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**Original Research Article**

# Prevalence of Malaria among Newborns at the Markala CSRef

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## Abstract

Malaria is a serious and potentially fatal parasitic infectious disease caused by several species of parasite belonging to the Plasmodium genus. The female Anopheles injects the parasite into humans in the form of a "sporozoite". This rapidly migrates via the bloodstream to the liver. Transmission can occur through mother-to-child transmission and transfusion of infected blood products. ***Objective***: To study the prevalence of malaria among newborn babies in the paediatric ward of the CSRéf in Markala. ***Methodology*:** Cross-sectional, retrospective, descriptive study from 1st January to 30th December 2023. ***Results*:** The mean age at admission was 03 to 07 days and 08 to 14 days of life. The sex ratio was in favour of males (51%). The overall result for the prevalence of malaria according to the means of biological diagnosisused was 0.62% for the RDT compared with 56.52% for the GE. The weight range where the RDT was positive was weights over 3.5kg. The results for congenital malaria were 0% for RDT and 60% for GE. The sex-ratio was in favour of males (51%). The age range at admission was 3 to14 days. The highest number of cases was observed in the month of May. The overall prevalence of congenital malaria including the total number of babies with cord blood parasitaemia and peripheral blood parasitaemia was 18.6% and 56.8% respectively using microscopy and real-time PCR. The frequency of cases of submicroscopic congenital malaria (negative on thick blood smear and positive on PCR) was 12.2%). Theaverageadmissionweightofnewbornswas2.9kg+/-0.9andtheaveragebirthweightwas2,319g(160.03)and 83 (81.4%). ***Conclusion*:** Congenital and neonatal malaria is a public health problem in a malaria-endemic country such as Mali. We note a difference in diagnosis according to the different biological means of diagnosis (RDT and EW). Newborns showing signs of suspected sepsis should be screened and treated early.

**Keywords:** Congenital Malaria, Prevalence, Markala.



## INTRODUCTION

Malaria is a serious and potentially fatal parasitic infectious disease caused by several species of parasites belonging to the Plasmodium genus. It is a major public health problem in terms of targets 3.2 and 3.3 of the United Nations Sustainable Development Goal (SDG) 3, "Good health and well-being". It is one of the biggest causes of death in tropical regions. The Plasmodium cycle is complex and comprises two essential stages: an a sexual phase in humans, and a sexual phase in mosquitoes.

The female Anopheles injects the parasite into humans in the form of a "sporozoite". This rapidly migrates via the blood stream to the liver.

Maternal malaria has a significant impact on newborns, being associated with an increased risk of spontaneous abortion, stillbirth, premature delivery, foetal death, low birthweight and foetal/child developmental delay in malaria-endemic countries [1]. Malaria in newborns can be caused by any of the Plasmodium species (P.vivax, P.falciparum, P.ovale, P.malariae or P.knowlesi) or by a mixed infection caused by several species.

The modes of transmission include transmission by the female Anopheles mosquito, mother-

to-child transmission and transfusion of infected blood products.

Factors that are thought to prevent malaria in newborns such as maternal antibodies passing to the newborn, fetal haemoglobin, abnormal haemoglobins in newborns, lymphocytes as toxic substances derived from macrophages across the placenta into the fetal circulation, partial chemotherapy of malaria during pregnancy, lactoferrin (iron-binding) and secretory IgA, found in breast milk, in maternal and infant sera, para-amino-benzoic acid in breast milk in hibit the growth and development of the parasite.

Given the objectives set out in the Global Technical Strategy against Malaria 2016-2030, it is important to have accurate epidemiological data on malaria in this age group.

In 2017, the WHO recorded 219 million cases of malaria, resulting in 435,000 deaths [2]. Most cases (80%) and deaths (90%) occurred in sub-Saharan Africa and mainly affected children under the age of 5 [3]. However, the devastating consequences of malaria begine before a child is born and these children suffer adverse consequences related to gestational malaria, placental malaria and congenital and neonatal malaria [4].

Diagnosis of congenital malaria is complicated by the low density of the parasite circulating in the cord blood and/or peripheral blood of newborns [5].

Malaria in newborns can be confused with sepsis and TORCH infections. Some African studies suggest that malaria parasitaemia is more frequent in neonates with sepsis than in neonates without sepsis.

Malaria infection during pregnancy is a major public health problem associated with adverse pregnancy outcomes such as abortion, stillbirth, intrauterine growth retardation, preterm delivery and low birth weight (LBW) [6].

