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Prevalence of malaria infection and associated risk factors in Adazi-Enu, Anambra State, Nigeria

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Abstract: **This study was carried out to determine the prevalence of malaria infection and associated risk factors in Adazi-Enu, Anaocha Local Government Area, Anambra State, Nigeria. Two hundred and two (202) individuals from five villages which make up Adazi Enu were examined from October to December, 2021 and the prevalence of malaria was determined using gold-standard microscopy. A total of 121 individuals representing 59.9% were infected. Individuals who are 11-15 years old had the highest malaria prevalence of 81.8%. Females had higher prevalence of 67.2% than males with 48.8%. Farmers had highest malaria prevalence of 79.0%. Individuals in nursery level of education had the highest malaria prevalence of 72.7%. Participants from Akwankwo village had the highest malaria prevalence of 66.7%. The prevalence of malaria in each of the above demographic variables had no significant difference statistically except for Occupation which had significant difference (P = 0.000). Individuals who properly screened their houses had the highest malaria prevalence of 64.1%. Those that use containers for water storage had the highest prevalence of 87.0%. Prevalence was highest (75.8%) for those that had vegetation around their homes and participants who rarely use LLINs had the highest prevalence of 79.2%. There is no statistical significant difference (P > 0.05) among the group of individuals in relation to malaria prevalence in each of the above factors except for 'water storage' and 'presence of vegetation' factors where the difference was statistically significant (P = 0.000). The high malaria prevalence in this study demonstrates that the disease remains a significant concern to the populations in the study area. There is immense need to prioritize educating the populace in public health campaigns to reduce misperception and increase knowledge.**

Keywords: **Malaria infection, Prevalence, Risk factors, Adazi-Enu, Anambra State.**

1. INTRODUCTION

Malaria is among the most debilitating diseases in the tropics and subtropics (Boraschi *et al.*, 2008). Malaria infection is endemic throughout much of tropical and sub-Saharan Africa and is a present major threat to public health (Boraschi *et al.*, 2008). This disease mostly occurs singly as mono-infection (Anaebonam *et al.*, 2021) Nigeria is endemic for malaria infection. It remains an enormous public health concern despite the ongoing malaria control effort implemented throughout the sub Saharan Africa (Ciubotarium *et al.*, 2020).

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Malaria is caused by a protozoan parasite *Plasmodium* species transmitted from human to human through the bite of an infected female Anopheles mosquito during blood meal. There are more than 400 species of *Anopheles* mosquito; around 30 are malaria vectors of major importance (WHO, 2021). Five *Plasmodium* species including *Plasmodium vivax, Plasmodium ovale, Plasmodium malaria, Plasmodium falciparum and Plasmodium knowlesi are known to infect man. P. knowlesi* has been reported in parts of South- Eastern Asia where it is also known to cause malaria in monkeys (Kantele and Jokiranta, 2011). *P. falciparum* and *P. vivax* are the greatest threat to man (WHO, 2021). *P. falciparum*, in 2018 accounted for 99.7% of estimated malaria cases in the WHO Africa region, 50% of cases in the WHO Southeast Asia regions, 71% of cases in the Eastern Mediterranean and 65% in the western pacific. *Plasmodium vivax* is the predominant parasite in the WHO region of the Americas, representing 75% of malaria cases (WHO, 2021).

The intensity or prevalence of malaria transmission depends on the factors related to the parasites which are the vector factors, human host factors and the environmental factors (WHO, 2021). The vector factors include the vectors' feeding habit, its life span and habitat. The human host factors include; presence of vegeation, availability of screens and nets (nature of houses), and human activities like house chores (Palaniyand, 2021).

The presence of malaria is a risk factor contributing to the prevalence of other infections or diseases (Boraschi *et al.* 2008). Therefore, it imposes a great burden on the country in terms of pains and trauma suffered by its victims as well as loss in outputs and cost of treatments (Onwujekwe *et al*. 2000). One hundred and thirty-two billion Naira (N132, 000 000 000) is said to be lost annually in Nigeria because of malaria (NMCP, 2017). Such a high burden underscores the need for concerted efforts and interventions, all aimed at reversing the situation (Anaebonam, 2021). So, this study is aimed at understanding the dynamics of malaria infection in Adazi-Enu, Anambra State, Nigeria by employing socio-demographic risk factors. It could help to provide additional insight to strengthen prevention and control plans including prioritizing educating the populace in public health campaigns to mitigate and cease the health impact of the disease.

