***Original Research Article***

# MALARIA VECTOR ABUNDANCE AND THE INCIDENCE OF MALARIA PARASITEMIA AMONGST STUDENTS LIVING IN NNAMDI AZIKIWE UNIVERSITY HOSTELS

## MALARIA PARASITAEMIA AND ITS VECTOR ABUNDANCE AMONGST STUDENTS IN NNAMDI AZIKIWE UNIVERSITY HOSTELS

**Comment [SSL1]:** I SUGGEST THIS TITLE


## ABSTRACT

**Comment [SSL2]:** It is important to give a brief (max two lines) background on your study in the abstract section before jumping into objectives.

The major intent of the study was to determine the prevalence of malaria parasitemia and the abundance of malaria vectors in and around the university hostels. The study was carried out in school hostels of Nnamdi Azikiwe University, Awka between March through September, 2018. A total of fifty (50) rooms, from five (5) different blocks were sampled. One hundred and fifty (150) students were tested for malaria parasitemia. Questionnaires on the frequency of clinical symptoms and signs of malaria as well as net ownership and usage were distributed to the students. Indoor resting mosquitoes were collected from the fifty (50) rooms through pyrethrum knockdown and larval survey was also carried out for the immature stages of mosquitoes. Data were analyzed statistically for significant differences using the Chi-square test. Of the 150 students examined for malaria parasitemia, 135 (90%) showed positivity to the parasite. Out of the infected population, 122(90.4%) had a low intensity of malaria infection, 13 (9.6%) had a medium intensity while none of them had a high intensity of the infection. Two hundred and twenty three (223) mosquito larvae were collected from their breeding habitats and one hundred and ninety three (193) adult mosquitoes of different species were collected indoors. Although there was no significant difference existing between the number of rooms sampled and the number of mosquitoes collected at 5% level of significance ($x^2$tab > $x^2$cal; 9.488 >6.307).From the questionnaire shared to the 150 students, 30 (20%) of the students treat malaria every 3months, 20(13.3%) every 6 months, 24 (16%) before resuming school, 76(50.7%) only when they develop clinical malaria. On possession of insecticide treated net, 81 (54%) of the students have insecticide treated net, while the remaining 69 (46%) students did not. In conclusion, sensitization and implementation of the use of long lasting Insecticidal Nets (LLINs) by the students will go a long way in reducing the prevalence of malaria as the practice kills the malaria vector and effectively reduce the chances of effective malaria transmission by the vector


**Comment [SSL3]:** Main goal or main aim

**Comment [SSL4]:** How many months of survey please be clear? Avoid contracted statements.

**Comment [SSL5]:** Please this statement does not educate me on which test was used to compare which parameters. If you cant make it clear in the abstract then avoid signalling stat tests here and detail it in the materials and methods section of the MS.

**Comment [SSL6]:** Past tense

**Comment [SSL7]:** Check tense


Keyword: Malaria, *Anopheles gambiae* sl, LLINs


## Introduction

Malaria remains an important public health disease in both tropical and subtropical countries of Africa where transmission is principally through the bite of an infected female *Anopheles* mosquito (1). Transmission rarely occurs through direct inoculation of infected red blood cells through blood transfusion, congenital transfer or sharing of needles (2).

The degree of malaria prevalence in any area is determined by species of indigenous anopheline mosquitoes, their relative abundance, feeding, resting behaviour and the suitability of human host to *Plasmodium*, among others (3).

The control of malaria is becoming increasingly challenging in many developing areas of the world including Nigeria asthe parasites as well as their vectors haveshown resistance to anti malarial drugs and insecticides in various part of the country (4, 5).

The government has been committed to malaria control by intensifying the malaria awareness campaign, emphasizing prevention and eradication of malaria using effective malaria control programme for pregnant women and children of pre-school age (6). This control programme has not been extended to the tertiary institutions of learning as the disease is known to have a negative impact on performance of students (7).As expected, students absent from lectures for one week or more over a semester due to malaria parasitemia have a higher possibility of poor school performance than those who were absent for less than one week. School absenteeism may lead to loss of knowledge provided in the lecture hall, leading to students academically lagging behind other students in the same class. The use of both free or subsidized chemotherapy and insecticide treated nets (ITNs) have not been extended to the academic communities which represents a considerable size of the Nigerian youths.

The major intent of the study is to determine the prevalence of malaria parasitaemia and the abundance of malaria vectors within the various locations in and around the university hostels.

