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Malaria Prevalence and Haemoglobin Level Assessment among Patients Attending a Healthcare Facility in North Central Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. Authors CAO, AQAO, RNNO and ICJO designed the study and managed the analyses of the study. Authors SSE and EOU performed the statistical analysis, wrote the protocol and the first draft of the manuscript. Authors ICE, SCH and HUY managed the literature searches. All authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

Aim: This study was carried out to assess malaria prevalence and haemoglobin (Hb) level among patients attending a healthcare facility in Abuja, North Central Nigeria.

Methodology: Study Design: Malaria parasite infection among the patients was determined by microscopy while the Hb levels was determined using the Mission Haemoglobin test meter. A total of 550 patients who came for consultation at the outpatient clinic of the hospital and whose written informed consents were obtained were randomly recruited for the study. This comprised of 288 adult males and 262 non-pregnant adult females.

Place and Duration of Study: The study was carried out at the Outpatient Clinic of Gwarinpa General Hospital, a healthcare facility in Abuja, North Central Nigeria. The study was conducted from March 2019 to May 2019.

Results: The overall malaria prevalence was 60.6%. The prevalence was significantly different both by age and gender ($P < 0.05$). In adult males the malaria prevalence was 64.2% while it was 56.5% in non-pregnant adult females. The mean Hb level among malaria positive patients was10.3g/dL while it was 12.5 g/dL among malaria negative patients. The mean Hb level in malaria positive adult males was 9.7 g/dL while it was 13.8 g/dL in malaria negative adult males. Also the mean Hb level in malaria positive non-pregnant females was 9.2 g/dL while it was 12.3 g/dL in malaria negative non-pregnant females. Pearson's correlation analysis showed that there was a significant difference at the 0.05 level.

Conclusion: It was concluded from the results of this study that malaria parasite infection if not confirmed by malaria test and treated promptly may lower haemoglobin levels and lead to anaemia in affected patients.

Keywords: Malaria; infection; plasmodium; prevalence; haemoglobin; anaemia.

1. INTRODUCTION

Malaria is a fatal insect-borne tropical disease that continues to pose public health challenges globally and is a major cause of mortality, especially in areas where it is endemic [1,2,3,4,5]. Malaria is caused by five species of *Plasmodium* with *Plasmodium falciparum* being the major cause of malaria cases which still poses a threat to the lives of millions in the tropics [6]. *Plasmodium falciparum* accounted for about 99.7% malaria cases in the World Health Organization African region in 2018 [5]. It remains a major public health problem and in Nigeria it is estimated that about two-thirds of the more than 60 million of its population are constantly exposed to malaria [1]. Haemoglobin is the part of red blood cells responsible for carrying oxygen in the body. The level of haemoglobin in the blood is very important as levels below normal is an indication that a person has low Red Blood Cell check which may lead to iron deficiency anemia and may cause serious health challenges to the patient. Polycythermia on the other hand is a condition where the Red Blood Cell check is higher than the normal level and also has its health implications [7,8].

It has been reported that malaria is a major cause of anemia in tropical countries where the disease is endemic [8]. The prevalence of anaemia due to malaria parasite infection is dependent on the intensity of transmission which is determined by various factors including the biting habits of the prevalent mosquito vectors [9]. Blood stage malaria parasites are responsible for malarial disease that might cause anaemia and other health challenges [7]. During the blood stage of the malaria parasite development, malaria trophozoites digest haemoglobin which affects the haemoglobin level in the blood leading to anemia [10]. Recent studies have reported an increasing incidence of resistance of the malaria parasite to currently used antimalarial drugs [11,12,13,4]. According to a recent study, the resistance of malaria to current malaria therapy causes recurrence of infections which has been reported to increase the prevalence and severity of anaemia caused by malaria [8].

2. MATERIALS AND METHODS

2.1 Study Area

This study was conducted at the General Outpatient Clinic of Gwarinpa General Hospital located a little north-west of Abuja, the Federal Capital of Nigeria. It has a latitude of 9.067318°N and a longitude of 7.39826°E. It lies on 492 m above sea level with an average annual temperature of 25.7°C and rainfall of 1378 mm.

