Texila International Journal of Public Health
ISSN: 2520-3134
DOI: 10.21522/TIJPH.2013.12.04.Art001

# Prevalence of Malaria among Children between 3 and 59 Months Old in Two Healthcare Districts of Burkina Faso, 2020

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***Abstract***

*Every 75 seconds, there's a child below 5 years of age who is dying from malaria throughout the world. Burkina Faso, which also suffers from the ravages of malaria, has developed several strategies to respond to the disease including seasonal malaria chemoprophylaxis (SMC). To generate basic data available for the study of the efficacy of a supervised distribution of the 3 doses of SMC, we conducted this study outside of SMC campaigns to determine the prevalence of malaria among children between 3 and 59 months old in two healthcare districts. A transversal descriptive study was conducted on children in the healthcare districts of Boromo and Gaoua. Data were collected on sociodemographic, and clinical features as well as on knowledge and practices on prevention outside of SMC from December 10 to 24, 2020. The prevalence of malaria was calculated, globally, and in each district and compared to each other using a chi-square test. Among the 2440 children, those from 2 to 5 years were the most represented with 64.22% (p < 0.0001). A total of 83.93% of families had long-lasting insecticide-treated nets (LLINs) (p<0.0001) and 68.57% had used them (p =0.04). The overall prevalence of malaria was 4.75%; the ones in Boromo and Gaoua were respectively 3.63% and 6.60% p=0,034). This study showed a high prevalence of malaria among children between 3 and 59 months, especially in Gaoua. Interventions should target parents of children in this age group and focus on promoting the use of LLINs.*

***Keywords:*** *Burkina Faso, Children Under 5 Years, Malaria Prevalence.*

## Introduction

For over a century, malaria has remained one of the major public health concerns worldwide and the most difficult to address [1]. Almost half of the world population (40%) live in an endemic zone of malaria thus making malaria the first parasitic endemic disease worldwide. According to the World Health Organization, the 2023 global report highlights the growing threat of climate change with increasing malaria incidence and death rates [2]. Malaria is a blood-borne parasitic infection caused by a protozoa named plasmodium which is transmitted to humankind through a female anopheles mosquito bite. It is a disease that causes fever and hemolysis and remains endo-epidemic in tropical and sub-tropical zones [3]. Malaria continues to cause thousands of victims worldwide even though it is a preventable and treatable disease.

According to the WHO Report 2021 on malaria in the world, the new cases of malaria were estimated to be 14 million in 2020 with

***Received: 13.02.2024*** ***Accepted: 12.03.2024*** ***Published on: 27.12.2024***
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69 000 deaths between 2019 and 2020 [4]. The data showed that pregnant women and children were the most vulnerable groups with 35% and 67% of deaths recorded in the same year. One child below 5 years of age dies from malaria somewhere in the world every 75 seconds [5]. The majority of malaria cases occur in sub-Saharan Africa with 95% of cases. Children below 5 years of age account for 81% of malaria cases with a death rate of 80% [4].

Burkina Faso is, since 2018, one of the 12 countries that have been identified as 'High Burden to High Impact' (HBHI) [6]. In the country, the disease was by far the first reason for health visits and the first cause of mortality in healthcare facilities in 2020 with 993 875 health visits among which 397 897 for children below five years of age (43%). It was followed by upper respiratory tract and gastrointestinal affections [7]. Severe malaria cases occurred in 223 425 people including 109 026 (59.67%) children below five years of age. The overall number of deaths was 1,398 including 729 children below five years of age (52.15% of deaths) [7]. This represents an obvious social and economic burden. In 2020, 10 million nets were distributed and 768 million euros were spent in the same year to respond to malaria [8].

To properly respond to malaria and reach to goal of its elimination worldwide by 2035 according to the sustainable development goals (SDG), the global technical strategy for malaria was designed by the WHO to guide and sustain the actions of all countries that are affected by the disease. In this perspective, the strategy has set global ambitious targets for 2030 aiming at reducing the mortality and the incidence of malaria by 90% based on the 2015 data report, with intermediary goals for 2020 and 2025 [9]. These strategies allowed a significant reduction in the number of malaria cases.

