Comparative Study of Malaria Infections and Associated Risk Factors among Pregnant and Non-Pregnant Women in the Town of Foumbot, Western Region - Cameroon

Mounvera Abdel Azizi1, Noumedem Anangmo Christelle Nadia2*, Yamssicédric3, Sop Foka Eric Igor1, Ngongang Ouankou Christian4, Simeni Raoul4, Tsila Henri Gabriel1 and Mpoame Mbida1

1Department of Animal Biology, University of Dschang, Cameroon
2Department of Microbiology, Haematology and Immunology, University of Dschang, Cameroon
3Department of Biomedical Sciences, University of Bamenda, Cameroon.
4Department of Internal Medicine and Specialties, University of Dschang, Cameroon

Abstract

**Background:** Malaria is a major public health problem in Cameroon and is the leading cause of morbidity and mortality. This work aimed to assess the malaria situation and associated risk factors among pregnant and non-pregnant women in the town of Foumbot.

**Methods:** This was a cross-sectional study and was carried out in Foumbot sub-Division among pregnant and non-pregnant women coming for ANC and consultation respectively in three selected Health facilities. The sample size required for this study was 180 approximately for each group studied that is pregnant and non-pregnant women and a total of 400 women were recruited for the study. Blood samples of the participants were collected by finger prick for the preparation of thick blood smear and Rapid Diagnostic Test (RDTs).

**Results:** Out of 400 women examined, 108 were infected with the prevalence of 27%. The prevalence was 33.16% and 20.7% in pregnant and non-pregnant women respectively. The rates of malaria infection according to parity were 58.3% 33.3% 29.9% respectively for secundigravidae, primigravidae and multigravidae. According to the place of residence, the prevalence was 46.29% and 19.7% (rural area); 15.75% and 11.11% (urban area) for pregnant and non-pregnant women respectively. Based occupations, the rate of infection were 24.07% and 8.33% (unemployed) among pregnant and non-pregnant women respectively. Measuring the sensitivity and specificity of the diagnostic tool used for this study, Rapid Diagnostic Test was found to have sensitivity of 92.6% and specificity of 99.3%. Regarding predictive values, this study revealed 8 cases of false positive and 2 cases of false negative.

**Conclusion:** The prevalence of infection has not change apart from some false negative and false positive recorded. The study also demonstrated that malaria infection associated with pregnancy shows normal symptoms but can also characterized by absence of fever which is the main characteristic of malaria infection. As malaria infection affects the entire immune system, it becomes necessary to integrate antimalarial medication into the management of pregnancy. This will help prevent pregnant and non-pregnant women from running the risk of high parasitaemia and therefore the risk of miss carriage.

INTRODUCTION

Malaria is an infectious disease, transmitted by female Anopheles mosquito. It is afebrile and hemolytic erythrocytopathy caused by a protozoan of the genus Plasmodium that infects alternately human and mosquitoes. *Plasmodium falciparum*, which is the most deadly species of malaria infection and, is mainly transmitted in sub-Saharan Africa by *Anopheles gambiae* and *Anopheles funestus* [1]. This diseases account for more than 216 million clinical infection and 655,000 deaths in 2010 [2] and it remains the most important infection with nearly 81% of cases recorded in Africa. The Population at high risk of infection is Children under five years and pregnant women. Sub-Saharan Africa harbors about twenty-five million infected pregnant women each year and according to the World Health Organization (WHO), malaria accounts for more than 10,000 maternal deaths and 200,000 neonatal deaths per year [3].
Cameroon is located in an epidemiological zone conducive to the outbreak of malaria infection. Malaria is a major public health problem. It is the leading cause of morbidity in the country. Although there are few areas where malaria is still hyper-endemic (especially in forest areas), the level of malaria endemicity has stabilized and has become meso-endemic due to improvements in people’s lifestyle, sanitation measures and greater access to health services. In urban areas, malaria infection is hypoendemic.

The declaration of the national policy for the fight against malaria in Cameroon in 2010, indicates that malaria is responsible for: 35-40% of total deaths in hospital facilities; 50% of morbidity in children under 5 years of age; 40-45% of medical consultations; 30% of hospitalizations; 57% of hospital days; 26% of sick leave and 40% of annual household expenditure appropriately on health.

