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Prevalence of asymptomatic carriage of plasmodium falciparum among blood donors at the Biyem-Assi District Hospital in Yaoundé, Cameroon

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Abstract

Background: Malaria is transmitted by the bite of a female Anopheles mosquito, interhuman (transplacental), and by blood transfusion. The present study aimed to determine the prevalence of *Plasmodium* parasitemia among blood donors at the Biyem-Assi district hospital in Yaoundé.
Methods: This was a descriptive and analytical study conducted on 267 blood donors recruited at the blood bank of the Biyem-Assi District Hospital over 3 months, from February to May 2024. To obtain the free and informed consent of the volunteers, a questionnaire form was submitted to them. Socio-demographic data, knowledge, and practical attitudes towards malaria were collected. A blood sample was taken in an EDTA tube. The biological analysis of the blood was done through rapid diagnostic test examinations. The thick smear was done to calculate the plasmodial intensity, and the blood smear to identify the species. Complete blood count was performed to determine hematological parameters. SPSS software version 26.0 was used for statistical analysis.
Results: It emerged that the most represented age group was that of 29-54 years old. The male gender was more represented. The prevalence of *Plasmodium* infection was 15.0% with a plasmodial intensity between 75 and 500 parasites/µl of blood. The sole species involved was *Plasmodium falciparum*. Analysis of risk factors revealed that the type of housing and bedtime were significantly associated with malaria infection. Grass and stagnant water near the house were not significant risk factors for malaria infection.
Conclusion: Ultimately, the plasmodial prevalence was 15.0% during the period of low transmission and in an endemic area. It would therefore be important to develop a safety strategy based on systematic screening measures for Plasmodium in blood donors.

Keywords: Blood donors; Cameroon; parasitic density; *Plasmodium falciparum;* prevalence; risk factors.

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Background

Malaria affects people of all ages and is one of the world's top causes of morbidity and mortality [1]. In 2022, the World Health Organization (WHO) reported approximately 249 million cases of malaria, with an estimated 608,000 deaths occurring primarily among African children under the age of five [2]. Globally, the prevalence of malaria varies significantly by region and Cameroon which is among the 11 countries most affected by the disease globally recorded more than 3 million cases and over 3800 deaths in 2021 [3]. Asymptomatic carriage of *Plasmodium falciparum* among blood donors is a reality in endemic areas. Plasmodia are transmitted mainly through the bites of infected female Anopheles mosquitoes and by blood transfusion and the transplacental route [4-6]. The transmission of Plasmodium by blood transfusion is a medical procedure that can be fatal for the blood recipient [7, 8]. Thus, Plasmodium can remain latent in the blood donor without him becoming ill [9, 10]. However, the presence of a single parasite in the collected blood could risk transmitting the disease to the blood recipient. He could become seriously ill or even succumb [11] to the extent that donors with symptomatic carriage of *Plasmodium falciparum* are not detected [12-14]. There is a risk of transmitting this *Plasmodium* infection to blood recipients, which will aggravate the anemia already present in blood recipients, thus leading to more demand for blood bags. The temporary separation of donors carrying asymptomatic carriage of *Plasmodium falciparum* therefore makes it possible to spare another bag of blood that the recipient could have requested during the blood transfusion and also to avoid jeopardizing their vital prognosis [15].

Being infected with Plasmodium through blood transfusion is one of the infectious transfusion accidents resulting in donation [16]; this act having saved lives rather than putting it in danger. Several studies carried out in the Democratic Republic of Congo and Nigeria have shown the importance of the transfusion risk of Plasmodium [15, 17, 18]. *Plasmodium* infection in a blood recipient can cause complications such as severe anemia, coma, and death. This raises both concern for our health system and interest in carrying out research in this area. The prevalence of *Plasmodium* infection among blood donors in sub-Saharan Africa is estimated between 14 and 29%, making it the first infectious agent transmissible by blood transfusion compared to other agents such as the human immunodeficiency virus, the hepatitis C virus and the hepatitis B virus, the prevalence of which is estimated between 0.5-16% respectively; 0.5-3% and 5-25% [19, 20].