Burkina Faso like other countries has implemented these interventions among which the seasonal malaria chemoprophylaxis (SMC) since 2014 based on a study that had recommended such intervention during the rainy season which is a period of high transmission rate of the disease to protect children. The SMC is defined as « the intermittent administration of a curative dose of antimalarial treatment during the season of high transmission of malaria to avoid the disease. The goal is to maintain the therapeutic concentration of the antimalarial drug in the blood during the period when there is the highest risk of contracting malaria [10].

In Burkina Faso, SMC consists of administering four cycles (July – October) of full treatment by sulfadoxine-pyrimethamine and amodiaquine every month to children between 3 to 59 months of age. The duration of the full treatment is of 3 days with a pill taken once daily at the same hour with the first intake being supervised by a community healthcare agent (CHBA). However, the reports of the SMC campaigns conducted by the National Malaria Control Program (NMCP) in 2017 in healthcare districts that implemented the SMC since 2015 showed a low-rate reduction in the incidence of malaria with the best rates reaching 49% and the poorest rates at 9%.

The country has advocated for the supervision of the three doses of SMC with 3 Directly observed treatments (3DOT) to increase the efficacy of the campaign. This strategy was implemented in 2020 in the healthcare districts of Batié, Mangodara, Diébougou and Gaoua. It appeared necessary to compare the efficacy of 3 DOT to that of 1DOT knowing that 3DOT has a higher cost. For this comparison, it was necessary to have, outside of the SMC campaign period, baseline data, on malaria prevalence in the districts that implement these strategies.

The healthcare district of Gaoua was selected for the study on strategy efficacy because it was the only one surrounded by districts that implemented 3 DOTs. Another district in which the first intake of SMC is the

only one supervised, located in a malaria high incidence zone similar to Gaoua and is not surrounded by districts that supervised the 3 doses of SMC is Boromo. The district of Boromo was therefore the ideal control for this study on the efficacy of the 3DOT strategy. Our study aimed to determine the prevalence of malaria in children below 5 years of age in the districts of Boromo and Gaoua. It aims to provide investigators with basic data for the study of the effectiveness of 3DOT, a study which could facilitate advocacy with SMC partners so that they agree to finance the best strategy which will accelerate progress towards the elimination of malaria by 2030 as targeted in the 2021-2025 strategic plan of the PNLP of Burkina.

# Methods

## Study Area

### The Heath District of Boromo

The health district of Boromo is located in the southwest region of Burkina Faso. It covers an area of 4 539km².

The global population of the district was estimated at 313 839 inhabitants in 2020 and 64.4% of them lived in rural areas. The children below 59 months of age represented 18.78% of the population. In this district of the south Soudanian climate type, malaria seems to have a permanent transmission and evolves in a hyper-endemic mode. In 2020, healthcare visits for malaria accounted for 389.92% of all visits. About 42.18% of malaria cases and 70.58% of deaths due to malaria have occurred among children below five years of age [11].

The type of climate in the district is south Jordanian and is characterized by a wet season from April to October and a dry season from November to March. The Balle province (Boromo) receives one of the highest rainfall in the country with an annual pluviometry of 935mm.

The district of Boromo has one medical centre, 31 centres for health and social promotion, and the regional hospital as a reference centre. The SMC was started in Burkina Faso in 2014 and was implemented in Dedougou (Region of Mouhoun Buckle) on Friday, July 28th, 2015. The target population in 2020 was 53,472 people throughout the district [11]. The strategy that was implemented consisted of supervising the first intake of the pills by a community-based agent and letting the mother or the legal tutor administer the two remaining pills in the next few days. This is the 1DOT strategy.

### The Health District of Gaoua

The district of Garoua belongs to the southwest region and spreads over 5 098 km2 with a population of 275.274 inhabitants. Children below five years of age represented 17.2% of the population. In 2020 there were 4 949 health visits for malaria in the southwest region and 935 visits in the district of Gaoua. About 42.18% of malaria cases and 70,58% of deaths due to malaria occurred among children below five years of age. The district of Gaoua has 1 medical centre (MC), 33 CHSP and the regional hospital of Gaoua as a reference centre [11].

The type of climate is south Jordanian and the region receives the highest rainfalls with an annual pluviometry of 1205 mm.

