ACTA SCIENTIFIC MEDICAL SCIENCES

Volume 3 Issue 3 March 2019

Research Article

The Pattern of Malaria Infection in and Around the Kwame Nkrumah University of Science and Technology (KNUST) Campus

E Akowuah[1,2] and K Nsiah[1]

[1]*Department of Biochemistry and Biotechnology, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana*

[2]*Kumasi Centre for Collaborative Research in Tropical Medicine, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana*

***Corresponding Author:** Emmanuel Akowuah, Kumasi Center for Collaborative Research in Tropical Medicine, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.

Received: February 07, 2019; **Published:** February 20, 2019

Abstract

Malaria is a common parasitic infection endemic in Ghana. It is one of the most commonly requested laboratory tests in hospitals. This study investigated the pattern of malaria tests in a clinical biochemistry laboratory in KNUST campus. The study participants were walk-in patients who visited the Laboratory in 2017. The CAn Lab is open to the university community and surrounding areas and performs some laboratory diagnostic tests. From the panel of tests that were undertaken in the laboratory in 2017, the data on malaria tests was extracted for statistical analysis, using SPSS, version 21. The data reveals that 1,990 patients had the malaria test in 2017. The test was done according to the CDC's protocol on laboratory testing for malaria parasites. Out of the 1,990 patients 939 (47.2%) had no malaria, 1,030 (51.75%) were reported as having +, 20 (1%) had++, only 1(0.05%) was +++ and no one was reported to have ++++. The month in which the highest number of malaria test was performed was November, followed by June. The month with the lowest test was September. The month with the highest malaria positive cases (70.8%) was January, while June recorded the lowest incidence (36.1%). The study confirms the endemicity of malaria in the university community.

Keywords: Malaria; CAn Lab; KNUST; Parasites; Incidence

Abbreviations

KNUST: Kwame Nkrumah University of Science and Technology; CAn Lab: Clinical Analyses Laboratory; CDC: Center for Disease Control.

Introduction

Malaria is a common life-threatening disease, caused by parasitic protozoans that are transmitted through the bites of infected female Anopheles mosquitoes [17]. The female mosquitoes, unlike the males feed on blood, usually at night [3]. Specifically, it is the genus *Plasmodium,* comprising mainly *Plasmodium falciparum* (common in Africa), *P. malariae, P. vivax, P. ovale* and less commonly *P. knowlesi* [13]. Upon infection, the commonly experienced symptoms that appear after 8-25 days, are usually headache, fever, chills and joint pains [9]. These symptoms are as a result of the release of merozoites from red cells when they are infected with sporozoites from mosquitoes [15]. The disease is widespread in the world but found mostly in tropical and sub-tropical regions [5]. According to the World Malaria Report (2017), 90% of the 216 million cases of malaria worldwide occurred in the WHO African region.

Due to its endemicity, it is one of the top three reasons patients visit the hospital, but in Ghana, it is the number one reason [21]. Ghana, as a developing African country experiences this disease; in the year 2016 the country recorded approximately 26,922 suspected cases of malaria daily in health facilities [19]. Despite the considerable progress made in malaria eradication, showing a significant reduction from 27% to 21% from 2015 to 2016 [16], the burden of the disease is still high. It is currently part of the six major killer diseases in Ghana. The occurrence of malaria is promoted by conditions that tend to favour the creation of high mosquito breeding sites. The location of the town or community, the design of houses and the level at which anti-mosquito measures are used, all

influence the degree to which people get exposed to the infection, as hygienic places or communities have less cases of malaria [11].

In spite of the vast data collected on malaria prevalence in Ghana, its occurrence or incidence in an academic or highly educated community in the country is scanty. The Kwame Nkrumah University of Science and Technology (KNUST) is the largest public university in the Kumasi Metropolis of Ashanti, Ghana and had a student population of approximately 42,590 in 2016 [20]. The institution has a number of health facilities, including the University Hospital, Student Clinic, Kumasi Center for Collaborative Research (KCCR), the Clinical Analyses Laboratory (CAn Lab) of the Department of Biochemistry and Biotechnology, etc., all collaborating to offer effective health care and research.

The CAn Lab located at the KNUST commercial area serves as a medical laboratory and research center. It assists patients and other clients in various laboratory tests. The objective of this study was to find the pattern of malaria tests in 2017.

Materials and Methods

Study locale

The study was carried out at the Kwame Nkrumah University of Science and Technology in the Kumasi Metropolis, in the Ashanti Region, Ghana and located on the geographical coordinates; 06º41'5.67"N 01º34'13.87"W/6.6849083ºN 1.5705194ºW [20]. It is the largest public university in the Kumasi Metropolis.