Pregnant women living in areas where malaria is endemic are particularly susceptibility to *P. falciparum* infection. This susceptibility is commonly associated with premature delivery, abortion, increased perinatal mortality and reduced birthweight. Pregnancy causes several physiological changes that make women more vulnerable, by weakening the immune system, pregnancy makes women more susceptible to malaria infection and increases their risk of illness, severe anaemia and death. In addition, infected erythrocytes of *P. falciparum* can be secreted into the intravillus spaces of the placenta, thus preventing the placenta from ensuring its function appropriately [4].

In Cameroon, as in most countries south of the Sahara, malaria is a public health problem. The disease is endemic, mainly caused by *Plasmodium falciparum*, and transmission is high [5]. However, the problem link to the coverage after free insecticide-treated net distribution interventions and its use among women persist [6]. The failure to reduce malaria morbidity and mortality levels can be explained firstly by a gap between official recommendations and the therapeutic practices of the population, i.e. the low level of adherence by the population to preventive and curative control protocols. Malaria control programs have paid little attention to social, behavioural and economic factors: “there is consensus that lack of attention to socio-cultural factors has been the main reasons for the failure of early malaria control programmes” [7]. The dramatic increase in malaria morbidity and mortality can be partly explained by the lack of consideration of social and behavioural aspects in the fight for malaria control. This work aimed to assess the malaria situation and associated risk factors among pregnant and non-pregnant women in the town of Foumbot. More specifically, to determine the prevalence and intensity of malaria among pregnant and non-pregnant women living in the town of Foumbot; to assess the reliability of the RDT compared to microscopy in the diagnosis of the disease and to determine the factors that promote malaria transmission in each group of women in the town of Foumbot.

**MATERIALS AND METHODS**

**Study site**

The study was conducted in Foumbot sub-Division found in Noun Division, West Region of Cameroon and is located 25km from the Regional and 48km from the Foumbon town. It occupies a surface area of about 579km². It is half the alluvial plain of Noun between Latitude 5°10’ and 5°35’ then Longitude 10°30’ and 10°45’ east. Foumbot is located in the so-called tropical Sudano-Guinean climatic region characteristic of the whole western region. This climate has two seasons: a rainy season from mid-March to mid-November and a dry season from mid-November to mid-March.

**Sampling method**

The study was conducted between February and April 2019 and concerned mostly pregnant and non-pregnant women who received prenatal and curative consultations respectively in the three selected Health facilities: Foumbot District Hospital, Protestant Hospital of Baïgom and a Private Hospital called Bonne Samaritaine. The sample size needed for this study was calculated according to the formula put in place by LORENZ and the estimated sample size for each group studied was approximately 198 and a total number 400 pregnant and non-pregnant women were recruited for the study.

\[
 n \geq \frac{Z^2 \cdot P \cdot q}{I^2} \quad n = \frac{1.96^2 \times 0.5 \times 0.4}{0.05^2}
\]

**Inclusion and Exclusion Criteria**

**Inclusion criteria:** Only pregnant and non-pregnant women age between 14-45years and accepted to sign the free informed consent form were included in the study.

**Exclusion criteria:** Was excluded those who do not belong to this age group and those that refused to sign the informed consent form. Also those that were under treatment with anti-malaria medications were equally excluded.

**Data collection plan**

Data collection was conducted over the period from March to April 2019. Data was collected using a structured questionnaire addressed to pregnant and non-pregnant women. The information was obtained through interview by the principal investigator. After signing the informed consent form, the participants gave a drop of blood obtained through finger prick for the determination of malaria parasite. Then the Rapid Diagnostic Test (RDT) test used in this work was 5D BIOLINE Malaria which detects the histidine rich protein II (HPR-II) antigen specific to *P. falciparum*. The choice of this test can be justified by the epidemiological profile of the disease. Indeed, in Cameroon, 98% of recorded malaria infections are due this malaria parasite [8]. Thus the thick blood smear was used for the microscopic and quantification of malaria infection.

