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Epidemiology of Malaria in Nise Community, Awka South Local Government Area, Anambra State, Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. Author IN designed the study, performed the statistical analysis, managed the analyses of the study and literature searches, wrote the protocol and wrote the first draft of the manuscript. Author PI supervised the work, author CN contributed financially towards the publication, while author CU managed the arrangement of references. All authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

Purpose: To investigate the prevalence of malaria in the area with reference to location, sex and age; mosquito vectors and the *Plasmodium specie* responsible for the transmission of malaria in the area, as well as the reliability of two diagnostic methods: rapid diagnostic test (RDT) and microscopy for determining malaria parasitemia.
Materials and Methods: The study design was a community-based descriptive, quantitative, cross-sectional household survey, while the data collected were statistically analyzed using chi-square (x^2) test. Three hundred (300) individuals (124 males and 176 females) were examined for malaria parasitaemia using standard parasitological and haematological procedures.
Results: Overall prevalence of malaria parasitaemia was 28.33%, but prevalence varied with location, sex and age. Prevalence of malaria parasitaemia was higher in Isiakpu (33.82%) and lowest in Umuazu (24.44%), but was not statistically significant (X^2 =0.665; P>0.05). Prevalence of malaria parasitaemia was significantly higher in females (34.09%) than in males (20.16%) (X^2 =

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0.008; P<0.05). Prevalence of malaria parasitaemia was 43.33% in 41-50 years and 15.79% in 21-30 years age group. Difference in prevalence among the age groups was not significant (X^2 = 0.181, P>0.05). Prevalence of malaria was significantly higher with microscopy (28.33%) than in RDT (12.67%) (X^2 = 0.000, P<0.05). Microscopy method was more reliable than RDT as revealed in this study. *Plasmodium falciparum* was the only species of *Plasmodium* identified in the study area, while *Anopheles gambiae sensu lato* (12 species collected) was the commonest mosquito species identified as responsible for transmission of malaria in the community. Other non-malaria vectors encountered during mosquito sampling include: *Aedes aegypti* (1) and *Culex quinquefasciatus* (15)
Conclusions: Study revealed that Nise is mesoendemic for malaria. Use of Long Lasting Insecticidal Treated Nets (LLITNs), campaign on Indoor Residual Spraying (IRS) by the government, at least every two years to reduce the vector population, as well as the Use of Artemisinin Combination Therapies (ACTs) as the first drug of choice should be sustained.

Keywords: Malaria; epidemology; nise community.

1. INTRODUCTION

Malaria caused by protozoan parasites of the genus *Plasmodium*, remains the most infectious parasitic disease of humans that infects and kills higher percentage of people than any other single infectious disease [1]. In 2012, malaria caused an estimated 207 million clinical episodes, and 627,000 deaths; an estimate of 91% deaths in 2010 were in the African region, while 86% were children under 5yrs of age [2]. In Nigeria, malaria is holoendemic and it is one of the reasons of the high mortality rate in children [3,4]. Four species of *Plasmodium* known to cause malaria are *Plasmodium falciparum*, *Plasmodium vivax*, *Plasmodium ovale* and *Plasmodium malariae* [5,6,7]. These parasites contribute to majority of human sufferings in malaria endemic regions of the world [8,9]. Among these malaria parasites, *P. falciparum* is the most predominant species accounting for about 98% of malaria cases in Nigeria [10]. *Plasmodium falciparum* malaria is often characterized by fever which may be acute, often times intermittent or continuous; the fever is sometimes followed by shivering and sweating [10]. Malaria parasites are spread from one person to another through the bites of haematophagus anthropophilic female adults of mosquitoes belonging to the insect genus *Anopheles* [10]. Hence, adult female *Anopheles* mosquitoes are said to be the carriers of malaria parasites. In Nigeria, *Anopheles gambiae* is the main vector of malaria, though *Anopheles funestus* and *Anopheles arabiensis* are also commonly encountered [10]. Malaria infection is largely distributed throughout warmer regions of the world especially in the tropics and subtropics where the vectors of malaria are found in large numbers [11]. Prevalence is linked to high breeding rates of vectors and high transmission rates occurring throughout the year especially in the rainy season [8,12,13].

