

# COVID-19 and Malaria Co-infection; Same coin but different faces?

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## Research Article

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# Abstract

**Background:** As the COVID-19 pandemic spreads rapidly around the world, urgent action is needed to combat the new coronavirus, while other deadly diseases such as malaria cannot be ignored. The impact of the coronavirus on countries affected by malaria and, where possible, contribute to a successful response to COVID19. Our aim is to assess the possible link between Malaria and COVID-19 .

**Methods:** This is a descriptive retrospective cross sectional study which was conducted among adult Sudanese COVID-19 patients admitted to the Universal and Ombada hospitals in the period (4th of April 2020 to the 15th of January, 2020). A total number of 87 patients were included.

**Results:** Among the 87 patients 64.9 % were males while 35.6 were females. 27.6 % had a positive blood film. 64.7% of the malaria patients had p.falciparum while 35.3% had p.vivax. 52.9% of the patients showed positive RT-PCR for COVID-19 with 52.9 % showed positive CT findings . Generalized fatigability was observed in 52.9 % of the patients with malaria followed by headache, nausea, fever with chills, fever with shivering, vomiting and diarrhea in 42.5%, 36.8%, 20.7%, 12.6%, 9.2% and 9.2% respectively. In COVID-19 patients 85.1% had fever and generalized fatigability, followed by cough, headache, SOB , sore throat ,myalgia, chest pain and diarrhea. 13.79 % of malaria patients had malarial pneumonitis, followed by pulmonary edema, cholemic malaria, thrombocytopenia and malaria induced hepatitis in 10.39 %, 9.2 %, 9.19 % and 6.9% respectively. 8.4% had cerebral malaria while 1.1% had cerebellar syndromes. 44.8 % had acute respiratory distress syndrome, 17.2% had heart failure, 8% had pulmonary embolism, 8% had stroke, 3.9% had encephalitis and 1.1% had convulsions.

**Conclusion:** Malaria and COVID-19 have a possible link that they both share similar presentations and complications.

## 1. Background

Malaria is caused by the Plasmodium parasite. The parasite is transmitted to humans through the bite of an infected female Anopheles mosquito, the so-called "malaria vector". There are 5 types of parasites that cause malaria in humans, of which Plasmodium falciparum and Plasmodium vivax pose the greatest threat. In 2018, Plasmodium falciparum accounted for 99.7% of suspected malaria cases in the WHO African Region, 50% in the WHO Southeast Asia Region, 71% in the Eastern Mediterranean, and 65% in the Western Pacific. Plasmodium vivax is the main parasite in the WHO Region of the Americas, accounting for 75% of malaria cases [1].

Coronavirus disease 2019 (COVID-19) is a highly infectious disease caused by Severe Acute Respiratory Syndrome Coronavirus 2 (SARSCoV2), which is causing a catastrophic impact on global demographics, deaths, and a crisis of more than 2.9 million people worldwide. Since the 1918 influenza pandemic. At the end of December 2019, after the first case of this respiratory-based viral disease was first reported in Wuhan City, Hubei Province, China, SARSCoV2 spread quickly across the world in a short period of time, and forced the World Health Organization (WHO) to Announcing a global pandemic on 11th March , 2020 [2]. As the COVID-19 pandemic spreads rapidly around the world, urgent action is needed to combat the new coronavirus, while other deadly diseases such as malaria cannot be ignored. The impact of the coronavirus on countries affected by malaria and, where possible, contribute to a successful response to COVID-19 [3]. Given the level of preparedness at the community, medical center, national, regional and global levels, it is currently expected that the high suspicious index will be consistent with COVID-19. Another issue is that people with fever are given priority to be tested for COVID-19 and to be sent home. Since the result is negative and vice versa, fever patients can be tested for malaria, even though they may actually be infected with COVID-19. Another case is where the patient may be infected with malaria and COVID-19 at the same time, and the diagnosis and treatment of one may cause the loss of the other. A case of COVID-19 can spread to as many as

358 susceptible people. On the other hand, untreated malaria may cause more social infections, and then become the leading cause of global disease and death. The COVID-19 virus and malaria parasite infection pose a direct threat to human health and have an impact on social public health. In addition, there are concerns that limited mobility and isolation will destroy the supply of antimalarial drugs [4].