**Parasitological test**

The Rapid Diagnostic Test (RDT) was taken out of its pouch and placed on a flat, dry surface. The test device was labeled with the patient’s code. The patient’s fingertip was cleaned with the alcohol swab and pricked on the side with a sterile single-use lancet provided in the kit using a capillary pipette or a single-use collection handle (5µl) provided, blood was drawn. The total blood collected was then transferred to the round sample well. 4 drops of diluent were added vertically to the square test well. The result was interpreted within a minimum of 15 minutes (within 30 minutes maximum):
The presence of a single colored band ("C" Control Line) in the result window indicates a negative result.

The presence of two colored bands ("P. f" Test Line and "C" Control Line) in the result window indicates a positive result, regardless of the order in which the bands appear. The test is considered positive even if the test line is pale/fine. If the control strip (Control Line "C") does not appear in the results window, the result is reported as invalid. In the latter case, the sample is reanalyzed using a new kit.

The thick drop was used for the microscopic and parasitological diagnosis of malaria. The technique was performed as follows:

The identification number was marked on each slide. The third finger of the left hand was disinfected with an alcohol swab, free of any inflammation. The excess alcohol was wiped off with dry cotton wool. The disinfected part of the finger pulp was pricked with a sterile vaccinostyle. The first drop of blood was removed with dry cotton wool. The second drop was placed in the centre of a blade. Using the angle of another blade, we proceeded to mechanical defibrination by a circular motion so that the blood was spread in a circle of about one centimeters in diameter. The marked blades were placed in collection boxes for drying, away from flies and dust.

The single-time (30 minutes) Giemsa 3% staining technique was chosen. After drying, the slides were arranged one by one in a staining tray. The Giemsa solution was poured into the tray, taking care to immerse all the slides. The thin discolouring film was removed with buffered water (pH=7.2). The slides were then rinsed with tap water and the tank was moved slightly. Finally, they were exposed to the rack for drying.

The stained, dried slides were examined under a 100 objective microscope (100 x immersion objective) in the laboratory of the District Hospital of Foumbot and the Protestant Hospital of Baigom.

Data Management and Statistical analysis

The data collected were entered into Excel 2010 and analyzed using Statistical Packages for Social Science (SPSS) software. The tests used were the Chi square and the Fisher test when the theoretical numbers are below 5. The different tests above were used to evaluate the parameters sought such as the prevalence according to age, religion, ethnicity was made by the use of the Chi square in a 95% confidence interval. The DUNCAN test was used to check for significant differences between these different parameters and the KRUSKAL WALLIS test was used to determine the intensities. The statistical confidence level for both types of analyses was tested at 5%. In this work we included 400 women in consultation, randomly assigned. The age of the participants ranged from 14-45 years, with the mean age among pregnant women being 25.14 ± 5.81 and among non-pregnant women being 29.22 ± 8.27. Pregnant and non-pregnant women representing 61.40% and 53.5% were Muslim, 46.5% and 37.6% were Christian, and 1% and 0% were of other faiths, respectively.

RESULTS

Overall prevalence

The study was carried out on a sample size of 400 women with an overall prevalence of 27%. Among non-pregnant women, 198 were examined and 41 positive cases were recorded giving an infection prevalence of 20.7%. Among the 202 pregnant women, we registered a prevalence of infection of 33.16% (p<0.05) (Figure 1).

Prevalence of malaria with respect to parity (pregnant women)

Table 1 shows the distribution according to parity, with a slight fluctuation in the proportion between primigravida, secongravid and multigestation. Despite this slight difference there is no significant difference (p>0.05).

Prevalence of malaria with respect to marital status

Table 2 shows that single and married women have 8.33% and 53.70% prevalence compared to single and married non-pregnant women. There is therefore a relationship between plasmodium infection and marital status in pregnant women (p<0.05). Likewise in non-pregnant women, there is a significant fluctuation between single and married women.

