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PREVALENCE OF MALARIA PARASITE AMONG PEOPLE RESIDING ALONG HADEJIA RIVER VALLEY, JIGAWA STATE, NIGERIA

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ABSTRACT

A study was conducted to determine the prevalence of malaria parasite among four communities residing along Hadejia River Valley, Jigawa State, Nigeria. A total of 447 blood samples was collected from people residing in four communities (Yamidi, Akubishin, Shawara and Dukkun villages) were examined for the presence or absence of malaria parasite using thick and thin blood smear for malaria parasite examination. respective prevalence of malaria parasite in study communities were 71.3%, 77.1%, 17.5% and 25.4% respectively. Prevalence of malaria parasite was higher among people with younger age than people with older age group in the study area. There was no statistical difference ($p>0.05$) in the prevalence of malaria parasite based on age (p value = 0.0033). Prevalence of malaria parasite was found to be higher in males than females in the study area. There was statistical relationship ($p<0.05$) in the prevalence of malaria parasite based on sex (p value = 0.5866). Higher prevalence of malaria parasite was (31.0%) among farmers while fishermen have least prevalence (10.0%). There was statistical relationship ($p<0.05$) in the prevalence of malaria parasite based on occupation (p value = 0.2449). Haematological parameters observed with malaria parasite based on age, sex and occupation showed mild anaemia.

Keywords: Malaria, Parasite, Residing, Urinary, Valley

INTRODUCTION

Malaria parasite is the most common protozoan parasitic disease in the tropical and sub tropical regions of the world (Davidson, 2000). It was once thought that the disease came from fetid marshes and hence the name malaria (Olomese *et al*. 1999). It has also been found out in 1880 by Charles Laveron a French army surgeon that has disease is caused by four different species; *Plasmodium falciparum(P. falciparum*), *Plasmodium ovale (P. ovale)*, *Plasmodium vivax (P. vivax) and Plasmodium malariae (P. malariae)* (Nonstrand, 1978), of those four different pathogenic species pathogenic to man, *P. falciparum* and *P vivax* infections are the commonest cause of death among children in endemic areas and is often causes complication of cerebral malaria (Bawa *et al*., 2014; WHO, 2016).

Three species within *Anopheles gambiae* together with *Anopheles funestus*, are principal vectors species that feed more opportunistically on both humans and livestock, such as *Anopheles arabiensis* are generally less efficient malaria vectors but can still be primary vector species in a given region (Sinka *et al*., 2012). These differences in ecology and behavior among vector species also lead to important differences in the effective vector control interventions. There are many factors that lead to site variation in the abundance and temporal dynamic of malaria vectors population that lead to differences in the risk of malaria parasite transmission among different sites (Imbahale *et al.*, 2012).

The clinical manifestation of malaria varies with geography, epidemiology, immunity and age (Tinashe *et al.*, 2018). Understanding complex pathogenesis of malaria requires exploring mechanisms of parasite inversion and host immune response. Symptoms of malaria includes: severe headache, nausea, vomiting, chills and typical fever cycles. The severe manifestation often leads to clinically cerebral malaria, pulmonary oedema, acute kidney injury, hypoglycemia, lactic acidosis, anaemia and liver involvement. Severe malaria often occurs in individual not previously exposed to malaria such as young children and travelers from non endemic areas. The control of vector-borne diseases such as malaria represents one of the global public health challenges of the twenty first century. There remains a gap in most setting in the use of those prevention methods (Olusegun-joseph *et al*., 2016). Most of the effort to control malaria has focused on the development of vector control strategies, which targeted high risk group such as pregnant women and young children (Tinashe *et al*., 2018)). Even in the modern world with effective anti malarial and Insecticide-Treated bed Nets (ITNs), people remain at risk and the number of malaria cases, particularly resulting from *P. falciparum* that causes the most serious infection (Cbulskis *et al*., 2016). The main aim of the study is to assess prevalence of malaria parasite of the subjects in the study area and its relationship with some haematological profile.

MATERIALS AND METHODS

Study Area

Hadejia Local Government is located in the north eastern part of Jigawa State. It lies between 9^0 37' E and 10^0 35' E Longitude and 13^0 02' N Latitude. The climate of the region is wet and dry type, rainfall spread between June and September with mean Annual rainfall of 315mm. The soil in the study area is sandy in nature except in Fadama area that has clay-loam soil. River Hadejia (Plate 1) provides water for irrigation and fish production (Abubakar *et al*., 2017). People in the area are farmers that grow both rain fed and irrigated crops, some are animal breeders and businessmen (Gambo *et al*., 2020).