The prevalence of COVID-19 among countries in malaria-endemic areas is lower than expected. In addition to the possible effects of sanitation infrastructure and the mitigation tools used, the variable distribution of ACE1/D and ACE2 polymorphisms (substitutes for C1173T) can partially explain this. In addition, patients with malaria will produce antibodies against GPI, which can recognize SARSCoV2 glycoprotein, which can protect against COVID-19 or lead to milder clinical manifestations. Due to the similarity of symptoms between malaria and COVID-19, doctors may mistakenly diagnose malaria cases as COVID-19 and vice versa, or miss possible co-infections. The prohibition and restriction of the freedom of movement of health care providers due to the COVID-19 pandemic disrupted the continuation of malaria control programs, such as the spread of seasonal malaria. Mosquito nets treated with chemoprevention and insecticides have led to an increase in malaria cases and deaths [5].

Malaria and COVID-19 may have similar aspects and have great potential for mutual influence. They both have caused millions of deaths, and malaria-endemic areas are at risk of suffering the consequences of COVID-19 due to mutual influence. For example, due to fear of entering a medical center, malaria patients have limited access to treatment, leading to poor results and delayed diagnosis; in addition, similar and general symptoms make it difficult to make a diagnosis immediately. The role of young health professionals who are proactive and trained in basic health care will also play an important role in countries with a high incidence of malaria. Our aim is to assess the possible link between malaria and COVID-19.

## 2. Methods And Materials

### **Study design:**

This is a descriptive retrospective cross sectional study which was conducted among Sudanese COVID-19 patients.

### **Study area:**

#### **Two tertiary hospitals and also working as isolation centres:**

1. Universal hospital , which is located in Sudan, Khartoum state, Khartoum north city.
2. Ombada hospital, which is located in Sudan, Khartoum state, Omdurman city.

### **Study population:**

Sudanese patients above 18 years old with a confirmed diagnosis of COVID-19 at Universal hospital and Ombada teaching hospital.

### **Study duration:**

From the 4th of April to the 15th of January, 2020.

### **Inclusion and exclusion criteria**

#### **Inclusion criteria :**

1- Sudanese nationality

2- Above 18 years old

3- Confirmed case of COVID-19 (By RT-PCR and/or CT chest)

**Exclusion criteria:**

1- Non Sudanese patients

2- Patients Less than 18 years old

3- Patients in isolation centers other than Universal hospital and Ombada teaching hospital

4- Patients who tested negative for COVID-19

**Sampling:**

A total coverage in a time frame technique was used.

**Data collection:**

Data collection was done through Validated highly confidential data collection sheet containing the following items:

1. Demographic data

2. Presenting complaint

3. Symptoms of COVID-19 & Malaria

4. Possible complications ( COVID-19 & Malaria)

5. Investigations done and lab findings.

**Data analysis:**

Data was analyzed using SPSS (Statistical Package for Social Sciences) software version 26.

**Ethical consideration:**

Ethical approval was obtained from the state ministry of health, Khartoum state . Both written and verbal consents were taken from the participants. Privacy and protection of the participant's files and information were of the highest priority.

### **3. Results**

Among the 87 patients 64.9% were males while 35.6% were females with an age distribution that showed a double peak. 50.6% of the patients are above 60, while 27.6% aged between 20 and 30 years and the rest are in between. Also among the 87 patients blood film for Malaria was done for 85.1% (74) of the patients with 27.6% having a positive blood film. The most commonly implicated species was Plasmodium Falciparum which is common in Sudan affecting 64.7% of the Malaria patients while plasmodium Vivax affected 35.3% of the patients. Furthermore ICT for Malaria was also done for 41.4% of the patients, 10.3% of them were positive for Malaria. With respect to general

symptomatology in favor of non complicated Malaria, the most common symptoms were generalized fatigability in 52.9% of the patients followed by headache, nausea, fever with chills, fever with shivering, vomiting and diarrhea in 42.5%, 36.8%, 20.7%, 12.6%, 9.2% and 9.2% respectively. Similarly regarding general symptoms In favor of COVID-19 the most common presentations were fever and generalized fatigability with a shared percentage of 85.1% for both, followed by cough, headache, SOB, Sore throat, myalgia, chest pain, and diarrhea in 73.6%, 59.8%, 52.9%, 20.7%, 20.7%, 10.3%, and 5.7% respectively. Non-neurological complications of Malaria included Malaria pneumonitis (as the most common presentation) with 13.79% among positive Malaria patients followed by pulmonary edema, choleric Malaria, thrombocytopenia and Malaria induced hepatitis in 10.39%, 9.2 %, 9.19 % and 6.9% respectively. Neurological manifestations of Malaria included cerebral malaria in 8.4% of the patients and cerebellar syndromes with Malaria induced cerebellitis in 1.1%. COVID-19 non-neurological complications were Acute respiratory distress syndrome (ARDS) as the most commonly encountered in 44.8% of the patients, followed by heart failure 17.2%, pulmonary embolisms in 8%. The neurological complications included stroke as the most common in 8% of the patients, followed by encephalitis and convulsions in 3.9 % and 1.1% of the patients respectively. None of the 87 patients developed peripheral neuropathy or Guillain barre syndrome which are known COVID-19 neurological complications.