Transfusion without risk of Plasmodium transmission contributes to the WHO objective of reducing the incidence of *Plasmodium* infection and associated mortality globally and to eliminate this *Plasmodium* infection in at least 35 countries [15]. While we know malaria is common in donors across Yaoundé and Buea, we still lack a clear picture for Biyem-Assi District Hospital, a critical hub for such a busy area. More importantly, we haven't yet seen how specific habits, like bedtime or housing, affect these rates during the low transmission season. It is in this context that the present study was undertaken with a view to contributing to the improvement of transfusion safety through the determination of *Plasmodium* parasitemia in blood donors at the Biyem-Assi District Hospital in Yaoundé.

Methods

Type, period and site of study

This was a descriptive and analytical study carried out on 267 blood donors recruited at the blood bank of the Biyem-Assi District Hospital (located in Yaoundé as shown in Figure 1) over a period of 3 months from February to May 2024.

Study Population

This study population consisted of blood donors from the Biyem-Assi District Hospital, in Yaoundé who did not present symptoms of malaria. Trained nursing personnel performed a standard pre-donation clinical assessment on all donors who arrived at the blood bank. This included measuring vital signs (temperature, blood pressure, pulse rate), determining hemoglobin levels using HemoCue, and screening for donation contraindications. The study only included donors who fulfilled all eligibility requirements and completed this basic clinical assessment. Since the study's goal was to determine the general prevalence among the blood donor community at this hospital, both first-time and repeat donors were eligible for inclusion; no differentiation was made based on donation history

Inclusion criteria

The following criteria were utilized for inclusion: (1) blood donors presenting at the Biyem-Assi District Hospital blood bank during the study period (February–May 2024); (2) age ≥ 17 years and fulfilling standard blood donation eligibility criteria (hemoglobin ≥ 12.5 g/dL in women and ≥ 13.5 g/dL in men, weight ≥ 50 kg, absence of acute illness); (3) absence of malaria-related symptoms (fever, chills, headache, vomiting) in the 48 hours preceding donation; (4) axillary temperature < 37.5°C at the time of donation; (5) provision of written informed consent to participate in the study.

Exclusion criteria

Donors were excluded if they: (1) did not meet standard blood donation eligibility criteria; (2) were currently under antimalarial treatment or had completed antimalarial treatment within the preceding 30 days; (3) presented any clinical signs compatible with active malaria on the day of donation; (4) declined to provide informed consent.

Sampling

The minimum sample size was calculated using the Lorentz formula for prevalence estimation:
$N = (Z^2 \times P(1 - P)) / d^2$

Where:
N = Minimum required sample size
Z = Z-score corresponding to a 95% confidence level (Z = 1.96)
P = Estimated prevalence of asymptomatic malaria among blood donors = 22% (0.22)
d = Acceptable margin of error = 5% (0.05)
Substituting the values into the formula:
$N = (1.96^2 \times 0.22 \times (1 - 0.22)) / (0.05^2)$
$N = (3.8416 \times 0.22 \times 0.78) / 0.0025$

N = 0.6595 / 0.0025
N ≈ 264

Thus, a minimum sample size of 264 participants was required. A total of 267 blood donors were recruited during the study period, which exceeded the minimum required sample size.

Variables studied

Dependent variables

The problem addressed in our study was to determine the prevalence and intensity of *Plasmodium* infection in blood donors. The variables that could describe it consisted of *Plasmodium* infection and parasitemia.

Independent variables

These are variables that describe the factors identified as the cause of the problem. In our study, sociodemographic characteristics mainly included age, sex, and marital status, and occupation, knowledge of malaria risk, possession and use of mosquito nets by donors.

Collection, conservation, realization and biological materials

The equipment used to collect and preserve the sample consisted of: EDTA tubes, a slide, protective gloves, syringe, tourniquet and a cooler.
The equipment that allowed us to carry out our analysis: notebook, pencil, tap water, MGG, methanol, immersion oil, slide, timer and optical microscope. As part of this work, we used venous blood.

Data collection procedures

Administrative procedures

This study received ethical clearance from the Centre Regional Ethics Committee for Human Health Research Dschang (Reference No.: CE N°0110/CRERSHC/2024:13th March 2024). The Director of the Biyem-Assi District Hospital also gave administrative permission (Authorisation No.: 232/AR/MINSANTE/DRSPC/DSBA/HBDA). Before signing up, each participant gave their written consent.