**STUDY AREA**

The study was carried out in the school hostels of Nnamdi Azikiwe University, Awka, Awka-South local government area of Anambra state between March through September, 2018. The climatic condition during the study period created favourable breeding sites for *Anopheles* species which are the known vectors of *Plasmodium* parasites. The study area and its environs house mainly the students and workers in Nnamdi Azikiwe University, Awka. The students live mainly in hostels which are partitioned in blocks.

**Comment [SSL8]:** Separate the words

**Comment [SSL9]:** Separate these words

**Comment [SSL10]:** Anti-malaria

**Comment [SSL11]:** Cite the study of Bamou R & Sevidzem SL. 2016. ABO/Rhesus blood group systems and malaria prevalence among students of the University of Dschang, Cameroon. Malaria World Journal, 7:4.

This study was carried out at the University level to assess the level malaria prevalence amongst students.

**Comment [SSL12]:** Main aim

**Comment [SSL13]:** tense

**Comment [SSL14]:** Place the map and GPS points under the study area heading and not under study population.

## STUDY POPULATION

The participants in the study were students of the University living in the school hostels in Agbani-Ifite. The participants were of various ages ranging from 17 to 30 years. A total of fifty (50) rooms were sampled from five (5) different blocks of the selected twenty five (25) hostels in the settlement. One hundred and fifty (150) students were tested for malaria parasitemia and the fifty (50) rooms were also sampled for indoor resting mosquitoes.

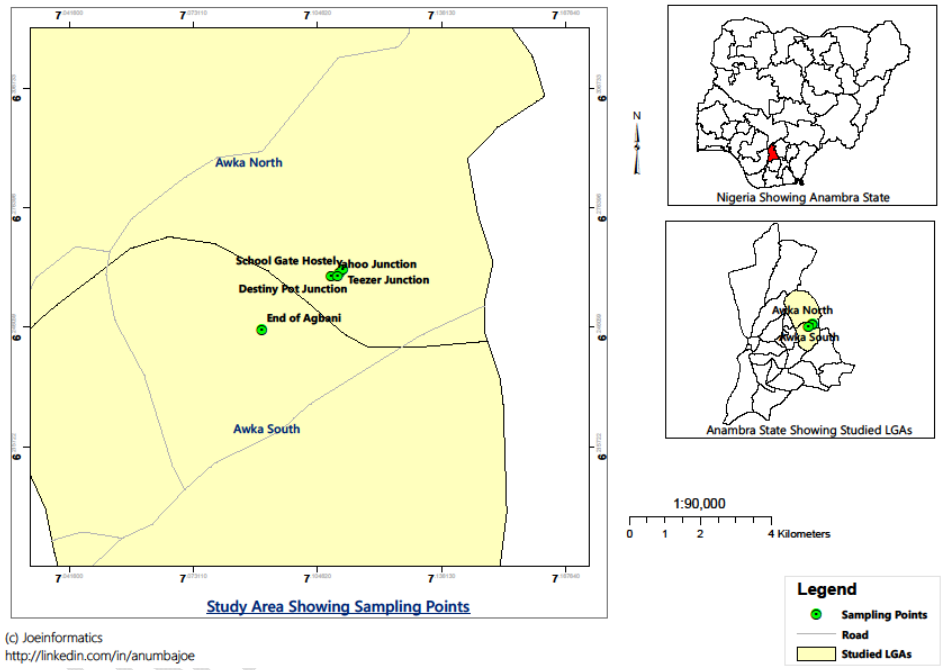



Figure 1: Map of the study site

## Ethical Consideration

Ethical approval was obtained from the Dean of the Student Affairs and Head of Department Parasitology and Entomology, Nnamdi Azikiwe University. Verbal consent was obtained from the occupants of all rooms used. Provision were made to contain students who may be absent on the supposed testing date.

## SAMPLE &DATA COLLECTION

Samples were collected from five different locations using the school (Nnamdi Azikiwe University) as stand point: Landmarks of the location of the hostels were listed in terms of the junctions closest to the hostels while the geographical coordinates used were for the particular hostels used for the study.

**Comment [SSL15]:** What sampling method was used to select participants?
Randomly or only volunteers? Please it is important to specify.