## 4. Discussion

In our study we found out that the prevalence of Malaria among COVID-19 patients was 32.4%. We found different types of Malaria associated with COVID-19. The commonest species was Plasmodium Falciparum which is common in Sudan affecting 64.7% of the Malaria co-infected patients, while plasmodium Vivax affected 35.3% of Malaria co-infected patients. From the above results both Malaria and COVID-19 share common symptoms. If the complications of both diseases are to be considered, they both share similar symptoms of systemic and neurological complications that may act as a challenge to a physician in terms of diagnosis as well as treatment. To our knowledge, this is the first study to have such a huge number of COVID-19 and Malaria Co-infections, and diversity in complications neurological or non – neurological. The prevalence of Malaria among COVID-19 patients was 32.4%. In contrast to a study done in India [6] that showed a prevalence of 5.49% ( n= 27 of 491) in COVID-19 patients with Co-infection with Malaria. This might be due to high prevalence of Malaria in Sudan, which suggests prior infection with Malaria, then getting co-infected with COVID 19, as estimated in a study [7] where its mathematical equations estimates that COVID-19 infection rate of individuals already infected with Malaria is 0.4(40%), which is close to our prevalence of Malaria among COVID-19 patients in this study. It's known that Plasmodium Falciparum Infection may protect a population from COVID-19 Infection [8]. Regions considered Malaria-endemic, have a statistically significant lower relative risk of COVID-19 infection ( $p < 0.0001$ ) [9]. But we think that this protection is in the long run, not during the malarial infection. Our results solidify the mathematical estimations, which say prior infection with Malaria increases the probability of getting infected with COVID-19 to an extent higher than the probability of getting a malarial infection after a COVID-19 infection; this suggests that Malaria weakens the immune system in a way that lets COVID-19 virus infect the body easier. We think that there might be a shared route between Malaria and COVID-19 , and that is thought to be through invasion via the erythrocyte CD147 receptor [9]. This needs further academic studies to prove its validity. The commonest species was Plasmodium Falciparum which is common in Sudan affecting 64.7% of the Malaria co-infected patients, while plasmodium Vivax affected 35.3% of Malaria co-infected patients. This prevalence of Malaria species is similar to a Meta study done in Ethiopia [10] that found the pooled prevalence estimates of P. Falciparum and P. Vivax parasites were 62.8% and 37.2%, respectively. This might be due to similarity between the two countries sharing close geographical location, hence similar quantitative distribution of infective species. P. Falciparum Co-infection presentation is similar to two case studies [11] [12]. In both cases it is not known which infection preceded the other. This suggests that either Malaria's complications increased the vulnerability to get