Technical procedures

Pre-analytical phase

The pre-analytical phase accounts for roughly 70% of the total research process. Here's how we carried it out:

Participant recruitment and asymptomatic definition

Participants were contacted and given a questionnaire form to complete. Participants were classified as asymptomatic if they reported no history of fever, chills, headache, or other malaria-compatible symptoms in the 48 hours preceding blood donation, and if their axillary temperature was below 37.5°C at the time of blood collection.

Sample collection

Venous blood was then collected from each participant. One drop was used for the thick smear, another for the thin smear, and three drops were reserved for the malaria Rapid Diagnostic Test (RDT).

Rapid diagnostic test (rdt)

The RDT used was the CareStart™ Malaria HRP2/pLDH Combo (Access Bio, Inc., Somerset, NJ, USA), which detects both HRP2 (P. falciparum-specific) and pan-Plasmodium pLDH.

Before testing, samples, buffers, and controls were removed from the refrigerator and allowed to reach room temperature (22°C). The test cassettes were also brought to room temperature, removed from their sealed sachets, and placed on a clean, flat surface. Three drops of blood were added followed by three drops of buffer, and a timer was started. Results were read after 15 minutes.

Quality Control: Each RDT test was controlled by the manufacturer's protocol; the control line must appear for the result to be valid. For microscopy, two experienced laboratory scientists independently read each slide; discordant results were resolved by a third reader. External quality control was performed through periodic verification against known positive and negative controls

Slide preparation (thick and thin smears)

Two drops of blood were placed on one end of a labeled slide, one for the thin smear and one for the thick smear. A second slide was placed at a 45-degree angle to spread the first drop by capillary action. For the thick smear, the corner of the second slide was used to spread the drop into a circle approximately 1 cm in diameter using circular motions. Both smears were left to dry on the bench, protected from dust and insects.

Staining Process

The staining procedure was as follows: first, the smear was fixed with methanol for 30 seconds, then covered with May-Grünwald stain for 30 seconds. Next, the entire slide was covered with 10% Giemsa solution and left for 15 minutes before rinsing.

Microscopy Analysis

Once dried, the slides were examined under a microscope using a 100× objective with immersion oil. Two experienced laboratory scientists independently read each slide; discordant results were resolved by a third reader. Parasitemia was calculated by counting parasites against 200 leukocytes using the formula: P = N x WBC/L [21].
P: Number of parasites/µL of blood; N: Number of parasites counted on leukocytes (L); L: Number of leukocytes counted (200); WBC: Estimated average number of leukocytes at 8000/mm3 of blood.
The final formula was then:

Parasites/µL = (Parasites counted × 8,000) / Leukocytes counted[21].

External Quality Control: Periodic verification against known positive and negative controls was performed.

Complete Blood Count (CBC)

The CBC provides a quantitative and qualitative assessment of blood cells, including red blood cells, white blood cells, and platelets. Parameters measured included hemoglobin (HBG), mean corpuscular volume (MCV), hematocrit (HCT), mean corpuscular hemoglobin concentration (MCHC), and mean corpuscular hemoglobin content (MCH).

The principle: a suspension of blood in a conductive diluent passes between two electrodes. Non-conductive blood cells cause a drop in conductivity proportional to their size, and these changes are counted and analyzed [22].

For CBC analysis, venipuncture was performed using EDTA tubes to prevent clotting and preserve cell integrity. The sample was gently rotated to ensure proper mixing, and the tube was inverted several times during collection to avoid micro clots. Samples were transported to the Hematology department in insulated cases at room temperature and stored at 2–8°C until analysis.

Before testing, sample quality was checked, and the sample was placed on a hematology mixer for up to 5 minutes. The analyzer was turned on, properly calibrated, and patient information was entered. Once loaded, the needle drew the sample for automatic counting, and results appeared directly on the connected computer screen.