TABLE 1: SAMPLE COLLECTION POINTS

| LOCATIONS | DESCRIPTION | LANDMARK | GEOGRAPHICAL CORDINATES |
|---|---|---|---|
| Location A | (Hostels before the school) | Commissioner's quarter Ifite | 06.2459N, 007.0997E |
| Location B | Hostels in front of the school) | Yahoo junction | 06.2590N, 007.1080E |
| Location C | (Hostels after the school) | Teezer junction | 06.26067N, 007.1109E |
| Location D | (Hostels farther down the school) | Next level junction | 06.2608N, 007.1108E |
| Location E | (Hostels at the end of Agbani-Ifite). | St Stephen's junction | 06.2665N, 007.1202E |

Mosquito samples were collected using the pyrethrum spray sheet collection (PSC) technique and larval sampling while blood samples collected from the students were tested for malaria parasite. Questionnaires were used to collect the bio-data and clinical details of the participants.

**Comment [SSL16]:** From all the students of the study blocks or volunteers? Please specify the nature of your participants.

### Collection of blood samples and film preparation

Capillary blood samples of the participants were collected aseptically with a lancet and were used to make thick blood films on clean grease free slides. The prepared blood films were properly labelled as recommended by the World Health Organization (8). Safety precautions were adopted in the collection of finger-prick blood samples by swabbing the area to be sampled with 70% alcohol and allowed to air dry before collection.

### Staining and microscopy

With the air-dried blood smear placed on the staining rack, 10% Giemsa stain was poured generously on the slide. The stain was allowed to stay for 10minutes before washing it off with clean water.

**Comment [SSL17]:** Poor technical term please re-word

The slide was then placed vertically and allowed to air dry. When dried, a drop of immersion oil was placed on the slide and examined under the microscope using x100 objective.
The intensity of malaria was recorded using the plus sign thus:

Mild infection (+): 1-10 parasites per 100 high power fields;

Moderate infection (++): 11-100 parasites per 100 high power fields;

Heavy infection (+++): 1-10 parasites per high power field (8).

**Mosquito larval collection**

Larvae from different locations were collected and put in separate sampling containers. Collected samples were differentiated based on certain macroscopic features such as their movements and the presence or absence of siphon. They were allowed to emerge into adult in a cage and then identified properly.

**Comment [SSL18]:** What was the type of identification used?
If it was morphological identification please cite the key that was used.

**Collection of indoor-biting mosquitoes**

Enumerated hostel rooms were sampled for indoor biting and resting adult mosquitoes using the pyrethrum knockdown technique. White sheet of cloth were laid from wall to wall and were made to overlap with each other at the centre of the room to avoid escape of knocked down mosquitoes. The rooms had no open eaves and so the windows and doors were properly shut for each room at the sampling time. The rooms were sprayed with Insecticide (Raid$^{TR}$), a brand of domestic aerosol insecticide commonly available in the local markets. After 20 minutes of spraying each room, the doors and windows were opened and the cloths were folded. Folding of the cloths was from the edges to ensure that all knocked down mosquitoes concentrated at the centre. They were then taken to the open space outside where they were opened. All the mosquitoes were carefully picked with forceps into Eppendorfs tubes. The collected mosquitoes where mounted on glass slides and viewed under microscope for identification using relevant taxonomic keys (9). Morphological feature of the mosquitoes such as, palps, proboscis, wings, scutellum, legs, thorax, abdomen, size and colour were used to identify the adult mosquitoes (10).

**Administration of questionnaires**

Structured questionnaires were given to the selected students of the various sampled hostels to provide information on how often they treat malaria, the drugs and insecticide used in the treatment of malaria and prevention of mosquito bite respectively, if self treatment and confirmatory testing is practiced, and what factors determine their choice of drugs as well as their use of interventions such as insecticide treated nets.

## DATA ANALYSIS

Data from the prevalence study were analyzed statistically for significant differences using the Chi-square test. Tables, bar charts and pie charts where used for descriptive analysis of the results obtained.

**Comment [SSL19]:** Not important

Please specify the statistical package used for analysis and the level of significance of the statistical test uses.