This distribution allows us to say that the prevalence is significant (p<0.05): pregnant women without employees were the majority in our sample, with a prevalence of 24.07%, followed...
by business- women with a prevalence of 15.74%, pregnant farmers with a prevalence of 14.81%, pregnant employed women with a prevalence of 5.55% and pregnant students with a prevalence of 1.85%. In contrast to non-pregnant women, who have a prevalence of 8.3% among unemployed women, Business 6.48%, farmers 19.44%, employed 2.77%, and students 0.92%, respectively as it can be seen on table 3.

**Prevalence of malaria infections by grade level**

Table 4 shows that the prevalence of malaria among pregnant women in primary, secondary and university education is 25%, 36.11% and 0.92%, respectively, while among non-pregnant women, for the same levels of schooling, we obtained 24%, 13.88% and 0%, respectively. However, we note that the prevalence of pregnant women at the secondary level is double that of non-pregnant women (p>0.05). There is a relationship between the level of education and malaria infection.

**Prevalence of malaria infections according to ethnic groups**

Table 5 presents the prevalence by ethnicity among pregnant and non-pregnant women. It appears from this table that pregnant and non-pregnant Bamum women were the most infected with prevalence of 55.22% (Pregnant) and 63.44% (Non-pregnant). Although there is a slight fluctuation between the prevalence among pregnant and non-pregnant Bamum women, it does not vary according to ethnicity (p>0.05). In pregnant and non-pregnant Bamileke and other women, there is also a large fluctuation but does not vary by ethnicity (p>0.05).

**Prevalence of malaria infections according to hospitals**

Table 6 shows a significant fluctuation by the site. For example, among pregnant women at the Foumbot District Hospital, the prevalence rate is 47.22%. This prevalence varies significantly depending on the site (p>0.05).

**Prevalence of malaria infections according to religion**

Table 7 shows the prevalence among pregnant and non-pregnant women by religion. It shows that Muslim pregnant and non-pregnant women have the following prevalence 31.5% and 18.52% respectively. Among Christian women, they are 29.62% and 19.44% respectively. Prevalence does not differ according to religion (P>0.05)

### Table 5: Prevalence of malaria according to ethnicity.

<table>
<thead>
<tr>
<th>Ethnic Groups</th>
<th>pregnant</th>
<th>Not pregnant</th>
<th>X²</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bamileke</td>
<td>23(34.32%)</td>
<td>9(21.95%)</td>
<td>5.63</td>
<td>0.06</td>
</tr>
<tr>
<td>Bamoun</td>
<td>37(55.22%)</td>
<td>26(34.31%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>7(10.44%)</td>
<td>6(14.63%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 6: Prevalence of malaria according to hospitals.

<table>
<thead>
<tr>
<th>Location</th>
<th>Pregnant</th>
<th>Non pregnant</th>
<th>X²</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>BS</td>
<td>5(7.46%)</td>
<td>10(24.39%)</td>
<td>2.97</td>
<td>0.22</td>
</tr>
<tr>
<td>HDF</td>
<td>51(76.11%)</td>
<td>16(39.02%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HPB</td>
<td>11(16.41%)</td>
<td>15(36.58%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 7: Prevalence of malaria by occupation.

<table>
<thead>
<tr>
<th>Occupation</th>
<th>pregnant</th>
<th>Not pregnant</th>
<th>X²</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business</td>
<td>17(15.74%)</td>
<td>7(6.48%)</td>
<td>14.24</td>
<td>0.002</td>
</tr>
<tr>
<td>Grower</td>
<td>16(14.81%)</td>
<td>21(19.44%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employed</td>
<td>6(5.55%)</td>
<td>3(2.77%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student</td>
<td>2(1.85%)</td>
<td>1(0.92%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unemployed</td>
<td>26(24.07%)</td>
<td>9(8.33%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 8: Prevalence of malaria according to the level of education.

<table>
<thead>
<tr>
<th>Level of study</th>
<th>Pregnant</th>
<th>Not pregnant</th>
<th>X²</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>27(25%)</td>
<td>26(24%)</td>
<td>12.11</td>
<td>0.002</td>
</tr>
<tr>
<td>Secondary</td>
<td>39(36.11%)</td>
<td>15(13.88%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>University</td>
<td>1(0.92%)</td>
<td>0(0%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 9: Prevalence of malaria by age.