Blood Grouping

Blood grouping classifies blood based on antigens on red blood cells and inherited antibodies. We used the classic plate technique: anti-A, anti-B, and anti-AB test sera were placed on a plate, mixed with a drop of the participant's red blood cell pellet, and gently rotated. Agglutination was observed within one minute to determine the blood group.

Data analysis

Data analysis was carried out with Excel and SPSS software version 16.0. Chi2 test and Student's test were carried out to search for a statistically significant relationship with $p < 0.05$ and the results were presented in tables.

Results

Distribution of blood donors according to sociodemographic characteristics

Table 1 presents the distribution of blood donors according to socio-demographic characteristics. It appears that the average age of donors varied from 20 to 54 years. The most representative age group was that of 30 years to 54 years, a percentage of 66.5% compared to the age group of 20 years to 29 years. The most representative sex was the male sex, i.e. a percentage of 82.5% compared to the female sex. The informal sector, i.e. 62%, was the more representative compared to the formal sector. Regarding marital status, there was a predominance of married people, i.e. 56% compared to single people.

Distribution of blood donors according to knowledge of Plasmodium infection

Table 2 presents the distribution of blood donors according to knowledge of *Plasmodium* infection. It appears from this table that the percentage of those who knew the mode of transmission and the symptoms of infection were high compared to those who did not know.

Distribution of blood donors according to blood donation status, blood group and rhesus

Table 3 presents the distribution of blood donors according to donation status, blood group and rhesus. It appears that family-type donations represented the majority with 67%, compared to a proportion of 33% of voluntary or voluntary donations. Blood group O was in the majority with 51.4%, followed by group A (21.7%), B (21.3% and AB (5.6%). Rhesus + with a predominance of (91.8%).

Overall prevalence of Plasmodium infection among blood donors

The overall prevalence of *Plasmodium* infection in blood donors studied is illustrated in Figure 2. It appears from this figure that out of the 267 samples analyzed, we observed an infection rate of 15.0% or 40 cases confirmed. Among the positive samples, only one species of plasmodium was found in all donors (40) positive for thick smear; it was *Plasmodium falciparum*.

Prevalence of Plasmodium infection of blood donors according to sociodemographic characteristics

Logistic regression analysis was performed to identify independent predictors of Plasmodium infection. Variables with a p-value < 0.20 in univariate chi-square analysis were entered into a multivariate binary logistic regression model using the enter method. Adjusted odds ratios (aOR) with 95% confidence intervals (CI) were calculated. Variables with a p-value < 0.05 in multivariate analysis were considered statistically significant independent risk factors. The results are presented in Table 4. The prevalence of Plasmodium infection according to socio-demographic characteristics. It appears that there is no significant association between age, sex, marital status, profession and Plasmodium infection ($p > 0.05$): these parameters are not part of the risk factors for infection. However, there is a relationship between sex and Plasmodium infection with men more parasitized than women.

Prevalence of Plasmodium infection of blood donors according to risk factors

Table 5 presents the prevalence of *Plasmodium* infection according to risk factors. It appears from this table that the type of housing and bedtime were associated ($p < 0.05$) with *Plasmodium* infection. Stagnant water near the house was a significant risk factor for *Plasmodium* infection.

Prevalence of Plasmodium infection of participants according to types of donations, blood group and Rhesus factor

Table 6 presents the prevalence of *Plasmodium* infection according to the type of donation, blood group and Rhesus factor. It appears from this table that the type of donation, blood group and Rhesus factor are not associated with *Plasmodium* infection ($p>0.05$).

Prevalence of Plasmodium infection as a function of hemoglobin level and number of white blood cells of participants

Table 7 presents the prevalence of *Plasmodium* infection according to the hemoglobin level and the number of white blood cells; it appears from this table that there is no significant association between the infection, the rate of hemoglobin and the number of white blood cells, however the number of cases positive for *Plasmodium* infection was high in those who had a hemoglobin level between 12 and 14g /dl and in those who had a white blood cell number between 5000 and 7000 white blood cells.

Average parasitic intensity depending on risk factors

Table 8 shows the distribution of plasmodial intensity according to potential risk factors. It appears from this table that the average parasitic density was higher in donors with stagnant water near houses (370.00±52.68), the age group of 20 to 29 years (285.11±77.05), male gender (284.50±111.88), those who did not use mosquito nets (271.00±134.28). However, there is no statistically significant correlation.

