***Original Research Article***

# The prevalence of malaria parasites and malaria vectors in Adenta-Barrier


## ABSTRACT

**Background**: Malaria burden is generally lower in urban settings. Urban malaria is likely to surge due to rapid and unplanned urbanization. Hence, this study sought to determine the prevalence of malaria parasite and malaria vectors in Adenta-barrier, a suburb of Adentan Municipality.

**Methods:** Mosquitoes were collected from 40 houses in the study site using the pyrethrum spray catches (PSC) method, and malaria parasite screening was carried out on 90 participants. A well-structured form was used to record data on the use of insecticide-treated nets, insecticide spray, and mosquito coil in the community. The mosquitoes collected were morphologically identified.

**Results:** The malaria parasite prevalence at the study site was 1.1%, and the use of insecticide-treated nets, insecticide spray, and mosquito coil were 13.4%, 7.5%, and 11.9% respectively. As far as vector abundance were concerned, habitat, resting and feeding behavior were taken into consideration. The majority of the mosquitoes collected during the study were *Culex* 95.7% (22), and the rest were *Aedes* 4.5% (1). Both *Culex* and *Aedes* mosquitoes were found in resting states. Study participants reported majority (80%) of the bites they sustained to have occurred during the early hours of the day. The study area also possessed several easily identifiable breeding sites for mosquitoes

**Conclusion:** The prevalence of malaria in the study area was low and no *Anopheles* mosquitoes was found. The majority of mosquito species present in the locality was *Culex* with a few *Aedes*.



**Keywords:** Malaria, *Anopheles* mosquitoes, Pyrethrum Spray Catches (PSC), *Culex* mosquitoes, *Aedes* mosquitoes

## INTRODUCTION

Malaria remains a public health menace responsible for over 229 million cases in 2019 in 87 malaria-endemic countries [19]. The WHO Africa region accounted for 94% of the global malaria burden in 2019 [19]. The high mortality of malaria recorded in Africa is mostly attributed to *Plasmodium falciparum* which is the most pathogenic among the four main human malarial parasites [3] accounting for 99.7% of estimated malaria cases in 2018 [18].

Entomological studies in Ghana have documented compelling evidence that malaria burden is significantly lower in urban areas[6]. Similar to sub-Saharan African countries, *Anopheles (An.) gambiae* complex and *An. funestus* are the predominant vector species for malaria in Ghana, and their distribution varies with climatic and ecological conditions [14]. *An. gambiae* is one of the most efficient vectors and is more intense in the rainy season; however, even a relatively small number of *Anopheles* mosquitoes can sustain significant levels of malaria endemicity [13]. *An. funestus* is also a very efficient vector of malaria transmission due to its year-round presence; *An. melas* being the less efficient vector are documented to be restricted to Ghana's coastal sites [2] [14].

The general research assumption is that urban areas would have a reduced incidence of malaria infection due to fewer breeding sites for vectors, favorable human to mosquito ratios, improved insecticide use, and safer housing facilities. However, several recent studies have highlighted growing urban malaria prevalence to increase in population, unplanned land use, resistance development by the vectors and parasite [2] [10] [12]. Clinical data have suggested an increased risk of malaria caused by proximity to urban agriculture.

There has been a 50% and 65% reduction in malaria-related morbidity and mortality in Ghana [16]. However, malaria continues to drive poverty and hamper economic progress by accounting for approximately 30% of all OPD attendance and 23% of inpatient admissions in children less than 5 years of age [13]. This study aimed to determine the malaria parasite prevalence and dynamics of the local vectors in an urban area of Accra while gauging the use of malaria control measures.

## METHODS

### STUDY SITE

This study was carried out in the Adenta barrier, a suburb of the Adentan municipality which is demarcated into 4 zonal councils; namely Gbentaana, Koose, Sutrunaa, and Nii Ashaley. Adenta lies 10 kilometers to the North-East with a land space of about 85 square kilometers and shares a boundary with Kpone-Katamanso and Ashaiman municipality in the south. The municipality serves as a nodal point where the main Accra/ Aburi/ Koforidua road and Accra/Dodowa trunk road passes. The majority of the houses have well-screened windows and trap doors before the main doors [6].