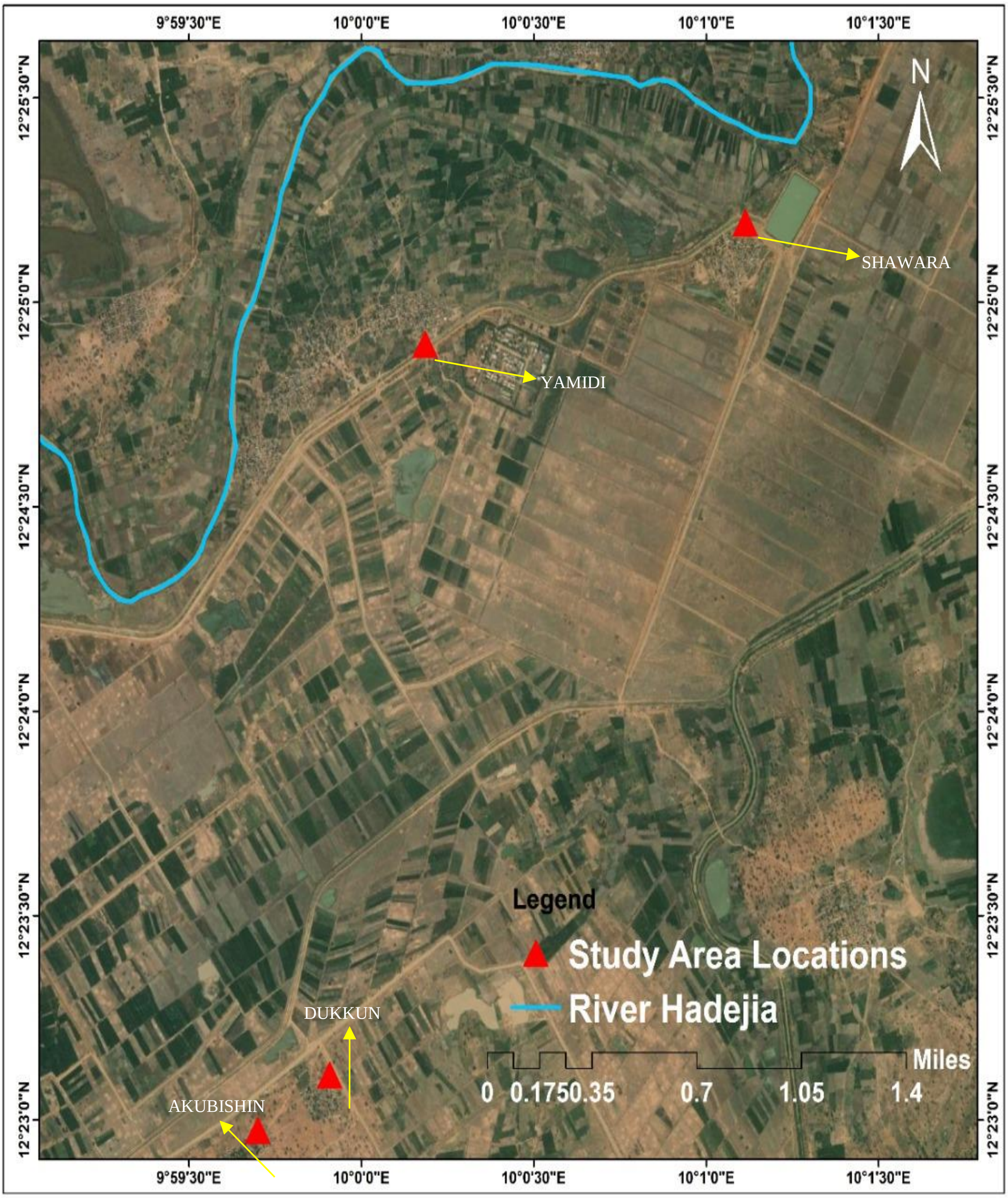

Figure 1: Showing study area location (Source using GPRS)

Ethical Considerations

The study was conducted with strict compliance to ethical review committee of the Ministry of Health Jigawa State, Nigeria (MOH/PH/RAT/MN/23/001). Informed consent was sought from the study participants who are adequately informed of the nature and importance of the study prior to the specimen collection.

