OPEN ACCESS
Saudi Journal of Nursing and Health Care
Abbreviated Key Title: Saudi J Nurs Health Care
ISSN 2616-7921 (Print) |ISSN 2616-6186 (Online)
Scholars Middle East Publishers, Dubai, United Arab Emirates
Journal homepage: https://saudijournals.com

Original Research Article

Prevalence of Malaria among Children Aged 06 to 59 Months Admitted to the Bougairé Health Center in Bongor, Chad

DJIMRANGAR Olivier[1], KAYALTO Barnabas[1*], BAKARNGA-VIA Issakou[2], ABDELSALAM Tidjani[3]

[1]Department of Life and Earth Sciences, Bongor Teachers' Training Higher School, Bongor, Chad
[1]Department of Life and Earth Sciences, Bongor Teachers' Training Higher School, Bongor, Chad
[2]Human Health Sciences Faculty, University of N'Djamena, Chad
[3]Food Science and Nutrition Research Laboratory (FSNRL), Faculty of Human Health Sciences, University of N'Djamena, Chad

DOI: https://doi.org/10.36348/sjnhc.2025.v08i02.004 | **Received:** 25.12.2024 | **Accepted:** 04.02.2025 | **Published:** 11.02.2025

***Corresponding author:** KAYALTO Barnabas
Department of Life and Earth Sciences, Bongor Teachers' Training Higher School, Bongor, Chad

Abstract

The aim of this study was to determine the prevalence of malaria in children aged between 06 and 59 months in the Bougairé health center in Bongor, Chad. It was a cross-sectional, prospective study running from 1 March to August 2023. The children selected were all given a complete physical examination by the doctors or interns on the ward. A thick blood sample or rapid diagnostic test (RDT) was performed in the laboratory on admission to confirm the diagnosis. Microscopic diagnosis of *Plasmodium* was carried out using a light microscope under an oil immersion system with an x100 objective; this was recorded in each patient's file. During this study, 813 patients were consulted, of whom 328 cases of malaria were diagnosed on the basis of clinical and biological arguments. Malaria cases accounted for 40.34% of consultations, including 153 cases of uncomplicated malaria (46.7%) and 175 cases of severe malaria (53.3%). The 36-59 month age group was the most represented (50.3%), with males predominating (52.0%). Most of the children's parents did not attend school (87.8%). Mothers were housewives (89.9%), while fathers were mainly farmers (67.0%) and followed by shepherds (10.0%). Fever (99.6%), vomiting (59.9%) and abdominal pain (36.0%) were the most frequent reasons for consultation among the children in the study. The study revealed that the most commonly used antimalarial drug was Artemether injection, which accounted for 57.9% of cases. This was followed by artemisinin-based combination therapy, ACT (27.4%), and injectable artesunate with ACT relay (8.2%). Quinine infusion with CTA relay was the least used drug in the study (6.4%). Management complied with national malaria control guidelines in 43.7% of cases. These results justify the continuing training of health workers at the Bougaire Health Center to comply with national directives

Keyword: Malaria, Children aged 6-59 months, Prevalence, Bougaire, Chad.

1. INTRODUCTION

Malaria is a blood parasitosis caused by a protozoan of the genus *Plasmodium*, transmitted to humans by the bite of a mosquito, the female Anopheles, when taking its blood meal. It is a febrile, haemolytic disease that is endemo-epidemic in tropical and subtropical areas (Allassane *et al*., 2005). Six (6) plasmodial species infest humans. These are: *Plasmodium falciparum*, which is the most to be feared and the most widespread. It is responsible for almost all deaths from malaria. It accounts for 85-90% of the parasite formula in Chad. *Plasmodium malariae*, representing 10 to 14% in Chad, *Plasmodium ovale*, representing less than 1%, *Plasmodium vivax* whose presence has been described in the north of Chad (Doumbo, 1992). Chad is thus one of the few countries where all four plasmodial species are found. A fifth species, *P. knowlesi*, of simian origin, has been identified in humans in South-East Asia (Cox-Singh *et al*., 2008). A new *P. cynomolgi* species was recently identified in a 39-year-old Malaysian woman from the east coast of Peninsular Malaysia (Hulu Terengganu) (Ta *et al*., 2014).

The parasite is transmitted to humans by the female anopheles during the blood meal. The infectious stage of the parasite, called the sporozoite, is introduced into the human bloodstream. The sporozoites quickly disappear from the circulation and infect the hepatocytes (Bousema *et al*., 2011). In liver cells, sporozoites multiply to form pre-erythrocytic schizonts, each containing thousands of merozoites. The released merozoites invade the erythrocytes, where they continue the asexual stage of the cycle. Clinical signs are only observed once the intra-erythrocytic cycle is in place. The parasite inside the newly invaded red blood cells is referred to as the ring stage. The rings then become trophozoites which, through asexual divisions, give rise to schizonts containing 8 to 24 merozoites. The merozoites are then released and invade new red blood cells.

Gametocytes, the differentiated sexual form of the parasite, develop from certain merozoites. The mosquito is infected by male and female gametocytes during a blood meal on an infected host. In the mosquito's midgut, microgametes fertilize macrogametes (sexual extra-erythrocytic stages) resulting in a zygotic (diploid) ookinete. The ookinetes pass through the wall of the intestine and form oocysts, which transform into numerous sporozoites (haploid). The sporozoites migrate to the mosquito's salivary glands, ready to start a new cycle at the next blood meal (Bousema *et al*., 2011).