Malaria prevalence in tropical and subtropical regions is attributed to rainfall, consistent high temperatures and humidity, thus providing the vectors with the environment needed for their continuous breeding [14]. Different researchers have carried out a lot of studies on the prevalence of malaria in different parts of the world including Africa. A prevalence of 11.5% was equally recorded by using RDT in a hilly forest area of Bangladesh, while a prevalence of 62.7% was recorded by microscopy in South Western Nigeria. In South Eastern Nigeria, 27.8% prevalence was recorded in children aged 6-59 months, while a prevalence of 59.80% and 59.30% was obtained for wet season in Udi, Enugu State and for children aged 0-5 years in Awka, Anambra State [13,15,16,17,18].

Nise community is one of the communities in the rain forest belt of Eastern Nigerian where malaria is endemic. Literature is replete with information on malaria prevalence in surrounding communities [18,19,20], but there is apparent dearth of information on malaria transmission and prevalence in Nise community. This study was designed to determine the malaria prevalence, parasite species composition in Nise community, reliability of the diagnostic tools: RDT and Microscopy in malaria diagnosis, as well as mosquito species responsible for malaria parasites transmission in Nise community.

2. MATERIALS AND METHODS

2.1 Study Area

The research work was carried out in Nise community. Nise community is one of the nine communities that make up Awka South Local

Government Area (L.G.A) in Anambra State. The town is bounded by six towns namely: Nibo and Amawbia (in the north), Agulu and Mbaukwu (in the south), Nibo (in the east), Enugwu-ukwu, and Agukwu Nri (in the west). It has four villages, namely: Isiakpu, Arah, Ngodo and Umuazu. It is located on latitudes 6° 9′ 0″ N and longitudes 7° 4′ 0″ E, and it is 114m above sea level [21]. It experiences two distinct seasons- a wet season which begins in April and ends in October or early November, and a dry season which lasts from November to March. The rainfall peaks between July and September. Nise is a community with fertile land, and as such, its inhabitants are predominantly peasant farmers (known mainly for cultivation of maize and vegetables) and petty traders, few civil servants, owners of small-scale enterprises, as well as students. Some of the houses in the community were characterized by presence of uncovered water drums, tanks, as well as dilapidated pit toilet; while some of the windows and doors were screened with mosquito insecticidal nets. Water for domestic use comes mainly from boreholes scattered across the four villages.

2.2 Study Design

The study design was a community-based descriptive, quantitative, cross-sectional household survey which was conducted between September 2015 and May 2016 in four villages of the community.

2.3 Sampling Population

Nise has a total population of 15,120 (NPC mock census 2016, unpublished report). The study population comprised males and females of different age brackets in the four villages from which blood samples were taken for malaria parasites examination.

2.4 Sampling Size

Sixty (60) individuals were randomly selected after the church service from SS Peter and Paul Ara (27) and St. Felix Catholic Church Ngodo (33) respectively, while two hundred and forty (240) individuals were randomly selected from the community Health Centre.

2.5 Collection of Blood Samples

One milli litre (1ml) of blood sample was randomly collected by a laboratory scientist (Research assistant), from the indigenes of the community who volunteered to be tested at the church premises after the church service, and from patients attending the Primary Health Care Centre at Nise maternity by venipuncture, using a 2ml syringe. A tourniquet was tied around the upper arm to increase blood pressure in the veins, according to [22]. A total of 300 individuals comprising 124 males and 176 females from the four villages that make up Nise community were sampled.

2.6 Malaria Diagnosis

Two methods were used on each blood sample collected: RDT 38(12.67%) and microscopy 85(28.33%).

2.6.1 Malaria diagnosis using RDT

Five microlitre (5μl) of whole blood of each sample was collected using a micro pipette, and added into the "S" well of the CareStart™ Malaria HRP2 (Pf) RDT kit manufactured by ACCESSBIO (CAT NO: G0141, MFD JAN 2015, EXP JUN 2017) Inc. USA.

This was followed by the addition of 3 drops of 60μl assay buffer solution and timed for 20 minutes, according to the manufacturer instructions. The test was regarded invalid when the line in the "C" area did not appear. The presence of only one line in the "C" area indicated a negative result, while the presence of two colour bands (i.e. one band in the "C" and another band in the "T") indicated a positive result for *P. falciparum.*

2.6.2 Microscopy method for malaria diagnosis

Thick and thin blood films were prepared using standard laboratory procedures and examined using oil immersion (x100) objective according to [23]. Thin films were used for the species identification of *Plasmodium* parasites using the species specific characteristics of human *Plasmodium* species as listed by [24].