During pregnancy, the acquired antimalarial immunity of a woman living in a malaria-endemic area decreases [7]. Several studies carried out over the last two decades, particularly in Nigeria, have shown that the prevalence of malaria in newborns appears to be increasing, reaching values of up to 25% [5-8].

In Mali according to the DHS 2018, According to data from the Ministry of Health's Demographic and Health Survey, the malaria prevalence rate is19%.

Neonatal mortality was estimated at 33 per 1000 births. The percentage of deaths due to malaria in children under 5 (2017UNICEF) is 14.2%.

**Definitions** [9]
**Neonatal Malaria:** Occurs between the 8th and 28th day of life and is caused by a mosquito bite.

**Congenital Malaria:** Is a parasitaemia detected during the first week of life. It is transmitted either via the placenta or during child birth. All species of malaria can be congenital.

**Aims**: to study the prevalence of malaria among newborn babies in the paediatric unit of the CSRéf in Markala.

## METHODOLOGY

**Type of Study**: This was a retrospective, descriptive and cross-sectional study.
**Study Setting**: This study took place in the paediatric unit of the Markala referral health center in the Ségou region. The Markala health district has a population of 337,170 and is crossed by the River Niger, with a hydraulic dam used to irrigate the rice-growing plain.

There were 22 CSCOms in the district. The number of pregnancies and unexpected births were 17318 and 15240 respectively.

**Collection Period**: This took place over a 12-month period, from 1st January to 31 December 2023.

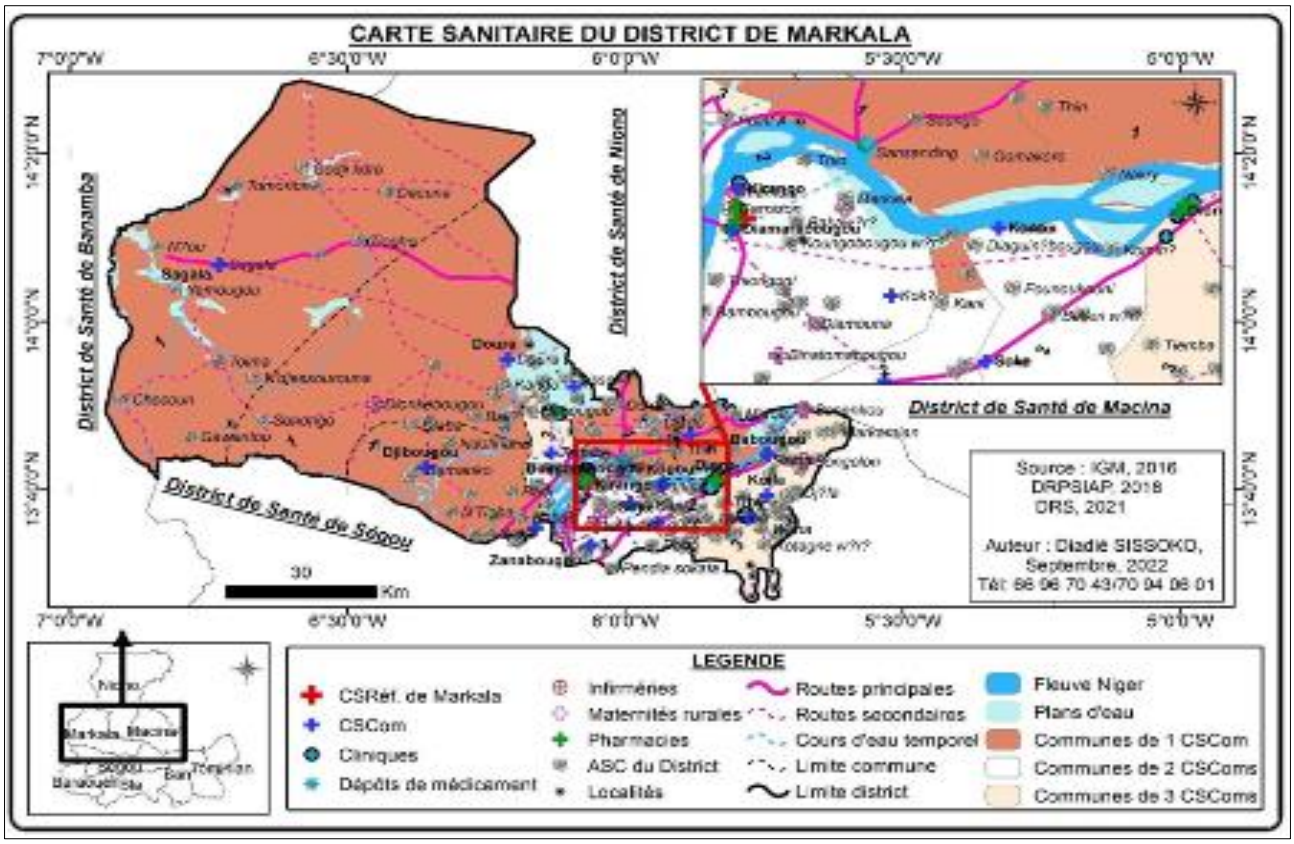
**Target Population**: All newborns admitted to the paediatric unit of the CSRéf.