2. MATERIALS AND METHODS

Study area

The study was conducted at selected hospitals in Adazi Enu in Anaocha Local Government Area, Anambra State, South East Nigeria. Adazi-Enu is approximately 18 km / 11 miles away from Awka, the capital of Anambra State. The town has geographical co-ordinates of 6^0 12N and 7^0 41E. The inhabitants of the area are predominantly farmers, students and traders. The ecological seasons of the area has marked differences of wet and dry seasons. The wet season spans from April to October while the dry season spans from November to March. The temperature ranges from 21^0C to 36.6^0C with relative humidity of about 70% reaching 80% during dry season and annual rainfall of 2000mm.

Study design

The design used is the cross-sectional study design. The study was hospital based which lasted for two months (October to December 2021).

Study population

Adazi-Enu has five villages which includes; Obe, Umuabu, Ogweni-ocha, Ogweni-oji and Akwankwo. The study population was those of these named villages, who visited Michael Memorial Hospital, Adazi-Enu. All those that were not indigene of Adazi-Enu were strictly screened out.

Sample size

The sample size constitutes two hundred and two (202) people. This number represents the entire population of the people of Adazi-Enu who visited the hospital during the time of the study.

Administration of questionnaire

Questionnaire that had spaces for the needed demographical data which included the age, sex, occupation, level of education, village and other important encouraging factors that aid in malaria distribution was filled by the participants.

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Sample collection

Venous blood samples were collected using 2ml syringe and transferred to 5ml blood collection tube (EDTA Bottle) that contained anti-coagulant to prevent the blood from clotting. Finger prick method was used for the children instead of syringe.

Parasitological determination of malaria parasite

Thick blood film: one or two drops of blood was placed on a clean slide and smeared gently, it was allowed to dry. Then stained in fields' stain A for 5 seconds and rinsed properly with clean water. It was stained again with fields stain B for 3 seconds and then rinsed gently. The stained blood was allowed to dry and later was viewed under the microscope using x100 objective lens with the aid of emersion oil.

Thin blood film: here, a drop of blood was placed on a clean slide and a well-trimmed slide was placed at angle 45 at the edge of the blood circumference, the trimmed slide was used to spread the blood evenly down to the tail of the slide the blood was placed on. The evenly spread blood was allowed to dry and then coated with absolute alcohol to prevent the blood from lysing. It was again allowed to dry. The slide was dipped for 5 seconds in fields stain B firstly before it was rinsed gently and dipped in fields stain A. it was then allowed to dry and viewed under the microscope using the x100 objective lens with the aid of emersion oil.

Finger prick: supplies were collected which includes; lancet, alcohol, micro pipette, cotton ball and hand gloves. The palms were positioned upwards and a finger that is less calloused was used. The finger was cleaned with alcohol and the sharp end of the lancet was pressed down on the tip, then as the blood dropped, a micropipette was used to collect the blood. Then the thick and thin blood films were made (WHO, 2000).

Identification of malaria parasites: the identification of malaria parasite was done according to the procedure outlined by WHO (2010). The identification according to world health organization was based on the shape, size, stippling and pigment, presence of early trophozoite, schizont and gametocyte in the blood sample.

Determination of intensity

Reporting malaria parasite (MP) according to WHO 2015

1-10 malaria parasites per 100 high power field is	+
11-100 malaria parasites per 100 high power field is	++
1-10 malaria parasites in every high power field is	+++
11-100 malaria parasites in every high power field is	++++

Data analysis

All the data generated were analyzed using Statistical Package for Social Sciences (SPSS) software version 20.0. Pearson's Chi square test and correlation analysis were used to compare parameters. For all the determinants, the statistical significant difference was set at $P<0.05$.

3. RESULTS

Prevalence according to demographic profile

Out of the two hundred and two people sampled for this study, people aged 11-15 had the highest infection rate of 81.8% while age range 41& above had the lowest infection rate of 38.9%. Females had higher prevalence rate of 67.2% than males who had 48.8%. Farmers had the highest prevalence rate of 79%, and the civil servants had the lowest (34.5%). Those that stopped at Nursery level of Education had the highest prevalence rate of 72.3%, and the least being 50% for those that are at the tertiary level and those that never attained any height in Education. People from Akwankwo village had the highest prevalence of 66.7%, and those from Ogweni Oji had the least prevalence of 44.4%.