2.7 Collection and Identification of Adult Mosquitoes

Adult mosquitoes for this work were collected between May 30th and 31st, 2016 using two methods: Pyrethrum Spray Catch and CDC Light Trapping respectively in and around selected homes.

2.8 House Selection Exercise

Twenty-four houses (six per village) were used for the survey. The houses were purposively selected from the four villages of the community,

based on the following criteria prescribed by the National Arbovirus and Vectors Research Centre Enugu, Nigeria: consent of the house owner, house must be in a well secured environment, it should be a poorly to fairly constructed and inadequately ventilated house (because they usually contain the largest numbers of mosquitoes), it may be situated on the fringe of a village or near known breeding sites of mosquito (as this often yields more day-resting mosquitoes), proximity to water body (particularly for light trap collection) and must have been inhabited the previous night. The house selection was done in collaboration with the personnel from the National Arbovirus and Vectors Research Centre Enugu. A Global Positioning System (G.P.S) device with an accuracy of 4m was used to obtain the co-ordinates and the elevation of each of the houses we entered and recorded on the recording forms, where the occupants gave us their consent from the four villages for the sampling exercise.

2.9 Pyrethrum Spray Catch (PSC)

Pyrethrum spray catch was carried out in a total of 20 houses; 5 houses from each of the four villages in Nise community (i.e. Isiakpu, Ara, Ngodo and Umuazu). Precautions were taken to ensure the safety and comfort of members of the selected households such as: staying outdoors by the members of the household during the spraying process to avoid inhalation of the chemical, removal of any food items (including drinking water) available to avoid the toxic chemicals contaminating them thereby leading to food poisoning, spraying the house at dawn (6am) when the household members must have woken up from sleep. These households thus selected were maintained all through the study period. Collection of indoor resting mosquitoes commenced from 6 am. White sheets were laid on the entire floor and over the furniture within the selected rooms of each house. White sheets facilitate visibility of the knocked down mosquitoes. The doors and windows of the houses were shut, and then the rooms sprayed with standard insecticide formulations. In houses that were not properly sealed (has open eaves), spraying started outside around the eaves with insecticide to prevent the mosquitoes inside the rooms from escaping, as another collector sprayed the roofs and the walls inside the house. After the spraying exercise, the rooms remained closed for 10-15 minutes. After this period, the white sheets were removed from the room of the house and the knocked down mosquitoes were collected with forceps into a prepared Petri dish (lined with a moistened filter paper) designated for each room.

2.10 Light Trap

Four houses were selected in all for this method (one house each per village), based on the number of persons living in the house, their level of acceptability, participation and security of the team. Two structures were visited per day and was maintained throughout the study. Centre for Disease Control (CDC) light trapping was carried out indoors and outdoors all through the night to evaluate the vector behaviour, feeding time and location. Light traps were hung a meter off the ground. They were positioned XCFat the leg side of the bed (i.e. the posterior end), while the human bait sleeping was protected with an insecticide treated net (ITN). This was done in the room. The traps were switched on at 1800hrs (6 pm in the evening) and switched off at 0600hrs (6 am the next morning), after which the mosquitoes were then collected [25]. Mosquitoes collected were transferred into netted collection cups. The cups were properly labeled in accordance with location and collection points. The data collected were recorded in the predesigned data collection sheet.

2.11 Identification of Mosquitoes

The mosquitoes collected with the CDC light trapping and PSC were identified morphologically in the Laboratory of National Arbovirus and Vectors Research Centre Enugu, using the taxonomic keys of [26].

2.12 Data Analysis

The data collected were statistically analyzed using chi-square (X^2) test to determine the difference in terms of prevalence between location, age and sex, as well as to determine the reliability between RDT and microscopy tools. The statistical package used for the data analysis was SPSS version 22 and excel spreadsheet (version 2013). Significant difference was declared at 5%.