**Inclusion Criteria**: neonates up to 28 days of age admitted to the paediatric unit of the CSRéf.

**Exclusion Criteria**: neonates not admitted to the paediatric unit.

**Biological Diagnostics**: The rapid diagnostic test (RDT) and the thick drop (HD) were used to confirm cases of malaria.

The Markala CSRéf has a laboratory equipped with an Olympus microscope and qualified staff, including an agent with a master's degree in medical biology, a TSS in the lab and a TS in the lab.)




**Thick Drop (GE) and Rapid Diagnostic Test (RDT) Techniques:**

- **GE**: Microscopic examination of malaria remains a first-rate reference method for field trials evaluating clinical interventions or diagnostic tools. It is a concentration technique that can also be used to detect trypanosomes and microfilariae:
- ***Blood Deposit****:* place a large drop of blood (twice the volume used for a smear) on a grease-free glass slide.
- ***Defibrination:*** In the case of capillary sampling, to prevent coagulation, use the corner of another slide or the tip of a vaccinostylus to spread the blood evenly over a surface1cm in diameter, turning regularly for 2 minutes.
- ***Drying*****:** Turn the slide over and leave to dry flat on a support, either for 24 hours at room temperature or for 1 hour in anovenat 37°C. Never fix with heator alcohol.
- ***Dehaemoglobinisation*****:** Generously cover the thick drop with the Giemsa mixture: 3 drops, neutral water: 2 ml.
- Leave to act for 5 to 10 minutes until completely discoloured. Then fix with methylated spirits.

***Staining*****:**

Carefully discard the liquid (risk of detaching the blood film) and immediately replace with the mixture: Giemsa: 1 ml, neutral water qsp: 10 ml. Leave for 20 minutes, then carefully discard the liquid. Wash with tap water, running the liquid very gently over the slide Air dry [23].

- **TDR**: The sample, taken by pipette or spike, is deposited on the 'starting' zone in a defined volume, from where it diffuses by capillary action into the membrane. A reagent is added, drawing the sample towards the absorption zone. This usually consists of antibodies labelled with gold nanoparticles (or coloured latex), which then bind specifically to the analyte. In the migration zone, the analyte-antibody complexes are specifically captured by antibodies (antiantibodies) immobilised at one or more levels, which then generally appear as coloured lines (pink or red for gold), with the marker concentrated there [24].
- **Variables Studied**: Age, Weight, Sex, TDR results, GE results

**Analysis and Data Collection**:

Data were collected from the primary documents in which the newborns were registered. Analysis was performed using Epi Info 7 software.

This work was carried out with the full support of the CSRéf administration, and the results will be used to improve medical practice.

## RESULTS

**Table I: Breakdown of newborns admitted by month**

| Date | Frequency | Percent | Cum. Percent | Exact 95% LCL | Exact 95% UCL |
|---|---|---|---|---|---|
| August | 5 | 3,09 | 3,09 | 1,01 | 7,06 |
| April | 10 | 6,17 | 9,26 | 3,00 | 11,06 |
| December | 13 | 8,02 | 17,28 | 4,34 | 13,33 |
| February | 9 | 5,56 | 22,84 | 2,57 | 10,28 |
| January | 9 | 5,56 | 28,40 | 2,57 | 10,28 |
| July | 17 | 10,49 | 38,89 | 6,23 | 16,27 |
| June | 21 | 12,96 | 51,85 | 8,21 | 19,13 |
| May | 19 | 11.73 | 63,58 | 7,21 | 17,1 |
| March | 17 | 10,49 | 74,07 | 6,23 | 16.27 |
| November | 21 | 12,96 | 87,04 | 8,21 | 19,13 |
| October | 18 | 11,11 | 98,15 | 6,72 | 16,99 |
| September | 3 | 1,85 | 100,0 | 0,38 | 5,32 |
| **TOTAL** | **162** | **100,00** | **100,0** | 6,23 | 16,27 |

The months with the highest number of admissions were June, November and May, with12.96%, 11.3% and 12.96% respectively: May, June and November were the busiest months.