Data collection

Monthly data of malaria tests for 2017 was retrieved from the database of the CAn Lab. The participants from whom the data was obtained were patients or persons who visited the Lab for malaria test in the year 2017. These walk-in persons included lecturers, students, other staff members in the University, workers in and around KNUST commercial area (ie. bankers, hawkers, retailers, etc) and referral cases from the University Hospital.

Sample preparation

Capillary blood samples were collected on sterile labeled slides by making an incision on the middle finger, using a lancet. For others, venous blood was taken and drops of blood were used to make a thick smear on the slide.

Staining

The blood-smeared slide was air-dried and stained with a working Giemsa stain (prepared 1:10 with phosphate buffered water of pH 7.2 from the stock solution) for 10mins. It was washed afterwards with distilled water and air dried.

Microscopy examination

The dried stained slide was examined for malaria parasites microscopically with a light microscope using ×100 objective lens after a drop of immersion oil was added to it. Two experienced laboratory technicians examined the slides.

Reporting format

No malaria parasites seen in at least 100 fields - No malaria parasites seen.

1 - 10 malaria parasites seen in 100 fields - malaria parasites present (+)

11 - 100 malaria parasites seen in 100 fields - malaria parasites present (++)

1 - 10 malaria parasites seen in every field - malaria parasites present (+++)

More than 10 malaria parasites seen in every field - malaria parasites present (++++)

Results and Discussion

Results

Classification of malaria cases in 2017

Table 1 shows that 1,990 people had the malaria test in the year 2017 and classifies the number of patients who were negative and positive in each month, according to the reporting format. November recorded the highest number of patients (195) and September the lowest (131).

Trend of malaria positive cases

Table 2 shows the monthly incidence of malaria in 2017. The highest incidence of malaria occurred in January (70.8%), followed by 64.4 in March, while the lowest was in June (36.1%), followed by 39.8% in December.

Classification of malaria intensity

Figure 1 gives a chart of the classification of malaria results for the year 2017. A total number of 1,990 patients tested for malaria

MONTH	Total number of patients	No malaria parasites seen	(+) Present	(++) Present	(+++) Present	(++++) Present
January	144	42	101	1	0	0
February	169	63	105	1	0	0
March	152	54	95	2	1	0
April	160	82	77	1	0	0
May	173	77	92	4	0	0
June	191	122	65	4	0	0
July	163	82	80	1	0	0
August	187	105	80	2	0	0
September	131	55	75	1	0	0
October	172	73	97	2	0	0
November	195	92	103	0	0	0
December	153	92	60	1	0	0
Total	1990	939	1030	20	1	0

Table 1: Classification of malaria positive patients and malaria negative patients for 2017.

MONTH	Total number of patients	No. of malaria positives	% of malaria incidence
January	144	102	70.8
February	169	106	62.7
March	152	98	64.4
April	160	78	48.7
May	173	96	55.5
June	191	69	36.1
July	163	81	49.7
August	187	82	43.8
September	131	76	58.0
October	172	99	57.5
November	195	103	52.8
December	153	61	39.8

Table 2: Incidence of malaria cases.

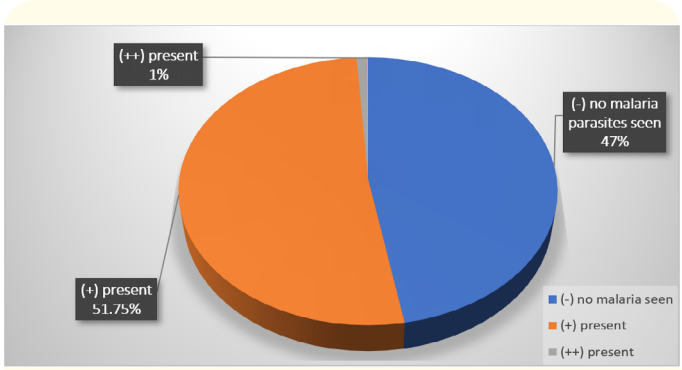

Figure 1: Classification of malaria test results for 2017.
Not seen: No malaria parasites seen in 100 fields
(+) Present: 1-10 malaria parasites seen in 100 fields
(++) Present: 11-100 malaria parasites seen in 100 fields
(+++) Present: 1-10 malaria parasites seen in every field

out of which 939 (47.2%) had no malaria, 1,030 (51.75%) were reported as having + malaria parasites present, 20 (1%) as ++, only 1(0.05%) as +++ and no one was reported to have ++++.

