American Journal of Infectious Diseases and Microbiology, 2020, Vol. 8, No. 1, 14-19
Available online at http://pubs.sciepub.com/ajidm/8/1/2
Published by Science and Education Publishing
DOI:10.12691/ajidm-8-1-2

Malaria Parasitaemia and Anaemia among Patients Attending a Palm Oil Plantation Hospital, Southwest Region, Cameroon

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Received December 01, 2019; Revised January 04, 2020; Accepted January 16, 2020

Abstract Endowed with extensive biological and cultural diversities, unique eco-climatic conditions and diverse topography implementing of the same malaria control measures throughout Cameroon, difficult. This study aimed to determine the prevalence of malaria in patients attending Pamol Hospital Lobe (PHL) in Lobe Estate, South West Region, Cameroon. This was a hospital-based cross-sectional study conducted at the PHL, between March and November 2014. The prevalence of malaria and anaemia were investigated in 581 patients using thick blood film and a Urit-1 systems respectively. All data obtained were analysed using SPSS 17.0. The chi-square test was used to establish the association between the prevalence of malaria and age, sex and place of residence of patients, while $P<0.05$ was considered statistically significant. The overall prevalence rate of malaria parasitaemia was 78.8% (458). The age group 10- 15 years had the highest prevalence of 80% and while 5-9 years had the least 77.6% (52). The prevalence of malaria was found not to be significantly associated with age group and gender ($\chi 2=0.200$, $P=0.978$; $\chi 2=1.425$, $P=0.233$). However, the Mean Trophozoites±SD significantly differed between males and females ($P<0.05$). Our findings indicate no significant difference between the place of residence and malaria parasitaemia. ($P>0.731$). Nearly half (49.2%) of the participants were anaemic (Hb level < 11 g/dL) while only 2.1% were severely anaemic (Hb level < 4 g/dL). The Mean Trophozoites±SD were higher in patients that were moderately anaemic (814.18±787.569), contrastingly lower in those that were severely anaemic (589.09±675.299). Malaria prevalence in the PHL remains high. The distribution of Long Lasting Insecticide Treated Nets (LLINs) should further be intensified in the communities, especially during peak malaria transmission season.

Keywords: *malaria, anaemia, prevalence, hospital-based, cross-sectional, rural areas*

Cite This Article: Bonaventure Tientche, Jerome Fru-Cho, Damian Nota Anong, and Theresa K. Nkuo-Akenji, "Malaria Parasitaemia and Anaemia among Patients Attending a Palm Oil Plantation Hospital, Southwest Region, Cameroon." *American Journal of Infectious Diseases and Microbiology*, vol. 8, no. 1 (2020): 14-19. doi: 10.12691/ajidm-8-1-2.

1. Introduction

Though the incidence rate of malaria decreased by 33% between 2010 and 2015 with a drop in mortality rate by 42% [1], malaria remains a public health concern in sub-Sahara Africa. These statistics represent significant achievements, however, major challenges remain. Sub-Sahara Africa accounts for the highest malaria burden with 90% of death [1]. Malaria in humans is caused by six *Plasmodium species*: *Plasmodium falciparum*, *Plasmodium vivax*, *Plasmodium malariae*, *Plasmodium ovale curtisi*, *P. ovale wallikeri* and *Plasmodium knowlesi* [2]. In Africa, millions of people still lack access to the tools needed to prevent and treat malarial [3]. In many countries, progress is threatened by the emergence and spread of antimalarial drug resistance, armed conflicts and mass movement of population across international boundaries that could jeopardize theses gains [4].

In some African countries, the prevalence of malaria based on hospital attendance stands at 29.8% such as in Kampala International University Teaching Hospital, Bushenyi, Western Uganda [5], 71.4% among the <20 years at Teaching Hospital Obafemi Awolowo University (OAUTHC) at Ile Ife, Osun State, Nigeria [6] and 22.5% of *P. falciparum* and 59.2% *P.vivax* among patients visiting Nekemte Hospital in Ethiopia [7].

Hospital-based data indicates that deaths from severe *falciparum* malaria vary between 10% and 40% depending on the time-lag between initial symptoms and effective treatment. In the management of malaria, early presentation to a health care facility, accurate diagnosis and prompt and appropriate treatment are fundamental components [1,8]. In the absence of treatment with effective drugs, the disease in children can progress to severe malaria and consequently death [9].