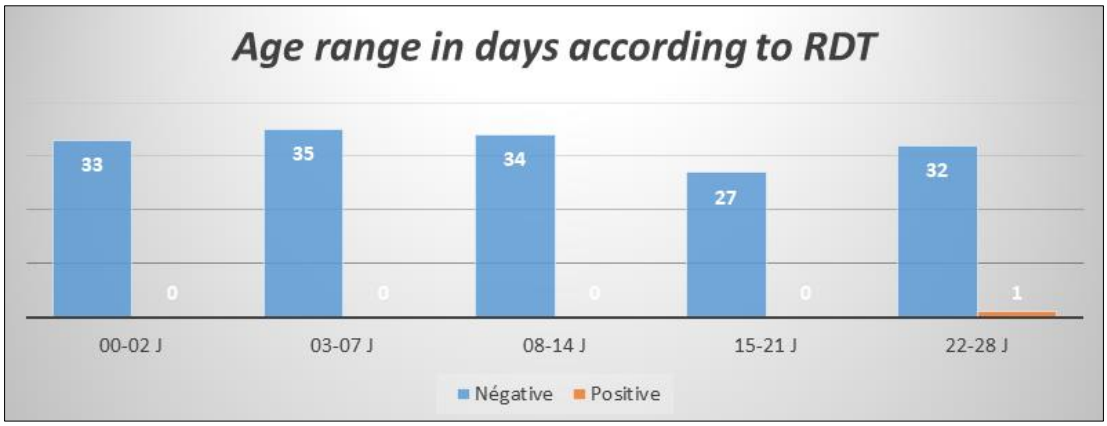
**Average Weight**: 2.9kg+/-0.9

| Obs | Total | Mean | Variance | Std | Dev |
|---|---|---|---|---|---|
| 162 | 0000465 | 96002 | 8763 | 0,9362 | 0,9676 |
| Minimum 25% | | Median75% | | Maximum Mode | |
| 0,90002,2000 | | 2,90003,5000 | | 5,50002,9000 | |

**Table II: Age range in Days at admission**

| Age group in days | Frequency | Percent | Cum.percent | Exact 95% LCL |
|---|---|---|---|---|
| 00-02 | 33 | 20,37% | 20,37% | 14,46% |
| **03-07** | **35** | **21,60%** | **41,98%** | **15,53%** |
| **08-14** | **34** | **20,99%** | **62,96%** | **14,99%** |
| 15-21 | 27 | 16,67% | 79,63% | 11,28% |
| 22-28 | 33 | 20,37% | 100,00% | 14,46% |
| **TOTAL** | **162** | **100,00%** | **100,00%** | |

The most representative age groups on admission were 03-07 days and 08-14 days of life.