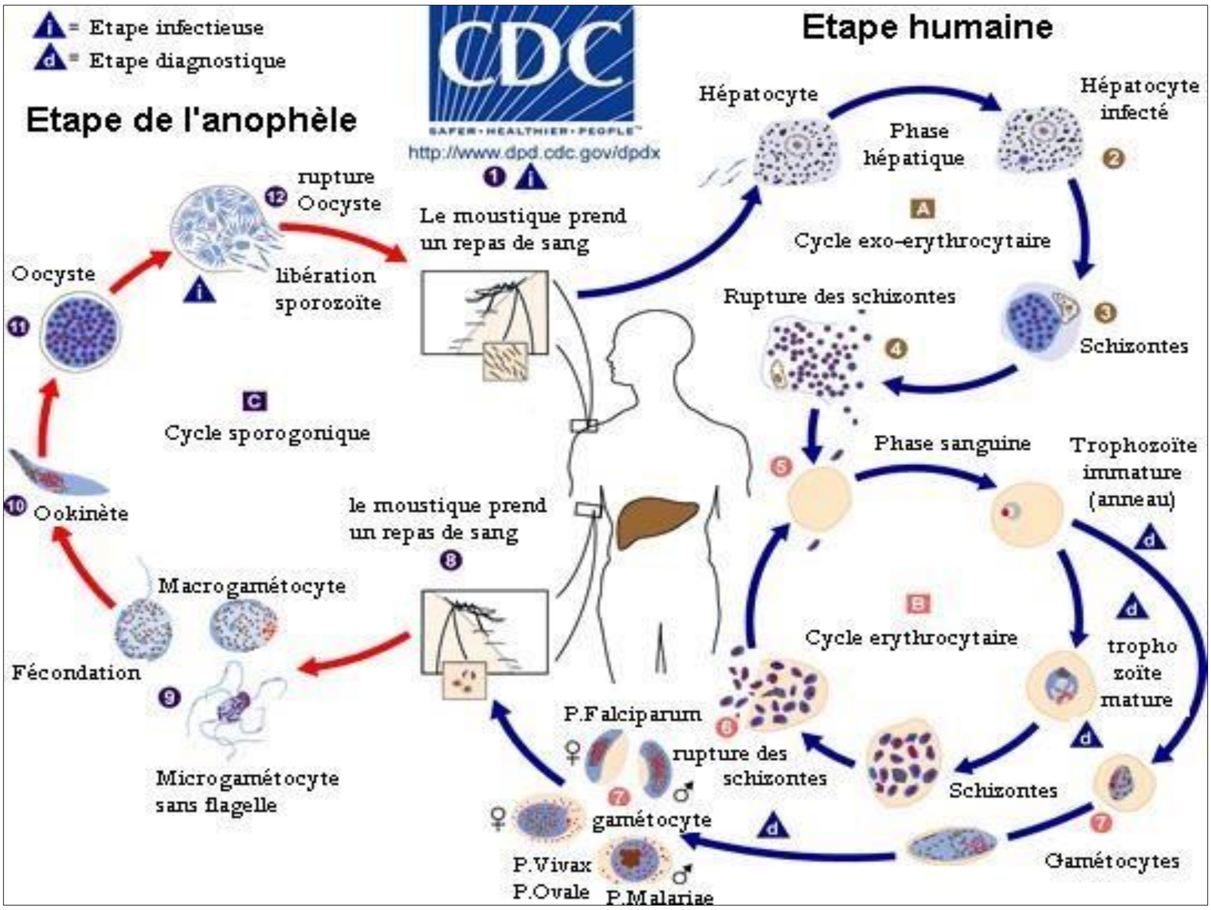

Figure 1: Plasmodium development cycle
Source*: http://www.dpd.cdc.gov/dpdx*

The incubation period of the disease is 7 to 21 days and varies according to the mode of contamination. Once the sporozoites (the infecting form of Plasmodium) have penetrated the human body, they settle in the liver and invade the red blood cells, leading to their massive destruction. This destruction is accompanied by the release of pyrogenic substances. Subsequently, the rosettes (or mature schizonts) in the red blood cells burst at the same time. In the absence of treatment, this phenomenon repeats itself every 48 hours (third fever) or every 72 hours (fourth fever), depending on the parasite species involved. The release of malarial pigment (a pyrogenic substance resulting from the breakdown of haemoglobin into haemozoin) into the bloodstream is responsible for the fever. The destruction of red blood cells leads to anaemia and the release of haemoglobin transformed into free bilirubin by the liver will cause the appearance of subicterus (Doumbia, 2015).

The negative socio-economic impact of malaria and its high morbidity and mortality make it a major public health problem (Gentilini, 1993; UNICEF, 2004). In fact, half the world's population (3.3 billion) is at risk of contracting malaria, and it is estimated that there are around 241 million episodes each year, including 627,000 deaths (WHO, 2018; 2021).

The African continent bears the majority of this global burden in terms of the number of cases and deaths. It accounts for more than 95% of malaria cases and 96% of deaths worldwide (WHO, 2021). Children under the age of five and pregnant women, who are recognized as being the most vulnerable to this scourge, are the population most affected, and 80% of deaths occur in children under the age of 5 years (Ouattara, 2012).