The seasonal malaria chemoprophylaxis was started on February 12th 2015 in the southwest region and the district of Gaoua was the first site for its implementation. The 1DOT strategy was carried out until 2020 when the 3DOT strategy was experienced in a few districts including the district of Gaoua. The targeted population was 45,958 in 2020 [11].

### Type and Period of Study

We conducted a descriptive cross-sectional study from December 9$^{th}$ -24$^{th}$, 2020.

## The population of Study and Criteria of Non-inclusion

Our study included children with ages ranging from 3 to 59 months and residents of

the districts of Boromo and Gaoua. Children who were transiting in the district (for vacation or other short stay) were not included. The following children were not eligible for SMC for other reasons besides age (the same population should be used to compare the efficacy of the 3 DOT):

1. An HIV-infected child that already receives cotrimoxazole so to avoid sulfamide overdose
2. A child who is allergic to one of the medications (sulfadoxine-pyrimethamine (SP) and amodiaquine (AQ).

## Sampling

this study aimed to make basic data available for the study of the effectiveness of the 3-dose supervision strategy of the CPS. It took place in the same health areas as the quasi-experimental study which will compare the 2 strategies. A cluster randomization was used and the unit of randomization was the Center for Health and Social Promotion as it is the smallest health area. The number of clusters and person-months required in each group was estimated by the randomized controlled trials size calculation method of Hayes [12]. The number of clusters estimated based on the incidence rate, the primary endpoint, was used to estimate the number of subjects needed for the estimate of the other study parameters.

Taking into account data from the District Health Information Software 2015 (DHIS2), the estimated overall incidence rate for all 15 CHSPs having implemented SMC was 24 cases per 100 person-months, corresponding in our hypothesis to the incidence rate in the 1DOT group. Considering the hypotheses of relative reduction in incidence rate in Table 1, a risk alpha equal to 0.05 and a power of 80%, for the optimum case of an equal number of subjects between the two groups, the scenario of size of the following sample can be considered (table 1).

**Table 1.** Estimate of the Number of Subjects Required for the Comparison of Incidence Rate between the Two Groups in the Month Following the Passage of SMC

| **Assumption** | **Expected relative reduction** | **Incidence rate 1DOT (case in person-months)** | **Incidence rate 3DOT (case in person-months)** | **m (Cluster size)** | **K (the coefficient of variation of** | **Assumption** | **Expected relative reduction** |
|---|---|---|---|---|---|---|---|
| 1 | 75% | 0,24 | 0,06 | 300 | 0,39 | 4 | 1200 |
| 2 | 67% | 0,24 | 0,0792 | 300 | 0,39 | 6 | 1800 |
| 3 | 50% | 0,24 | 0,12 | 300 | 0,39 | 12 | 3600 |
| 4 | 34% | 0,24 | 0,1584 | 300 | 0,39 | 30 | 9000 |
| 5 | 30% | 0,24 | 0,168 | 300 | 0,39 | 36 | 10800 |

Considering the budget, hypothesis 2 will be used. At least 1980 children will be included in at least 8 clusters if we consider an increase of 10% in prevision of the non-responses.

As the district of Boromo has 57 426 children and the district of Gaoua has 45 958 children, proportionally 0,56% (3.33 CHSP) of the participants will be drawn from Boromo and 0,44% (2.67 CHSP) from Gaoua.

From the above, at least 7 health facilities will be drawn at random from the health districts of Boromo and Gaoua to receive the 3DOTs or 1DOT strategy. The choice of these districts was explained above in the sub-chapter framework of the study. For a chosen CHSP, all children will be included in the study.

The CHSP of Koikoi, Madou, Ourobounou, and Yona, were selected in the health district

of Boromo and the CHSP of Niampira, Tako and Dapola in Gaoua, representing respectively 1516 children in Boromo and 924 children in Gaoua. The sample size was 2440 children.

### Data Collection

We conducted interviews, reviews of a number of documents (health booklet, free care forms, outpatient visit registers, and SMC registers) and observations. A form was used to collect data.