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Pregnant</th>
<th>Not pregnant</th>
<th>X²</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-12</td>
<td>22(20.80%)</td>
<td>9(8.16%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13-17</td>
<td>29(27.22%)</td>
<td>27(25.14%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-22</td>
<td>35(33.19%)</td>
<td>30(27.44%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23-27</td>
<td>29(27.22%)</td>
<td>22(20.03%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>28-34</td>
<td>12(11.11%)</td>
<td>15(13.88%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 10: Prevalence of malaria by residence.

<table>
<thead>
<tr>
<th>Location</th>
<th>Pregnant</th>
<th>Not pregnant</th>
<th>X²</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>56(53.70%)</td>
<td>29(27.17%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td>35(33.19%)</td>
<td>19(17.42%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Prevalence of malaria Infections according to the Place of Residence**

Table 8 shows that the prevalence among pregnant women in rural areas is 49.29% and in urban areas 15.75%; among non-pregnant women living in rural and urban areas it is 19.7% and 11.11% respectively. This prevalence varies according to women’s residence (p<0.05).

**Prevalence of malaria infections according to age group**

The table 9 below shows the prevalence of malaria by age group. Plasmodial infection varies little with age in non-pregnant women as opposed to pregnant women. We have found that the 21-27 age groups seem to have the highest prevalence in both pregnant and non-pregnant women with rates of 38.50% and 20.80% respectively. In contrast, among non-pregnant women, the 28-34 age groups had the lowest prevalence, which was 7.50%. However, the difference was not significant across age groups in both pregnant (p>0.05) and non-pregnant women (p>0.05)

**Prevalence of malaria infections as a function of sleeping time (bed time)**

We will first note that 74.5% of the women surveyed said they had received an insecticide-treated mosquito net, of which 68.9% actually use it. Typical bedtime and the risk of the occurrence of plasmodial infections were assessed and the results are presented in Table 10. We found that the prevalence of plasmodial infections is always higher among pregnant and non-pregnant women going to bed after 10 p.m. with rates of 36% and 48% respectively, while among pregnant and non-pregnant women going to bed before 10 p.m. with rates of 32.8% and 16.8% respectively. Bedtime significantly affected the prevalence of plasmodial infections is always higher among pregnant and non-pregnant women (p<0.05).

**Prevalence of plasmodial infections as a function of sleeping time (bed time)**

We will first note that 74.5% of the women surveyed said they had received an insecticide-treated mosquito net, of which 68.9% actually use it. Usual bedtime and the risk of the occurrence of plasmodial infections were assessed and the results are presented in Table 10. We found that the prevalence of plasmodial infections is always higher among pregnant and non-pregnant women going to bed after 10 p.m. with rates of 36% and 48% respectively, while among pregnant and non-pregnant women going to bed before 10 p.m. with rates of 32.8% and 16.8% respectively. Bedtime significantly affected the prevalence of plasmodial infections (p<0.05). However, in pregnant women, the difference was not significant (p>0.05), ddl=1.
Table 7: Prevalence of malaria by religion.

<table>
<thead>
<tr>
<th>Religion</th>
<th>Pregnant</th>
<th>Not pregnant</th>
<th>X²</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Christian</td>
<td>32(29,62%)</td>
<td>21(19,44%)</td>
<td>3,74</td>
<td>0,15</td>
</tr>
<tr>
<td>Muslim</td>
<td>4(31,5%)</td>
<td>20(18,52%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>1(0,92%)</td>
<td>0(0%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 8: Prevalence of malaria the population according to the place of residence.

<table>
<thead>
<tr>
<th>Residence</th>
<th>Pregnant</th>
<th>Not pregnant</th>
<th>X²</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>50(74,62%)</td>
<td>29(70,73%)</td>
<td>26,5</td>
<td>0,0</td>
</tr>
<tr>
<td>Urban</td>
<td>17(25,37%)</td>
<td>12(29,26%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 9: Prevalence of malaria the population by age group.