3. RESULTS

3.1 Prevalence of Malaria in Nise

Prevalence of malaria parasitaemia in the sampled population is shown in Table 1. Out of

the 300 persons examined for malaria parasitaemia using microscopy, 85 (28.33%) were positive for *P.falciparum*. Twenty five (20.16%) out of 124 males examined and 60 (34.09%) out of 176 females examined were positive for malaria parasitaemia. Chi-square test showed that there was significant difference in prevalence among males and females (X^2 =0.008, P< 0.05).Malaria parasitaemia was present in all the villages in Nise community as shown in Table 2. However, prevalence varied from one village to another. Isiakpu village had the highest prevalence of 33.82%, followed by Ngodo village (28.42%), Ara village (26.08%) and Umuazu village (24.44%), though there was no significant difference (X^2 =0.665, P>0.05). Malaria parasitaemia was also present in all the age groups as shown in Table 3, but the prevalence varied from one age group to another. The 41-50 years age group had the highest prevalence of 43.33% while 21-30 years age group had the least prevalence of 15.79%. Also, females of 41-50 years recorded the highest prevalence of 54.17% while males of 41-50 and 51-60 years had the least prevalence of 0% each. Chi-square test showed the difference in prevalence to be insignificant (X^2 = 0.181, P>0.05).

3.2 Distribution of *Plasmodium* Species among the Inhabitants of Nise Community

The distribution of the *Plasmodium* species in the sampled population is shown in Table 4. *Plasmodium falciparum* was identified in 85 (100%) out of the 85 positive cases, thus making it the only cause of malaria parasitaemia in the population. No positive cases of *P. ovale, P. malariae* and *P.vivax* were recorded in the sampled population.

3.3 Efficiency of the Commonly Used Rapid Diagnostic Test (RDT) Kits and Microscopy as Instruments for Determining Malaria Parasitaemia

Fig. 1. Shows the efficiency of the commonly used RDT tools and microscopy as instruments for determining malaria parasitaemia. Out of the 300 persons examined, 85 (28.33%) persons recorded a positive result with microscopy, while 38 (12.67%) persons recorded a positive result with RDT tools. Chi-square test showed the reliability between the two instruments (microscopy and RDT) to be significant (X^2 = 0.000, P<0.05).Fig. 2 shows the number of *Anopheles* mosquitoes collected from the four villages of Nise community using CDC light trap for outdoor collection method. In Umuazu and Ngodo villages, *Anopheles gambiae sensu lato* was recorded as 2 and 1 respectively, while none was recorded for Isiakpu and Ara respectively using this method. Using CDC light trap indoor collection method, no *Anopheles gambiae sensu lato* was recorded across the four villages. Fig. 3 shows the number of *Anopheles* mosquitoes found across the four villages of the community using Pyrethrum Spray Catch (PSC) method. Ngodo village recorded the highest number of *A. gambiae sensu lato* (5 mosquitoes), followed by Ara and Isiakpu villages with 2 mosquitoes each, while none was found in Umuazu village.

3.4 Other Non-Malaria Disease Vectors Encountered In the Study Area

Apart from *A. gambiae sensu lato* found in this study, other non-malaria vectors were also encountered in the study area. They include: *Culex quinquefasciatus* with a total number of 15 (26.79%) individuals, as well as *Aedes aegypti* which recorded only one (1.79%) individual.

4. DISCUSSION

4.1 Malaria Prevalence

The prevalence of 28.33% for malaria parasitaemia using microscopy recorded in this study indicates that Nise community is mesoendemic for malaria. This is according to the World Health Organization (WHO) classification of malaria prevalence from spleen rate surveys, where mesoendemicity has values between 11-50% [27]. The outcome of this study correlates with the mesoendemicity status obtained respectively for pregnant women in Onitsha (48.5% and 47.5%), blood donors in NAUTH Nnewi (46%), hostel residents in NAU Awka (38.93%), pregnant women in Katsina metropolis (36.5%), Sokoto (27.29%) and Mulleba District of Tanzania (26.3%) [28,29,30,20,31,32,33].

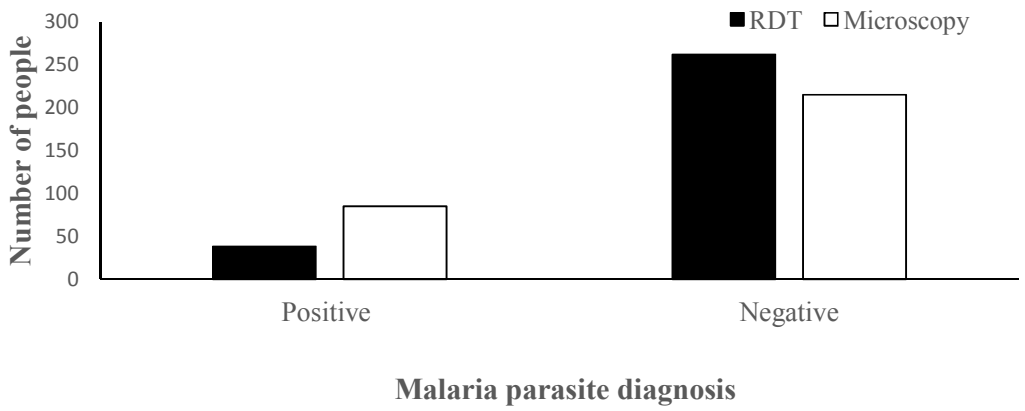

Fig. 1. The reliability or the efficiency of the commonly used RDT kits and microscopy as instruments for determining malaria parasitaemia

