



## PREVALENCE OF MALARIA AMONG COVID-19, EXHIBIT SEVERITY, MANAGEMENT, AND OUTCOME

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### ABSTRACT

Coronavirus disease (COVID-19) is an infectious disease caused by a new coronavirus strain. Malaria is a parasitic disease caused by protozoan parasites of the genus *Plasmodium*, transmitted by mosquitoes of the genus *Anopheles*. The dual infection of malaria and COVID-19 is not fully understood or reported. We aimed to identify the association between malaria and COVID-19, its severity, management, and clinical outcome. This is a prospective hospital-based study conducted in isolation centers in Khartoum state during the period from October to December 2020. We used the total coverage method as a sampling technique to include participants from Khartoum isolation. We included 143 participants chosen from three centers. Data were collected from the patients and their files for those who met inclusion criteria using a questionnaire as a study tool filled out by the principal researcher. All participants in this study were COVID-19 patients diagnosed by PCR. Malaria was diagnosed in 115 patients (80.4%), and fever was the most common presenting symptom that occurred in all patients followed by fatigability in 125 (87.4%), cough in 115 (80.4%), and headache in 83 (58.1%). This study found an association between malaria and COVID-19. And revealed that there is a better outcome for the patient with malaria and COVID-19 compared to those without malaria (p-value=0.036). This study revealed that there is a significant relation between COVID-19 and malaria, also it reveals that anti-malaria treatment may improve patients' clinical outcomes. Owing to widespread COVID-19, PCR tests were considered for any patient who had malaria.

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### Introduction

Coronavirus disease-2019 (COVID-19) is an infectious disease caused by a new coronavirus strain [1]. COVID-19 causes mild to moderate respiratory disease, many patients recover without requiring special treatment, on the other hand; older patients and patients with comorbidities (like diabetes, cardiovascular disease, chronic respiratory disease, and cancer) are more likely to suffer from serious forms of the disease [2]. Coronaviruses (SARS-CoV) were responsible for an outbreak of severe pneumonia in China, in November 2002 which infect more than 8000 people before it had been controlled, coronaviruses (MERS-CoV) also were responsible for another outbreak which start in June 2012 in Saudi Arabia leading to infection of more than 2000 people [3]. In December 2019 Coronaviruses (COVID-19) start another outbreak, which began in Wuhan (China) before it spread to other countries [4].

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Malaria is a parasitic disease caused by protozoan parasites of the genus *Plasmodium*, transmitted by mosquitoes of the genus *Anopheles*—is among the top ten causes of death in low-income countries and represents one of the great global health challenges [5]. About 100 countries worldwide have achieved disease elimination and are now malaria-free [6, 7]. The co-infection between malaria and COVID-19 is not understood or fully reported [8]. However, there are some associations between COVID-19 and malaria [9]. COVID-19 disturbs the continuity of the preventive measures conducted against malaria; also, malaria testing and treatment are disturbed due to risks of infection to healthcare workers during the pandemic [10]. There is a low prevalence of COVID-19 in malaria-endemic areas, this fact suggests an association between the two diseases and stimulates researchers to conduct studies to get answers [11].

In Sudan, COVID-19 and malaria are common febrile conditions and both of them have a high morbidity and mortality rate [12]. Both of the diseases put a high burden on the health care system in Sudan. According to our best knowledge, there is no published data from Sudan covering this area.

In this study, we aimed to identify the association between Malaria and COVID-19, its severity, management, and clinical outcome.

## Materials and Methods

This was a prospective hospital-based study conducted in isolation centers in Khartoum state, Sudan (Royal Care Hospital, Ibrahim Malik Hospital, and Alshaab Hospital). The study was conducted from October to December 2020. We included all patients diagnosed with COVID-19 from October to December 2020 and patients who accepted to participate in this study. We exclude any patients who refused to participate in the study and patients who came from other isolation centers. We used the total coverage method as a sampling technique to include 143 participants from Khartoum isolation centers namely Royal Care Hospital Isolation Center 94 (65.7%), Ibrahim Malik Hospital Isolation Center 27 (18.9%), and Alshaab Teaching Hospital 22 (15.4%).

Data were collected from the patients and their files for those who met inclusion criteria after taking written consent using a questionnaire as a study tool filled out by the principal researcher. Study variables included the socio-demographic data of the patients with COVID-19 (age, gender), results of blood film for malaria (BFFM) presence of co-morbidity, and the possible outcome of the patients.

### Data Analysis

Data were analyzed using Statistical Packages for Social Sciences (SPSS) version 24. Frequency listings and percentages were used to describe categorical variables. The P-value was considered significant if  $p < 0.05$ .

### Ethical Consideration

Ethical clearance was obtained from the committee of the Sudan Medical Specialization Board (SMSB) and EDC. Approval to conduct this study was obtained from the administration of included centers. Written informed consent from patients was obtained before participation.

## Results and Discussion

A total of 143 participants were enrolled in this study from various age groups. Patients had a history of several diseases most notably diabetes mellitus (55%) (**Table 1**). The patients experienced several presentation symptoms most notably fever (100%) (**Table 2**). Study participants suffered from a variety of complications, most notably sepsis (52%) (**Table 3**).