COVID-19. Or COVID-19 infection reduced the immunity that led to a malarial infection. P. Vivax Co-infection presentation is similar to two case studies [13] [14]. One in Doha, Qatar [14] in which the source from which Malaria infection was contracted remains suspicious, with a plausible explanation suggesting re-activation of Plasmodium Vivax from previous infection with hypnozoites. This suggests re-activation of Plasmodium Vivax from earlier infection with dormant stage hypnozoites due to the dysregulation caused by COVID-19. From the above results both Malaria and COVID-19 share common symptoms. With respect to general symptomatology in favor of non complicated Malaria Co-infected patients, the most common symptoms were generalized fatigability in 52.9% of the patients. Concerning general symptoms in favor of COVID-19 -only patients, most common presentations were fever and generalized fatigability with a shared percentage of 85.1% for both. These nonspecific symptoms are similar to a case study [15] with P. Vivax and COVID-19 Co-infection. In this case the patient started to spike high-grade fever of 39.1 degree Celsius again on the 4th day after COVID-19 diagnosis and established treatment. A blood smear was done. Blood smears showed rings and trophozoites of P. Vivax. This shows similarity in symptoms and coinciding that can lead to missing the diagnosis. Non-neurological complications of Malaria Co-infected patients included Malaria pneumonitis as the most common presentation with 13.79% among positive Malaria patients (n=24). COVID-19 -only patients' most common non-neurological complications were Acute respiratory distress syndrome (ARDS) as encountered with 44.8% of the patients. These similarities in respiratory complications of Malaria Co-infected patients are similar to a case report [16] where the case showed Co-infection of Malaria and COVID-19 with almost the same respiratory symptoms. This suggests that COVID-19 patients with Malaria Co-infection can have exactly similar respiratory complications presentations, and it's frequent to miss a diagnosis of a disease while focusing on the other more likely disease. Neurological manifestations of Malaria Co-infected patients included cerebral Malaria in 8.4% of the patients. The neurological complications of COVID-19 -only patients included stroke as the most common with 8% of the patients. These neurological manifestations of Malaria Co-infected patients are similar to a case study [17] where symptoms overlapped. The major event in the case was the delayed diagnosis of Malaria until the third day of hospitalization instead of at the time of admission due to symptoms coinciding with that of COVID 19. This suggests that even neurological manifestations can be misleading and lead to a missed diagnosis. Severe manifestations of Malaria and COVID-19 may be due to heightened proinflammatory response [18]. Our results suggest that a Co-infection that also leads to an excess of pro-inflammatory responses might result in more overall severe manifestations and poor prognosis. From our results we emphasize on the importance of identifying possible underlying secondary infections coinciding with COVID-19, which may be a challenge in the current COVID-19 pandemic. In malaria endemic areas, one of the guidelines in testing for COVID-19 complicated cases should be screening also for Malaria while testing for COVID-19. This would help in identification of two infectious diseases in the right time, and reduce unnecessary morbidity and mortality.

### **Limitations:**

Our data can not reveal the mechanisms behind this association. Also we did not dig deep into co-morbidities and its possible association. Further research investigations are required to provide possible associations between the two diseases and clinical outcomes.

### **Implications and future research**

It is crucial for health-care professionals to bear in mind that we can't rule out Co-infection with pathogens when COVID-19 is confirmed, nor does testing positive for other pathogens completely excludes COVID-19 Co-infection.

Increasing efforts for treating Malaria is necessary, especially in rainy seasons where mosquitoes reproduce and Malaria rates get higher which in return means possible increase in COVID-19 infections. Further studies are needed to identify the risk factors, clinical outcomes, obstacles in management, and prognosis of cases with COVID-19 and Co-infection with Malaria.

## 5. Conclusion

Malaria and COVID-19 have a possible link that they both share similar presentations and complications which results in one of them being under diagnosed and hence under treated, imposing more implications on patients with COVID-19 increasing their chances of complications as well as undesirable outcomes. Malaria endemic areas such as Sudan suffer from a preexisting Malaria burden that can be worsened by COVID-19 pandemic. We hypothesize that Malaria weakens the immune system in a way that allows COVID-19 infection to occur easier. Plasmodium Vivax which is less common in Sudan has been implicated in 35.3% of the Malaria co-infected patients which raises the possibility of reactivation of the hypnozoites stage due to the dysregulation caused by COVID-19.

## Abbreviations

P.falciparum : Plasmodium falciparum

P.vivax : Plasmodium vivax

RT-PCR: Real time polymerase chain reaction

CT: Computer tomography

SOB: Shortness of breath

ACEI/D: Angiotensin converting enzyme gene polymorphism

ACE2: Angiotensin-converting enzyme 2

GPI: Glucose-6-phosphate isomerase

ICT: Immunochromatographic test

## Declarations

### Conflicts of interest:

All authors declare that there are no conflicts of interest.

### Funding:

There was no fund.

### Informed consents:

Both written and verbal consents were taken from each patient.

### Ethical approval:

Ethical approval was obtained from Sudan State Ministry of Health. Both privacy and protection of the participant's files and information were of the highest priority.

#### **Author contributions:**

conceptualisation, data curation, formal analysis KAM, AH investigation, methodology, project administration, resources KAM, MSH, MEO, Supervision, AH, validation, visualisation, and writing – review & editing, MEO, writing – original draft KAM, MSH and MEO,