Most of the rain is experienced in the month of September with an average of 282 mm. December is the driest month having about 1mm of rain. April is the warmest month with an average temperature of 28.5°C while August with an average temperature of 23.9°C has the lowest temperature of the year.

2.2 Study Population and Duration

Adult male and non-pregnant female patients attending the outpatient clinic of Gwarimpa General Hospital Abuja, Nigeria, who gave their written informed consents were enrolled in the study. The criteria for inclusion in the study were fever or a history of fever in the 24 to 48 hours preceding presentation. Patients who had ingested antimalarial drugs in the 24 to 72 hours preceding presentation were excluded from the study. A total of 550 patients whose written consents were obtained participated in this study. This comprised of 288 adult males and 262 non-pregnant adult females. The study was conducted from the months of March to May 2019.

2.3 Sample Collection and Laboratory Analysis

2.3.1 Collection of blood samples

For the blood samples collection, patients who had taken or ingested antimalarial drugs 24 to 72 hours before the research were excluded from those selected for the study. This was done in order to avoid the effect of such drugs on the result of the malaria tests of the samples. Collection of blood samples to be used for the study was by venipuncture.

2.3.2 Preparation of blood films

This was carried out following the methods described by Cheesbrough 2006 [14]. For the thin film, a small drop of blood was placed on the center of a grease free microscope slide and spread using a slide spreader to produce a thin film which was fixed with methanol for 2 minutes. For the thick film, a larger drop of the blood sample was placed on a grease free microscope slide and then spread with a plastic bulb pipette to produce a thick smear, both of the films were allowed to air dry and then stained with 10% Giemsa stain and allowed to stand for 10 minutes. The stain was washed away and the slides were placed facing up in a draining rack to dry.

2.4 Statistical Analysis

Data from the results were statistically analyzed using SPSS (version 20.0). Comparisons between populations, malaria infection and anaemia were made using Chi-Square analysis with an alpha value of $P < 0.05$ denoting a statistically significant difference. Relationship between age and haemoglobin level was analyzed using Pearson's correlation.

3. RESULTS

A total of 550 patients whose consents were obtained participated in this study. This comprised of 288 adult males and 262 non-pregnant adult females. The overall malaria prevalence was 60.55% (Fig. 1) and was significantly different both by age and gender ($p < 0.05$). The number and percentage of malaria positive and negative patients in the different age groups and the prevalence of malaria among the patients is shown in Table 1. In adult males the malaria prevalence was 64.2% while it was 56.5% in non-pregnant adult females. Malaria positive and malaria negative patients according to gender are shown in Table 2. Percentage malaria positive and malaria negative patients according to gender are shown in Fig. 2. The percentage Malaria positive and malaria negative patients according to gender are shown in Fig. 2.

Table 1. Malaria positive and negative patients according to age

Age	No. Examined (%)	No. Positive (%)	No. Negative (%)
18-27	118 (21.45)	79 (27.72)	39 (17.97)
28-37	117 (21.27)	72 (21,62)	45 (20.74)
38-47	106 (19.27)	63 (18.92)	43 (19.82)
48-57	107 (19.46)	61 (18.32)	46 (21.19)
58-67	102 (18.55)	58 (17.42)	44 (20.28)
Total	550 (100)	333 (60.55)	217 (39.45)

X^2 Cal = 3.27; X^2 tab = 9.49; df =1

Table 2. Malaria positive and negative patients according to gender

Gender	No. Examined (%)	No. Positive (%)	No. Negative (%)
Male	288 (52.36)	185 (55.56)	103 (47.47)
Female	262 (47.64)	148 (44.44)	114 (66.36)
Total	550 (100)	333 (60.55)	217 (39.45)