Fig. 2. The number of *Anopheles* mosquitoes collected from the four villages using CDC light trap outdoor method

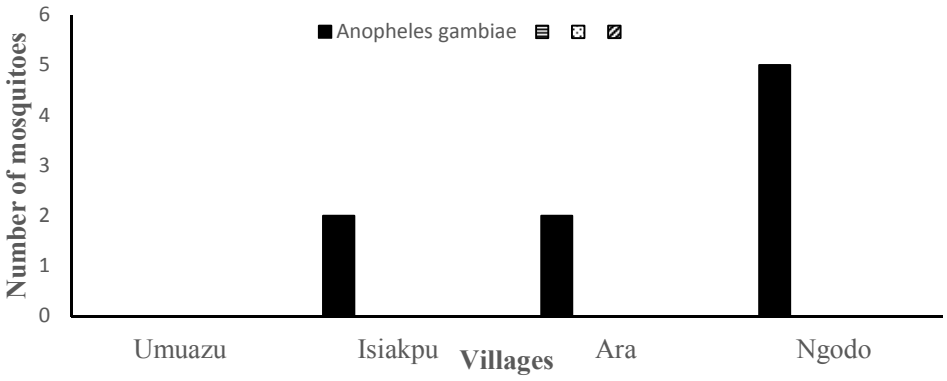

Fig. 3. The number of *Anopheles* mosquitoes collected across the four villages using PSC method

Table 1. Prevalence of malaria parasitaemia among inhabitants of nise community by gender

	Microscopy		RDT	
Gender	**No examined**	**No infected**	**No examined**	**No infected**
Male	124	25(20.16%)	124	13(10.48%)
Female	176	60(34.09%)	176	25(14.20%)
Total	300	85(28.33%)	300	38(12.67%)

(X2 = 0.008, P<0.05)

Table 2. Prevalence of malaria parasitaemia among inhabitants of nise community by location

	Microscopy		RDT	
Villages	**No examined**	**No infected**	**No examined**	**No infected**
Umuazu	45	11(24.44%)	45	6(13.33%)
Isiakpu	68	23(33.82%)	68	11(16.18%)
Ngodo	95	27(28.42%)	95	12(12.63%)
Ara	92	24(26.08%)	92	9(9.78%)
Total	300	85(28.33%)	300	38(12.67%)

(X2 =0.665, P>0.05)

A higher prevalence rate of 93.43% was reported in Odoakpu Onitsha, 93.3% prevalence of malaria parasitemia was equally reported in Aba, 83.3% in Lagos State University, 80.5% in Ota, 76% in Azia, 64% among NAU students and 58% in Onitsha North [22,34,35,36,19,37,38].

The low prevalence of malaria parasitaemia in Nise community could be attributed to the period of the study which commenced on September 2015 to May 2016, in which there was low rainfall (especially the months of November 2015 to April 2016) which could reduce breeding of the mosquito vectors responsible for the transmission of *P.falciparum* [32]. Also, the scale up interventions by the Anambra State Ministry of Health, with support from the Roll Back Malaria Partners, World Bank and the Federal Ministry of Health, which carried out an Indoor Residual Spraying (IRS) in the community in 2012 and 2014 as well as the distribution of Long Lasting Insecticide Treated Nets in the year 2014 and 2015, equally contributed to the low prevalence recorded in this study. Also, the use of long lasting Insecticidal Treated Nets (LLITNs) and Artemisinin-based Combination Therapy (ACT) as the drug of choice by the inhabitants as recommended by physicians or through self-medication may have also contributed to the low prevalence [32,33,39,40] .