Discussion

Malaria incidence is predominant in tropical and sub-tropical areas where there is high sustainability and reproduction of the female Anopheles mosquito [7]. Several studies have also associated the incidence of malaria with environmental factors, seasonal changes, transmission intensity and other climatic variables [2]. Malaria in Ghana is known to be associated with excessive rainfall and warmer temperatures, usually accounting for the intense malaria incidence from April to September [1], a finding which agrees with a study in Kenya [12].

Malaria reporting format used for this particular study was the "plus system". However, according to the WHO malaria microscopy SOP (MM-SOP-06B), parasite intensity (parasitaemia) is quantified by counting both sexual and asexual parasites-infected erythrocy-

tes and a standard 200 leucocytes in 100 microscopic fields, relating it to a pre-determined number of WBCs at an average of 8000/µl. (ie. No. of parasites/µl = No. of Parasites/No. of WBCs counted) × 8000) [16]. If 200 leucocytes are counted, the number of parasites counted to that point is multiplied by 40 and the results recorded as No. of parasites/µl of blood. This method of reporting is usually for research purposes and considered more effective, as compared with the "Plus system". For the purpose of this study, the plus system was used because it is readily assessible and easy to interpret to/by patients.

It was observed that November recorded the highest number of test frequency, followed by June. The least number of tests was seen in September, followed by January (Table 1). Despite June having recorded the second highest test frequency, it recorded the most malaria- negative results. The opposite could be said in the month of January as it recorded the second lowest number of tests, but had the highest percentage of malaria cases. In Ghana, malaria incidence has been documented to be high in heavy rainy months, specifically from May to August, possibly due to high mosquito breeding sites [22]. Contrarily, it was seen that in the University community, even though the number of tests in June was very high, it recorded the lowest malaria incidence, whilst in non-rainy months, though less cases were recorded, higher percentage of malaria positive cases were seen, as in January and March, where the highest incidence rates occurred (Table 1).

It has to be noted that during the rainy season, there could be the transmission of other infectious diseases that produce symptoms similar to malaria. Due to the probable multiple nature of infections, the tendency to obtain positive malaria tests gets lower. On the other hand, in the dry season, the transmission of other infections would be low, so most persons with symptoms are more likely to have malaria. The highest incidence of malaria was in January (70.8%), followed by March (64.4%) and then February (62.7%) (Table 2). All these months are in the dry season. Another factor that could have influenced the malaria test results could be the unhealthy practice of taking anti-malaria drugs without prescription. Such persons would have low parasite densities that cannot be detected by the malaria test. From our findings, there was also low incidence in December (Table 1). The dry season begins in December but intensifies in January. Based on the explanation given for the high incidence of malaria in January, the lower level in December is not unexpected, except that the margin of difference between the two months is too high. December is vacation period and it is for celebration of Christmas, there is less crowding, as lecturers, other staff of the university are less burdened and workers around close earlier than usual. It is however noted that crowding increases the burden of malaria by increasing the density and proximity of both infected and susceptible people [8]. This could explain why the university community was less susceptible to malaria in December. Early January, the university is back in session [18]. The increase in number in the university community when the university returns from vacation, increases wastes, littering and possibly stagnant waters which are all contributory factors to mosquito-breeding. Furthermore, the in and out movement between places can increase people's exposure to malaria, especially in a malaria-endemic areas [14]. These might be why there is high malaria incidence in early months of the semesters.

It is of interest to note that the lowest incidence of 36.1% was in June, in the rainy season. This was followed by the incidence of 39.8% in December, in the dry season. What these findings imply is that the conditions of the weather cannot be the sole determinant of the incidence of malaria; other factors need to be considered.

Even though most persons who came for the test complained of malarial-like symptoms, 47.2% of the total population were negative for the test, despite their complaints. A febrile condition like typhoid fever which is also endemic in Ghana might have been the origin of their symptoms. According to [4], there is a considerable overlap of signs and symptoms of malaria and typhoid fever and have led to misdiagnosis of many febrile patients [6]. It could also be possible that some patients may have already started anti-malarial treatment prior to testing whilst others come to test after completing the course of an anti-malarial drug, of which the results will be negative. Furthermore, a study stated that light microscopy (used in this study) underestimates the prevalence of infection with *Plasmodium* spp., particularly in detecting low-density infections and so it could be possible that the results may have been underestimated [10].

The combined percentage of subjects who had + and ++ was 52.8% (Fig.1). According to the reporting format, such levels of classification of malaria means the subjects are not severely infected. The only severe malaria case recorded occurred in March, and this can clearly be considered as an outlier. The KNUST as an institution has many educated and enlightened people in its jurisdiction, so most of them are conscious of their health and report to hospital or get tested even at the slightest discomfort they feel. The incidence of severe malaria was not experienced, obviously because of early diagnosis due to the availability of a diagnostic labora-

tory like the CAn Lab. This laboratory is not attached to a hospital, so it does not encounter patients with serious cases of malaria. All the cases of malaria are from persons who walk into the laboratory. Such persons are less likely to have more than ++ classification. It is however, possible to come across few cases of some immune-competent persons who could be more than ++.