Discussion

The present study aimed to contribute to the management of malaria through the determination of *Plasmodium* parasitemia in blood donors at the Biyem-Assi District Hospital. The 15.0% overall prevalence of *Plasmodium* infection found in this study which was lower than the prevalence of malaria (33.1%) obtained in the general population of Yaoundé [23]. According to the WHO, children aged between 0 and 5 years are the most susceptible due to their weak immune systems [24]. However, adults and adolescents were targeted in our study, which could explain the low prevalence observed. Our result is much lower than that reported by Jacques Ossinga Bassandja et al. [25] in the Democratic Republic of Congo whose prevalence was 28.3%. Furthermore, several studies carried out in Africa have reported much higher prevalences, particularly in Burkina Faso, Benin and Nigeria, with respective rates of 50.7%, 33.5% and 51.5% [9. 10, 11]. These rates can be explained by the fact that these countries are declared to be the most affected by malaria in the world [3]. Other authors reported much lower prevalence rates: Rakotoniaina *et al*. in 2019 in the south of Madagascar, Kwenti *et al* in 2017 in Buea and Noubouossie *et al* in 2011 in Yaoundé who found prevalence rates of 1.5%, 8.1% and 6.5% respectively [3, 11, 10]. These different prevalence rates could also be explained by the level of endemicity of the environment and the study period. The results of these studies show that the risk of malaria transmission through blood transfusion is a reality, which implies the taking of effective preventive measures.

The finding of Plasmodium falciparum as the only species in this study confirms the responsibility of this species in the occurrence of malaria infection in Cameroon and sub-Saharan Africa. This result is similar to those obtained in the Democratic Republic of Congo, Mali, Malawi, Nigeria and in the southern region of Madagascar which showed that *Plasmodium falciparum* is the main species found in blood donors [15, 26-28]. These results are consistent with scientific reviews on the responsibility of *Plasmodium falciparum* in transfusion malaria [28].

In the present study, parasite density varied from 75 to 500 parasites/µl different from the density reported in the Democratic Republic of Congo; which were greater than 2000 parasites/µL; and that reported in the southern region of Madagascar which varied between 150 and 400 parasites/µL. These different intensities could be explained by environmental climate; the season at the time of the study or the study period [29-32]. Thus, considering the average parasite density calculated statistically in this study; it follows that the average parasitic intensity was higher in donors with grass or stagnant water near the houses; the age range of 20 years to 29 years; males and those who did not use mosquito nets. The parasite densities obtained in this study should be taken seriously given that a parasitemia of 500 parasites per microliter, considered low, represents in a recipient transfused with 500 ml of blood, an inoculum of approximately 250,000,000 parasites, often pathogenic in humans.

The significant association found between the type of housing and bedtime with *Plasmodium* infection, grass and stagnant water near the house indicates that these factors are risk factors for *Plasmodium* infection. This result obtained is in contradiction with that of Jacques Ossinga Bassandja et al [25] who carried out a study on the prevalence of asymptomatic plasmodium carriage among volunteer blood donors in Kisangani, Democratic Republic of Congo which showed that the factors which were significantly associated with parasitemia were young age, first donation, and non-use of insecticide-treated mosquito nets. Donor sex did not appear to influence parasite carriage; in discordance with this study because there was no significant association between Age, sex, non-use of the mosquito net and malaria infection. Indeed, the type of housing plays a role in the transmission of malaria infection because poorly constructed or poorly maintained homes; especially those which are not well protected against mosquitoes, can encourage the proliferation of mosquitoes [3]. Houses with cracks, windows without screens or curtains, porous roofs, or nearby standing water provide opportunities for mosquitoes to breed and feed; thus, increasing the risk of exposure and infection for residents. So the bedtime could be explained by the fact that malaria-carrying mosquitoes are more active during twilight hours, that is to say at sunrise and therefore at sunset, if a person is goes to bed early without taking protective measures against mosquito bites, she may be more exposed to mosquitoes during this period of increased activity: moreover the study showed that men were more parasitized compared to women, this result corroborates with that of the Democratic Republic of Congo (DRC) and the southern region of Madagascar, Indeed, this could be explained by the assigned roles which can lead men to work in the fields at nightfall or get up early in the morning for service, thus exposing them at times when mosquitoes bite the most.