### Mosquito Collections

A total of 40 houses were randomly selected using systematic random selection technique for Pyrethrum spray catches (PSC). The sample size was based on availability of resources to the research team at the time of study and hence was based on convenience. Indoor resting mosquitoes were collected daily in the morning between 6:00am and 7:00am in each of 2 rooms in selected houses for 11 days. The study was conducted during the dry season (February). A white sheet was spread on the floor of each room before spraying with pyrethroids insecticide formulation for easy detection of dead and moribund mosquitoes. After 15 minutes, all moribund or dead mosquitoes were collected (figure 1a and 1b) and kept in moist petri dishes and transferred to the laboratory for sorting and identification.

### Detection of Malaria parasites

Capillary blood was obtained from a total of 90 consenting participants who were occupants of the sampled households. Microscopy and rapid diagnostic testing using immunochromatographic test kits were utilized for the detection of malaria parasites. The stained blood (thick and thin) smears were observed under a light microscope with a 100X oil immersion objective according to WHO guidelines. Both the immunochromatographic rapid test kits (SD BIOLINE Malaria Ag Pf / Pan) and blood smears were used to determine the prevalence of malaria infection in the population.

### Data collection form

A well-structured form was designed to aid in the collection of information regarding the use of insecticide-treated nets, insecticide spray, and mosquito coil, as well as other pertinent demographic information.

**Figure 1a: Spraying of a room with Pyrethroids Spray**

**Figure 1b: Collection of knockdown mosquitoes**



### Morphological identification of mosquito vectors

All adult mosquitoes collected were transferred from the Petri dishes into 1.5ml Eppendorf tubes containing silica gel. Morphological identification of the mosquitoes was conducted using the standard entomological keys of Gilles and de Mellion [7].

### Data analysis

The data gathered in this study was analyzed entirely on the basis of descriptive statistics. Frequencies and parasite prevalence was calculated without the use of any inferential statistics and or hypotheses testing.

## RESULTS

### Distribution of Mosquitoes

A total number of 67 rooms were sprayed in the study. In all, 14.9% had mosquitoes resting indoor which were identified to be *Culex* spp.. and *Aedes* spp. mosquitoes. The majority of the mosquitoes collected during the study were *Culex* 95.7% (22) and the rest were *Aedes* 4.5% (1). Both *Culex* and

*Aedes* mosquitoes were found resting in a house and one room with no occupant had 3 *Culex* mosquitoes (Figure 2). No *Anopheles* mosquito was captured during the study.