Malaria is the number one public health problem in Chad. According to the National Survey on Malaria Indicators in Chad (ENIPT 2017), with a prevalence of 40.9% in children under five and 41.3% in children aged 5 to 14 in 2017, it is the leading cause of hospitalization (36.26%) and the leading cause of hospital deaths (35.98%) **(INSSED, Tchad 2017)**. Children under 5 and pregnant women accounted for 70% of deaths. In 2023, malaria cases, numbering 1,727,230, accounted for around 30% of all new consultations received by health facilities. In the same year, malaria caused the death of 2,864 people, representing around 28% of all deaths recorded in the country (WHO, 2024). According to Tatoloum (2016) the prevalence of malaria in the general population is 29.8% but varies according to age group. It is 35.8% in children under 5; 39.3% in the 5-14 age group and 15.2% in the over-15s. To tackle this situation, Chad, with the support of its partners, including the WHO (2024), is stepping up its prevention and treatment efforts. The country regularly organizes national campaigns to distribute long-acting insecticide-impregnated mosquito nets targeting the vector. The most recent campaign saw more than 9 million impregnated mosquito nets distributed to over 19 million people, reaching almost 4 million households in 17 provinces. As a result of these mass distribution campaigns, 80% of households in Chad have at least one mosquito net, and more than two-thirds of them have impregnated mosquito nets protecting 24.8% of children under the age of 5 and 22.2% of pregnant women (WHO, 2024). Chad also runs seasonal chemoprevention campaigns, which involve administering monthly treatments during the rainy season to children under the age of 5. In 2023, the country introduced technology to these campaigns. 'Thanks to the use of digital technology, more than one million children have benefited from at least 3 cycles of treatment, i.e. 96.36% of children compared with 95.94% in 2022', said the Secretary General of the Ministry of Public Health and Prevention, Mr. Dabsou Guidaoussou. Chad introduced the malaria vaccine into its Expanded Program on 25 October 2024 through the Ministry of Health, with the support of Gavi, the Vaccine Alliance, UNICEF and WHO.

Since 2010, the WHO has been recommending that endemic countries confirm any suspected case of malaria with a parasitological test before administering an antimalarial drug. Chad has adhered to these recommendations, and the Ministry of Public Health has published directives to guide those involved in the fight against malaria on the strategies to be implemented, including the training of agents responsible for biological diagnosis.

Faced with this scourge of very distant origin, Chad has made a commitment with the international community to act together to reduce malaria mortality and morbidity so that it no longer constitutes a public health problem (Yandaï *et al*., 2017). However, despite all the efforts made with the support of partners, malaria is still a worrying problem in Chad (WHO, 2021). The hope that rests on the development of an effective malaria vaccine that is accessible to poor populations in endemic areas seems remote (INSTAT, 2018).

For the time being, the only alternative is prevention and the early and correct management of cases. Unfortunately, these strategies are also fraught with problems due to the resistance of vectors to insecticides and parasites to antimalarial drugs. Self-medication, poor compliance with chemoprevention among pregnant women and inadequate management of malaria cases in health centers are some of the causes (Safronetz *et al*., 2017).

The present study aims to determine the prevalence of malaria in children aged 06 to 59 months admitted to the Bougaïré Health Center in Bongor, Chad, in order to develop response strategies.

MATERIALS AND METHODS

1-MATERIALS

1.1 Technical equipment

The technical equipment used consists of: hydrophilic cotton, indelible marker, vaccinostyles, slides and slides, alcohol swab, safety box to guarantee the safety of the objects used, waste bins, pen, rapid diagnostic test (RDT), lancets, buffer solution pH = 7.2 (1 tablet for a liter of water), sampling tool (handle, inverted beaker or pipette), examination gloves, watch/timer.

Equipment for the microscopic investigation of *Plasmodium*

This included the microscope, a soft, lint-free cloth for cleaning objects to be used on the bench, immersion oil and a manual counter. We used a bench notebook to record all the details of our work.

1.2 Equipment required for staining

These are the staining tray, the trolley rack, the stain (Giemsa), buffered or tap water and the rack.

Giemsa (Gustav Giemsa, 1902) is a dye composed of a mixture of eosin and methylene blue. The eosin colours the parasite's chromatin red or pink, while the methylene blue colours its cytoplasm blue. Giemsa is purchased ready-to-use, but certain precautions must be taken to ensure it is used correctly.

1.3 Biological material

This consists of blood taken from the children of the study for analysis, with the parents' agreement.

2-METHODS

2.1. Study framework

The work was carried out at the Bougaire health center. This center is located in the town of Bongor in the Bougaire neighborhood towards the north-east exit of Bongor on the governorate axis on the way to Guissédé. It was set up in 2018 by the NGO APCD (Association la Plume pour la Culture et le Développement). The population of Bougaire is made up of several communities, including Arabs, Foulbé, Massa and Marba.

The Bougaire Health Centre is bounded:

- to the north by the rice plain;
- to the east by the cemetery;
- to the south by the Christian Assembly's secondary school;
- to the west by the bus station.

2.2. Type and period of study

This is a cross-sectional, prospective and descriptive study at the Bougaire health center running from March to August 2023, i.e. 5 months.

2.3. Study population

Our study population consisted of children aged 06 to 59 months, regardless of sex, whose parents live in Bongor.

2.4. Survey

The survey was carried out in the consultation room of the Bougaire Health Centre (CSB). The variables studied related to sociodemographic data (age, sex, ethnicity, and residence); clinical data (general signs, functional signs and physical signs) and biological data.

The form was completed by observing and listening to the service providers. Everything was recorded in the consultation registers.

2.4.1. Sampling

Consecutive exhaustive sampling was carried out. All children aged between 06 and 59 months who met the inclusion criteria during the study period and whose parents or care giver gave their consent were included in the study. We therefore registered a sample of three hundred and twenty-eight (328) patients, including 172 boys and 156 girls.