**Table 1.** Co-morbidities distribution among study participants (N=143)

Co-morbid illness	Frequency (%)
Diabetes mellitus	79 (55.2 %)
Hypertension	34 (23.8 %)
Asthma	22 (15.4 %)
Renal disease	24 (16.8 %)
Chronic Obstructive Pulmonary Disease	1 (0.7 %)
Cardiovascular	41 (28.7 %)
Malignancy	4 (2.8 %)
None	3 (2.1 %)

**Table 2.** Presenting symptoms of the study participants (N=143)

Presenting symptoms	Frequency (%)
Fever	143 (100 %)

Fatigability	125 (87.4 %)
Cough	115 (80.4 %)
Headache	83 (58.1 %)
Vomiting	8 (5.6 %)
Diarrhea	19 (13.3 %)
Shortness of breath	72 (50.3 %)
Tachypnea	62 (43.3 %)
Oxygen saturation less than 93	52 (36.4 %)
Loss of appetite	1 (0.7 %)
Shock	1 (0.7 %)

**Table 3.** Complications among the study participants (N=143)

Complications	Frequency (%)
Severe pneumonia	22 (15.4 %)
Respiratory failure	14 (9.8 %)
Organ failure	3 (2.1 %)
Sepsis	75 (52.4 %)
Septic shock	3 (2.1 %)
None	45 (31.5 %)

There was a significant association between age and the outcome ( $p = 0.00$ ) (**Table 4**). There was a significant difference between the outcome of patients with Malaria and COVID-19 compared to those without Malaria ( $p = 0.036$ ) (**Table 5**). There was a significant association between medications received for Malaria and the outcome ( $p = 0.000$ ) (**Table 6**).

**Table 4.** Association between age and the outcome of the participants (N=143)

Age groups (in years)	Death	Discharge in a good condition	Full recovery	Total	P-value
25-30	0	0	1	1 (0.7 %)	0.00
35-40	0	2	1	3 (2.1 %)	
40-45	0	4	4	8 (5.6 %)	
45-50	1	7	4	12 (8.4 %)	
50-55	0	8	6	14 (9.8 %)	
55-60	0	17	15	32 (22.4 %)	
65-70	4	12	8	24 (16.8 %)	
70-75	4	13	1	18 (12.6 %)	
75-80	11	6	3	20 (14 %)	
80-90	9	0	1	10 (7 %)	
Above 96	1	0	0	1 (0.7 %)	

**Table 5.** Outcome of patients with malaria and COVID-19 compared to those without Malaria (N=143)

Patient test for Malaria	Outcome			Total	P-value
	death	Discharge in a good condition	Full recovery		
Negative	11 (7.7%)	11 (7.7%)	6 (3.5%)	28 (18.9%)	0.036*
Positive	19 (13.3%)	58 (40.6%)	38 (26.6%)	115 (80.4%)	
Total	30 (21.0%)	69 (48.3%)	44 (30.8%)	143 (100%)	

**Table 6.** Medications received for Malaria and the outcome cross-tabulation (N=143)

Medications received for Malaria	Outcome			Total	P-value
	Full recovery	Discharge in a good condition	Death		
Artemether-lumefantrine	39 (27.3%)	49 (34.3%)	9 (6.3%)	97 (67.8%)	0.000
Artesunate intravenous	0 (0%)	10 (7%)	10 (7%)	20 (14%)	
None	5 (3.5%)	10 (7%)	11 (7.7%)	26 (18.2%)	

Total	44 (30.8%)	69 (48.3%)	30 (21%)	143 (100%)
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In this study, about four-fifths of the study participants had malaria. More than two-thirds of the participants were discharged in good condition. This study found an association between malaria and COVID-19 [13]. According to WHO reports, this finding is high when compared to reports from Nigeria (25%), the Democratic Republic of the Congo (11%), Mozambique (5%), and Uganda (4%) [7]. It is important to mention that most of the malaria cases and death occurs in sub-Saharan Africa, about 92% of global cases of malaria occur in the African region. In 2019, there were an estimated 229 million cases of malaria worldwide and about 409,000 deaths [6]. This study found that fever was the most common clinical presentation followed by fatigability, cough, headache, Tachypnea, Oxygen saturation of less than 93, and other clinical presentations [14]. This finding is consistent with another study where fever (58.66%) was the most common clinical presentation followed by: cough (54.52%), dyspnea (30.82%), malaise (29.75%), fatigue (28.16%) and sputum/secretion (25.33%), Neurological symptoms (20.82%), dermatological manifestations (20.45%), anorexia (20.26%), myalgia (16.9%), and other clinical presentations [15]. In this study, Artemether-lumefantrine was the most commonly used drug [16]. The development of resistance to drugs poses one of the greatest threats to malaria control and results in increased malaria morbidity and mortality [17]. Resistance to currently available anti-malarial drugs has been confirmed in only two of the four human malaria parasite species, *Plasmodium falciparum*, and *Plasmodium vivax*. Due to resistance against most of the anti-malaria, artemisinin-based combination therapies (ACTs) become widely used, and Artemether-lumefantrine is the most commonly used combination [18, 19].

In this study, more than four-fifths of the participants were admitted to ICU [20]. This finding is comparable to a meta-analysis study conducted by Semagn Mekonnen Abate *et al.*, in which the rate of ICU admission among patients with coronavirus varied from 3% to 100%. Some studies suggest a better outcome and a lower risk of COVID-19 in malaria-endemic areas, however; the underlying mechanism has yet to be investigated [21, 22].

This study found that there is an association between age and outcome [23]. Centers for Disease Control and Prevention (CDC) reported that the risk for severe illness with COVID-19 increases with age, with older adults at the highest risk [24].

This study found an association between malaria and COVID-19, also, this study found that there is a better outcome for the patient with malaria and COVID-19 compared to those without malaria [25]. Several studies conducted in different countries found an association between COVID-19 and malaria. However, this association required more studies to reveal the mechanism of the effect of malaria on COVID-19 [10, 26].

## Conclusion

This study revealed that there is a significant relationship between COVID-19 and Malaria, also it revealed that anti-Malaria treatment may improve patient's clinical outcomes.

Considering the wide spread of COVID-19, we consider doing COVID-19 tests for every patient with a positive Malaria test, and start the COVID-19 protocol.

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