Study Population

A total of 447 subjects were screened for the presence or absence of malaria parasite in both the selected villages. The subjects are both young and adult of both sexes; the purpose of study was explained to the subjects in order to obtain their consent. The subjects were asked to provide blood sample to determine presence or absence of malaria parasite (Cheesbrough, 2014).Blood samples were collected a long with personal data that consist of name, sex, address and occupation.

Administering Questionnaires

In all four hundred and forty seven (447) questionnaires were administered to the subjects from whom sample of blood were collected. The questionnaires contain person data that consist of name, age, sex, address and occupation. The blood sample containers were labeled in accordance with the number of questionnaires.

Blood Sample Collection

Blood sample was collected aseptically from the subjects until the required sample size was achieved. A total of 4 ml venous blood sample was collected using sterilized vacutainer needle/holder dispensed into Ethylene Di-amine Tetra Acetic Acid (EDTA) bottle and mixed properly to avoid blood clot for malaria parasite diagnosis, Parked Cell Volume and Haemoglobin Concentration (Salisu *et al*., 2020).

Examination of Blood for Malaria Parasite

Thick and thin blood smear was made on the different slide and were directly stain with Giemsa for 30 minutes and malaria parasite was observed under microscope. The blood film was stained with Leishmans stain for 30 minutes. Stained film was rinsed with running water from tap for 10 seconds and then allowed to dry. The slides were examined under light microscope (×100 oil immersion objective lens) (Cheesbrough, 2014).

Haemoglobin Estimation (Sahli Method)

Haemoglobin concentration was estimated using Sahli Method (Salisu *et al*., 2020).

Determination of Packed Cell Volume

Packed Cell Volume measures the percentage volume of blood that is occupied by the red cells. The value is called Packed Cell Volume (PCV) and blood from the EDTA container was allowed to enter heparinised capillary tube, until the tube was filled to about three quarter. The end of capillary tube that is free of blood was sealed with placticine. The sealed tube was centrifuged for 15 minutes at 300 rpm, after which the values were read directly using microhaematocrit reader (Cheesebrough, 2014; Salisu *et al*., 2020).

Red Blood Cells Count

Red Blood Cell count was made using Neubauer's chamber (haematocytometer) (Cheesebrough, 2014; Salisu *et al*., 2020).

Data Analysis

Data was analyzed statistically using Statistical Package for Social Sciences (SPSS) software at 95% confidence level with significant p value ≤ 0.05. Chi-square(X^2) test was used to determine the degree of association between prevalence of the infection, age, sex and occupation.

RESULTS AND DISCUSSION

A total of 447 subjects were screened for the presence or absence of malaria parasite in both the selected villages. Out of this number 333 were males and 114 were females. The subjects are both young and adult.

Table 1 summarized prevalence of malaria parasite based on age in the study area. Prevalence of the infection was found to be higher among people with younger age group than people with older age group in the study area. There was no statistical difference (p>0.0) in the prevalence of malaria parasite based on age.

Table 2 summarized prevalence of malaria parasite based on sex in the study area. Prevalence of malaria parasite was found to be higher among males than females in all the four villages of the study area. There was statistical relationship (p<0.05) in the prevalence of malaria parasite based on sex.

Prevalence of malaria parasite based on occupation in the study area shows malaria parasite was higher among farmers followed by people with other occupation and least was fishermen that recorded lower prevalence in the study area. There was statistical relationship (p<0.05) in the prevalence of malaria base on occupation.

Table 1: Prevalence of Malaria Parasite Based on Age in the Study Area

	Urinary Schistosomiasis											
	Yam			**Aku**			**Sha**			**Duk**		
Age Range (Yrs)	**NE**	**NI**	**PR (%)**	**NE**	**NI**	**PR (%)**	**NE**	**NI**	**PR (%)**	**NE**	**NI**	**PR (%)**
05-15	22	20	12.5	14	16	11.4	13	5	6.3	8	6	9.0
16- 25	32	26	16.3	30	24	17.2	16	4	5.0	14	5	7.4
26-35	22	16	10.0	26	16	11.4	9	2	2.5	12	2	3.0
36-45	38	22	13.7	28	16	11.4	18	2	2.5	15	2	3.0
46-55	24	20	12.5	24	22	15.7	12	Nil	Nil	9	Nil	Nil
56-Above	22	10	6.3	18	14	10.0	12	1	1.2	9	2	3.0
P value = 0.0033												
Total	**160**	**114**	**71.3**	**140**	**108**	**77.1**	**80**	**14**	**17.5**	**67**	**17**	**25.4**