Despite the above, the risk of transmission of malaria by blood transfusion at the Biyem-Assi District Hospital is a reality and this constitutes a major public health problem which requires particular attention, to remain in agreement with the medical act which consists of transfusing blood without bringing other pathologies to the recipients, screening for Plasmodium in pre-donation examinations constitutes a good alternative for good prevention of transfusion malaria in all blood recipients.

The higher rates of Plasmodium falciparum infection in residents of homes with clay walls than residents of homes with hard construction might be linked to the fact that due to its gaps, lack of window screens, and inadequate ventilation, clay homes make perfect indoor resting places for mosquitoes that spread malaria. This is consistent with studies conducted in sub-Saharan Africa

that indicate the quality of a home's construction has a significant impact on the spread of malaria [3]. The conclusion is obvious: enhancing housing, whether by using better building materials, sealed windows, or greater ventilation, is a workable, long-term solution to lower malaria in endemic areas. It makes biological sense that those who went to bed before 22:00 had a higher (tenfold) risk of contracting malaria because Anopheles gambiae, the primary malaria mosquito in Cameroon, bites most frequently between 22:00 and 02:00. People who go to bed early without using bed nets are at their most susceptible when mosquito activity is at its highest [9]. Because only 40 donors lived close to sources of stagnant water, the elevated infection rate (25% vs. 13%) in those who did so was not statistically significant. This link would probably be seen in a bigger cohort. The biology is simple: malaria mosquitoes breed in stagnant water. This discovery serves as a reminder that environmental management, such as clearing standing water from dwellings, is still essential to prevent malaria [15].

This research emphasizes the importance of insecticide-treated bed nets, which offer a straightforward and efficient barrier during mosquito-biting hours.

This study took place from February to May 2024, which is when the dry season ends and the rain begins in Yaoundé. This is when malaria transmission is usually lower than it is during the peak rainy months (September–November). The 15.0% prevalence during this low-transmission period indicates that the actual annual rate may be significantly elevated. This shows that we need to screen people all year long instead of just during certain times of the year.

Out of 267 donors screened, 40 (15.0%) had parasites that didn't show any symptoms, which was a significant risk for transfusion. Transfusion-transmitted malaria can be deadly, especially for newborns, pregnant women, and people with weak immune systems. Biyem-Assi District Hospital does not currently do routine malaria screenings. As the WHO suggests, starting RDT screening for all donors could stop a lot of TTM cases.

Although 15% of blood donors had malaria parasites, Cameroonian blood banks do not regularly screen for malaria, in contrast to HIV or hepatitis. This gap is crucial. Newborns, pregnant women, and immunocompromised patients are among the susceptible receivers who could be protected against transfusion-transmitted malaria by a quick test that can detect infected donors for less than $1.

When compared to treating even one instance of malaria contracted through blood transfusion, the expense is negligible [19]. It is both cost-effective and lifesaving to make malaria screening mandatory at Biyem-Assi Hospital and across the country.

The study was done at one hospital, so the results may not be the same at other blood collection sites in Yaoundé or Cameroon. The three-month period also makes it harder to see seasonal trends. Microscopy, although the gold standard, can overlook low-level parasitemia, and PCR, which is significantly more sensitive, was not carried out. Future research should employ molecular techniques and encompass various seasons and locations.

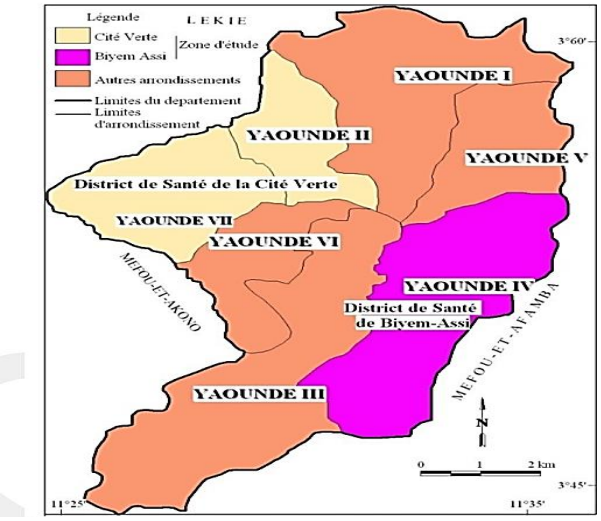

Figure 1. Location of the study site in Mfoundi Department [33].