<table>
<thead>
<tr>
<th>Age range</th>
<th>Pregnant</th>
<th>Not pregnant</th>
</tr>
</thead>
<tbody>
<tr>
<td>14-20</td>
<td>53(26,2%)</td>
<td>27(13,6%)</td>
</tr>
<tr>
<td>21-27</td>
<td>78(38,6%)</td>
<td>72(36,4%)</td>
</tr>
<tr>
<td>28-34</td>
<td>54(26,7%)</td>
<td>53(26,8%)</td>
</tr>
<tr>
<td>≤ 35</td>
<td>17(8,4%)</td>
<td>46(23,2%)</td>
</tr>
</tbody>
</table>

Prevalence of malaria infections according to waking hours

Usual wake-up times and the risk of the occurrence of plasmodial infections were evaluated and the results are presented in Table 11. The results show that non-pregnant and pregnant women who get up before 5 a.m. have the highest malaria prevalence with rates of 38.50% and 48.10% respectively. However, statistical analysis revealed that malaria prevalence does not differ significantly according to the time of getting up only in non-pregnant women (p>0.05). Pregnant and non-pregnant women who get up after 5 A.M. have a prevalence of 16.46% and 30.9% respectively, and therefore the prevalence differs significantly between pregnant women getting up before 5 a.m. and those gets up after 5 a.m. (p<0.05).

Average intensity of plasmodial infection according to the profession

Figure 2 gives us the distribution of the intensity of plasmodial infection according to the occupation. It shows that the average intensity of infection in pregnant and non-pregnant women varies little with the other occupations except for female farmers where the infection is higher in pregnant women with an average intensity of infection of 2164 compared to 1123 in non-pregnant women (p<0.05).

Average intensity of plasmodial infection according to the level of study

Figure 5 gives us the distribution of the intensity of the plasmodial infection as a function of the level of study. It shows that except for the university level where a very high intensity was recorded in pregnant women and none in non-pregnant women (p<0.05), the average intensity of infection varies little between pregnant and non-pregnant women according to the level of study (Primary & Secondary).
Average intensity of plasmodium infection according to marital status

Figure 6 gives us the distribution of the intensity of plasmodial infection according to marital status. It shows that the average intensity of infection varies according to religious affiliation. Among Christian women, pregnant women have a higher intensity of infection than non-pregnant women. The situation is reversed among Muslim women. Among women of other religious denominations, only pregnant women were infected and with a lower intensity of infection than the other two groups.

Average intensity of infection by age group

Figure 9 shows the distribution of the intensity of plasmodial infection according to age group. It shows that the average intensity of infection varies little in all age groups, both pregnant and single women, a higher intensity of infection is observed in non-pregnant women compared to pregnant women (p<0.05).
and non-pregnant women. The exception is the 28-34 age group, in which non-pregnant women have a higher intensity.

Comparison of the microscopic results with the TDR

Of the 400 subjects examined for malaria, 102 were RDT positive and 108 were microscopically positive. Considering the thick drop as the reference method, Table XII presents the comparative result of the two diagnostic techniques. We have identified 2 false-positive results (RDT+/Microscopic-) and 8 false-negative results (RDT-/Microscopic+) in this study. Only the 2 false-positives were of interest in this study.

The RDT used in this study has a sensitivity, specificity, positive predictive value and negative predictive value of 92.6%, 99.3%, 0.7% and 7.4% respectively (Table 12).

The sensitivity of this RDT was evaluated according to parasitaemia classes. We noted that the sensitivity of the RDT decreases along with parasitemia. For parasitemia ≤ 500µl the sensitivity is 95.45% and 100% for parasitemia.

DISCUSSION

Almost all of the women surveyed were on chemoprevention, which demonstrates that pregnant and non-pregnant women have good access to health facilities, which is also facilitated by the geographical accessibility of these facilities. Other studies carried out in urban and peri-urban areas had made the same observation. Among these studies, we can mention those conducted in Yaoundé [9] and Madagascar [10] where 80% of women regularly attended their prenatal consultation (ANC) and the number of ANCs performed by these women was directly related to the geographical accessibility of the health facilities and not to their level of education. The number of ANCs performed by these women was directly related to the geographical accessibility of the health facilities and not to their level of education. It thus appears that the accessibility of health facilities plays a determining role in the success of the new programme developed by WHO which advocates directly observed treatment (DOT) with Sulfadoxine-Pyrimethamine (SP) for the prevention of malaria in pregnant women.