Conclusion

The malaria incidence in and around KNUST campus is high, accounting for 52.8%, but there was no severe infection due to early diagnosis and treatment. The incidence of malaria was highest in January, in the dry season, while the lowest incidence was 36.1% in the rainy season. The implication from this finding is that the weather conditions cannot be the sole determinant of the spread of malaria infection. Factors like co-infection, prior treatment with anti-malarials and low parasite density, could be at play. This is the records of malaria in only one year, 2017. It is recommended that the pattern should be found for many more years for comparison and more convincing deduction.

Acknowledgement

We acknowledge all the laboratory staffs at CAn Lab, KNUST especially Mr. Frank Agyemang Bonsu for the intense support given towards the completing of this particular research.

Conflict of Interest

We declare that we have no competing interests regarding the publication of this study.

Bibliography

1. Akpalu W and Codjoe SNA. "Economic analysis of climate variability impact on malaria prevalence: the case of Ghana". *Sustainability* (Switzerland). 5.10 (2013): 4362-4378.

2. Alemu A., *et al*. "Climatic variables and malaria transmission dynamics in Jimma town, South West Ethiopia". *Parasites and Vectors* 4 (2011).

3. Arrow KJ., *et al*. "Saving lives, buying time: Economics of malaria drugs in an age of resistance. Institute of Medicine (US) committee on the economics of anti-malarial drugs". National Academics press (US) (2004): 141.

4. Birhanie M., *et al*. "Malaria, Typhoid Fever, and their coinfection among febrile patients at a rural health center in Northwest Ethiopia: A Cross-Sectional Study". *Advances in Medicine* 2014 (2014).

5. Caraballo H. "Emergency department management of mosquito-borne illness: Malaria, dengue, and west nile virus". *Emergency Medicine Practice* 16.5 (2014): 1-23.

6. Cheesbrough M. "District Laboratory Practice in Tropical Countries (Part1)", Cambridge University Press, Cambridge, UK, 2nd edition (2006).

7. Darkoh EL., *et al*. "A weather-based prediction model of malaria prevalence in Amenfi West District, Ghana". *Malaria Research and Treatment* (2017): 7820454.

8. Defo BK. "Epidemiology and control of infant and early childhood malaria: A competing risks analysis". *International Journal of Epidemiology* 24 (1995): 204-217.

9. Fairhust RM and Wellems TE. "Plasmodium species (malaria): Principles and practice of infectious diseases, 7th Ed., Philadelphia, Pennsylvania; Churchill livingstone/ Elsevier (2010): 3437-3462.

10. Fried M., *et al*. "Diagnosing malaria in pregnancy: an update". *Expert Review of Anti-infective Therapy* 10 (2012): 1177-1187.

11. Greenwood BM. "The microepidemiology of malaria control". *The Royal Society of Tropical Medicine and Hygiene* 83 (1989): 25-29.

12. Mbogo CM., *et al*. "Spatial and temporal heterogeneity of Anopheles mosquitoes and Plasmodium falciparum transmission along the Kenyan coast". *The American Journal of Tropical Medicine and Hygiene* 68 (2003): 734-742.

13. Mueller I., *et al*. "Plasmodium malariae and Plasmodium ovale-the bashful malaria parasites". *Trends in Parasitology* 23.6 (2007): 278-283.

14. Prothero RM. "Disease and mobility: A neglected factor in epidemiology". *International Journal of Epidemiology* 6 (1977): 259-267.

15. Steketee RW., *et al*. "Malaria parasite infection during pregnancy and at delivery in mother, placenta, and newborn: efficacy of chloroquine and mefloquine in rural Malawi". *American Journal of Tropical Medicine and Hygiene* 55 (1996): 24-32.

16. World Health Organization. Basic malaria microscopy. Part I. Learner's guide. Second edition. Geneva (2016).

17. World Health Organization. Malaria fact sheet N"94 (2018).

18. https://www.myjcr.com/notices/knust-notices/knust-20172018-academic-calender-first-semester/

19. https://mobile.ghanaweb.com/GhanaHomepage

20. https://en.m.wikipedia.org./wiki/Kwame-Nkrumah-University-of-Science-and-Technology

21. https://www.ghanahealthservice.org/ghanamalariabulletin

22. https://www.ghanaweb.com/GhanaHomePage/features/high-transmission-of-malaria-during-rainy-seasons

Volume 3 Issue 3 March 2019