Key: Yam = Yamidi Village, Aku. = Akubishin Village, Sha = Shawara Village, Duk = Dukkun Village, Yrs = Years, NE = Number Examined, NI = Number Infected, PR = Prevalence, (%) = Values in Parenthesis are Percentage; there was no Statistical Difference (p>0.05) in the Prevalence of Malaria Parasite Based on Age.

Table 2: Prevalence of Malaria Parasite Based on Sex and Occupation in the Study Area

Variable	Urinary Schistosomiasis											
	Yam			Aku			Sha			Duk		
	NE	NI	PR (%)	NE	NI	PR (%)	NE	NI	PR (%)	NE	NI	PR (%)
Sex												
Male	112	82	51.3	112	84	60.0	56	12	15.0	53	13	19.4
Female	48	32	20.0	28	24	17.1	24	2	2.5	14	4	6.0
P value = 0.5866												
Total	**160**	**114**	**71.3**	**140**	**108**	**77.1**	**80**	**14**	**17.6**	**67**	**17**	**25.4**
Occupation												
Farming	74	50	31.3	96	68	48.6	50	10	12.5	52	12	17.9
Fishing	20	16	10.0	6	6	4.3	8	3	3.8	2	1	1.5
Others	66	48	30.0	38	34	24.2	22	1	1.3	13	4	6.0
P value = 0.2449												
Total	**160**	**114**	**71.3**	**140**	**108**	**77.1**	**80**	**14**	**17.6**	**67**	**17**	**25.4**

Key: Yam = Yamidi Village, Aku. = Akubishin Village, Sha = Shawara Village, Duk = Dukkun Village, Yrs = Years, NE = Number Examined, NI = Number Infected, PR = Prevalence, (%) = Values in Parenthesis are Percentage, Others = Other Occupation (Traders, Civil servants, Students, Housewives); there was Statistical Difference ($p<0.05$) in the Prevalence of Malaria Parasite Based on Sex and Occupation.

Table 3 shows haematological status variation with malaria parasite based on age in the study area. Haematological values were found to be higher among people with older age group than people with younger age group. Haematological parameters with respect to malaria parasite based on age were found to show mild anaemia in all the four villages of the study area. There was statistical difference ($p<0.05$) in the haematological parameters with malaria based on age.

Table 4 shows haematological status variation with malaria parasite based on sex in the study area. Haematological parameters were found to be higher in males than females in all the four villages. There was statistical difference ($p<0.05$) in the haematological parameters with malaria based on sex.

Haematological status variation with malaria parasite based on occupation shows higher haematological values among farmers and fishermen than people with other occupation that show least prevalence in most of the villages of the study area. Generally mild anaemia exists among all occupational groups. There was statistical difference ($p<0.05$) in the haematological parameters with malaria based on occupation.

Table 3: Haematological Parameters with Co-infection of Urinary Schistosomiasis and Malaria Parasite Based on Age in the Study Area

Age Range (Yrs)	Malaria Parasite											
	Yam			Aku			Sha			Duk		
	mHb (g/%)	mPCV (%)	mRBC (m/mm^3)	mHb (g/%)	mPCV (%)	mRBC (m/mm^3)	mHb (g/%)	mPCV (%)	mRBC (m/mm^3)	mHb (g/%)	mPCV (%)	mRBC (m/mm^3)
05-15	11.8	33.7	4.0	12.7	38.1	3.4	11.9	35.4	3.7	12.6	33.4	3.5
16- 25	11.6	31.3	3.7	14.1	42.3	4.5	12.0	36.2	3.2	14.3	43.2	4.1
26-35	13.2	39.5	3.9	13.4	40.1	4.1	14.1	38.4	3.9	13.4	40.8	3.9
36-45	13.6	40.8	4.5	13.0	39.1	4.0	14.3	42.9	3.9	14.0	41.8	4.1
46-55	13.1	39.4	3.9	13.4	40.1	4.2	13.4	40.6	3.8	13.3	40.1	3.7
56-Above	13.2	39.7	4.2	13.0	38.9	4.4	12.7	38.3	3.4	14.0	42.8	3.8
Pvalue = 0.3092												
Total	**12.8**	**38.4**	**4.0**	**13.2**	**39.6**	**4.1**	**13.1**	**38.6**	**3.7**	**13.6**	**40.4**	**3.9**