The fairly high overall malaria prevalence (27%). In this study could be due to the poor practice of prevention methods by those concerned and also to agriculture, which remains the dominant activity for these populations. This result is in agreement with that obtained by the ENIPT [11,12], which also had a malaria prevalence of 27.8%. Among pregnant women the prevalence is higher than the overall prevalence of (33.16%) women. This result highlights the fact that a large number of pregnant women are indeed carriers of the malaria parasite in their blood. These results are similar to those obtained by WHO [13], and [14]. The prevalence of malaria infection among pregnant women (33.16%) was higher than among non-pregnant women (20.7%). Our results are similar to those of Dao [15] in Mali, who reported a prevalence of 36% among pregnant women compared to 22.3% among non-pregnant women [16,17] also made the same observation. Indeed, pregnant women are in a state of immunodeficiency which increases their vulnerability to malaria. This level of malaria prevalence could also be explained by the climatic conditions of the town of Foumbot, which are favourable to the proliferation of mosquitoes amplified by the practice of agriculture, which remains a dominant activity that is an important factor in the multiplication of mosquito breeding grounds through cultivation techniques that develop water accumulation points in the fields.

This study demonstrates that during the first and second pregnancy, pregnant women are particularly vulnerable to plasmodium parasitaemia. This indicates a strong relationship between parity and malaria infection, with average levels of parasite intensity decreasing as the number of pregnancies increases, confirming that primigravidae remain undoubtedly the most vulnerable. We found that malaria prevalence is not age-specific. The same observation was made by [18], who mentioned that age had no significant relationship with malaria. The residence would have an impact on malaria. Our results

<table>
<thead>
<tr>
<th>Table 12: Comparison of RDT and microscopic results.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Test</strong></td>
</tr>
<tr>
<td><strong>Negative</strong></td>
</tr>
<tr>
<td>RDT</td>
</tr>
<tr>
<td>P</td>
</tr>
<tr>
<td><strong>Total</strong></td>
</tr>
</tbody>
</table>
corroborate those obtained by Part (18) which showed that malaria is mainly a rural disease. Pregnant women living in urban areas were (15.75%) and non-pregnant women (11.11%). This low rate observed in the urban environment may be due to sensitization, easy access to impregnated mosquito nets and the efforts made to combat this scourge. The results show that religions have no impact on malaria. These results are contrary to those obtained by [19], which showed that religious affiliation is an etiological interpretation guide frequently taken into account in the study of behavioural determinants related to diseases. It does not emerge exclusively from spiritual motives but also significantly influences social contingencies. In this sense, we have considered religious denomination as a differentiating factor in cultural practices, forms of social organization and behavioral norms that can influence malaria transmission. This shows no significant relationship between malaria prevalence and religious affiliation. Indeed, Christians are more malarial than Muslims. This trend is earlier contrary to our hypothesis because we thought that, contrary to this result, Muslim women who are generally assumed to be out of the nets at a certain time of vector activity (prayers at 7:30 pm and 5 am) are the most malarious. As this study did not take into account behavioural factors within the populations of both religions, it is rather difficult to really know the factors that could justify this result.

Anthropogenic behavior in the occurrence of malaria after Long-Lasting Insecticidal Net (LLIN) coverage. During our study, 74.5% of respondents said they received free impregnated nets in three hospitals and during mass distribution, compared to 68.9% who did not receive them. The prevalence of infection among those who received is 25.5% compared to 31.1% among those who did not. However, the relationship between the use of LLINs and the carrying of malaria parasites reveals that there is no significant difference between subjects sleeping on LLINs and those who do not. Moreover, subjects with LLINs have the same risk of being infected with Plasmodium as those without. The effectiveness of ITNs in reducing transmission and thus malaria morbidity has been observed in some endemic areas [20] and [21]. However, the observations were only of short duration. Paradoxically, the comparison between areas with different transmission rates did not show a significant difference in the occurrence of severe malaria in Tanzania and Kenya [22] and [23]. It has been shown that reducing transmission will, in the long term, only shift the age of onset of malaria and thus the age of premunition [24]. However, good patient management with antimalarial drugs, with at least two effective molecules, combined with the use of impregnated mosquito nets with a 100% coverage rate could reduce malaria morbidity in the long term.