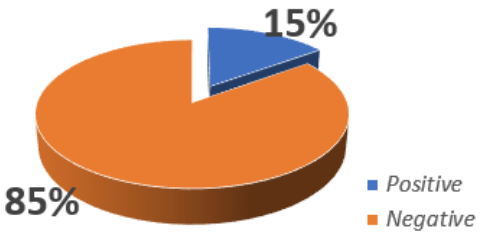

Figure 2. General prevalence of Plasmodium infection in blood donors at Biyem-Assi district hospital

Table 1. Distribution of blood donors at Biyem-Assi District Hospital according to socio-demographic characteristics

Parameters	Effective (n)	Percentages (%)
Age		
[20 – 29]	84	30.5
[30 – 54]	183	66.5
Sex		
Female	40	14.5
Male	227	82.5
Profession		
Formal sector	101	38
Informal sector	166	62
Marital status		
Bachelor	117	42.5
Married	150	57.5
Total	**267**	**100**

Table 2. Distribution of blood donors at Biyem-Assi District hospital on *Plasmodium* infection

Variables	Effective (n)	Percentages (%)
Knowledge of the mode of transmission		
yes	256	95.9
No	11	4.1
Total	267	100
Mode of transmission		
Mosquito bite	178	66.7
Blood transfusion	50	18.7
Transfusion and mosquito bite	29	10.6
I don't know	10	3.7
Total	267	100
Signs and symptoms		
Fever	147	55.1
Vomiting	35	13.1
Headache	73	27.3
Others	2	0.7
I don't know	10	3.7
Total	267	100

Table 3. Distribution of blood donors at Biyem-Assi District hospital according to blood group, donation status, and rhesus

Parameters	Effective (n)	Percentage (%)
Type of donations		I
Family	179	67
Volunteer	88	33
Blood group		
A	58	21.7
B	57	21.3
AB	15	5.6
O	137	51.4
Rhésus		
Rhésus D-	22	8.2
Rhésus D+	245	91.8
Total	N=267	100

Table 4. Prevalence of *Plasmodium* infection according to sociodemographic characteristics of participants at Biyem-Assi District Hospital

Variables	Effective	Number positive (n)	Prevalence (%)	P value	OR (95% CI)
Age				0.364	
[20–29]	84	10	11.9		0.69 (95% CI: 0.32–1.49)
[30–54]	183	30	16.4		1 (reference)
				0.472	
Sex					
Female	40	4	10.0		0.59 (95% CI: 0.20–1.76)
Male	227	36	15.9		1 (reference)
				0.062	
Marital status					
Bachelor	117	15	12.8		0.74 (95% CI: 0.37–1.47)
Married	150	25	16.7		1 (reference)
				0.302	
Profession					
Formal Sector	91	16	17.6		1.35 (95% CI: 0.68–2.71)
Informal Sector *(ref)*	176	24	13.6		1 (reference)
	267	**40**	**15.0**		
Total					

95% CI: 95% Confidence Interval; OR: Odds radio

Table 5. Risk factors associated with *Plasmodium* infection in blood donors at Biyem-Assi district hospital

