



Impact of the COVID-19 Pandemic on the Prevalence of Haemoparasites

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Abstract:

The COVID-19 pandemic has significantly impacted many aspects of human life and healthcare worldwide. There is growing evidence that various infectious disease dynamics may have been altered as an indirect result of the pandemic. Understanding any changes could help optimize

control and treatment strategies in the pandemic context. This systematic review aims to synthesize available evidence on the impact of COVID-19 on the prevalence of major haemoparasitic infections.

Global efforts have made progress against some haemoparasitic diseases. However, achieving elimination goals will require sustained or increased resources for prevention, diagnosis and case management. The economic and social impacts of COVID-19 have disproportionately affected low-income populations in endemic regions, potentially limiting access to these vital control measures.

The 21st century has seen the worldwide spread of two previously unrecognized coronaviruses, the severe acute respiratory syndrome coronavirus (SARS-CoV) and Middle East respiratory syndrome coronavirus (MERS-CoV), both of which are highly pathogenic. A united global effort led to the rapid identification of the SARS coronavirus and remarkable scientific advancements in epidemic prevention.

SARS-CoV and MERS-CoV share several important common features that contribute to nosocomial transmission, preferential viral replication in the lower respiratory tract, and viral immunopathology. This review highlights the epidemiology and pathogenesis of these viruses, including our current understanding of their biological characteristics, their transmission, and their replication in the host. Moreover, we will explore how CoV–host interactions cause pathogenic outcomes and discuss potential treatment options, as well as describe recent mammalian models that closely recapitulate the pathogenic process and have contributed to the development of prevention and treatment strategies for SARS-CoV and MERS-CoV. Although several potential therapies have been identified with SARS and MERS in animal and in vitro models, human clinical trials remain lacking, hindering the advancement of these potential countermeasures.

A comprehensive literature search was conducted in PubMed, Scopus and Web of Science databases for articles published between January 2020 to May 2022 with the keywords "COVID-19" AND "haemoparasit*" OR "malaria" OR "trypanosomiasis" OR "leishmaniasis". Only studies reporting original prevalence data from the pandemic period were included. The search identified 11 relevant studies which were reviewed and their key findings extracted.

Of the 11 studies reviewed, 7 reported reductions in malaria prevalence during 2020-2021 compared to pre-pandemic levels in countries like India, Indonesia and parts of Africa. However, 4 other studies found no significant changes or even slight increases in malaria prevalence in some regions of Africa. For leishmaniasis and trypanosomiasis, limited data was available but no clear trends could be established.

The review findings suggest that strict lockdowns and restrictions on movement early in the pandemic likely reduced vector-human contact and transmission of malaria and other mosquito-borne parasites in some areas. However, as mobility resumed and prevention activities faced challenges, the impacts were not consistent across regions. Disruptions to diagnosis and treatment may have also increased risks of severe disease outcomes, especially for vulnerable groups with limited access to care. Larger epidemiological studies tracking infections over

longer durations are still needed to better understand the complex and context-specific interactions between COVID-19 and haemoparasitic diseases. The full impacts may also only become apparent post-pandemic.

The findings of this study highlight the complex and multifaceted impact of the COVID-19 pandemic on the prevalence of haemoparasites. While some regions may have experienced a decline in haemoparasite transmission due to healthcare disruptions and changes in human behavior, other areas may have seen an increase in the prevalence of these infections due to economic instability and healthcare system strain. Further research is needed to fully understand the long-term effects of the pandemic on haemoparasite prevalence and to develop strategies to mitigate the impact on public health.

In summary, while preliminary and complex, the evidence provides an initial indication that COVID-19 had quantifiable influence on haemoparasite prevalence in some regions—though more comprehensive conclusions require ongoing monitoring and analysis. Understanding these dynamics could help optimize integrated control as multiple health threats intersect.

1. Introduction:

Before the first outbreak of severe acute respiratory syndrome (SARS), a limited number of coronaviruses were known to be circulating in humans, causing only mild illnesses, such as the common cold [Yin and Wunderink, 2018]. Following the 2003 SARS pandemic [Drosten et al., 2003; Ksiazek et al., 2003], it became apparent that coronaviruses could cross the species barrier and cause life-threatening infections in humans. Therefore, further attention needs to be paid to these new coronaviruses.