2.4.2 Inclusion criteria

The study covered children aged between 6 and 59 months with fever (history within 24 hours, body warm to the touch or axillary temperature ≥ 38°5 c) and presenting a positive thick blood drop or rapid diagnostic test (RDT) (paracheck®), whose parents or caregiver resided in Bongor at the time of the study and who agreed to answer the questionnaire.

2.4.3. Non-inclusion criteria

The following were excluded from the study: all children aged less than 06 and more than 59 months, seen for malaria outside our study period, as well as those with other non-malarial febrile illnesses and suffering from malaria but whose parents were visiting.

2.4.4. Clinical variables

The clinical manifestations of malaria are very diverse, ranging from flu-like symptoms accompanied by high fever (39 or 40°C), chills, intense headache, abdominal pain and muscle aches.

2.4.5. Socio-demographic variables

These are composed of: Parents' age and sex, level of education, occupation, marital status and place of origin.

2.5. Conduct of the study

2.5.1. Protocol development and validation

We developed a protocol by setting objectives, describing the methodology to be adopted and specifying the data collection tool. The research protocol was validated by a committee at the ENSB. Before the survey phase, a research authorization was submitted to the head of the Bougaire health center in order to obtain his agreement.

2.5.2 Questioning the mothers or care giver

Each mother or care giver was questioned in detail, in accordance with the survey form.

2.5.3. General physical examination

The following parameters were measured or investigated using standard methods: weight, temperature, height, mucocutaneous pallor and jaundice, state of hydration, nutritional status (red or relaxed hair, malnutrition folds, bilateral oedema of the extremities, weight/height ratio and brachial circumference), respiratory rate, heart rate, state of shock, abdominal palpation and convulsion.

2.6. Operating procedure for blood smear/thick smear

On admission, all children were given a full examination by the department's doctors or interns, based on the patient's history, physical examination and additional tests, supported by a file for each patient.

2.6.1. Complementary examinations

Thick drop or rapid diagnostic test (RDT) were performed by CSB laboratory staff on all patients on admission to confirm the diagnosis.

2.6.2. Procedure for thick blood smear

GE was performed using blood taken from one of the fingers of the hand. The finger was disinfected with an alcohol swab. Using a single-use vaccinostyle, a capillary puncture was made on the pulp of the disinfected finger. The first drop was removed with dry cotton wool. The second drop was placed in the middle of a slide with the angle of a second slide. Mechanical defibrillation was performed using circular movements from the center to the periphery of the slide so as to spread the blood in a circle approximately 1 cm in diameter. The slides were dried at the temperature of the sampling room, away from dust, sunlight and flies. The slides were stained with Giemsa 3% dye diluted in buffered water at pH = 7.2 for 30 minutes, then rinsed and dried.

2.6.3. Procedure for the RDT

Bring the contents of the paracheck Pf® kit to room temperature before performing the test in the open air (if stored in the refrigerator). Open the sachet and remove the device. Once the sachet has been opened, the device must be used immediately. But before use, check the color of the desiccant. It should be blue. If it has become colorless or pale blue, discard it and use another one. Write the patient's name or code, the date and the exact time (hour and minute) on the plastic frame of the test. Clean the chosen area, either the finger (preferably the palmar surface of the tip of the 3rd or 4th left finger), the big toe or the heel in infants, with an alcohol swab. Then leave it to dry for a few seconds (or clean it with a dry swab). With your left hand, press firmly on the proximal part of the cleaned finger to stimulate circulation and, using a sterile vaccinostyle, prick the chosen part with one movement and control. With one hand, squeeze the finger to draw out a drop of blood. With the other hand, hold the sampling pipette in the middle and bring the pipette into contact with the surface of the drop of blood: the appropriate quantity of blood (approximately 5µl) will be collected by the action of surface tension. Transfer the blood thus collected onto the test pad, in sampling port A' a whole blood sample of 5µl can thus be obtained or a micro pipette can also be used to transfer 5µl of the anti-coagulated sample or sample obtained by finger pricking onto the test pad, in sampling port A'.

Homogenize the anticoagulated blood sample by mixing gently. Bring the sample loop into contact with the surface of the blood sample contained in the container, ensuring that the blood from the sample loop has been fully absorbed by the test buffer. Place 6 drops (300 µl) of wash buffer into sample port B' while holding the plastic dropper steady. After 15 minutes, read the results: the Rhesus blood grouping and the blood cell count (CBC) according to clinical indications are obtained.

2.7. Microscopic procedure

Microscopic diagnosis of Plasmodium is carried out by a qualified person using an optical microscope with an immersion oil base and an x100 objective. The procedure is carried out in the following chronological order:

- Place a drop of immersion oil on the thick drop and another on the blood smear;
- Place the slide in the slot in the microscope carriage;
- Select the X100 objective and position it on the thick drop;
- Adjust using the screws that slide up and down so that the objective touches the blood smears;
- Observe through the eyepieces and adjust the screws to obtain an image of the blood components and any parasites;
- Using the screw on the carriage, scan the thick drop from side to side, looking at several microscopic fields for parasites;
- A true parasite is one that has a nucleus colored red and a distinct cytoplasm colored light blue;
- Look at the blood smear to determine the plasmodia species present;
- On the thick drop, choose an area where the blood is homogeneous to distinguish the parasites from the blood components;

2.8. Ethical considerations

We obtained prior authorization for the research from the authorities at the Bongor Teachers' Training Higher School, followed by authorization from the Bougaire Health Centre. Informed consent was obtained from the children's parents and/or carers. Patient anonymity and data confidentiality were respected.