Parameters		Effective	Prevalence (%)	p-value	OR	95% CI
Sleep under mosquito net	Yes	217	36 (16.6)	0.448	2.79	0.63–12.23
	Sometimes	20	2 (10.0)		1.56	0.20–12.07
	No *(ref)*	30	2 (6.7)		1 (ref)	—
	Clay	20	9 (45.0)	**0.001**	5.70	2.19–14.85
Type of housing						
	Hard *(ref)*	247	31 (12.6)		1 (ref)	—
	Yes	40	10 (25.0)	0.059	2.19	0.97–4.93
Stagnant water near house						
	No *(ref)*	227	30 (13.2)		1 (ref)	—
	Before 22h	217	39 (18.0)	**0.050**	10.74	1.44–80.26
Bedtime						
	After 22h *(ref)*	50	1 (2.0)		1 (ref)	—
	Before 5h	240	34 (14.2)	0.271	0.58	0.22–1.54
Wake-up time						
	After 5h *(ref)*	27	6 (22.2)		1 (ref)	—
Total		267	40 (15.0)			

ref: reference; 95% CI: 95% Confidence Interval; OR: Odds radio

Table 6. Prevalence of *Plasmodium* infection according to types of donations, blood group and Rhesus factor among participants

Variables	Effective (n)	Number of positive	Prevalence (%)	p-value
Types of donations				
Family	179	28	15.6	0.719
Volunteer	88	12	13.6	
Blood group				
A	58	8	13.8	0.094
B	57	14	24.6	
AB	15	3	20.0	
O	137	15	10.9	
Rh factors				
Positive	245	37	15.1	0.07
Negative	22	3	13.6	
	N= 267			

Table 7. Prevalence of *Plasmodium* infection according to hemoglobin level and white blood cell count in participants

Variables	Effective (n)	Number of **positive**	Prevalence(%)	p-value
Hemoglobin level				
12-14g/dl	177	37	21	0.063
14-17g/dl	90	13	14.4	
White Blood Cell count				
5000-7000	170	30	18	0.070
7000-9000	97	10	10.3	

Table 8: Average parasite intensity according to risk factors

Variables	Number of positive	Average parasite intensity	P value
Âges of donors			0.416
[20-29]	10	285.11±77.05	
[30-54]	30	248.48±126.30	
Sex			
Female	4	247.47±134.21	0.394
Male	36	284.50±111.88	
Use of mosquito nets			
Yes	35	254.69±116.58	0.775
No	5	271.00±134.28	
Bedtime			
Before 22h	28	257.86± 123.13	0.927
After 22h	12	254.08±107.00	
Grass or stagnant water near habitats			
Yes	3	370.00±52.68	0.081
No	37	247.54± 116.45	
Total	40	256.73±117.17	

Conclusion

Malaria is a potentially fatal disease and remains a major public health problem. We recommend that the blood bank of the Biyem-Assi District Hospital as well as other hospitals in Cameroon and sub-Saharan countries screen blood donors for malaria before any blood transfusion.

Abbreviations

aOR: Adjusted Odds Ratio
CBC: Complete Blood Count
CE: *Comité d'Éthique* (Ethics Committee reference number)
CI: Confidence Interval
DRC: Democratic Republic of Congo
EDTA: Ethylenediaminetetraacetic Acid
HBV: Hepatitis B Virus
HBG: Hemoglobin
HCT: Hematocrit
HCV: Hepatitis C Virus
HIV: Human Immunodeficiency Virus
HRP2: Histidine-Rich Protein 2
MCV: Mean Corpuscular Volume
MCH: Mean Corpuscular Hemoglobin
MCHC: Mean Corpuscular Hemoglobin Concentration
MGG: May-Grünwald–Giemsa
NJ: New Jersey
OR: Odds Ratio
PCR: Polymerase Chain Reaction
pLDH: Parasite Lactate Dehydrogenase
RDT: Rapid Diagnostic Test
SPSS: Statistical Package for Social Sciences
TTM: Transfusion-Transmitted Malaria
UR-BIODEME: Unité de Recherche Biomédicale et Développement des Médicaments
WBC: White Blood Cells
WHO: World Health Organization

Authors' Contribution

Conceptualization, C.K.F, D.E.D, JAN.K., C.Y. and C.N.N.A.; Methodology, C.K.F, D.E.D, J.S.T.N. and A.A.M.; Validation, JAN.K., C.Y. and C.N.N.A. ; Writing – Original Draft Preparation, C.K.F, D.E.D, J.S.T.N. and A.A.M.; Writing – Review & Editing, all authors.; Supervision, JAN.K., C.Y. and C.N.N.A. All authors have reviewed the manuscript.

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Conflict of interest

The authors declare no conflict of interest

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