In this study, malaria parasitaemia was significantly higher in females than in males. This conforms to the findings of the studies in Aba and Umuahia [34], Udi, Enugu State [13] and Lagos, Lagos State [41]. It however contrasts with the findings of some related studies in which males had higher parasitaemia in Odoakpu-Onitsha [22], Okigwe and Owerri [4] and in Awka metropolis [18]. It could be attributed to men's outdoor activities like sleeping outside at night during hot weather, self-medication, not wearing protective clothing to sleep at night even inside the house such as trousers and long sleeve shirts. The higher malaria prevalence in females as recorded in the present studies could be attributed to women's work in agriculture or their household chores like cooking the evening meal outdoors or waking up before sunrise to fetch water therefore making them more vulnerable to mosquito bite [42].

Malaria parasitaemia was present in all the villages in the community. Differences in prevalence by location were not statistically significant, inferring that malaria infection in the community was not selective for a particular village or location (Table 2). Malaria parasitaemia though present in all the age groups, was not found to be significantly different (Table 3). This means that malaria infection in the community was not selective for age. This was in line with a study carried out to determine the effects of management of malaria on haematological, biochemical and nutritional changes in children in Anambra State [43]. The results also showed that the *Plasmodium* species responsible for the prevalence in the study area was *P. falciparum,* which was the only species identified in 85 positive cases; thus, it is the commonest cause of malaria parasitaemia in the population. This agrees with related studies in Azia [19], Awka [18] and in Kastina [31], but differs from the observations of related studies in Aba and Umuahia [34], Okigwe and Owerri [4], Nnewi [30], Lagos state University [44,35]; where *P. falciparum* and *P. malariae* infections were seen.

Table 3. Prevalence of malaria parasitaemia among inhabitants of nise community by age and sex

	Male			Female				
Age (Years)	**No examined**	**No examined**	**No examined**	**No examined**	**Prevalence (%)**	**No examined**	**No infected**	**Prevalence (%)**
<10	26	11(42.31%)	16	6	37.50	10	5	50.00
10-20	20	7(35.0%)	11	3	27.27	9	4	44.44
21-30	38	6(15.79%)	15	3	20.00	23	3	13.04
31-40	38	10(26.32%)	17	1	5.88	21	9	42.86
41-50	30	13(43.33%)	6	0	0.00	24	13	54.17
51-60	23	8(34.78%)	3	0	0.00	20	8	40.00
61-above	65	18(27.69%)	25	7	28.00	40	11	27.50
TOTAL	240	73(30.41%)	93	20	21.51	147	53	36.05

(X2 = 0.181, P>0.05)

Table 4. Distribution of *Plasmodium* species among the inhabitants of Nise community

Plasmodium species	No examined	No infected with *Plasmodium* Species (%)	No infected by species	Prevalence of infection due to
P.falciparum	300	85	85	100.00
P.ovale	0	0	0	0
P.malariae	0	0	0	0
P.vivax	0	0	0	0

4.2 Reliability of Microscopy and RDT Tools

Results on the survey equally revealed the reliability or the efficiency of the commonly used kits and microscopy as instruments for determining malaria parasitaemia. It was observed that microscopy method recorded a higher positive result (28.33%) than the commonly used RDT kits, which recorded a lower positive result (12.67%). Result showed the difference between the two instruments to be significant, which means that microscopy method is more reliable for determining malaria parasitaemia than RDT kits in the study area. The result of the present study corroborates the findings of studies carried out in Ijebu-Ode [45], Osogbo [46], Kano [47] and Aviation Medical Clinic Laboratory of Murtala Mohammed Airport, Ikeja [48], where microscopy recorded higher prevalence of 66.8%, 48.4%, 38.7% and 22% compared with prevalence of 36.8%, 38.7%, 34.3%, and 9.8% respectively recorded with RDT.

However, in a similar study carried out in Nigeria [49], 59% prevalence was recorded with microscopy while RDT recorded higher values of 100% for malaria antibodies in serum and 64% for whole blood. The reason for these divergent results is not known, but further studies aimed at evaluating the reliability of the two techniques is suggested.