The prevalence of malaria in relation to all these variables had no statistical significant difference except for Occupation which had statistical significant difference ($P=0.000$).

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Table 1: Prevalence of malaria in relation to age, sex, occupation, education and village

VARIABLES	NUMBER EXAMINED	NUMBER INFECTED
AGE	χ^2 = 14.891.	P= 0.061
1-5	9	5(55.5)
6-10	30	14(46.7)
11-15	22	18(81.8)
16-20	38	20(52.6)
21-25	22	15(68.2)
26-30	23	17(73.9)
31-35	21	15(71.4)
36-40	19	10(52.6)
41 & ABOVE	18	7(38.8)
SEX	χ^2 = 6.857	P= 0.09
FEMALE	122	82(67.2)
MALE	80	39(48.8)
OCCUPATION	χ^2 = 30.741	P= 0.000
NONE	76	57(75.0)
FARMER	38	30(79.0)
TRADER	30	14(46.67)
CIVIL SERVANT	58	20(34.5)
HIGHEST LEVEL OF EDUCATION	χ^2 = 7.384	P= 0.117
NONE	20	10(50)
NURSERY	66	48(72.7)
PRIMARY	45	26(57.8)
SECONDARY	31	17(54.8)
TERTIARY	40	20(50)
VILLAGE	χ^2 = 6.064	P= 0.194
OGWENI OCHA	60	38(63.3)
OGWENI OJI	45	20(44.4)
OBE	20	12(60.0)
AKWANKWO	45	30(66.7)
UMUABU	32	21(65.6)
TOTAL	202	121(59.9)

Risks in Practice Profile of Respondents and Malaria Infection

Enquiries were made with the help of the questionnaire which scrutinized the behaviors and lifestyles as well as the living quarters of these 202 participants and some factors were picked out to play vital roles in the distribution of malaria, which included; maintainance of screens, water storage, use of LLINs and presence of vegetation around their living quarters. Table 2 below shows the entirety of the result gotten. In the number '1' factor, those with the highest infection rate are those that their houses are properly screened with the infection rate of 64.1%, others were 61.9% for no screen and 53.5% for torn screen. The difference is not statistically significant (p=0.480).The number '2' factor shows that those that uses containers like barrels or drums had the highest infection rate of 87% while those that make use of closed tanks had least rate of 28.1%. The difference is statistically significant (p=0.000). The number '3'factor depicts that those who rarely use LLINs had the highest infection rate of 79.2%, while those that don't use the LLINs had the least infection rate of 50%. The difference is not statistically significant (p=0.59). The number '4' factor shows that those who have vegetation around there living quarters had the highest infection rate of 75.9% while those that don't have vegetation around there living quarters have the infection rate of 36.6%. The difference is statistically significant (p=0.000).

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Table 2: Prevalence of malaria in relation to risk factors.

RISK FACTOR	NUMBER EXAMINED	NUMBER INFECTED
1. SCREEN	$\mathcal{X}^2 = 1.468$	P= 0.480.
TORN SCREEN NO SCREEN PROPERLY SCREENED	8 105 39	31(53.5) 65(61.9) 25(64.1)
2. WATER STORAGE	$\mathcal{X}^2 = 64.722$	P= 0.000
CONTAINERS OPEN TANK CLOSED TANK	54 60 88	47(87.0) 49(81.7) 25(28.4)
3. USE OF LLINs	$\mathcal{X}^2 = 7.436$	P=0.59
RARELY SOMETIMES ALWAYS NOT USED	24 60 38 80	19(79.2) 38(63.3) 24(63.2) 40(50)
4. PRESENCE OF VEGETATION	$\mathcal{X}^2 = 31.240$	P=0.00
YES NO	120 82	91(75.8) 30(36.6)
TOTAL	202	121(59.9)

Key:*numbers in parenthesis are percentages.

4. DISCUSSION

The overall prevalence of malaria in this study was 59.9%. This result is lower than the result of 85% in Igbesa Ado/ Odo-Ota Local Government Area ,72% both in Abia and Umuahia and 64% among NAU students which were all reported by Ajayi *et al.* (2020), Kalu *et al*. (2012) and Ezugbo-Nwobi *et al*. (2011) respectively and relatively higher than 28.3% and 22% recorded in Nise community and Anambra East Local Government Area by Nnatuanya *et al.* (2021) and Ajayi *et al*. (2021) respectively.