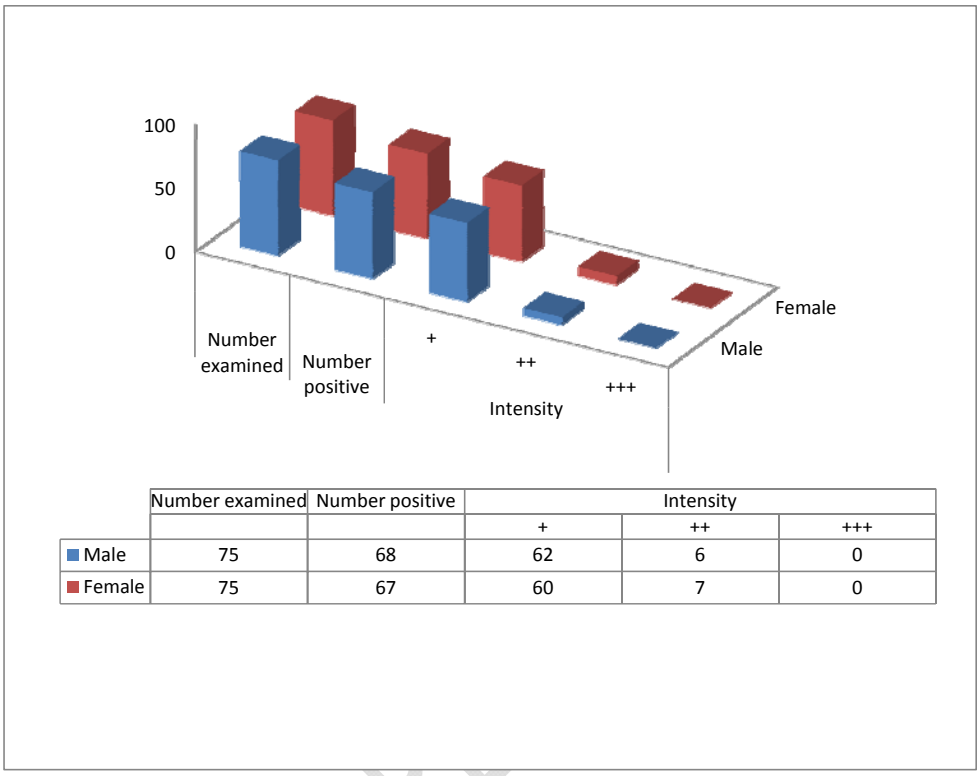
## RESULTS

Of the 150 students examined for malaria parasite, 135 (90%) of them showed positive peripheral blood film for malaria parasites. The students living at Location E recorded the highest prevalence of 100% followed by students living at Location C, and then students at Location D. The students living at Location A recorded 86.7%, while those living at Location B recorded the least prevalence of malaria infection (76.7%). The difference in prevalence of malaria in the various locations was statistically significant at 5% level of probability ($x^2$ cal > $x^2$ tab; 16.88> 9.488)

TABLE 2: PREVALENCE OF MALARIA INFECTION IN DIFFERENT LOCATIONS

| Locations | Numbers examined | Numbers infected (%) |
|---|---|---|
| Location A | 30 | 26 (86.7%) |
| Location B | 30 | 23 (76.7%) |
| Location C | 30 | 29 (96.7%) |
| Location D | 30 | 27 (90.0%) |
| Location E | 30 | 30 (100%) |
| **Total** | **150** | **135 (90%)** |

Prevalence of malaria among the different sexes showed that of the 150 students (75 females and 75 males) examined, more males (68) than females (67) had the malaria parasite. Although there is no statistical significant difference between prevalence of malaria infection among males and females at 5% level of significance ($x^2$tab >$x^2$ cal; 3.841 > 0.0473)




| | Number examined | Number positive | Intensity | | |
|---|---|---|---|---|---|
| | | | + | ++ | +++ |
| Male | 75 | 68 | 62 | 6 | 0 |
| Female | 75 | 67 | 60 | 7 | 0 |

Figure 2: Prevalence and intensity of malaria parasite among the sexes

Of the infected population (60 females and 62 males) had a low intensity of malaria infection, seven females and six males had a medium intensity while none of them had a high intensity of the infection.

On the three consecutive visits, a total of two hundred and thirty three (233) mosquito larvae were collected from their breeding habitats which includes: pot holes, stagnant water, gutters,–hoof marks and tyre marks from different locations, one hundred and forty five (145) *Anopheles gambiae sl* were collected from natural pools of water and eighty eight (88) were of *Culex species*

TABLE 3: LOCATIONS OF LARVAL SAMPLING, EMERGED SPECIES AND HABITAT CONDITIONS

| **Types of Breeding site** | **Locations** | **Species collected and number** | **Water condition** |
|---|---|---|---|
| Standing water which includes: pot holes, gutters, foot marks and tyre marks | A = 17 | *An.g* = 13<br>*Cx.que*= 4 | clear water with algea |
| | B= 31 | *Cx.tig*= 4<br>*Cx.que*= 25<br>*An.g* =2 | mud water with leaves, gutters |
| | C= `24 | *Cx.que*= 24 | dirty smelly water where run-off water from hostels collect |
| | D= 73 | *An.g* =42<br>*Cx que*= 31 | water with gasoline, fermented water from cassava, drums for collection of rain water |
| | E= 88 | *An.g* =88 | dirty water with leaves as shades |