Key: Yam = Yamidi Village, Aku = Akubishin Village, Sha = Shawara Village, Duk = Dukkun Village, Yrs = Years, NE = Number Examined, NI = Number Infected, mHb = Mean Haemoglobin Concentration, mPCV = Mean Packed Cell Volume, mRBC = Mean Red Blood Cell Count, (%) = Values in Parenthesis are percentage, g/% = gram percent, m/mm^3 = Million Cells per Cubic Millimeter, there was Statistical difference ($p<0.05$) in the Haematological Parameters with Malaria Parasite Based on Age.

Table 4: Haematological Parameters with Co-infection of Urinary Schistosomiasis and Malaria Parasite Based on Sex and Occupation in the Study Area

	Malaria Parasite											
	Yam			**Aku**			**Sha**			**Duk**		
Variable	**mHb (g/%)**	**mPCV(%)**	**mRBC (m/mm^3)**	**mHb (g/%)**	**mPCV (%)**	**mRBC (m/mm^3)**	**mHb (g/%)**	**mPCV (%)**	**mRBC (m/mm^3)**	**mHb (g/%)**	**mPCV (%)**	**mRBC (m/mm^3)**
Sex												
Male	14.2	42.7	4.0	14.1	42.3	4.2	14.6	39.7	3.9	14.6	41.5	4.4
Female	11.3	34.0	3.9	12.2	36.6	3.9	11.5	35.0	3.4	12.5	39.3	3.4
P value = 0.9745												
Total	**12.8**	**38.4**	**4.0**	**13.2**	**39.7**	**4.1**	**13.1**	**38.6**	**3.7**	**13.6**	**40.4**	**3.9**
Occupation												
Farming	13.1	39.4	3.9	13.5	40.6	4.3	12.5	37.1	3.8	15.7	42.3	4.0
Fishing	15.5	46.5	4.2	13.2	39.7	4.0	14.5	43.4	4.0	12.3	38.7	3.9
Others	9.8	29.4	3.8	12.9	38.8	3.9	12.3	35.4	3.3	12.8	40.7	3.9
P value = 0.9578												
Total	**12.8**	**38.4**	**4.0**	**13.2**	**39.7**	**4.1**	**13.1**	**38.6**	**3.7**	**13.6**	**40.4**	**3.9**

Key: Yam = Yamidi Village, Aku = Akubishin Village, Sha = Shawara Village, Duk = Dukkun Village, Yrs = Years, NE = Number Examined, NI = Number Infected, mHb = Mean Haemoglobin Concentration, mPCV = Mean Packed Cell Volume, mRBC = Mean Red Blood Cell Count, (%) = Values in Parenthesis are percentage, Others = Other Occupation (Traders, Civil servants, Students, Housewives), g/% = gram percent, m/mm^3 = Million Cells per Cubic Millimeter; there was Statistical Difference ($p<0.05$) in the Haematological Parameters with Malaria Parasite Based on Sex and Occupation.

Discussion

Prevalence of malaria parasite in Yamidi, Akubishin, Shawara and Dukkun village was 71.3%, 77.1%, 17.5% and 25.4% respectively. The study reported high prevalence of malaria parasite in the study area. This shows the disease was of great public significance in the study area. From the results obtained in the present study higher prevalence of malaria parasite was in Yamidi (71.3%) and Akubishin (77.5%). This is because Yamidi village is closer to the river Hadejia and also closer to the irrigation scheme that provide availability of surface water that provide breeding place for mosquitoes vectors. This is in agreement with Oladele *et al.* (2018) who described factors that spread the disease like proximity to stagnant bodies of water and exposure of public to surface water. But Akubishin village that is far from the river but was surrounded by the irrigation scheme that further provide breeding site for mosquitoes, where people living in Shawara and Dukkun villages have moderate prevalence of 17.5% and 25.4%. Even though Shawara is closer to the river site but irrigation scheme is far from the village and surface water used to drain easily to the river thus reduced mosquitoes breeding site. This assertion was in conformity with work of Ukwubile *et al*. (2018) that determined prevalence of malaria parasite in Takum Local Government Area of Taraba State, Nigeria, reported people in the area drain water in to gutters denying mosquitoes breeding site. But Dukkun village was found to be far from the river thus it has reduced mosquitoes breeding sites.