In Cameroon, approximately 97% of the estimated 23 344 179 million inhabitants are at risk of *Plasmodium* infection and more than 25% infected with malaria

parasites [1]. The *Anopheles gambiae* s.l. and *Anopheles funestus* s.l are the major vectors in Cameroon and they are highly anthropophilic, endophagy, endophily, exophily, and exophagy [10,11]. Although in Cameroon malaria is endemic nationwide, the level of endemicity greatly varies from four geographical, ecological and climatic regions: the southern equatorial forest, coastal and western plateau, the Adamawa plateau and savannah forest, the Sudano-Sahelian region [12]. The 2011 DHS-MICS in Cameroon indicated that in 2004, only 2 % of the population owned at least one insecticide treated net (ITN). However, in 2011, 50 % of children under 5 years of age 5 in urban areas were reported to have slept under an ITN the night before the survey compared with 39 percent in rural areas [13]. Malaria accounts for 49% of prenatal consultations, 59% of hospitalizations during pregnancy [12], 40 to 45% of medical consultations, and 30 to 47% of hospitalizations in Cameroon [14].

The search for a world that is free of malaria had prompted international interventions and programs meant, to end the epidemics of acquired immune-deficiency syndrome (AIDS), tuberculosis (TB), malaria and neglected tropical diseases (NTDs) by 2030, which is Target 3.3 of the Sustainable Development Goals (SDGs). Nevertheless, progress in many countries cannot be assessed due to limitations in their reported data and where a prevailing weaker surveillance system [1] hindered the collection of appropriate information on malaria epidemics. Prevalence studies and other community-based malaria surveys are important tools for assessing the impact and effectiveness of malaria control measures and programs at local and national levels [15].

However, in Cameroon, there is a scarcity of information on malaria-related morbidities at presentation in the general medical outpatient department in the country [16]. This study aimed to determine the prevalence of malaria in patients attending Pamol Hospital Lobe Estate, South West Region, Cameroon.

2. Methods

2.1. Study Area

This study took place in Ekondo Titi Subdivision which has been described elsewhere [17]. The study was conducted at the PHL at Lobe Estate. The PHL belongs to Pamol Plantations Plc. At the study time, PHL was a reference centre in the Subdivision in spite of the presence of District Hospital located at Ekondo Titi (Government 's owed institution) and several health centres. PHL is made up of a laboratory, a male ward, a female ward, a paediatric ward, a maternity ward, radiology, an outpatient department and a theatre.

2.2. Study Design and Study Population

This study was a cross-sectional hospital-based, consisting of all patients who were referred to the Laboratory Unit for confirmatory malaria diagnosis by the medical officer at the PHL, from March to November 2014. Bio-data collected from hospital records, including sex and age were used to complete a standardized case report form for each participant. Prior to blood sample collection, a written informed consent of parents/guardians was obtained.

2.3. Samples Collection

Blood was collected using finger prick as described by [18]. The finger to be pricked is swabbed 70% alcohol before collection. The samples were processed in the Hospital Laboratory and later at the Clinical Diagnostic Laboratory of the Faculty of Science, University of Buea.

2.4. Preparation and Examination of Blood Films

Thick and Thin blood smear was prepared according to the technique outlined by Cheesbrough [18] for malaria microscopy, stained with 10% Giemsa stain pH 7.2 for 45 minutes and examined microscopically using x100 objective. Microscopic analysis later conducted to determine the *Plasmodium* species. A thick film was considered negative after 100 high power fields (HPF) microscopic showed no parasites. Parasitaemia was classified as low (< 500 parasites/µl of blood), moderate (501-5000 parasites/µl of blood) and high (>5000 parasites/µl of blood) [19].

2.5. Assessment of Haemoglobin Concentration (Hb in g/dl)

Measurement of Hb was done using a URIT-1 (URIT Medical Electronic Co. Ltd, China). Blood collected by finger prick, was blotted on the test strip and immediately placed into a portable spectrophotometeric instrument. The hemoglobin value was displayed within the 15-60 seconds. Anaemia was classified according to Sumbele [16].

