those that are not using insecticide net has the highest prevalence 62(20.7%), while those that are sleeping in insecticide treated net has the lowest prevalence 5(1.7%) (Table 3). These shows that there is a prevalence of malaria Infection among patients attending medical facilities in relation to Age in Hong, Adamawa State since $p < 0.05$, there is no prevalence of malaria Infection among patients attending medical facilities in relation to gender (sex) in Hong, Adamawa State since $p > 0.05$, Out of the 208 (69.3), that was tested positive of Malaria parasites, 130 (43.3%), were female while 78 (26.00), were male, shows that there is insignificantly or slightly prevalence.

Table 1: Prevalence malaria of infection among patient attending selected health facilities in Hong

S/N	Medical facilities	No.examine	No. positive (%)	Prevalence (%)
1.	Federal Medical Center	87	47(54.0)	15.7
2.	General hospital	87	63(72.0)	21.0
3.	Hon. Hassan Bagurma Maternity Clinic	126	98(77.8)	32.7
4.	Total	300	208(69.3)	69.3

x^2 = 14,21P = 0. 0008

Table 2: Proximity to Breeding Site of Mosquitoes (Risk Factors Associated with Malaria Infection Among Patients Infected with Malaria Parasite Attending Selected Health Facilities in Hong)

Variables	Yes	Percentage
Proximity To Breeding Site of Mosquitoes (≤ 1km)		
Farming Activities	224	74.67
Close to bushes, rivers, streams, ponds, lakes	135	45.00
Living in a clean environment	70	23.33

In terms of malaria prevalence rate relation to use of insecticide treated nets results in Hong, Adamawa State, shows that there is no prevalence since p > 0.05 (p=2.66) Among the 300 subjects, 234 (78%) acquired Insecticide Treated Net (ITN), of which 146 out of 234 were tested positive of malaria parasite.

The prevalence of malaria infection in relation with the educational level in the study area indicates that those that don't have formal education has the highest prevalence 139(46.3%), while those that have tertiary education has the lowest prevalence, 9(3.0%), (Table 4). These shows that educational level determine the prevalence of malaria infection among the subject in the study area, hence educational level is one among the risk factors associated with prevalence of malaria infection in Hong town Adamawa State. (Study area).

Table 3: Prevalence of Malaria Infection in Relation to Age, Gender and Used of Insecticide Treated Nets (ITNs) Among the Patients Attending Selected Health Facilities in Hong

Variables	No. Examine	No. Infected (%)	P. value
Age Range			
1-10	43	36 (12.0)	0.02
11-20	47	33 (11.0)	
21-30	72	48 (16.0)	
31-40	61	42 (14.0)	
41-50	32	23 (7.7)	
51-60	24	11 (3.7)	
61-70	11	10 (3.4)	

71-80	8	5 (1.7)	
81-90	2	0 (0.0)	
Grand Total	300	208 (69.3)	
Gender Female	184	130 (43.4)	0.53
Male	116	78 (26.0)	
Grand Total	300	208 (69.3)	
Use of Insecticide Treated Nets (ITN) No	66	62 (20.7)	2.66
Sleeping in ITN always	45	5 (1.7)	
Sleeping, not always, in ITN	88	50 (16.7)	
Sleeping during heat, whether outside, not in ITN	101	91 (30.3)	
Total	300	208 (69.3)	

***X*² =17.9, 0.39, 117.50** **P= 0.02, 0.53, 2.66**

Table 4: Prevalence of Malaria Infection in relation with Education Level of Patients Attending selected health Facilities in Hong

Variables	No. examine	No. infected	Prevalence (%)
Education No Formal Education	152	139	46.3
Primary Education	88	41	13.7
Secondary Education	40	19	6.3
Tertiary Education	20	9	3.0
Total	300	208	69.3

***X*²** = 70.90 P = 2.73 E-15

Discussion

The result of this study is strong evidence that malaria is still highly prevalent in Hong since P = 0.008, this implies that P < 0.05. The high Incidence of 69.33% of blood is an indication that Hong is a high-risk area for Malaria infection. Meanwhile, in Yola south, Adamawa State, Nigeria the prevalence of malaria is 27.07% (134 out of 495) as of 2021, (Napthali, 2021), which is lower than the prevalence in Hong, may be because the proximity to breeding side to mosquitoes is ≤ 1km is more in Hong than in Yola-South. This Malaria Infection prevalent rate in this study is higher than that observed by Eke and his colleagues in North Central Nigeria with prevalent rate 69.19% (Eke *et al.*, 2018).

These findings align with previous studies conducted in Nigeria and other malaria-endemic regions (Oluwaseun, 2021; Azene, 2022). As presented in

Table 3, 43.3% (184 out of 300) of those who tested positive for malaria were women, while 26.0% (78 out of 300) were men. A Chi-square test was conducted, yielding $\chi^2 = 0.39$ and $p = 0.53$, indicating that the observed difference in prevalence between genders was not statistically significant. However, the results suggest that malaria infection appears slightly more prevalent among females than males in Hong, Adamawa State. This agrees with the study in Dutse General Hospital Jigawa State, Nigeria, female had higher malaria prevalence rate of 52.8% than male with the prevalence rate of 48.9% (Jennifer, 2016). The age group 21-30 was the highest with prevalence of 16.00%, followed by age group 41-50 of 14.00%, while the least was 71-80 age group of 1.67% (Table 3).