X^2 Cal = 3.48; X^2 tab =3.84; df = 1

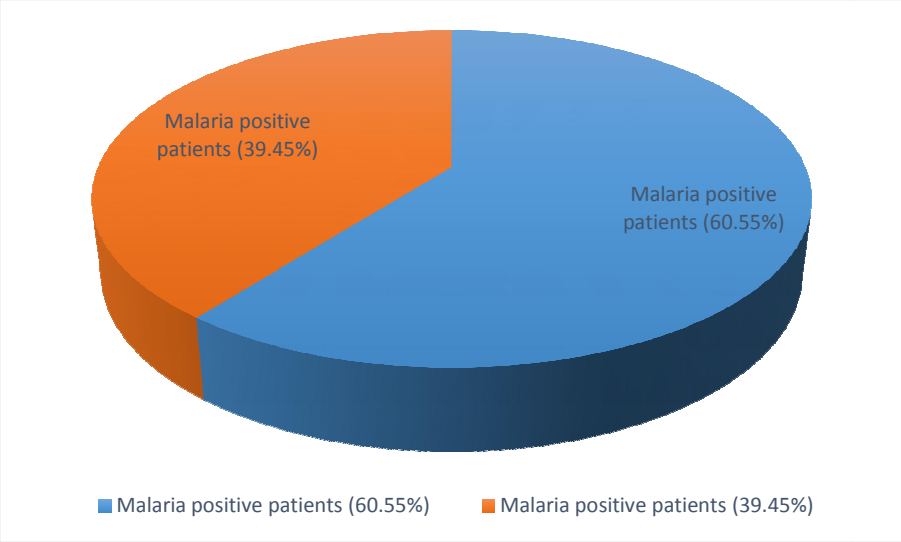

Fig. 1. Percentage malaria positive and malaria negative patients and malaria prevalence

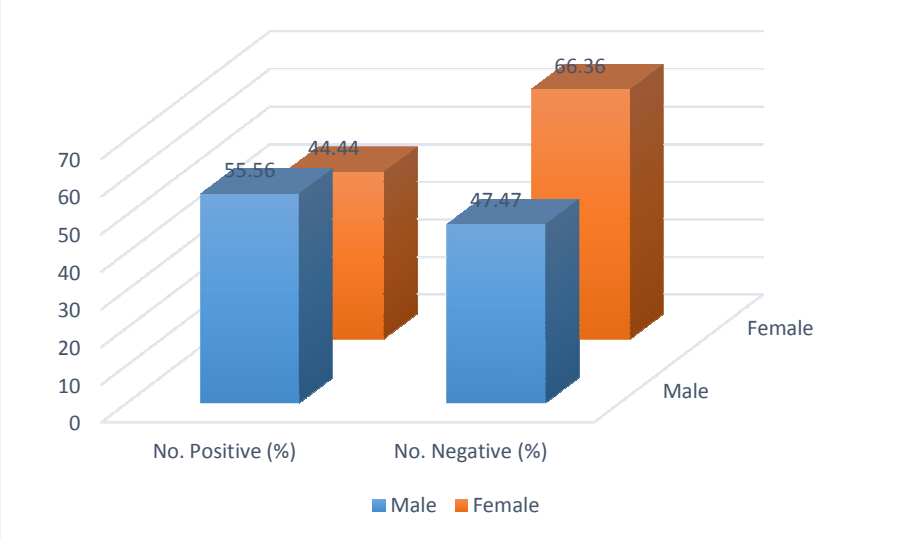

Fig. 2. Percentage malaria positive and negative patients according to gender

The mean Hb level among malaria positive patients was 10.3 g/dL while it was 12.5 g/dL among malaria negative patients. The mean Hb levels in malaria positive and negative patients in the different age groups are shown in Table 3. The mean Hb level in malaria positive males was 9.7 g/dL while it was 13.8 g/dL in malaria negative males. Also the mean Hb level in malaria positive females was 9.2 g/dL while it was 12.3 g/dL in malaria negative females. The mean Hb level in malaria positive and negative patients according to gender are shown in Table 4. Percentage mean Hb level in malaria positive and negative patients according to gender are

shown in Fig. 3. The relationship between age and haemoglobin level was determined using Pearson's correlation. There was a significant difference between age and haemoglobin level at 0.05 level (2-tailed) as shown in Table 5. Percentage mean haemoglobin level in malaria positive and negative patients according to gender are shown in Fig. 3.