2.6. Statistical Analyses

All data obtained were entered into an excel sheet and exported in SPSS (version 17.0) for analysis. The chi-square test was used to establish the association between the prevalence of malaria and age, sex and place of residence of the patients while $P<0.05$ was considered statistically significant.

2.7. Ethical Approval

The ethical clearance was obtained from the South West Regional Delegation of Public Health. Informed consent was sought from patients or parent/legal guardian after details of the study was explained to them in English and pidgin language for those who could not understand English language.

3. Results

3.1. Baseline Data

In the present study, a total of 581 blood samples were collected from febrile patients and examined by microscopy. Among these, 284 (48.9%) and 297 (51.1%) were males and females respectively. The mean age of children enrolled in this study was 23.11±16.372 years

(one month–44 years). Most of the patients (Table 1) were residents of Lobe Estate Camp 359 (61.8%) and Lipenja Camp 74 (12.7%).

Table 1. Sociodemographic characteristics of the study population

Parameter	Number *n*=581 (%)
Sex	
Male	284 (48.9%)
Female	297 (51.1%)
Age	
<5years	108 (18.6%)
6-9 years	67 (11.5%)
10-14 years	40 (6.9%)
≥15 years	366 (63.0%)
Residence	
Lobe Estate Camp	371(63.9%)
Ekondo Titi	38 (6.5%)
Lipenja Camp	74 (12.7%)
Management Quarter	49 (8.4%)
Others	49 (8.4%))

Table 2. Mean (± SE) Hb (haemoglobin) in relation to age and malaria infection status

Age group (years)	Number examined	% infected (Number)	Mean Hemoglobin±SD
>5	108	77.8 (84)	11.418±8.215
5-9	67	77.6 (52)	11.29±7.384
10-14	40	80 (32)	16.779±20.568
≥15	366	79.2 (290)	16.157±73.161
Total	581	78.8 (458)	14.757±58.485
Level of significance		χ^2=0.200, *P*=0.978	F=0.281, *P*=0.839

3.2. Haemoglobin Level in Relation to Age and Malaria Infection Status

The overall prevalence was found to be 78.8 %. The result reveals that children of age group 10 to 15 years had the highest infection (80%) followed by ≥15 years (79.2%) and 0 -4 years (77.8 %) (Table 2). Mean haemoglobin ranges from 11.418±8.215 for 0- 4 years' age group to 16.157±73.161 of those ≥15 years. The mean haemoglobin concentration in the study population was 14.757±58.485. Although the Haemoglobin level increased with age, it was neither affected by age nor the malaria infection status of patients (*P* =0.978).

3.3. Levels of Parasitaemia by Sex and Age Group among the Study Participants

The gender-related levels of parasitaemia (Table 3) showed that the female had lower parasite density 52.1%(125) compare to male 61.0%(133), though this difference was not statistically significant (p=0.122). With respect to the level of parasitaemia by age group, Table 3 indicates that the majority of participants of ≥15 years 61.4% (178) had the lowest parasite density compare to participants below 15 years (41%) but this was not statistically significant (P=0.121).

Table 3. Levels of parasitaemia by sex and age group among the study participants

Parameter	Parasite density distribution per micro litre of blood			
	1-499 %(n)	500-4999 %(n)	>5000 % (n)	P-value
Sex				
female	52.1(125)	46.7(112)	1.2(3)	0.122
male	61.0(133)	38.5(84)	0.5(1)	
Total	56.3(258)	42.8(196)	0.9(4)	
Age group(years				
0-4	50(42)	48.80(41)	1.2(1)	0.121
5-9	48.1(25)	50(26)	1.9(1)	
10-14	40.6(13)	59.4(19)	00(0)	
≥15	61.4(178)	37.9(110)	0.7(2)	
Total	56.3(258)	42.8(196)	0.9(4)	

Table 4. The relationship of sex, age group, residence and anaemic status with prevalence and the mean trophozoites