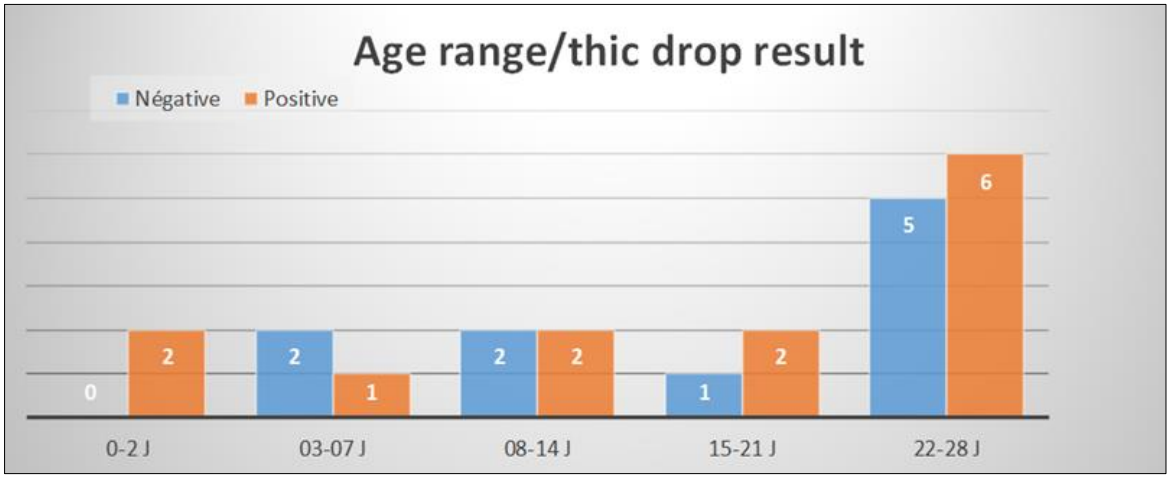



**Graph I: Variable hand: Age range in days according to RDT**

| Chi-square | df | Probability |
|---|---|---|
| 3,9334 | 4 | 0,4151 |
| **Fisher's Exact** | | 0,5741 |
| An expected cell value is | | |

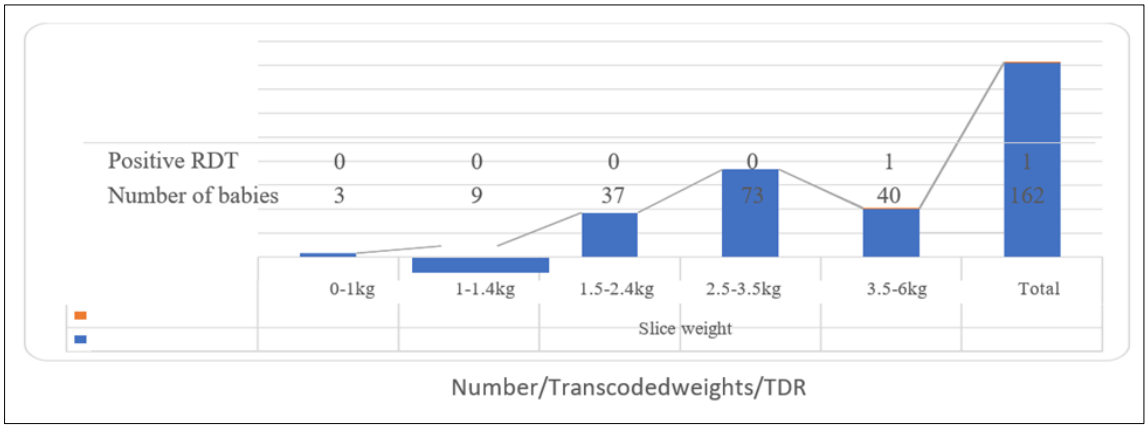
The highest number of malaria cases was recorded in May. The sex ratio was1.04 in favor of males.

This results in a very low proportion of positive results (0.62%) compared with 99.38% of negative RDT (rapid diagnostic test) results.



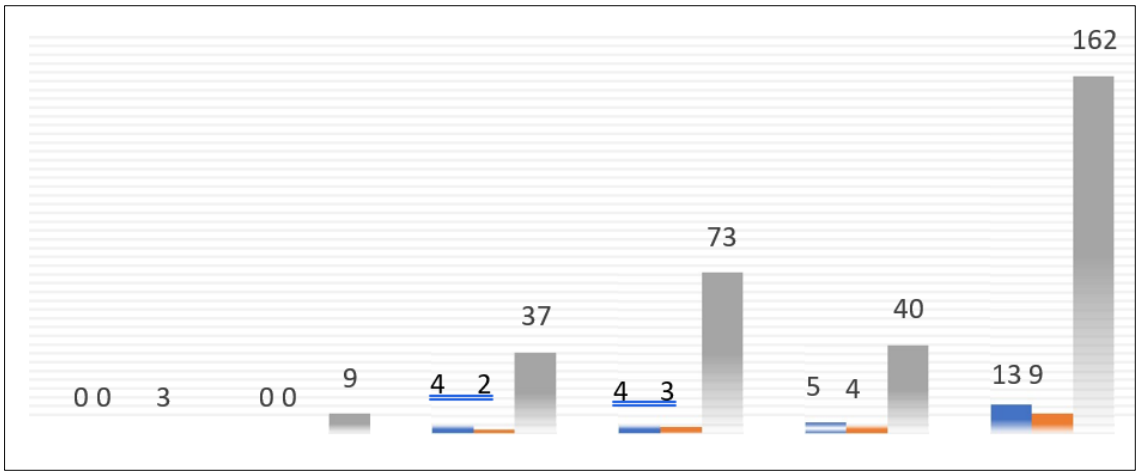

**Graph II: Age group in days as a function of thick drop**

This result shows a lower rate of negative results (43.48%) compared with 56.52% of positive thick drops during the second half of the neonatal period.