We conducted this survey along with 13 other surveyors including seven community-based agents from the CHSP. These agents also served as guides and translators to the parents/tutors whenever they couldn't understand the student's spoken language. The surveyor administered the form to the children's parents/tutor during a face-to-face encounter. This allowed the gathering of socio-demographic data on the child and parents as well as clinical data on the child and knowledge of parents on malaria preventive measures. The missing information at the end of the encounter was filled in by using the health documents listed above. The information was also confirmed through the same documents.

The sensation of fever within the last 72 hours was verified and the diagnostic through rapid diagnostic test (RDT) was performed on children who were not yet diagnosed with malaria.

The parents were encouraged to seek help from a community-based agent or go to a health centre whenever the child had a fever.

The children suffering from malaria or fever of another origin were sent to a health centre to be treated. Otherwise, the treatment was conducted according to the integrated management of childhood illnesses (IMCI) for children below five years of age for two diseases or more, namely diarrhoea, pneumonia, malaria, and severe malnutrition diagnosed at a community level (by community-based health agents).

### Operational Definitions

Confirmed case of malaria: Patient suspected to have malaria with a positive diagnostic test (RDT, Microscopy) + patients suspected to have malaria without performing a diagnostic test [13].

Fever: is defined as an axillary temperature $\geq 38°$ Celsius; the history of fever in the last 72 hours is summarized in the sensation of high temperature in the last 72 hours that was reported by the parents/tutors during the survey.

### Data Analysis

We described the socio-demographic features of the population; qualitative variables were expressed in proportions and ratios (CI 95%) and quantitative variables in means and standard deviations. The prevalence of malaria was calculated, globally, and in each district and compared to each other using a chi-square test. Analysis was performed with the statistical software Epi-Info version 7.2.2.6.

## Results

### Socio-demographic Features of Children of the Study

A total of 2440 children were surveyed during our study time and we received informed consent from all parents for voluntary participation in the study. The children from ages 2 to 5 were the most represented (64.22%) with a $p< 0.0001$. Our study sample consisted of 1233 male participants (50.97%) and 1186 female participants (49.03%). The sex ratio of male/female was 1.03. Among the 2240 children who were surveyed, 2048 (84%) of them had bed nets. In terms of clinical features, we reported 207 children (8.66%) with fever and a significant p-value ($p<0.0001$), (Table 2).

**Table 2.** Socio-demographic and Clinical Features of Children from 3 to 59 Months Old in the Health Districts of Boromo and Gaoua in 2020, Burkina Faso

| Variables | Number (n = 2440) | Percentage (%) | P value |
|---|---|---|---|
| **Age** | | | <0.0001 |
| [3 months -1 year] | 504 | 20.67 | |
| [1 year - 2 years] | 369 | 15.12 | |
| [2years – 5 years] | 1567 | 64.22 | |
| **Sex** | | | 0.53 |
| Male | 1233 | 50.97 | |
| Female | 1186 | 49.03 | |
| **Possession of a bed net** | | | <0.0001 |
| Yes | 2048 | 84 | |
| No | 392 | 16 | |
| **History of fever** | | | <0.0001 |
| Yes | 207 | 8.48 | |
| No | 2184 | 91.34 | |

## Socio-demographic Features of Tutors of Children of the Study

Among those people who were surveyed, females were predominant with a sex ratio = 0.11. These results were statistically significant with a p value= 0.028. Among tutors, 91.10% were not schooled and 8.9% of people were schooled. This difference was statistically significant p=0.01. Among the people surveyed, mothers were the most represented group with 1512 people (64.07%); these results were statistically significant (p=0.04) (Table 3).

**Table 3.** Distribution of Socio-demographic Features of Tutors of Children from 3 to 59 Months Old Within the Districts of Boromo and Gaoua in 2020, Burkina Faso

| **Variables** | **Number (n)** | **Percentage (%)** | **P-value** |
|---|---|---|---|
| **Children below 5 years of age with a tutor** | | | 0.4 |
| 1 child | 655 | 32.95 | |
| [2-6[ | 1288 | 64.79 | |
| ≥6 | 45 | 2.26 | |
| **Persons in the family** | | | 0.13 |
| [0-6] | 985 | 50.10 | |
| [6-11] | 597 | 30.37 | |
| [11-21] | 311 | 15.82 | |
| >21 | 73 | 3.71 | |
| **Tutors** | | | 0.04 |