2.9. Data capture and analysis

The data collected were subjected to statistical analysis. The frequency of the various parameters was determined and the Chi2 test was used to compare the means. A p-value of less than 0.05 was considered significant.

3. RESULTS AND DISCUSSION

1. Results

1.1 Sociodemographic characteristics

1.1.1. Apportionment of patients according to age

Table 1 shows us the apportionment of children according to age.

Table 1: Apportionment of children by age group

Age ranges (in months)	frequency	Percentage
6-11	22	6,7
12-23	66	20,1
24-35	75	22,9
36-59	**166**	**50,3**
Total	328	100

The table shows that the most common age group is 36-59 months, with 50.3% of patients, followed by 24-35 months (22.9%) and 12-23 months (20.1%).

1.1.2. Distribution of children by gender

Figure 2 shows the distribution of children by gender.

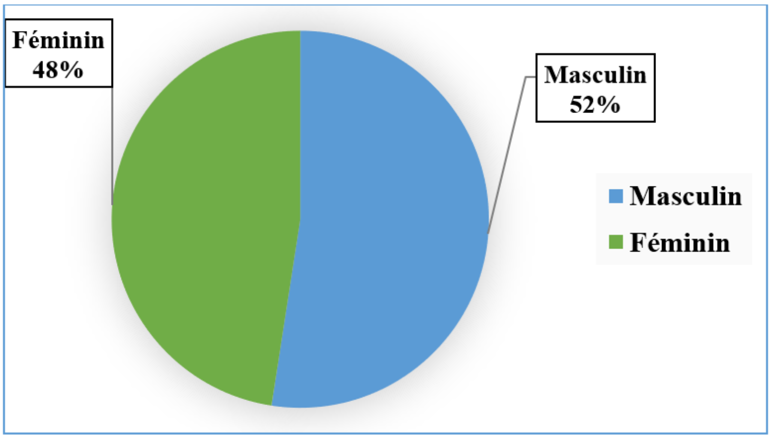

Figure 2: Distribution of children by gender
Féminin = Girls (green color); **Masculin** = Boys (blue color)

The figure shows that the majority of patients were boys (52%), compared with girls (48%).

1.1.3. Apportionment of patients by place of residence

Table 2 shows the apportionment of patients by place of residence.

Table 2: Apportionment of patients by place of residence

Residences	frequency	Percentage
Bongor	174	53,1
Darkawoye	23	7,0
Bougaïré	67	20,4
Guissedé	22	6,71
Others	42	12,8
Total	**328**	**100**

The table shows that more than half the patients live in the town of Bongor (53.1%), followed by Bougaire, where the health center is located (20.4%). The other patients came from the surrounding villages of Darkawoye and Guissedé.

1.1.4. Distribution of patients by ethnicity

Figure 3 shows the distribution of patients by ethnicity.

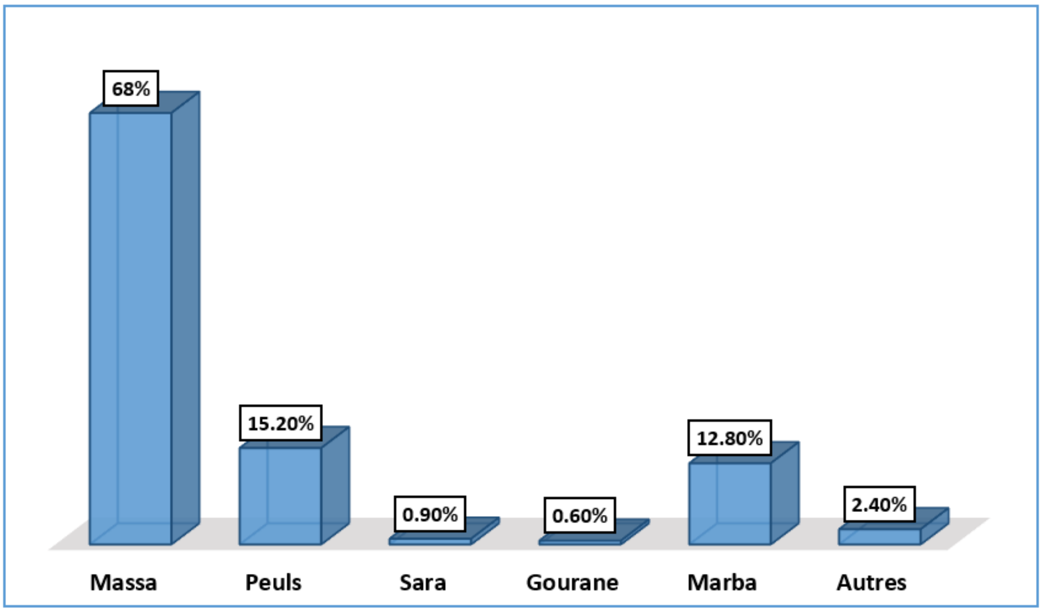

Figure 3: Distribution of patients by ethnic group

Analysis of Figure 5 shows that the majority of patients are of Massa origin (68%), followed by Fulani (15.20%) and Marbas (12%).

1.1.5. Marital status of the patient's parents

Table 3 shows the marital status of the patient's parents.