The sensitivity, specificity, positive predictive value, negative predictive value of a test is parameters used to measure the intrinsic value of a test in relation to a reference.

Sensitivity: The result reveals a sensitivity of 92.6% with the TDR. This result is contrary to those obtained by [25]; [26] who obtained sensitivities of 96.3% and 94.7% respectively. This difference in sensitivity could be due to the epidemiological context, which is not always identical for these different regions, and also to the level of endemicity of the disease, which could in either direction increase or decrease the sensitivity of the RDTs. Beyond the epidemiological contexts, several other reasons may explain the low sensitivity of the RDT.

Specificity: As for specificity, it is 99.3%. This value obtained in our study is higher than that reported by [27] who found 96.7%. This difference could be explained by the persistence of several antigens in the blood. This result is in agreement with that of the WHO [28] which showed that the presence of certain rheumatoid factors at high levels in the body and the persistence of several antigens in the blood are at the origin of the variation in specificity.

Positive predictive value: Our results revealed 2 cases of false positive, or 0.7%. This rate is lower than those obtained by WHO [29,30] and which found a positive predictive value of 4% and 17.1% respectively. These cases of false-positive could be due to the persistence of proteins in the blood, as several authors [29] and [31] have recognized. In addition, other factors such as temperature and low parasitaemia have been cited as causes of false positives.

Negative predictive value: The study revealed 8 cases of false negatives, or 7.4%. The 8 cases of false negatives corresponded to cases of low parasitaemia. This value is higher than that found by [32] who found a value of 3.6%. The capacity of the RDT to detect the disease in case of parasitaemia was determined by the WHO in its detection threshold indicated in the results of product evaluations, i.e. 200 parasites/L of blood. Based on the diagnostic performance evaluation criteria of the thick blood smear and the SD BIOLINE Malar RDT

CONCLUSION

At the end of our work, which aimed to compare malaria infections and associated risk factors in pregnant and non-pregnant women in the town of Foumbot, it appears that malaria is indeed present and that pregnant women are generally more affected by malaria than non-pregnant women. Furthermore, we note that its prevalence does not vary according to age group or religion but rather according to parity, profession, residence and physiological status (pregnant and non-pregnant) and women’s behaviour in terms of bedtime and waking hours. The RDT can be used for diagnostic as well as microscopy because this level of sensitivity has led us to say that this test can be used for the diagnosis of the disease because the margins of error are quite negligible compared to microscopy. The evaluation of anthropogenic behaviour in women reveals that despite the high coverage of the population with LLINs, the prevalence of malaria remains quite high among women in the town of Foumbot. However, in an epidemiological framework that consists of avoiding the disease and treating it, the presence of Plasmodium in the blood of a subject must lead to appropriate treatment in order to reduce the risk of transmission to others. In this sense, the epidemiological parameters evaluated in this study must be followed in order to avoid the occurrence of a malaria epidemic in this population.

ETHIC APPROVAL AND CONSENT TO PARTICIPATE

To carry out this research, an Ethical Clarence was obtained from the “Comite National D’ethique De La Recherche Pour La
REFERENCES

1. Crompton PD, Pierce SK, Miller LH. Avancées et défis dans le développement de vaccins contre la malaria. The Journal of Clinical Investigation. 2010; 120.


12. OMS (du partenariat Roll Back Malaria Genève 27, Suisse.


27. Norbert DT. “Comparative study of a Rapid Diagnostic Test for Malaria (RDT) with Thick Drop (DDT) at Bafoussam Hospital in Cameroon”. 2012.


32. Davou D. “Comparative Study of The Results of The Thick Drop and Rapid Diagnostic Test (SD Bioline Malaria PI) And Microscopy In The Biological Diagnosis Of Malaria At The Chdu-B And As of Kpebie in Parakou.” 2011.