4.3 Malaria Vector Abundance

Results on entomology indicate the presence of endophagic/endophilic female *Anopheles* mosquito (*A. gambiae s.l),* as the primary mosquito species responsible for the transmission of malaria in Nise community). This agrees with the findings of related studies in Kenya [39], Mali [50], Kano [51], and in Awka [20], who found that the most important vector of malaria parasite in sub – Saharan Africa is *A. gambiae*. The result however differs from the observations of a related study in a highland area of Western Kenya [52], where *A. gambiaes.l* which is the most abundant vector was found alongside *A. funestus* and *A. arabiensis.* The reason for the absence of the last two *Anopheles* species in the present study area could be as a result of the duration of the sampling which lasted for two days only (i.e. May 30-31st, 2016), which may not be the biting season for *A. funestus*; non-use of Polymerase Chain Reaction (PCR) in the species identification to distinguish between *A. gambiense* and *A. arabiensis* spp. The total number of *A.gambiae s. l* collected in this study across the four villages was 12, 9 were collected through Pyrethrum Spray Catch (PSC) method, while 3 were collected through CDC light trap outdoor collection method; none was collected through indoor light trap collection method. The reasons for the few numbers may be due to the period of collection which was in the month of May and is not the peak for wet season in the study area, the duration of collection which lasted only for two days, as well as environmental conditions in the study area [20]. Abundant rainfall facilitates the breeding of the vector by providing varied breeding sites which increase its reproductive potential, thus its high presence in human population.

From the result, PSC method yielded more *Anopheles gambiae s. l* than the light trap (outdoor) method; this could be due to the fact that PSC targets mostly endophagic and endophilic anopheline mosquito species, unlike the light trapping. This result differs from the observations of a related survey in Kwale County, South Coast Kenya [25], where light traps were most effective for sampling female *A. gambiae s.l* and *A. funestus*, but agrees with the results of the studies carried out in Benin City [53], where PSC method yielded a greater proportion of blood fed *A. gambiae,* as well as that of in Awka [20], where spray sheet collection yielded 38 (18.90%) *Anopheles* species out of the 201 adult mosquitoes collected. Further studies is suggested to establish the reason (s) for the differences. Furthermore, entomologic results revealed the presence of other non – malaria vectors in the study area, such as *Aedes aegypti* which recorded one individual in Arah

village, *Culex quinquefasciatus* which had 15 individuals across the three villages of Umuazu (4 individuals), Ngodo (4 individuals) and Arah (7 individuals).These non – malaria vectors pose a great danger to the inhabitants of the community, as they serve as vectors of disease agents such as – *Culex quniquefasciatus* (*W. bancrofti,* avian malaria, arboviruses like St. Louis encephalitis virus, Western equine encephalitis virus and West Nile virus), *A. aegypti* (dengue fever, Chikungunya, Zika fever and yellow fever viruses) [54,55].

5. CONCLUSION

The findings of the present study indicate that there's a low prevalence of malaria in Nise community. The study also revealed that the commonest *Plasmodium spp.* responsible for malaria infection in the area was *P. falciparum*, while the predominant mosquito species responsible for transmitting the disease pathogen was *Anopheles gambiae sensu lato*. Microscopy method was found to be more reliable for determining malaria parasitaemia than RDT tool in the study area. The study also revealed the presence of other non-malaria vectors that can cause deadly diseases in Nise, therefore, there is an urgent need to take preventive measures to avert the possibilities of such diseases in the community. Based on the findings of this study, the following suggestions are made for the reduction/elimination of malaria prevalence, and for safeguarding the overall health of the inhabitants of Nise Community: use of Long Lasting Insecticidal Treated Nets (LLITNs) - since they have proven to be effective in controlling the vector (*A. gambiae s.l*) that transmits *P. falciparum*, sustained campaign on Indoor Residual Spraying (IRS) by the government, at least every two years to reduce the vector population, thereby reducing malaria prevalence, sustaining net replacement campaign by the stakeholders and health care providers, to ensure that those who misplaced their nets, were given a new one; and those who have collected but have not hung theirs are helped to have their nets hanged, so that the nets will be put to judicious use. Also, screening of doors, windows and other entrances into the house with mosquito nets should be encouraged, use of ACTs as the first drug of choice should be sustained and lastly use of microscopy as the standard instrument for determining malaria parasitaemia should be encouraged.

CONSENT AND ETHICAL APPROVAL

An identification letter from the Department of Zoology, Nnamdi Azikiwe University, Awka and project proposal was submitted to the Office of the Director, Medical Services, Anambra State Ministry of Health, Awka, who issued the ethical clearance to me after studying my project proposal.

Also, consent for this work was obtained from the Traditional ruler of the community, the President General of the community, the village Heads, health committee chairman of the community, individuals in whose houses the adult mosquito sampling was done across the four villages and the Parish Priests of SS Peter and Paul Ara, as well as that of St. Felix Catholic Church Nise. Oral consent was equally obtained from individuals whose blood samples were used for the study.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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