Note: *An.g = Anopheles gambiae* sl, *Cx. que = Culex quenquefasciatus*, *Cx. tig= Culex tigripis*

A total of 50 rooms were sampled from among the 25 hostels and 3 different species of different genera were collected. Although there was no significant difference existing between the number of rooms sampled and the number of mosquitoes collected at 5% level of significance ($x^2$tab > $x^2$cal; 9.488 >6.307). Nevertheless, a significant difference in number of *Anopheles* mosquitoes collected from the different locations was evident. Among the mosquitoes collected, 48 (25%) were *Anopheles gambiae* sl, 136 (70%) were *Culex quiquefasciatus* and 9(5%) were *Mansonia africana*.

**Comment [SSL20]:** Please find a row to your table for total flies emerged per location, total species per location etc.

This table is not a normal scientific table.

**Comment [SSL21]:** Characterisation of breeding sites

**Comment [SSL22]:**

**Comment [SSL23]:** ??????????????????????????
?
Create different columns for site and number

**Comment [SSL24]:** Separate species and number this style of presentation is

**Comment [SSL25]:** Misleading.

**Comment [SSL26]:** Attach photos

TABLE 4: INDOOR RESTING ADULT MOSQUITOES COLLECTED IN THE HOSTEL USING PYRETHRUM KNOCKDOWN COLLECTION (PKC)

| Locations | Number of room | Number of mosquitoes | Mean *Anopheles* abundance | Species of mosquitoes collected | | |
|---|---|---|---|---|---|---|
| | | | | *An gambiae* sl | *Cx quiquefasciatus* | *Mansonia africana* |
| A | 13 | 36 | 0.3 | 4(11.1%) | 32(88.9%) | 0 (0%) |
| B | 13 | 30 | 0.8 | 8(26.7%) | 22(73.3%) | 0(0%) |
| C | 12 | 54 | 1.4 | 17(31.5%) | 37(68.5%) | 1(1%) |
| D | 12 | 30 | 0.4 | 7(16.7%) | 25(83.3%) | 3(1%) |
| E | 12 | 43 | 1 | 12(27.9%) | 31(72.1%) | 5(%) |
| Total | 50 | 193 | | 48(25%) | 147(76.2%) | 9(12%) |

**Comment [SSL27]:** How did you calculate the abundance and why is the total space empty?

From the questionnaire shared to the 150 students, it was gathered that 30(20%) of the students treat malaria every 3months, 20(13.3%) every 6 months, 24 (16%) before resuming school, 76(50.7%) only when they fall ill to malaria.

**Comment [SSL28]:** Compare the different % responses for each parameter using chi-square and present it in form of a table

On the possession of LLINs, majority {81 (54%)} of the students have LLINs, while the remaining {69(46%)} students do not. Out of the 81 (54%) of the students that have the nets, 34 (54%) of them do not use it, 20(24.7%) use it every day, 8(9.9%) use it only when they remember, 4(4.9%) use it only when they are cold and 15(18.5%) of them use it anytime they like.

**Comment [SSL29]:** Please use chi-square to compare respondent responses for each parameter. Present this result in form of a scientific table.

## DISCUSSION

The results obtained in the study showed that the prevalence of malaria infection among Nnamdi Azikiwe university students living in Agbani-Ifite is high (90%). This result is in line with the findings of (11) conducted among first year students of the same university. This is relatively high when compared to 38.93% by (10) among students living in the same university hostel, 61% for students in University of Abuja by (12), and 59.4% recorded for post primary students of Umunede and Asaba by (13), though most of the study were carried out in the wet season. In contrast to our

finding, (14) recorded a low prevalence of 17% for students of University of Ibadan, Oyo State. Major factor on the low prevalence is the awareness level of the disease by the students, knowledge of the disease, prompt treatment upon infection and strict adherence to the control measures probably brought about the low prevalence of malaria.

The high prevalence recorded in the study may be attributed to the fact that many of the students do not have mosquito nets and among those that have, only (24.7%) of them use them judiciously (everyday) despite being proved as an effective method of malaria intervention as adopted by the Roll Back Malaria programme (15). A few, 4(4.9%), of the study population use the LLINs only during cold weather conditions is in agreement with the findings of (16) that people do not use the mosquito nets due to increased temperatures.