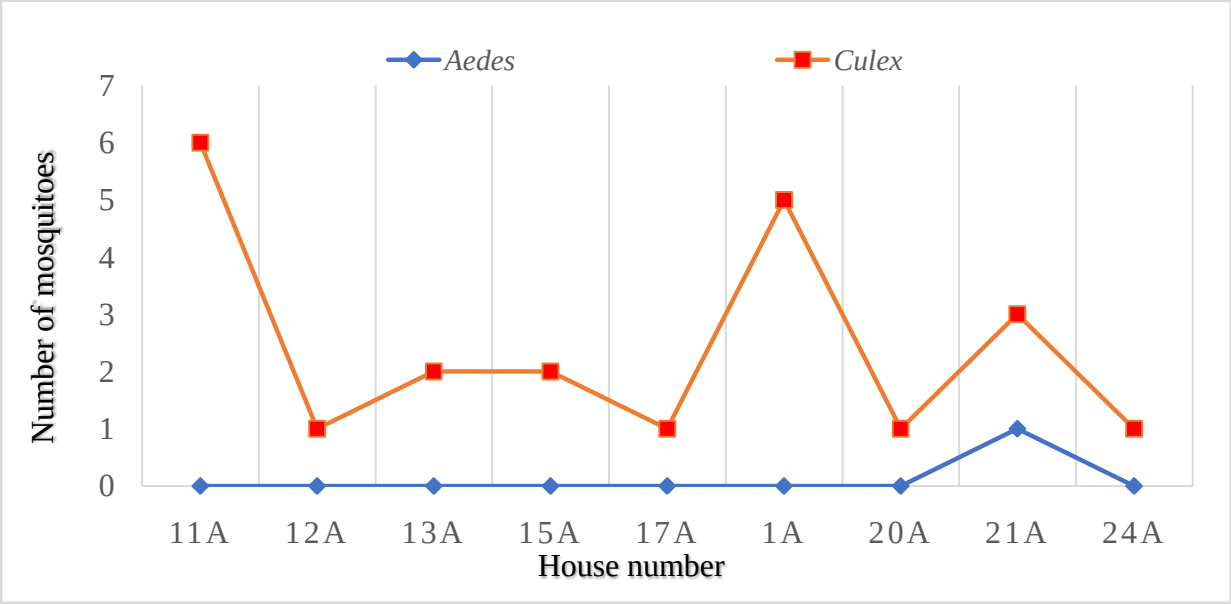


Figure 2. Distribution of mosquitoes in the rooms.

**Malaria parasite prevalence**

The capillary blood obtained was from individuals who spanned the ages of 2 and 80 years. The general prevalence among the study population of 90 individuals was 1.1%.

**Usage of malaria control measures**

The usage of mosquito coils and insecticide sprays at the study site was 11.9% and spray 7.5% respectively. Insecticide-treated net usage in the study site was found to be 13.4% while another 8.9% were using untreated nets. Overall, the usage of malaria control measures in the study sites was low. None of the houses was found to be using a combination of either of the control measures (figure 3).

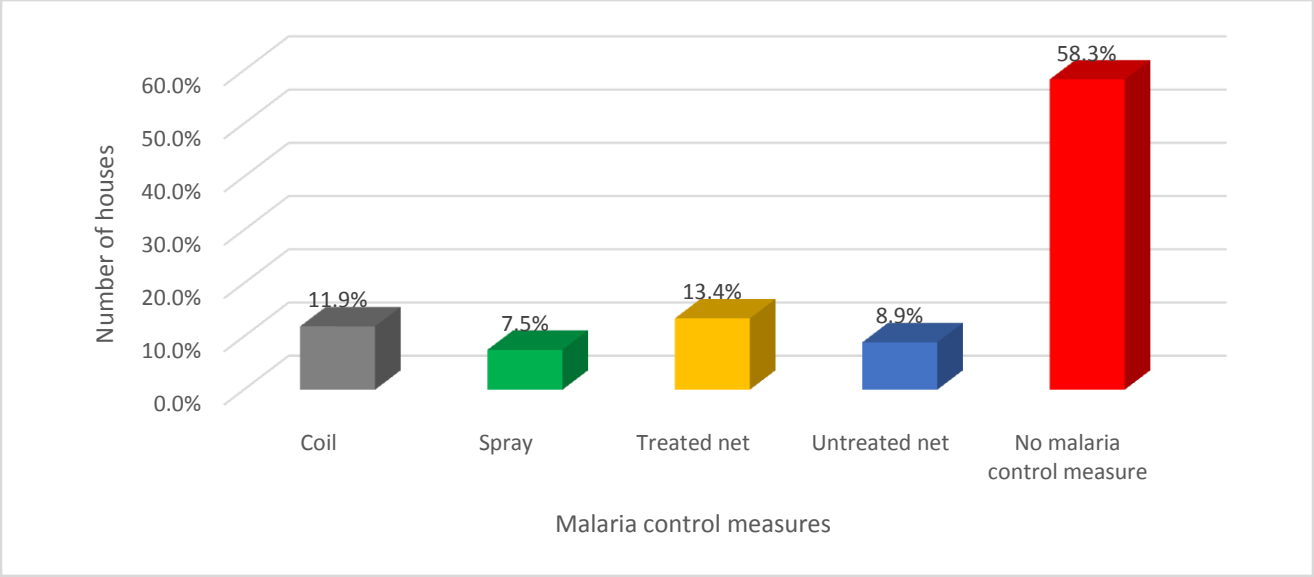


Figure 3. The number of houses using malaria control measures.