Table 3. Mean Hb level in malaria positive and negative patients according to age

Age	No. Positive (Mean Hb level in g/dL)	No. Negative (Mean Hb level in g/dL)	Total
18-27	79 (9.6)	39 (13.8)	118 (23.4)
28-37	72 (11.8)	45 (13.2)	117 (25.0)
38-47	63 (11.6)	43 (12.8)	106 (24.4)
48-57	61 (9.1)	46 (12.5)	107 (21.6)
58-67	58 (9.5)	44 (10.1)	102 (19.6)
Total	333 (51.6)	217 (62.4)	550 (114.0)

X^2 Cal = 0.43; X^2 tab = 9.49; df = 4

Table 4. Mean Hb levels in malaria positive and negative patients according to gender

Gender	No. Positive (Mean Hb Levels g/dL)	No. Negative (Mean Hb Levels g/dL)	Total (Mean Hb Levels g/dL)
Male	185 (9.7)	103 (13.8)	288 (23.5)
Female	148 (9.2)	114 (12.3)	262 (21.5)
Total	333 (18.9)	217 (26.1)	550 (45.0)

X^2 Cal = 0.01; X^2 tab = 3.84; df = 1

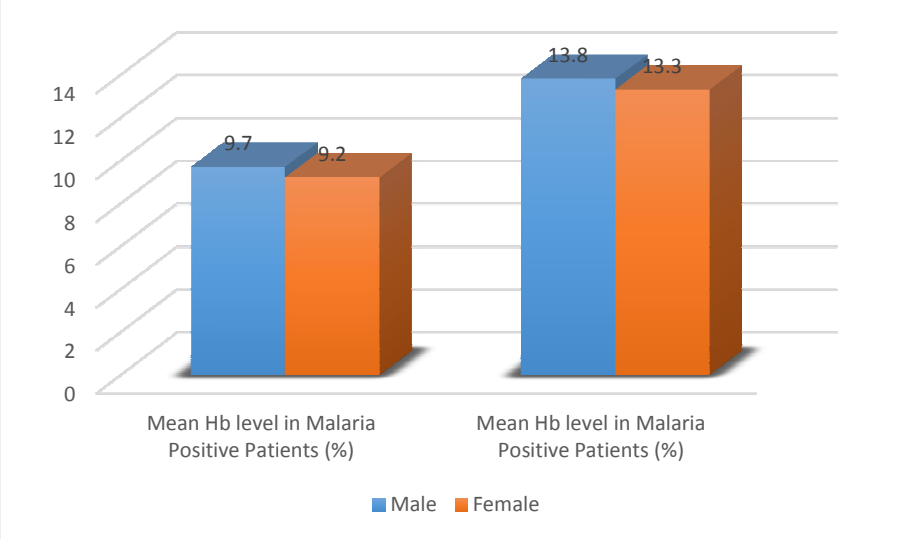

Fig. 3. Percentage mean Hb level in malaria positive and negative patients according to gender

Table 5. Pearson's correlation for Age vs Hb level of the patients

Correlations			
		AGE	HB
AGE	Pearson Correlation	1	-.934*
	Sig. (2-tailed)		.020
	N	5	5
HB	Pearson Correlation	-.934*	1
	Sig. (2-tailed)	.020	
	N	5	5