The results also showed a higher infection in males than females: out of 75 males, 68(90.7%) of them where infected, and of the 75 females sampled, 67(89.3%) of them of where infected although there was no significant difference between prevalence of malaria between males and females. This agrees with the findings of (17, 18) who reported that prevalence of malaria among the male gender is higher than of the female. (19) also reported that the cause of higher prevalence observed in male could be due to the fact that they expose their bodies more than females when the weather is hot and thus increases their chances of being bitten by the mosquito. The sampled male students most often exhibit a carefree attitude and pay little or no attention to damaged window nets, bad doors and the use of mosquito nets compared to the female students.

The difference in malaria prevalence and number of *Anopheles* mosquitoes in the different locations was significant ($P<0.05$). This difference is mainly due to the differences in the availability of breeding sites, use of ITNs and other personal protections from the bites of *Anopheles* mosquitoes such as wearing clothes that properly cover the body, closing doors and ensuring the repair of damaged doors, windows and torn nets. Locations C, D, E have many breeding sites for *Anopheles* mosquitoes consisting of pools and puddles of various sizes majority of which were created artificially. Poor drainage system and waste disposal was obvious especially at locations D and C where water from various rooms collects through exposed gutters from the different rooms channelled to the major collecting gutter; and majority of the students there do not use mosquito nets. The use of interventions were highly practiced by the students in locations A and B especially from location B coupled with the fact that sampled hostels from this location were mainly neat hostels with clean surroundings. Good sanitation is maintained within the hostels.

Hence correlating *Anopheles* mosquito abundance with malaria prevalence, a positive correlation is seen especially in Locations D and E. Positive correlation as it was seen in the study of (20) who opined that since the *An. gambiae* species is a very effective vector of malaria, the presence of even one is a big cause for public health concern; thus, the effect of forty-six of them in an area cannot be over emphasized.

Also, the differences in mean *Anopheles* mosquito abundance in the various locations could be due to the pattern of the room and the number of persons dwelling therein as observed during the course of

**Comment [SSL30]:** Compare this finding with that of
Bamou R & Sevidzem SL. 2016. ABO/Rhesus blood group systems and malaria prevalence among students of the University of Dschang, Cameroon. Malaria World Journal, 7:4.

NB But take care because the study of Bamou and Sevidzem ued rapid diagnostic kits and yours used microscopy.

Check tense

**Comment [SSL31]:** Please you did not use a correlation test so avoid using the term and rather use corresponded to……

the study. In well built location (spacious, tiled, and having good window nettings and doors), fewer number of mosquitoes were collected compared to houses with torn nets, loosely-fitted doors, smaller space. Also larger numbers of mosquitoes were collected from rooms occupied by larger number of persons (2-5 students) compared to rooms occupied by a single student. This is because *Anopheles gambiae* sl are strongly attracted to the scent from the human body (21); therefore, the more the people in a room the higher the concentration of the scent and a corresponding increase in the number of mosquitoes attracted.

Despite the intervention, high malaria infection prevalence was still recorded and this could be attributed to the night activities of the students such as parties, ranging from birthday parties to departmental nights. The most common of these activities is night reading, normally practiced by majority of the students and more often done in the open (Garba square) thereby exposing them to infection from infected *Anopheles* mosquitoes.

Of the mosquitoes collected during larval sampling, 62% were *Anopheles* mosquitoes. More collection was made in Location E with dirty water which has leaves as shades. The collection of *Anopheles gambiae* sl in dirty water supports the finding of (22) that some species of *Anopheles gambiae* mosquitoes can also breed in dirty water as against the general knowledge that *Anopheles* mosquitoes breeds in a clean and clear water (23).The breeding sites with smelly dirty water collected more *Culex* mosquitoes. Surprisingly, *Anopheles* mosquito larvae were collected in the habitat with gasoline at location D, as it have also been reported in the study of (24). The outcome of the sampling and the type of breeding habitat predominant in all the locations gives us an insight in the abundance of the malaria vector

**Comment [SSL32]:** has

In conclusion, results from this study have shown how highly exposed the University students living in the hostels are to malaria infection and a host of other mosquito borne diseases. Most of the students though aware of the disease malaria and various preventive and therapeutic measures often undermine the lethality of the disease and pay little attention to applying simple preventive measure like the use of net by the students will go a long way in reducing the prevalence of malaria as the practice will kill many endophagic and endophilic *Anopheles* mosquito and reduces the chance of the vector living long enough to transmit malaria parasites.

**Comment [SSL33]:** Write conclusion clearly

## REFERENCES

Comment [SSL34]: Check the author guide of IJTDH to homogenise references.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