Parameter	Category	N^0 examined	% infected (number)	Mean Trophozoites±SD
Sex	Male	284	76.8 (218)	585.78±669.889
	Female	297	80.8 (240)	877.37±1022.591
Total		581	78.8 (458)	738.58±883.861
Level of significance			χ^2=1.425, P=0.233	F=12.753, P=0.000
Age group (years)	0 -4	108	77.8 (84)	854.64±969.304
	5-9	67	77.6 (52)	887.31±1227.930
	10-15	40	80 (32)	1066.25±1080.865
	≥15	366	79.2 (290)	642.14±738.231
Total		581	78.8 (458)	738.58±883.861
Level of significance			χ^2=0.200, *P*=0.978	F=3.653, P=0.013
Residence	Lobe Estate Camp	371	78.2 (290)	779.17±952.819
	Ekondo Titi	38	81.6 (31)	610.97±667.649
	Lipenja Camp	74	81.1 (60)	519.00±397.879
	Management Quarter	49	73.5 (36)	806.67±947.803
Total	Others	49	83.7 (41)	809.51±951.798
		581	78.8 (458)	738.58±883.861
Level of significance			χ^2=2.027, *P*=0.731	F=1.364, P=0.245
Anemic status	Non	295	79.7 (235)	690.09±837.861
	Mild	206	76.2 (157)	795.16±991.002
	Moderate	66	83.3 (55)	814.18±787.569
	Severe	14	78.6 (11)	589.09±675.299
Total		581	78.8 (458)	738.58±883.861
Level of significance			χ^2=1.770, *P*=0.622	F=0.688, P=0.560

3.4. The Relationship of Sex, Age Group, Residence and Anaemic Status with Prevalence and Density of Asexual Stages of P. Falciparum

Prevalence of malaria parasitaemia according to the place of residence (Table 4) showed that Lipenja Camp 81.1 % (60) had the highest malaria infection, following by Lobe Estate Camp 77.8 % (84). Analysis indicated no significant difference between the place of residence and infection rate (P=0.731). Nearly half (49.2%) of the participants were anaemic (Hb level < 11 g/dL) while only 2.1% were severely anaemic (Hb level < 7 g/dL). The Mean trophozoites±SD were higher in patients that were moderately anaemic (814.18±787.569), contrastingly lower in those that were severely anaemic (589.09±675.299). Prevalence did not significantly differ between males 76.8 % (218) and females 80.8 % (240), On the contrary, the mean Trophozoites±SD was higher in females (877.37±1022.591) than in males and differed significantly.

4. Discussion

Although the national prevalence of malaria in Cameroon stands at 29.0% and might be showing a declining pattern in some parts of the country [20], in the present study, malaria statistics is still a cause for concern. The overall prevalence of malaria infection at PHL stands at 78.8%. Our findings showed that intensive malaria intervention strategies that involved distribution of antimalarial drugs at subsidized rates and distribution of long-lasting insecticide-treated nets (LLINs) are yet to result in decreasing cases of malaria in the study area.

Among a total of 581 individuals tested for malaria based on gender at PHL, *Plasmodium falciparum* was found to be more prevalent in female participants than in the male. Although this is in agreement with studies by Afolabi [21] where *Plasmodium falciparum* was found to be more prevalent in females (75%) than in males (68.8%), it, however, contradicts the findings of Mphahlele [8] and Omololu-Aso [6]. The high prevalence of malaria observed in females than in males could probably due to the fact that males are more negligent on issues relating to health. They tend to patronize drug street vendors, herbs and local concoctions, preferably spending more time drinking palm wine and other locally produced alcoholic beverages to the detriment of their health. However, frequent visit to ante-natal clinics has raise the awareness of female on the knowledge and preventive measures against malaria.

Pertaining to age-related prevalence of malarial infection in PHL, *Plasmodium falciparum* was found to be more present in individuals in the age group 10-14 years and ≥15 years than the other age grouping. Malaria is a scourge to all humanity. However, the most vulnerable (biologically at the highest risk) are infants and young children (due to their underdeveloped immunity). Our findings showed that older subjects had lower parasite densities and therefore, could probably develop less-severe clinical manifestations. Furthermore, the presence of low malaria parasites in participants ≥15 years of age could partly be due to acquired immunity [22].

Indeed, at the study site, the 2010 annual report of the Regional Malaria Control Unit, indicated that 2620 (87%) below 5 years Children and 6183 (74%) of children above 5 years were diagnosed for malaria [23]. Although our study was conducted for only 9 months (March - November), it has the merit of including a rainy season in which an increase in malaria cases in Cameroon has been observed [10]. This highlights the importance of proper diagnosis as a major tool for monitoring a malaria control program [24].