The prevalence reported in Yamidi and Akubishin villages was found to be similar to the report of Ezenwaka. (2018) that determined prevalence of malaria infection among students attending Federal University Otuoke Health Center, Bayelsa State, Nigeria that reported 80% prevalence. The prevalence reported in Shawara and Dukkun villages was similar to the work of Rachael *et al.* (2015) that determined malaria parasite in Kisumu country, Kenya that reported 28.1% prevalence. The prevalence reported in Yamidi and Akubishin villages was found to be higher than the report of Ocheje and Dogara (2016) that determined prevalence of malaria infection among patient attending Dutse General Hospital, Jigawa State, Nigeria reported 51% prevalence, but this report was higher than the values reported in the present study in Shawara and Dukkun village. Similarly the prevalence report of Yamidi and Akubishin villages was higher than the report of Salwa *et al.* (2016) in assessment of Malaria among Hausa communities in Kano State that reported 60.6% prevalence. This report was also higher than the present report in Shawara and Dukkun villages. The variation in overall prevalence in different studies may be attributed to different climatic conditions, rainfall and surface water availability that serve as mosquito breeding sites (Salwa *et al.*, 2016; Oladele *et al*., 2018).

Prevalence of malaria parasite based on age in the present study was found to be higher among people with younger age group (05 – 15 years and 16 – 25 years) than people with older age group (26 years and above) in most of the villages. This finding was found to be similar to previous literatures: Peter *et al*. (2019) that determined prevalence of *P. falciparum* among Nigerians in Abuja that reported lower prevalence of 57.4% among people with lower age group (< 20 years) while higher prevalence of 78.9% was reported among people with older age group (51 years and above). Ezenwaka (2018) that determined prevalence of malaria infection among students Attending Federal University Otuoke Heath Center, Bayelsa State, Nigeria reported 100% prevalence among students aged 16 – 20 years than students with older age group that recorded less prevalence. The studies conducted by Rachael *et al.* (2015) reported that risk of malaria attacks declines with age between childhood and adulthood, this is because protective immunity acquired with increasing age up to adulthood. The work in the present study was contrary to the work of Oladele (2018) who reported increase in prevalence with increase in age (58.4% for ages 21 – 30, 76.9% for ages 31 – 40, 64.3% for ages 41 – 50 and 75% for ages 51 – 60). Hence the variations in parasites density observed among aged groups may be linked to the level of immunity that fluctuate with age and life style of individual (Ogomaka, 2020). Other finding suggests that other environmental factors are responsible for the change in breeding and transmission pattern of *P. falciparum* infection detection (Anon, 2010; Umaru and Uyaiabasi, 2015).

Prevalence of malaria parasite based on sex during dry season was found to be higher in males than females in the study area. Males are usually more exposed to malaria parasite due to their life style (staying outdoors late in the evening) that most of their females counterparts (Ogomaka, 2020). Males also exposed their body during hot weather and predominantly sleep outside insecticide treated bed net. This increase the chance of mosquito bites (Ezenwaka, 2018). Females usually do not stay naked and tend to stay indoor doing household activities thus reducing their contact with malaria parasite vector (Ezugba-Nwobi *et al*., 2011). There could also be possibility of the body of males to produce more chemical attractant to mosquito. Human body release heat and various compounds such as carbon dioxide, ammonia, lactic acid and carboxylic acid. Some of those compounds have largely synergetic effect on attractiveness (Ezenwaka, 2018).

The prevalence retrieved according to gender in the present study was in agreement with the work of Peter *et al.* (2019) that determined prevalence of *P. falciparum* among Nigerians in Abuja who reported higher prevalence in males (54.4%) than females (47.1%). Similarly the prevalence was in concordance with the work of Ogomaka (2020) that reported higher prevalence in males (90.7%) than females (69.4%). The work in the present study disagrees with previous studies. The work of Shu'aibu *et al.* (2017) that determined Prevalence of *P. falciparum* in Gwaram Local Government Area, Jigawa State, Nigeria, reported higher prevalence in males 61.4% than females 51.7%. The work in the present study also disagrees with the work of Ukwubile *et al.* (2018) that reported higher prevalence in females 71.4% than males 49.1%.

