**Original Article**

# Prevalence of Different Types of Malaria in Shendi, Sudan

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**Abstract**
**Introduction:** This cross-sectional descriptive study aims to detect the incidence of different types of Malaria in Shendi, Sudan, during the period from November 2019 to February 2020. This study was conducted in Shendi, Sudan, which lies 150 km from the national capital of the Republic of Sudan, Khartoum.
**Methods:** One hundred samples were taken, and the study was conducted in several hospitals in Shendi (Shendi teaching hospital, Almak Nimer hospital, and many laboratories in Shendi). This study examined different types of malaria parasite among the population of Shendi, taking into account the age, gender, residence. A rapid immunochromatographic test and blood film were used to diagnose the incidence of *Plasmodium falciparum* compared to the other types of *Plasmodium*.
**Results:** On blood film test, 98% of already diagnosed cases of malaria by microscope were positive, and only 2% were negative; furthermore, 96 % of malaria cases were caused by *P. falciparum*, and only 2 % were caused by *Plasmodium vivax*.
**Conclusion:** The present study concluded that the incidence of malaria was high in the study area. More than two-thirds of patients diagnosed with malaria in Shendi in 2019-2020 were young aged 15-30 years, and more than half of the cases were female. Blood film examination is the gold standard for malaria diagnosis. *P. falciparum* was responsible for 96% of cases, and the other species were much less common.
**Keywords:** Incidence of malaria, Shendi, Immunochromatographic test, Blood film

## Introduction

Malaria is a major health problem in Sudan. The peak period of transmission is during the rainy season mainly from April to October. *Plasmodium falciparum* is the dominant species of parasite and is responsible for more than 90% of the cases, especially all cases of cerebral malaria in Sudan (1,2). There is wide variation in the virulence of different strains of the malaria parasite which may account for the wide variation in clinical symptoms and the number and frequency of mosquito bites that transmit the parasite of malaria in Shendi and river Nile state, leading to a semi-immune status. Recent studies have indicated that there are clinical and pathophysiological differences in severe malaria in populations with different ages and in several geographical locations, and genotype immunity to malaria increases after each malaria attack (3). Symptoms of malaria include fever and flu-like illness (e.g., shivering, chills, headache, muscle aches, and tiredness). Nausea, vomiting, and diarrhea may also occur. Malaria may cause anemia and jaundice (yellow coloring of the skin and eyes) because of the loss of red blood cells. For most people, manifestation begins 10 days to 4 weeks after illness, although a person may feel sick as early as 8 days or up to one year later. Malaria can be cured by antimalarial drugs. The type of drugs and length of treatment depends on which kind of malaria is diagnosed, where the patient is infected, the age of the patient, and how severely ill the patient is at the start of treatment. The antimalarial drugs must be taken exactly on schedule. Mosquito and different insect bites can be managed by applying insect repellent on uncovered skin and flying insect spray in the room where you sleep, as well as by wearing long pants and long-sleeved shirts, especially from dusk to dawn (6). Malaria in River Nile State is one of the most important health problems and the most a continuation of the state in general, so the estimated number of cases annually is more than 28 000 cases and 22% of deaths also represent an economical obsession for families, society, and the state, through its impact on the loss of working days (7,8). In Shendi

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locality, the number of cases each year is estimated to be about 5000, and 25% of the total mortality occurs in Kposhiah administrative unit of the most malaria areas, followed by administrative units of Hajaralasal, in which the child mortality and maternal mortality is about 10% of total deaths (9).

## Materials and Methods
### Design of Study
This was a prospective cross-sectional and hospital-based study.

### Duration of Study
This study lasted from November 2019 to February 2020.

### Study Population
Any individual with malaria in Shendi had the same chance to be chosen as the sample, considering their age, sex, and residence.

### Sample Size
A total of 100 samples were collected.

### Data Collection
Data were collected from the patients using a structured questionnaire containing all study variables.

### Study Area
This study was conducted in Shendi locality, River Nile State, which lies in the Northern area of Sudan, between the latitudes 16-22 North and longitudes 30-32 East. The total area is estimated to be 124 000 km with the total population of about 269 440 people. Shendi is a subtropical desert with low latitude and arid hot climate. According to the hold ridge life zone system of bioclimatic classification, Shendi is situated in or near the tropical desert biome. It has five administration units, Shendi town, north rural of Shendi, south rural of Shendi, Kaboushia, and Hajaralasl.

### Data Analysis
Data were analyzed using the Microsoft Excel program.

## Results
Out of 100 samples, 58 (58%) were females and 42 (42%) were Male as represented in Table 1. As depicted in Table 2, out of 100 samples, 34 samples were taken from patients with mean age < 15, 44 from age group 16-30, 15 from age group 31-45, 7 from age group > 45, and the majority samples were taken from age group 15-30 years old. On blood film test, 98% of already diagnosed cases of malaria by microscope were positive, and only 2% were negative; moreover, 96% of malaria cases were caused by *P. falciparum* and only 2% were induced by *Plasmodium vivax* as illustrated in Table 3. In addition, Table 4 indicates that the incidence of malaria according to residence in

Shendi city is approximately 79%, followed by Al-gulayaa (about14%), Moies (about 8%), Quraysh (about 5%), and the other area (about 2%). Out of 98 positive cases by blood films, 70 were previously treated, while 28 were not previously treated. Further, of 70 treated cases, 60 were treated with artemether, 8 with artesunate, and 2 with quinine (Tables 5-9).