Malaria incidence varied, with a predominance in the densely populated and poor neighbourhoods such as Lipenja Camp 60 (81.1%) and Lobe Estate Camp 290 (78.2%). These two Camps are hosts of the lowest income earners of Pamol Plantations Plc. The population lives in dilapidated houses with no waste disposal system and water distribution system. Defecation is done in the nearby palm oil plantations. Besides, these camps are characterized by the presence of grasses, congestion, stagnant waters, and dirty surroundings covered with grasses and filths. Most family lives in a single overcrowded room with no ceiling housing numerous children without long-lasting insecticide-treated nets. This environment provides a wide range of breeding sites that generally favour high densities and diversity of the malaria vector. The majority of people are uneducated and have poor knowledge of the cause of malaria and therefore do not take appropriate preventive measures. These data are superimposable on that reported in 1994 by Dossou [25] in Allokokro, a village located in the wet savannah and Nkuo-Akenji [26] working in a rural community in Bolifamba. On the other hand, it was lower than the 85% rate observed in the Tai forest area by Nzeyimana [27]. The high prevalence of malaria infections in the area could largely reflect the fact that subjects were constantly exposed to infective bites of mosquitoes. The data obtained by Tanga and Ngundub [28] established that in high plantation agriculture activity areas, *Anopheles funestus* is the predominant malaria vector responsible for malaria transmission. *Anopheles funestus s.s.* is highly susceptible to human malaria parasites and has been observed to display a strong anthropophilic and endophilic biting behaviour [11].

In the present study, the burden of malaria infection was measured as a mean parasite density throughout the study period. The mean parasite densities found in the present study was higher than that of [27,28.29], and by far lower than the data recorded by Aba in Côte d'Ivoire [25].

Low parasite density could also be due to the fact that a sizeable proportion of the population does take various type of traditional medicine to fight malaria before seeking treatment from conventional health centres. In Cameroon, about a hundred phytochemicals have been isolated from 26 species some among which are potential leads for the development of new antimalarials. Crude extracts or essential oils prepared from 54 other species showed a wide range of activity on *Plasmodium* [30]. Unfortunately, most malaria cases are managed at home outside the formal health sector with herbal formulations, or drugs bought from shops, kiosks and street vendors.

Usually, anaemia is a hallmark of *P. falciparum* infection due to intense destruction of infected red blood

cells due to higher parasitaemia caused by the malaria parasite. Our findings also indicated that the mean Hemoglobin±SD (11.418±8.215) among age group of 0-4 years was far higher than the data obtained by Achidi [31] while studying severe and uncomplicated falciparum malaria in children from different regions and ethnic groups in Cameroon. We found that nearly half (49.2%) of the participants were anaemic (Hb level < 11 g/dL) while 2.1% were severely anaemic (Hb <7 g/dL) and this is in agreement with studies conducted in Mutengene [32]. The aetiology of anaemia is complex and multi-factorial. Our findings indicated no significant association between anaemia and malaria parasitaemia. This is in line with studies by Umaru [15] in patients attending General Hospital Makarfi, Nigeria, but contrast with other studies by Kimbi [20] in Cameroon. In the present study, anaemia could be attributed to other factors such as bacterial, viral infections, systemic fungal.

5. Conclusion

This study indicated that, the prevalence of malaria parasitaemia among febrile patients remains very high at PHL despite national efforts in conjunction with the global partnership to curb the disease. We observed no significant association between the level of parasitaemia and haemoglobin level among patients. The antimalarial drug should be administered only to microscopically confirmed cases of malaria. There is a need to intensify the distribution of LLINs in the study area.

Acknowledgements

The authors thank all study participants, for their participation and the lab technicians of Pamol Estate Hospital at Lobe for reading the slides.

Author Contributions

Conceived and designed the study: Bonaventure Tientche, Damian Nota Anong, Theresa K. Nkuo-Akenji: Conducted the laboratory investigations: Bonaventure Tientche, Damian Nota Anong, Jerome Fru-Cho. Analyzed the data: Bonaventure Tientche, Jerome Fru-Cho. Drafted the manuscript: Bonaventure Tientche, Damian Nota Anong, Jerome Fru-Cho, Theresa K. Nkuo-Akenji.

Competing Interests

The authors declare that they have no competing interests.

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