In this study, children aged 11-15 appeared to be more susceptible than others which is similar to the findings of Adedotun *et al.* (2013) and with the highest prevalence of 81.8%, which is higher than 44.4% recorded by Adedotun *et al.* (2013). This may be attributed to the habit of not wearing protective wears while doing their common chores which most of the times is in sync with the time the mosquito comes out to have a blood meal which is in line with the findings of Mourou *et al.* (2019), who reported that common night chores or all night entertainment leads to the increase in malaria. Then the least prevalence 38.8% for age range 41 and above may be due to their habit of being cautious which is similar to the findings of Igiri *et al.* (2018). However with P=0.061, the difference was not statistically significant which means that all age group is susceptible to malaria parasite which is also similar to the findings of Nas *et al.* (2017) in Kano and Abah *et al*. (2017) in Port Harcourt who both reported that there is no association between age and malaria prevalence.

The prevalence of malaria based on gender has been previously reported by some researchers including Okeke *et al.* (2016) and Garba *et al*. (2016). In this study females have higher prevalence of 67.2% than the males who have 48.8% prevalence. This is similar to the report of Nas *et al.* (2017) that females are more susceptible than the males. But with P= 0.09 the difference is statistically insignificant. In other words, malaria infection is not selective to a particular gender which is corroborated by the findings of Dike-Ndudim *et al.* (2020).

Farmers had the highest prevalence of 79% in this study which can be attributed to risks of having contact with Anopheles mosquitoes in the farms. This is similar to the report of Paul *et al.* (2018) and another by Dharma *et al.* (2015) who reported that farmers are at greater risk through increased contact with malaria vectors in the fields. Also having P=0.000 (<0.05) shows that the difference is statistically significance similar to the findings of Wobo *et al.* (2014) who reported that there is statistical significance in the relation between malaria prevalence and the occupation of the participants. In other words, prevalence of malaria depends on the occupation of the participant.

Those that stopped or are at the Nursery level of education has the highest prevalence of 72.7% with the least (50%) being for those at the Tertiary level of education and those that attained no level of education. Nevertheless, the prevalence of malaria in this study showed no significant relation with the varying levels of education (P>0.05) which is similar to the findings of Nwangwu *et al*. (2020) who reported that malaria prevalence is not determined by educational qualification.

According to the study, Akwankwo village has the highest prevalence of 66.7% while Ogweni Oji has the lowest prevalence. However, the study recorded P>0.05 meaning that there is no association between malaria prevalence and villages. This lends credence to the report by Dawasaki *et al.* (2016) that there is no relation between the prevalence of malaria and the villages.

Nonetheless, the moderately high prevalence of malaria in Akwankwo village and moderately low prevalence in Ogweni Oji can be as a result of how the participants store their water, it can also be attributed to the varying use of LLINs which may be as a result of discomfort or constriction of air, which many gave as their reason and some others did not have LLINs at all. This confirms the findings among community members of Aguleri in regards to LLINs by Egbuche *et al.* (2013)

Some participants do not have a properly screened house which is supposed to confer protection against mosquito bites. This is similar to the findings of kaindoa *et al.* (2018) that made a report about the increase of malaria transmission in individuals living in houses with open gaps. However, the difference was not statistically significant (P = 0.480) meaning that having a proper screen or not has no association with increase in infection rate. Also, having screens or not didn't make them less susceptible to malaria infection.

Furthermore, most of the participants have different types of vegetation around their living quarters which, due to landscape change, provides a good breeding site for mosquitoes. This confirms the report of Shearer *et al.* (2016) that environmental changes modify human risk of getting malaria.

Consequently, not using the LLINs always, improper way of storing water, keeping vegetation around their living quarters and not having a properly screened house altogether confirms the moderately high prevalence of malaria.

5. CONCLUSION

Malaria is still a significant concern to the populations in the study area irrespective of the age, gender, education qualification or village. However, the risk heightens with the occupation, water storage system and presence of vegetation around people's homes. There is immense need to prioritize educating the populace in public health campaigns in addition to spreading key messages through social media and students' associations to reduce misperception and increase knowledge. This will give hope of lower prevalence in future studies and also reduce malaria burden in the study area.

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