## DISCUSSION

Malaria poses a significant threat to human life in sub-Saharan Africa, claiming many lives and generating the greatest morbidity when compared to other infectious diseases [9]. Although the study was conducted in an urban setting, the area contained varying types of housing structures. This variability in structures is a known determinant for the presence of various mosquito species [8]. In the past, thatched houses have been noted to harbor more mosquitoes than brick-constructed houses [5].

The individuals and families in the study sites lived in different types of structures such as buildings made of bricks, containers made of metal or wood, and kiosk made of metal or wood. On average, each house included in this study accommodated about four people. Only a few houses harbored mosquitoes in this study. This could be attributed to the presence of predominantly well-structured housing at the study site since mosquito populations have a reported causal link to building-type and presence of breeding habitats in communities [5].

The captured *Culex* spp. and *Aedes* spp. at the study site are both species that can breed in varying environments which include tires, bowls, water storage containers within houses, and polluted or stagnant water bodies [11]. *Aedes* mosquitoes are known for their tendency to be diurnal and be present in areas where unplanned urbanization practices are common place [4]. The absence of *Anopheles*

mosquitoes at the study site could explain the low prevalence of malaria. This could be due to the usage of insecticide-treated nets, insecticide sprays, and mosquito coils. There are records of these measures being used in other countries with significant *Anopheles* populations and malaria endemicity [14].

The low malaria prevalence in this study (1.1%) is in congruence with findings that show urban areas possess a lower malaria burden [8] which could be due to the general absence of mosquito breeding sites coupled with higher usage of vector control measures [15]. Urban agricultural practices have been known to have positive effects on the populations of *Anopheles* mosquitoes and hence malaria transmission. However, no such activities were noted to be taking place at the study site. In this study, the single malaria case recorded may have not been caused by the mosquitoes captured since there was no female *An. gambiae* captured. The absence of *Anopheles* mosquito results in a decrease in malaria transmission. Although a study has proven the ability of *Plasmodium* spp. to adapt to new vectors, and current ecological changes caused by humans can promote the adaptation of human-infectious *Plasmodium* parasites to *Culicines* [1]; the same study concluded that *Culicine* mosquitoes do not transmit the malaria parasite.

The burgeoning status of insecticide resistance is a significant barrier to eliminating malaria [14]. This is a noteworthy assertion since some of the *Culex* mosquitoes were collected from houses that were using insecticide-treated nets. This poses a major threat to the malaria control program since this could indicate that there are insecticide-resistant strains of *Culex* mosquitoes at the study site.

The time frame for the study was quite short and was conducted only during the dry season. This makes it difficult to discuss concretely the dynamics of the malaria vector.

## CONCLUSION

The malaria prevalence in the study site was low and no *Anopheles* mosquitoes was found. The majority of mosquito species present in the locality was *Culex* with a few *Aedes*. More studies on *Culex* and *Aedes* mosquitoes should be carried out in Adenta Municipality to investigate their role in the transmission of other infections. A similar study should also be repeated during the rainy season to investigate the seasonality of the *Anopheles* mosquito in the area.

## DATA AVAILABILITY STATEMENT

All data regarding this research can be made available upon request.

## ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Ethic clearance for this study was obtained from Radford University College ethical and protocol review committee prior to data collection and consent to participate was obtained from each participant before recruiting into the study.

## CONSENT FOR PUBLICATION

Not applicable



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