| | | | |
|---|---|---|---|
| Legal Guardian | 602 | 25.51 | |
| Mother | 1512 | 64.07 | |
| Father | 246 | 10.42 | |
| **Level of education of tutors** | | | 0.011 |
| Not schooled | 1750 | 91.10 | |
| Schooled | 171 | 8.90 | |
| **Gender of tutors** | | | 0.028 |
| Male | 246 | 10.42 | |
| Female | 2114 | 89.58 | |
| **Marital status** | | | 0.14 |
| Single | 2255 | 93.96 | |
| Married | 44 | 1.80 | |
| Divorced | 145 | 6.04 | |
| **Age of tutors** | | | 0.48 |
| <18 years | 36 | 1.71 | |
| [18-25] | 400 | 19.05 | |
| [25-60] | 1597 | 76.05 | |
| [60-79] | 67 | 3.19 | |

## Knowledge and Practices of Surveyed People on Malaria Prevention

A total of 2048 families (83.93%) had insecticide-treated nets. These results were statistically significant with a p-value <0.0001. Most families (1673) representing 68.57% had their members sleeping under bed nets with a P=0.04. Among the surveyed people, 1900 (80%) had slept under a long-lasting insecticide-treated net (LLIN). These results were statistically significant with a P<0.0001 (Table 4).

**Table 4.** Knowledge and Practices of Surveyed People on Malaria Prevention in the Districts of Boromo and Gaoua in 2020

| **Variables** | **Number** | **Percentage (%)** | **P-value** |
|---|---|---|---|
| **Sleep under a bed net.** | | | 0.04 |
| Yes | 1673 | 68.57 | |
| No | 767 | 31.43 | |
| **Net deployed** | | | 0.33 |
| Yes | 1556 | 71.54 | |
| No | 619 | 28.46 | |
| **Use of LLIN during the last night** | | | <0.0001 |
| Yes | 1900 | 80.13 | |
| No | 471 | 19.87 | |
| **Having an LLIN** | | | <0.0001 |
| No | 392 | 16.07 | |
| Yes | 2048 | 83.93 | |

| | | | |
|---|---|---|---|
| **Knowledge of malaria prevention** | | | 0.09 |
| No | 647 | 26.43 | |
| Yes | 1795 | 73.57 | |
| **IRS (Indoor residual spraying)** | | | 0.36 |
| No | 2424 | 99.34 | |
| Yes | 16 | 0.66 | |
| **Use of insecticides** | | | 0.82 |
| Yes | 26 | 1.07 | |
| No | 2414 | 98.93 | |
| **Heard about the MCP Campaign** | | | 0.20 |
| No | 253 | 10.37 | |
| Yes | 2187 | 89.63 | |
| **Water drainage system** | | | 0.21 |
| No | 2139 | 87.66 | |
| Yes | 318 | 12.34 | |
| **Curtain** | | | 0.37 |
| No | 2417 | 99.06 | |
| Yes | 23 | 0.94 | |
| **Distance to the health centre** | | | <0.0001 |
| <5km | 1444 | 79.39 | |
| >=5km | 271 | 20.61 | |
| **Intermittent treatment** | | | 0.61 |
| No | 2046 | 98.61 | |
| Yes | 34 | 1.39 | |
| **Knowledge of malaria symptoms** | | | 0.009 |
| No | 210 | 9.31 | |
| Yes | 2045 | 90.69 | |

## Prevalence of Malaria among Children from 3 to 59 Months Old in the Health Districts of Boromo and Gaoua in 2020

The prevalence of malaria in the district of Boromo was 3.63%. The prevalence of malaria in the district of Gaoua was 6.60%. The overall prevalence in the two districts was 4,75% (Table 5).