Table 3: Marital status of patients' parents

Marital status	frequency	Percentages (%)
married	326	99,4
Bachelor	1	0,3
divorced	1	0,3

This table shows that the majority of patients' parents are married (99.4%). Divorced and single people each represent 0.3%. Which shows that almost all patients have parents living with them together.

1.1.6. Distribution of patients according to mothers' professions

Figure 4 below shows the distribution of children's parents according to the mother's occupation.

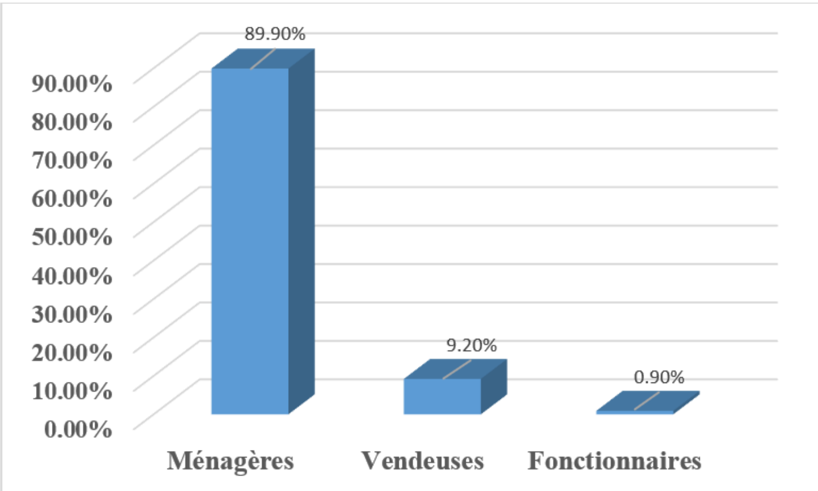

Figure 4: Distribution of patients according to mothers' profession
Housewives = housekeeping; **Vendeuses** = Saleswomen; **Fonctionnaires** = Civil servants.

From this figure, it appears that the majority of patients' mothers are housekeeping, i.e. 89.9%, followed by saleswomen (9.2%). Civil servant mothers represent only 0.9%.

1.1.7. Distribution of patients according to fathers' profession

This result is presented in Figure 5.

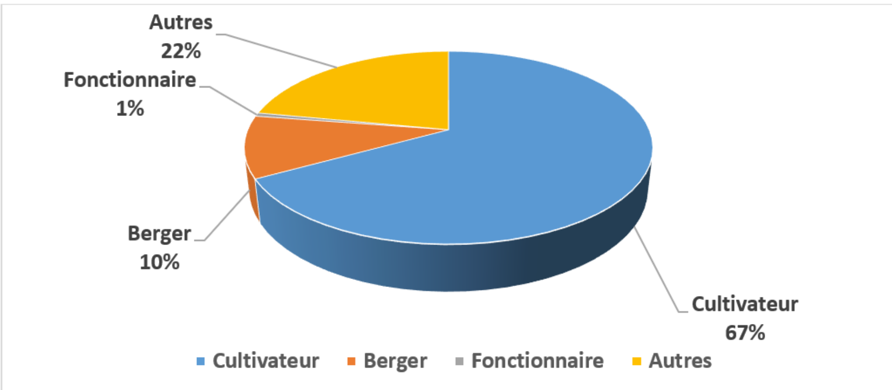

Figure 5: Distribution of patients according to fathers' profession
Cultivateurs = farmers; **Berger** = shepherds; **Autres** = Others.

It appears from this figure that 67% of patients' fathers are farmers. They are followed by shepherds (10%). Civil servant parents make just 1%. Fathers of children who practice other activities apart from those mentioned above represent 22%. The professional status of fathers can influence the quality of life of children as well as their health status.

1.1.8. Apportionment of patients according to the level of education of the parents

Table 4 presents the results regarding the level of education of the parents.

Table 4: Apportionment according to the educational level of the patients' parents

Educational level of parents	Number	Percentage
Unschooled	288	87,8
Primary school	34	10,4
College	6	1,8
Total	**328**	**100**

From this table, it appears that the majority of the parents of these patients are unschooled (87.8%), followed by those who attended primary school with 10.4%. Those parents who attended school until college represented only 1.8%.

1.1. Clinical characteristics

1.1.1. Frequency of reasons for consultations in children aged 6 to 59 months

Table 5 summarizes the results regarding the reasons for consultation.

Table 5: Frequency of reasons for consultations in children aged 6 to 59 months

Reasons for consultations	Frequency	Percentage (%)
Headache	84	27,3
Vomiting	184	59,7
Fever	327	99,6
Convulsion	31	10,1
Respiratory distress	45	14,6
Diarrhea	58	18,8
Thrill	72	23,4
icterus	56	18,2
Abdominal pain	111	36,0

The results in this table show us that almost all patients were consulted for fever (99.6%) followed by vomiting (59.7%). This was followed by patients who complained of abdominal pain (36.0%), followed by headaches (27.3%), chills (23.4%). Diarrhea and jaundice come respectively with 18.8 and 18.2%. Respiratory distress and convulsions, which are the least represented signs in the study, ended with 14.6 and 10.1% respectively.

1.2.2. Frequency of clinical signs found on abdominal examination in children aged 6 to 59 months

Splenomegaly was often found on abdominal examination, i.e. 4.6% and associated with hepatomegaly i.e. 2.4% according to table 6.