**. Correlation is significant at the 0.05 level (2-tailed).*

4. DISCUSSION

The prevalence of 60.6% obtained in this study was higher than that earlier reported by Noland et al. 2014 in Abia and Plateau States of Nigeria (36.1% and 36.6% respectively) [15]. It was also higher than the prevalence reported by Otuu et al. 2019 (54.31%) among persons seeking treatment from private drug retailers in North Central Nigeria [4]. Nnamonu et al. 2020 reported a lower prevalence of 43.3% in rice farm settlements, South East Nigeria [16]. Jenkins et al. 2015 reported a lower prevalence of 28.1% in adult patients in malaria endemic area of Kisumu County, Kenya [17]. A lower prevalence of 22% was reported by Njuguna et al. 2016 among febrile patients seeking clinical care at an outpatient health facility in Nairobi, Kenya [18]. Eke et al. 2018 reported a higher prevalence of 69.19% among patients attending General Hospital Minna, North Central Nigeria [3]. A prevalence of 65.5% which was higher than that of this study was reported in a cross-sectional study in a semi-rural Nigerian Medical Centre in Jigawa State by Michael et al. 2019 [19]. Sam Wobo et al. 2014 also reported a higher prevalence of 71.1% in Primary Health Facilities attendees in Ogun State, South Western Nigeria [20]. The prevalence in this is similar to that reported by Dawaki et al. 2016 (60.6%) in Hausa communities in Kano, North Western Nigeria [21]. The prevalence of malaria in this study was higher in male participants (64.2%) than the female participants (56.5%). This agrees with the studies of Jenkins et al. 2015 with 24.1% malaria prevalence in males compared to 32.3% in females [16] and Sakzabre et al. 2020 with prevalence of 30.93% in males as compared to 69.07% in females [22].

The World Health Organization classification of Haemoglobin levels was used to determine whether the haemoglobin level of each patient in the study was within the normal range or not. The World Health Organization classifies normal Hb levels as 13 g/dL in adult males and 12 g/dL in non-pregnant adult females. In this study, haemoglobin levels below 13 g/dl in adult men and below 12 g/dl in non-pregnant adult women were regarded as being below the normal threshold levels. The mean Hb level in malaria positive males was 9.7 g/dL while it was 13.8 g/dL in malaria negative males. Also the mean Hb level in malaria positive females was 9.2 g/dL while it was 12.3 g/dL in malaria negative females. This result indicates lower Hb levels in malaria positive patients compared to malaria negative patients which may be due to the destruction of red blood cells by the malaria parasite in malaria positive patients. This agrees with the results of Ajibola et al. 2012, Moore, et al. 2008 and Noland et al. 2014 who reported destruction of red blood cells and lowered haemoglobin levels in malaria positive patients [23,10,15] and Sakzabre et al. 2020 who reported anaemia as one of the haematological abnormalities in malaria infected patients [22].

According to Mockenhaupt et al. 1999 [24], acute malaria attacks, chronic and repeated *Plasmodium falciparum* infections are some of the factors that lead to varying degrees of anaemia in malaria endemic regions of the world. They also reported an association between Plasmodium falciparum infection and low haemoglobin levels which they considered as the most significant manifestation of malaria apart from parasitaemia. In a study by Kotepui et al 2014 [25] on the effect of malaria infection on haematological parameters in populations near Thailand-Myanmar, haemoglobin was among the parameters that was significantly low in malaria infected-patients. In a research by Lombardo et al 2017 [26], the results suggested that if an association between haemoglobin and malaria exists, this would be in favour of increased risk of malaria and low haemoglobin levels. Osaro et al 2019 [27] in their study on some haematological parameters of pregnant women in Sokoto, North Western Nigeria, also reported a significant decrease in haemoglobin levels in malaria infected patients compared to non-infected ones.

5. CONCLUSION

In conclusion, the relationship between malaria parasite infection and haemoglobin level in adult male and non-pregnant adult female subjects was investigated. There was a statistically significant difference between malaria infection and haemoglobin level with subjects positive for malaria infection having low haemoglobin levels compared to malaria negative subjects. Pearson's correlation analysis also revealed a significant difference between age and haemoglobin level. From the results of this study, it was concluded that malaria parasite infection if untreated may lower haemoglobin levels and lead to anaemia in affected patients with the resultant negative health outcomes.

CONSENT

As per international standard or university standard written patient consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

Ethical approval and permission for this study was obtained from the Research and Ethics Committee (REC) of the Gwarimpa General Hospital, Abuja, Nigeria with REC Approval Number 11/02/2019-30/06/2019.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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