**Graph III: Distribution of RDT results according to newborn weight range**

A positive RDT is found in the3.5 to 6 kg weight range.




**Graph IV: Distribution of GE results according to newborn weight range**

| | 0-1kg | 1-1.4kg | Weight slice | | 3.6-6kg | Total |
|---|---|---|---|---|---|---|
| | | | 1.5-2.4kg | 2.5-3.5kg | | |
| GE + | 0 | 0 | 4 | 4 | 5 | 13 |
| GE- | 0 | 0 | 2 | 3 | 4 | 9 |
| Number of babies | 3 | 9 | 37 | 73 | 40 | 162 |

Positive GE was most represented in the 1.5 to 2.4 kg range. These correspond to newborns with a low admission weight.

## DISCUSSIONS

Our study on the prevalence of malaria in newborns, which was carried out over 12 months, involved 162 newborns who met our inclusion criteria.

The prevalence of malaria in our study varies according to the biological diagnostic method used (RDT and GE).

The overall result was 0.62% for the TDR and 56.52% for the GE. The results for congenital cases are 0% for RDT and 60% for GE.

This result is lower than that published by the WHO, which found that the congenital case ratewas16/261 (6.1%). All cases were positive by microscopy and RDT [2].

Our 60% microscopic result falls short of several studies.

Our results were close to those of the study on congenital malaria using real-time PCR versus microscopy (18.6%) carried out in Sudan, which revealed a high prevalence (56.8%) [11].

In our study, congenital malaria confirmed by EW was higher than in the two studies conducted in Kenya and Ghana, which reported 0% congenital malaria infection by microscopy, compared with 12% prevalence by nested PCR in Kenya [12], and 45% by real-time PCR in Ghana [13]. Other studies from Burkina Faso and Colombia found 10.2% and27% respectively of newborns with positive infections by real-time PCR [14, 15].

Our results differed from those of the Nigerian study, where the parasite prevalence in the majority of recent cross-sectional studies was 58.5% for neonatal malaria [16]. In a recent hospital-based study in Nigeria, the prevalence of malaria in hospitalised newborns was found to be very high (37%) [17].

The overall prevalence of congenital malaria including the total number of babies with cord blood parasitaemia and peripheral blood parasitaemia was 18.6% and 56.8% respectively using microscopy and real-time PCR [11]. In India, Sri Lanka and Nigeria, the prevalence of congenital malariawas3.17%, 4.3%, 6.9%and 4.45% respectively in various studies [18, 19].

However our result is superior to that of Benin city where the prevalence of congenital malaria in subjects was significantly higher than in controls (34.6% and 22.2%, p =0.014) [20]. Our data were higher than the overall crude prevalence of clinical congenital malaria which was40.4‰ (95% CI19.6-67.7; 17 studies) [21].

Congenital malaria cases were submicroscopic (thick blood smear (TBS) negative and PCR positive), and the frequency was 12.2% (95% CI = 9.4-14.9). Detection was statistically higher in the umbilical cord at 16.2% (95% CI = 12.4-19.9) compared with the newbom's peripheral blood at 2.2% (95% CI= 0.7-4.9) [22].

The sex ratio was in favour of males at 1.04 in this study. This result corroborates the result of the study conducted in Sudan in which more than fifty (52.9%) of the newborns were male [11].

The mean admission weight of the newborns in our study was 2.9 kg +/-0.9. This result is higher than the mean (SD) birth weight of the Sudan study, which was 2,319 g(160.03), and 83 (81.4%) of the newborns were born with a low birth weight (birth weight < 2,500 g) [11].This difference could be explained by the quality of the targets in the two studies (admission weight and birth weight).

The highest numbers of newborn babies were seen in May, June and November, with 12.96%, 12.96% and 11.30% respectively. This could be explained by the fact that this period coincides with periods of high malaria transmission.

## CONCLUSION

Malaria in newborns is a public health problem in malaria-endemic country like Mali. We observed a difference in diagnostic test results depending on the different biological diagnostic methods used (RDT and EWG). Newborns showing signs of sepsis should be screened and managed in accordance with national guidelines for the management of malaria in Mali. It is important to step up malaria prevention, specifically for pregnant women and newborns, in order to reduce the harmful effects on these groups.

Particular emphasis should be placed on raising awareness, chemoprevention and the use of insecticide-treated mosquito nets (ITNs).

**Conflict of Interest**: None.

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