Table 6: Frequency of clinical signs found on abdominal examination in children aged 6 to 59 months

Abdomen	Number	Percentage (%)
Splenomegaly	15	**4,6**
Hepatomegaly	12	3,7
Hepato-Splenomegaly	8	**2,4**
Normal	293	89,3
TOTAL	**328**	**100,0**

1.2.3. Apportionment of malaria cases according to care providers

Most diagnoses were made by the doctor, i.e. 46.3% compared to 37.8% by a nurse when the doctor was traveling.

Table 7: Apportionment of malaria cases according to care providers

Care providers	Frequency	Percentage (%)
physician	152	**46,3**
Nurse	124	37,8
Responsible for vaccinations	52	15,9
Total	**328**	**100,0**

1.2.4. Prevalence (P) of malaria

$$P = \frac{\textit{Number of malaria patients}}{\textit{Number of patients consulted}}$$

$\mathbf{P} = \frac{328}{813}$x 100 = 40,34 %

During the time of our study, we calculated and obtained a malaria prevalence which was 40.34%.

1.2.5. Frequency of use of antimalarial in children aged 6 to 59 months

Table 9 shows the results of the use of anti-malarials in the children in the study.

Table 8: Frequency of anti-malaria molecules used in children aged 6 to 59 months

Molecule used	Frequency	Percentage (%)
therapeutic combination based on artemisinin (CTA)	90	27,4
injectable Artemether	190	**57,9**
injectable artesunate with CTA relay	27	8,2
Quinine infusion with CTA relay	21	6,4
TOTAL	**328**	**100,0**

The results show that the most used antimalarial is injectable Artemether which represents 57.9% of cases. It is followed by the therapeutic combination based on artemisinin (CTA) (27.4%); comes injectable artesunate with CTA relay (8.2%). Quinine infusion with CTA relay is the least used in the study with (6.4%).

4. DISCUSSION

Our study conducted at the Bougaire Health Center in Bongor aimed to determine the prevalence of Malaria in children aged 6 to 59 months. This age group was chosen for its vulnerability and also the period where the child has not yet reached immune maturity.

The results of the study revealed that the most represented age group was that between 36-59 months with 50.3% of patients, followed by the age group of 24-35 months (22.9%) and 12-23 months (20.1%). Diarra (2021) in Mali found that the most represented age group was 6 to 59 months with 89.6% of children and an average age of 20 months.

Our results are lower than those obtained by Fané who reported 58.1% of children in the 24-59 month age group (Fané, 2019).

As for the gender distribution of the children in the study, we found a male predominance of 52%, i.e. a sex ratio of 1.08. Our results are close to those of Diarra who found a male predominance of 51.3% and a sex ratio of 1.05 (Darra, 2021).

The staff of the Bougaire Health Center were able to correctly diagnose malaria in 86.6% of cases, including 73.33% of cases for severe malaria based on WHO severity criteria. TRAORE (2009) in Kati, in Mali found 22.14% for simple malaria; 47.40% for severe malaria. As for Yaméogo *et al.*, (2015) at Bobo-Dioulasso University Hospital, they reported that only 13.82% of the diagnosis was consistent.

However, upgrading the staff at the Bougaire Health Center would further improve these observed diagnosis rates. Regarding the frequency of reasons for consultation of children aged 6 to 59 months, fever (99.6%) was the main reason for consultation and clinical sign observed. Coma and convulsion have been observed only in severe malaria. Severe anemia was found in 32.3% of cases of severe malaria. Our results are lower than those obtained by Yaméogo *et al.*, (2015) at Bobo-Dioulasso University Hospital which was 45.69% severe anemia.

Therapeutically, our study showed that overall 47.1% of treatments prescribed by staff complied with the national protocol. Treatment was compliant in 81.6% and 19.4% for simple malaria and severe malaria, respectively. The therapeutic combination based on artemisinin (CTA) recommended by the National Malaria Control Program (PNLP) was the most prescribed molecule in the treatment of simple malaria (58.7%) followed by Artemether (39 .9%). This rate of use of CTA can be explained by the performance of this molecule in the treatment of malaria and its compatibility with the body of the majority of patients. Diarra (2006) at the Cscom in Sabalibougou in 2010 found that CTAs were used in 35.90% of cases to treat simple malaria.

Yaméogo *et al.*, (2015) found that 57.49% of treatment complied with national guidelines. According to national guidelines for the management of malaria, severe forms should be treated with injectable artesunate, artemether or injectable quinines. In our study, injectable artemether was used as first-line treatment in 57.9% of cases. This choice could be explained by the non-compliance with the national protocol by providers and the incessant shortage of artesunate at the Bougairé Health Center during the study period. Furthermore, artemether constitutes a good alternative in anemic forms of malaria (PNLP, 2014).

Maiga *et al*., (2019) in Sikasso in Mali found that injectable artemether was used at 88.9% and quinine infusion 11.1%.

Our obtained prevalence is 40.34%. It is higher than the national prevalence of malaria (35.8%) among children under 5 years old (Tatoloum, 2016). This requires adequate measures and means of response.

CONCLUSION

At the end of our study, the prevalence was determined at the Bougaïré Health Center in Bongor. It is higher than the national prevalence. The study found that less than half of cases were treated according to national guidelines. Malaria among children aged 6-59 months remains a public health problem in Chad. Adequate case management is conditioned by access to a confirmatory diagnosis and treatment with effective medications in accordance with the recommendations of the National Malaria Control Program of Chad.

Acknowledgments

We thank all the staff of the Bougaïré Health Center (CSB) for their good collaboration during this study.