## Discussion
The present study was carried out on 100 samples obtained from patients with clinical symptoms of malaria at Shendi Teaching Hospital and Mak-Namer Hospital in

**Table 1.** Distribution of the Participants According to the Gender Group

| Gender | No. | % |
|---|---|---|
| Male | 42 | 42 |
| Female | 58 | 58 |
| Total | 100 | 100 |

**Table 2.** Distribution of the Participants According to Their Age Group

| Ages Groups | No. | % |
|---|---|---|
| Less than 15 | 34 | 34 |
| 16-30 | 44 | 44 |
| 31-45 | 15 | 15 |
| More than 45 | 7 | 7 |
| Total | 100 | 100 |

**Table 3.** The Incidence of Different Types of Malaria

| Type of Malaria | No. | % |
|---|---|---|
| *Plasmodium falciparum* | 96 | 96% |
| Other | 2 | 2% |
| Negative | 2 | 2% |
| Total | 100 | 100% |

**Table 4.** The Distribution of the Study Groups According to Their Residence

| Residence | % |
|---|---|
| Shendi | 77 |
| Al-gulayaa | 10 |
| Moies | 6 |
| Quraysh | 5 |
| Other | 2 |
| Total | 100 |

**Table 5.** The Incidence of Malaria Using Blood Films According to Age

| Age Groups (y) | Blood Films | | Total |
|---|---|---|---|
| | Positive | Negative | |
| Less than 15 | 34 | 0 | 34 |
| 16-30 | 42 | 2 | 44 |
| 31-45 | 15 | 0 | 15 |
| More than 45 | 7 | 0 | 7 |
| Total | 98 | 2 | 100 |

**Table 6.** Relationship Between Malaria and Fever

|  |  | Fever | | Total |
|---|---|---|---|---|
|  |  | Yes | No |  |
| B.F for malaria | Positive | 98 | 0 | 98 |
|  | Negative | 2 | 0 | 2 |
| Total |  | 100 | 0 | 100 |

BF: Blood Film

**Table 7.** Relationship Between Malaria and Headache

|  |  | Headache | | Total |
|---|---|---|---|---|
|  |  | Yes | No |  |
| B.F for malaria | Positive | 68 | 30 | 98 |
|  | Negative | 1 | 1 | 2 |
| Total |  | 69 | 31 | 100 |

BF: Blood Film

**Table 8.** Relationship Between Malaria and Vomiting

|  |  | Vomiting | | Total |
|---|---|---|---|---|
|  |  | Yes | No |  |
| B.F for malaria | Positive | 18 | 80 | 98 |
|  | Negative | 0 | 2 | 2 |
| Total |  | 18 | 82 | 100 |

BF: Blood Film

**Table 9.** Relationship Between Malaria and Fatigue

|  |  | Fatigue | | Total |
|---|---|---|---|---|
|  |  | Yes | No |  |
| B.F for malaria | Positive | 66 | 32 | 98 |
|  | Negative | 0 | 2 | 2 |
| Total |  | 66 | 34 | 100 |

BF: Blood Film

Shandi locality. Out of 100 samples, 42 (42%) were males and 58 (58%) were females. In this study, the common age group affected by malaria was the age between 15-30 years in 44% of cases. This is most probably due to their greater exposure to mosquito. Moreover, the incidence decreased with age due to immunity, but in the study of the distribution of falciparum malaria in the UK the incidence was more common in age group > 45 years (10-12). Malaria was found to be more common in females (58%) than in males (42%), respectively, while the incidence was higher in males than in females. However, in the study of the distribution of falciparum malaria in the UK, the incidence of malaria manifested wide variation in males (64%) and females (36%) (13-15). When the diagnosis was conducted by microscope and confirmed by immunochromatographic test results, 98% of cases were positive, and 96% of these cases were caused by *P. falciparum,* while the incidence of *falciparum* malaria was 90% in the previous study.

## Conclusion
The present study concluded that the incidence of malaria was high in the study area. More than two-thirds of patients diagnosed with malaria in Shendi in 2019-2020 were young aged 15-30 years, and more than half of the cases were female. Blood film. Examination was found as the gold standard for malaria diagnosis, and *P. falciparum* was found responsible for 96% of cases, while the other species were much less common.

## Authors' Contribution
Conceptualization: MNMH, MEAA, Methodology: MNMH, OAS, MA, Validation: GMM, TaaA, Formal Analysis: Mubarak A, Investigation: TaaA, Resources: MNMH, Data Curation: GMM, Writing—Review and Editing: MNMH, Visualization: MNMH, Supervision: MNMH, Project Administration:MEAA, OAS, Funding Acquisition:MNMH.

## Ethical Issues
Approval for doing this research was taken from the Department of Community Medicine and Shendi University. Further, the request was approved by the manager of the hospitals.

## Funding

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