## **References**

1. Fact sheet about Malaria [Internet]. Who.int. 2021 [cited 10 July 2021]. Available from: <https://www.who.int/news-room/fact-sheets/detail/malaria>
2. Cascella M, Rajnik M, Aleem A, Dulebohn S, Napoli R. Features, Evaluation, and Treatment of Coronavirus (COVID-19) [Internet]. Ncbi.nlm.nih.gov. 2021 [cited 10 July 2021]. Available from: [https://www.ncbi.nlm.nih.gov/books/NBK554776/#\\_NBK554776\\_pubdet\\_](https://www.ncbi.nlm.nih.gov/books/NBK554776/#_NBK554776_pubdet_)
3. Malaria and COVID-19 [Internet]. Who.int. 2021 [cited 10 July 2021]. Available from: <https://www.who.int/teams/global-malaria-programme/covid-19>
4. Chanda-Kapata P, Kapata N, Zumla A. COVID-19 and malaria: A symptom screening challenge for malaria endemic countries. International Journal of Infectious Diseases. 2020;94:151-153.
5. Hussein M, Albasir A, Elawad O, Homeida A. Malaria and COVID-19: unmasking their ties. Malaria Journal. 2020;19(1).
6. Mahajan NN, Gajbhiye RK, Bahirat S, Lokhande PD, Mathe A, Rathi S, et al. Co-infection of malaria and early clearance of SARS-CoV-2 in healthcare workers. J Med Virol. 2021 Apr 1;93(4):2431–8.
7. Tchoumi SY, Diagne ML, Rwezaura H, Tchuenche JM. Malaria and COVID-19 co-dynamics: A mathematical model and optimal control. Appl Math Model [Internet]. 2021; Available from: <https://doi.org/10.1016/j.apm.2021.06.016>
8. Panda AK, Tripathy R, Das BK. Plasmodium falciparum Infection May Protect a Population from Severe Acute Respiratory Syndrome Coronavirus 2 Infection. J Infect Dis. 2020;222(9):1570–1.
9. Iesa MAM, Osman MEM, Hassan MA, Dirar AIA, Abuzeid N, Mancuso JJ, et al. SARS-CoV-2 and Plasmodium falciparum common immunodominant regions may explain low COVID-19 incidence in the malaria-endemic belt. New Microbes New Infect [Internet]. 2020;38:100817. Available from: [https://doi.org/10.1016/j\\_nmni.2020.100817](https://doi.org/10.1016/j_nmni.2020.100817)
10. Deress T, Girma M. Plasmodium falciparum and Plasmodium vivax Prevalence in Ethiopia: A Systematic Review and Meta-Analysis. Malar Res Treat. 2019;2019.
11. Eid MM. Co-infection with COVID-19 and Malaria in a Young Man. Dubai Med J. 2021;1006:1–3.
12. Maria João Correia, Luciana Frade, Renato Guerreiro, Inês Araujo, Teresa Baptista, Cândida Fonseca, et al. A Patient with Severe Malaria and COVID-19 : How Do You Tell the Difference between These Infections? Eur J Case Reports Intern Med. 2020;(LATEST ONLINE):10–1.

13. Ray M, Vazifdar A, Shivaprakash S, Division H, Foundation SHNR, Reliance SHN, et al. Co - infection with Malaria and Coronavirus Disease - 2019 Over 8000 Macaque Bites Since 2014 but No Herpes B Virus Infection Reported from Shimla , India. 2020;12(3):2019–20.
14. Sardar S, Sharma R, Alyamani TYM, Aboukamar M. COVID-19 and Plasmodium vivax malaria Co-infection. IDCases [Internet]. 2020;21:e00879. Available from: <https://doi.org/10.1016/j.idcr.2020.e00879>
15. Shahid Z, Karim N, Shahid F, Yousaf Z. COVID-19 Associated Imported Plasmodium vivax Malaria Relapse: First Reported Case and Literature Review. Res Rep Trop Med. 2021;Volume 12:77–80.
16. Junaedi M, Daud N, Saleh S, Rasyid H, Katu S, Ilyas M, et al. Case report: COVID-19 and severe malaria Co-infection. Eur J Mol Clin Med [Internet]. 2020;7(8):961–8. Available from: [https://ejmcm.com/article\\_3385\\_59acf726120fec738af1b2a1d5a0b849.pdf%0Ahttp://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=emexb&NEWS=N&AN=2010514449](https://ejmcm.com/article_3385_59acf726120fec738af1b2a1d5a0b849.pdf%0Ahttp://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=emexb&NEWS=N&AN=2010514449)
17. Indari O, Baral B, Muduli K, Prasad A, Swain N. Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID- 19 . The COVID-19 resource centre is hosted on Elsevier Connect , the company ' s public news and information . 2020;(January).
18. Gutman JR, Lucchi NW, Cantey PT, Steinhardt LC, Samuels AM, Kamb ML, et al. Malaria and parasitic neglected tropical diseases: Potential syndemics with COVID-19 ? Am J Trop Med Hyg. 2020;103(2):572–7.