REFERENCES

- Alassane, D., Boureima, K., Issaka, S., Mahamadou, A. T., Seydou, D., Mouctar, D., Belco, P., Mahamadou, D. & Ogobara, K. D. (2005). Season, fever prevalence and pyrogenic threshold for malaria disease definition in an endemic area of Mali. *Trop. Med. Int. Health*, *10*(6): 550–556.
- Bousema, T. & Drakeley, C. (2011). Epidemiology and Infectivity of Plasmodium falciparum and Plasmodium vivax Gametocytes in Relation to Malaria Control and Elimination. *Clin Microbiol Rev*.
- Charlotte, W., Zana, C., Azoukalne, M. & Alice, M. (2019). La chimio prévention saisonnière au Tchad: Comprendre les facteurs limitant la distribution des médicaments du Programme actuel, la faisabilité et l’acceptabilité de l’extension au groupe d’enfants de 5-10 ans dans le District de Massaguet. Juillet 2019.
- Cox-Singh, J., Davis, T. M., Lee, K. S., Shamsul, S. S., Matusop, A., Ratnam, S., ... & Singh, B. (2008). Plasmodium knowlesi malaria in humans is widely distributed and potentially life threatening. *Clinical infectious diseases*, *46*(2), 165-171.
- Diarra, J. P. (2006). *Etude clinique de la mortalité et de la morbidité dues au paludisme dans le service de Pédiatrie de l'Hôpital Régional Nianankoro FOMBA-Ségou* (Doctoral dissertation, Université de Bamako).
- Doumbia, H. (2015). Place de la médecine traditionnelle dans la prise en charge thérapeutique des enfants de moins de 5 ans avant leur hospitalisation au CSRéf de Koutiala.
- Doumbo, O. (1992). *Epidémiologie du paludisme au Mali: étude de la chloroquinorésistance, essai de stratégie de contrôle basée sur l'utilisation de rideaux imprégnés de perméthrine associée au traitement systématique des accès fébriles* (Doctoral dissertation, Montpellier 2).
- Fané, B. (2019). *Evaluation de la prise en charge du paludisme chez les enfants de 0 à 59 mois admis dans le centre de santé communautaire de Farako* (Doctoral dissertation, USTTB).
- Gentilini, M. (1993). Médecine Tropicale 5e édition. Médecine-Sciences Flammarion, 91-122.
- INSEED, Tchad. (2017). L’Enquête Nationale sur les Indicateurs du Paludisme au Tchad de 2017 (ENIPT-2017).
- INSTAT, (2018). Cellule de Planification et de Statistique Secteur Santé-Développement Social et Promotion de la Famille (CPS/SS-DS-PF) et ICF. 2019. Enquête Démographique et de Santé au Mali 2018. Bamako, Mali et Rockville, Maryland, USA: INSTAT, CPS/SS-DS-PF et ICF.
- OMS, (2018). Paludisme. Principaux faits. 20 octobre 2021.
- OMS, (2021). Rapport 2021 sur le paludisme dans le monde, Principaux messages. p. 24. Report No.: ISBN: 978 92 4 004049 6. 5. mondiale de la Santé.
- OMS, (2024). Tchad: des innovations pour soutenir la lutte contre le paludisme**,** 25 avril 2024.
- Ouattara, S. M. (2012). Paludisme chez l’enfant de six (6) à cinquante-neuf (59) mois, dans la zone périurbaine de Banfora (Burkina Faso): étude des indicateurs paludologies selon les saisons et de l’incidence du paludisme clinique en saison de forte transmission palustre [transversale descriptive]. [BURKINA FASO]: UNIVERSITE DE OUAGADOUGOU; 2012;
- PNLP, (2014). Guide de formation sur le diagnostic biologique du Paludisme dans les formations Sanitaires; décembre 2014;
- Safronetz, D., Sogoba, N., Diawara, S. I., Bane, S., Rosenke, K., Maiga, O., ... & Doumbia, S. (2017). Annual incidence of Lassa virus infection in southern Mali. *The American journal of tropical medicine and hygiene*, *96*(4), 944.
- Ta, T.H. Hisam, S. Lanza, M. Jiram, A.I. Ismail, N. & Rubio, J.M. (2014). Premier cas d’infection humaine acquise naturellement par Plasmodium cynomolgi. *Malar J*. 24;13:68. doi: 10.1186/1475-2875-13-68. PMID: 24564912; PMCID: PMC3937822;
- Tatoloum, A. (2016). Contribution à l’étude de la vulnérabilité sociale urbaine au risque palustre. Cas de la ville de Moundou au Tchad. Rev. *Scient. Tch.*, *1*(9): 35-47.
- Tchad, Gavi, (2024). Le Tchad lance la vaccination contre le paludisme, les infections à pneumocoque et les diarrhées à rotavirus, N’Djaména, 25 octobre 2024.

- UNICEF, (2004). Le paludisme : une des principales causes de décès et pauvreté des enfants en Afrique. Octobre 2004 ;
- Yaméogo, T. M., Tapsoba, S. P., Sombié, I., & Guiguemdé, T. R. (2015). Évaluation de l'application des directives nationales de prise en charge des cas de paludisme au CHU de Bobo-Dioulasso. *Santé publique*, *27*(2), 265-273.
- Yandaï, F. H., Moundine, K., Djoumbe, E., Boulotigam, K., Moukenet, A., Kodindo, I. D., & Hinzoumbe, C. K. (2017). Perception de risques du paludisme et utilisation des moustiquaires au Tchad. *International Journal of Biological and Chemical Sciences*, *11*(1), 228-236. DOI : https://dx.doi.org / 10.4314/ijbcs.v