**Table 5**. The Prevalence of Malaria among Children from 3 to 59 Months Old in Each of the Two Districts

| **Region and districts** | **n/N** | **Prevalence (%)** | **CI 95%** | ***p*** |
|---|---|---|---|---|
| Districts (Garoua and Boromo) | 116/2440 | 4.75 | [3.98-5.67] | |
| Boromo | 55/1516 | 3.63 | [2.80-4.69] | *p*=0.034). |
| Gaoua | 61/994 | 6.60 | [5.17-8.39] | |

n = number of malaria cases according to the variable modality

N = Total number of people surveyed according to the variable modality

*p:* comparison between malaria prevalence in Gaoua and Boromo

## Discussion

The prevalence of malaria was 3.63% in the district of Boromo and 6.6% in the district of Gaoua with an overall prevalence of 4.75%. Such prevalence was at 51% nationwide in 2020 [11] and 50% in 2021 in children below 5 years of age [7]. Our two prevalences could correspond to 123.8% if the study was conducted over a whole year since it only lasted two weeks in December. This almost triples the national prevalence in the annual statistical records book which was at 51% in children below 5 years of age [11].

As a reminder, the study was conducted outside of the SMC period. This high prevalence even though the study was conducted in a time of low malaria transmission attests to the high transmission rate for malaria in the region. Our results are similar to the national survey in 2017-2018 in which the study was conducted over four months (December to March) with a prevalence of 23% in Boromo and 39% in Gaoua [14]. Relatively, the estimated global prevalence in our two-week study in December could correspond to an estimate of 36.3% over five months. This is easily understandable since the two studies were conducted in the same zone and the same period. The high prevalence of malaria in these two districts could be linked to the climate and the rainfalls in these two regions (the highest rainfalls occur in the south of the country) which favour the transmission of malaria given the permanent presence of natural water reserves, and temporarily stagnant water from rainfalls which create more larval breeding sites.

Our results are similar to the findings of Kamaldeen Mohammed et al who reported a high prevalence of 67% in their study on the prevalence of malaria among children below five years of age in Ghana in 2022, a place with abundant pluviometry [15]. On the contrary, it was quite different from the prevalence of 22.1 % in Arsi Negele, Ethiopia from April to May 2017 [16]. The study period that corresponds to the season where rainfalls are not heavy and mosquito bites less frequent could explain this difference.

Several means are recommended for malaria prevention including drying up stagnant waters, cleaning up our life environment to reduce the creation of larval sites thus stopping the larval development, and indoor residual spraying as a way of hindering malaria transmission through mosquito bites. Beyond these measures, it has been recommended, since 2010, to use LLIN and SMC in children to reduce the transmission of malaria [17]. We reported a high use of LLIN (80.13%, having slept under an LLIN during the previous night). However, several studies were reporting resistance of malaria vectors to insecticide (including LLIN) in the vectorial fight. This phenomenon is mainly due to the large-scale use of pesticides in agriculture especially cotton culture in these regions and could be solved by adopting/implementing regulatory rules on the use of pesticides. The advocacy could target several partners to introduce new generation LLIN based on research results on vector resistance to insecticides in the upcoming LLIN distribution campaigns.

The security environment should also be considered since the regions of Mouhoun buckle and South-West have been under terrorist threats and attacks for the last few years. This environment led to the closure of several health centres and a movement of populations toward refugee camps. This unstable health system in these regions and the poor life standard of the migrated population could have increased the cases of malaria in these regions. A study that was conducted in Congo reported a significant influence of promiscuity on the incidence of malaria in children [18].

## Conclusion

This study allowed us to report a high prevalence of malaria among children from 3 to 59 years old in the two districts. The interventions should target parents of children from 2 to 5 years old and focus on promoting the use of long-lasting insecticide-treated nets, and the necessity to consider health center as reference centre for patient care and take any children with fever to the health centre.

The creation of more health facilities especially in regions with a high number of migrated people could bring people nearer to their health centers. The combination of different strategies is the main way to lead the country toward eliminating malaria by the horizon of 2035 as stated but the development goals (ODD). The implication of partners in technical and financial support are required to reach the goal. It requires a peaceful security environment and voluntary administrative/community participation with more engagement.


## Acknowledgement

We thank the surveyors including the community-based agents from the CHSP who sometimes served as guides and translators to the parents/tutors. We also thank the authorities of the health districts and the responsible of CHSPs.


## Conflict of Interest

The authors declare that they have NO affiliations with or involvement in any organization or entity with any financial interest in the subject matter or materials discussed in this manuscript.

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