Prevalence of malaria parasite based on occupation during dry season was found to be higher among farmers and people with other occupation and least prevalence was recorded among fishermen. The socio-economic status played a role in the observed prevalence depending on the occupation (Onah and Omudu, 2016). The prevalence observed in relation to occupation was found to be in line with the work of Pam *et al*. (2018) that reported malaria parasite among patient in Mangu Local Government Area, Plateau State, Nigeria, reported highest prevalence rate among farmers with 45.2%. The work in the present study was similar to the work of Peter *et al.* (2019) that reported higher prevalence among civil servant 60% and students 58.3% (people with other occupation).

Anaemia was categorized for both males and females as Hb value < 11.0 g/% (WHO, 2011). Anaemia classification was further categorized as follows (Hb – 10.9 g/%) was mild, (Hb 7 – 9.9 g/ %) was moderate and severe anaemia was (Hb < 7.0 g/%) (WHO, 2011). Anaemia in males was also defined as follows Hb value < 13 g/% or PCV value < 39 % or RBC value < 5.0 m/mm^3. But in females anaemia was defined as Hb value < 12g/% or PCV value < 36% or RBC value < 4.5m//mm^3 (WHO, 2011; Sembulingam and Sembulingam, 2012; Jonathan *et al*., 2016). The haematological values reported in the present study according to age, sex and occupation in relation to urinary schistosomiasis shows mild anaemia, which is in line with values reported by (WHO, 2011; Sembulingam and Sembulingam, 2012; Jonathan *et al*., 2016) as shown in the result.

Haematological parameters based on age during dry season shows people aged 05 – 15 years, 16 – 25 years have developed lower haematological values than adult. Mild anaemia was observed. Recall that in the present study people with younger aged a group have higher malaria prevalence rate than people with older age group. Malaria anaemia is multifactorial disease for which complex aetiological basis is only partially defined. Malaria anaemia is one of the clinical presentations. This is caused by lyses of infected and uninfected red blood cells (Irene *et al*. 2016). Observation from this finding is comparable to the finding of Irene *et al.* (2016) that reported 62% anaemia prevalence among children 1 – 5 years, followed by children 11 – 14 years having moderate to severe anaemia due to malaria. Parasitic infections are the leading cause of anaemia in the tropics and subtropics, particularly malaria infection in younger children and pregnant women (Keptcheu *et al.,* 2020). *Plasmodium falciparum* infected children had lower haemoglobin concentration compared with children not infected (Ruth *et al.,* 2018). The older people without anaemia might be because they have developed immunity and live without problem (Keptcheu *et al.* (2020). Prevalence of anaemia also coincide with the work of Safari, Humphrey, David, Stella, Godfrey, Coleman *et al.* (2017) that work on schistosomiasis co-infection with malaria and haemoglobin level reported higher prevalence of anaemia among children with malaria infection than those with *S. mansoni* infection.

Haematological status variation with malaria based on sex in dry season shows higher haematological values in males than females in all the villages. Results show mild anaemia that is higher among females than males. The mild anaemia reported in the present study may probably be due to low malaria prevalence in the study area, coupled with the fact that most of the subjects are healthy not necessarily sick as supported (Sakwe *et al*., 2021). The high anaemia reported in females than males in the current study may be because females of reproductive age group had higher chance of being anaemic (Shankar *et al*., 2022). The work in the present study was found to be contrary to the work of Sakwe *et al.* (2019) in a work conducted in the North region of Cameroon that reported higher anaemia in males 21.3% than females 20.0%.

Haematological status variation with malaria based on occupation during dry season also shows mild level of anaemia among farmers and fishermen and people with other occupation. This work was supported by the work of Keptcheu *et al.* (2020) that reported 33.3% of anaemia due to malaria parasite among fishermen and 23.1% and 23.1% among farmers and civil servant recording least prevalence of 20.0%.

CONCLUSION

Malaria parasite was still a disease of great public significance in the study area. Results revealed a high prevalence of malaria among the inhabitants. Environmental factors help in breeding of the mosquito vectors as observed in the study area. There is a need to enhance health education programmes by environmental health workers and civic societies among local inhabitants about the potential risk of surface water availability within residential area. Distribution of Insecticide Treated Net to household should be made annually in malaria risk areas for all household members.

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