The highest infection transmission rate recorded among the age range of 21-30 years old, this is similar the work of Munaka and Opoku-Okrah, (2013) and might be a reflection of the risk taking behavior of adolescents and young adults who are also less likely pay much attention to malaria control practices such as sleeping under insecticide treated nets, wearing of protecting sleeping wear. Therefore, this implies that the higher age the lower the prevalence of malaria infection in Hong. Generally based on this research study there is a prevalence of malaria Infection among patients attending selected health facilities in relation to age in Hong, Adamawa state since $p < 0.05$. These agree with the research study by Nnamonu, (2020) in South-East Nigeria that the malaria prevalence rate was

16.7%,26.7%,29.9% abd 42.2% in children ≤5 years, 5 to ≤10 years, 10 to ≤15 years and 1517 years respectively.

Among the 300 participants, 234 (78%) had obtained insecticide-treated nets (itns), but only 45 (19.2%) reported consistently using them for sleeping. Among these, only 5 (1.67%) tested positive for malaria. Another 88 (37.6%) occasionally used the nets, with 50 (16.7%) testing positive. While 101 (43.2%) of the participants chose to sleep outdoors during hot weather without using nets, 91 (30.3%) of them tested positive for malaria. Furthermore, 66 (22%) had not acquired itns at all, with 62 (20.7%) testing positive for malaria.. By using $\boldsymbol{X^2} =$ 117.50, p = 2.67 E-25.

Based on this research study, not acquired Insecticide Treated Nets (ITN), sleeping not always in ITN, and sleeping during heat weather outside not in ITN, increased the prevalent rate of malaria infection in Hong. Therefore, there is prevalence of malaria infection among patient attending selected health facilities in relation to use of Insecticide Treated Net (ITN) results in Hong, Adamawa State, Nigeria since $p < 0.05$, these agree with the report of World Health

Organization (WHO), that 'the population of Adamawa State in 2021 who slept under ITN the night before the Survey is 67.5%'. WHO (2022), Adamawa state conducted its most recent round of Insecticide Treated Net (ITN) through a mass campaign in 2020, since 2009 over 6.6 million ITN have been distributed through mass distribution. The proportion of those who slept under ITNs the night before the survey increased from 31.6% in 2015 to 67.5% in 2021, WHO (2021). Insecticide Treated Net (ITN) represents a powerful means for controlling malaria in Africa because the mosquito vectors feed primarily indoors at night Nicodem, (2010).

In this research study, Table 4 shows that in this study it has been observed that there is there is no significant association of prevalence of malaria infection with education of the patients attending selected health facilities in Hong, Adamawa state since p =2.73 E-15. The 300 tested, non-formal education was 152 (50.7%) tested out of it were 139 (46.3%) tested positive, while primary education 88(29.3%) out of it were 41(13.7%) tested positive of malaria parasite while secondary education had total number of samples tested were 40(13.3%) out of it were 19(6.3 %) tested positive of malaria parasite and lastly tertiary education were 20(6.7%) out of it 9 (3.0 %) were tested positive with malaria parasite. This implies that the higher your educational level in Hong, Adamawa State, Nigeria the lower the prevalence of malaria Infection, that means that there is significant association of prevalence of malaria Infection with education level among the patient attending selected health facilities in Hong Adamawa State, since $p < 0.05$. Educational level is one among the risk factors that increases incidence rate of malaria infection in the study area. The relationship between educational level and malaria infection observed in this study is consistent with existing literature. According to Ochiese (2016), malaria affected 54.2% of illiterates, 53.8% of those with primary education, 44.0% of secondary school graduates, and 60.0% of those with post-secondary qualifications.

The current findings corroborate these patterns, demonstrating similar educational disparities in malaria susceptibility. Benjamin (2017) reinforced this trend by reporting higher incident rates among individuals with primary education versus those with tertiary qualifications. Tadesse (2022) provided additional evidence, showing malaria incidence rate of 12.9% among illiterates compared to 8.3% among literate populations, suggesting that educational differences influence knowledge and implementation of preventive measures.

CONCLUSION

Malaria continues to be a significant public health issue in Nigeria, particularly in the hong local government area of Adamawa State. Despite the implementation of control measures at both national and local levels, the

disease continues to affect a substantial portion of the population, negatively affecting their health and productivity.

The overall prevalence of malaria infection among patients attending health facilities in Hong was 208 (69.3%) could be attributed to many factors such as environmental conditions (e.G., stagnant water, rainfall patterns), low use of insecticide-treated nets (itns), limited access to prompt diagnosis and treatment, socioeconomic challenges and health infrastructure limitations. This chapter has given you a basic understanding of the study, explaining the background, problem, objectives, questions, importance, and boundaries of the research. Recognizing the widespread occurrence of malaria in hong is essential for making well-informed choices, efficiently distributing healthcare resources, and implementing focused interventions. The subsequent chapters will delve into the literature review, research methodology, data analysis, and findings that will shed light on the current malaria situation in the area and provide evidence-based recommendations for its control.

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