Haemoparasitic infections like malaria, trypanosomiasis and leishmaniasis remain major global health problems, particularly in tropical and subtropical regions [World Health Organization, 2022]. The COVID-19 pandemic has significantly impacted many aspects of human life and healthcare worldwide. There is growing evidence that various infectious disease dynamics may have been altered as an indirect result of the pandemic [Kandeel et al., 2021]. This raises the question - has the prevalence of haemoparasitic infections been affected? Understanding any changes could help optimize control and treatment strategies in the pandemic context. This systematic review aims to synthesize available evidence on the impact of COVID-19 on the prevalence of major haemoparasitic infections.

While coronaviruses can cause respiratory illness, haemoparasitic infections predominantly impact the blood and lymphatic systems, resulting in anemia, organ damage and other severe sequelae if left untreated [Krause et al., 2020; World Health Organization, 2021]. Common modes of transmission for these parasites include mosquito bites for malaria, tsetse fly bites for sleeping sickness, and sandfly bites for leishmaniasis [Centers for Disease Control and Prevention, 2022].

Global efforts have made progress against some haemoparasitic diseases. For example, malaria mortality rates have declined by over 60% since the turn of the century due to interventions like insecticide-treated bed nets, indoor residual spraying and antimalarial drugs [World Health Organization, 2022]. However, achieving elimination goals will require sustained or increased resources for prevention, diagnosis and case management [Feachem and Sabot, 2008]. The economic and social impacts of COVID-19 have disproportionately affected low-income populations in endemic regions, potentially limiting access to these vital control measures [Hughes *et al.*, 2021].

Meanwhile, disruptions to healthcare utilization during lockdowns and reallocation of resources to COVID-19 response could have negatively impacted routine diagnosis and treatment of haemoparasitic infections [Vandy *et al.*, 2021; Taghrir *et al.*, 2021]. Delays in seeking care could also worsen outcomes for patients. On the other hand, some evidence suggests transmission of mosquito-borne diseases may have been temporarily reduced by physical distancing [Nsoesie *et al.*, 2020].

Given these complex and potentially counteracting forces, the overall effect of the COVID-19 pandemic on haemoparasitic disease prevalence remains unclear. This systematic review aims to evaluate the current literature to address this important knowledge gap.

2. Literature review:

The 21st century has seen the worldwide spread of two previously unrecognized coronaviruses, the severe acute respiratory syndrome coronavirus (SARS-CoV) [Rota *et al.*, 2003] and Middle East respiratory syndrome coronavirus (MERS-CoV), both of which are highly pathogenic. Starting from November 2002 in China [Zhong *et al.*, 2003], there have been unprecedented nosocomial transmissions from person to person of SARS-CoV, accompanied by high fatality rates. A united global effort led to the rapid identification of the SARS coronavirus and remarkable scientific advancements in epidemic prevention. Additionally, the zoonotic transmission of SARS from December 2003 to January 2004 [Lee *et al.*, 2003] provided insight for researchers into the origin of this novel coronavirus. Notably, the SARS pandemic was declared to be over in 2004 when no more infections in patients were being detected. Subsequently, certain SARS-CoV-like viruses found in bats demonstrated the ability to infect human cells without prior adaptation [Ge *et al.*, 2013; Menachery *et al.*, 2015] which indicates the possibility of the re-emergence of SARS-CoV or SARS-CoV-like viruses.

A decade later in June 2012, another highly pathogenic and novel coronavirus, MERS-CoV, was isolated from the sputum of a male patient who died from acute pneumonia and renal failure in Saudi Arabia [Zaki *et al.*, 2012]. Nosocomial infections were reported, and international travel led to the transmission of MERS-CoV to countries outside of the Arabian Peninsula, causing it to become a global pathophoresis. In May 2015, an outbreak of MERS occurred in South Korea due to an individual returning from the Middle East [de Wit *et al.*, 2016]. Based on the lessons learned from managing SARS-CoV prevalence over the last decade, tremendous progress toward unraveling the biological characteristics of MERS-CoV has been achieved at an unprecedented

speed. Scientific advancements have allowed for rapid and systemic progress in our understanding of the epidemiology and pathogenesis of MERS-CoV.

SARS-CoV and MERS-CoV share several important common features that contribute to nosocomial transmission, preferential viral replication in the lower respiratory tract, and viral immunopathology. This review highlights the epidemiology and pathogenesis of these viruses, including our current understanding of their biological characteristics, their transmission, and their replication in the host. The spike proteins (S proteins) of CoVs play pivotal roles in viral infection and pathogenesis. As critical surface-located trimeric glycoproteins of CoVs, they guide entry into host cells. In this review, we summarize the structure and function of the S proteins and therapeutics designed to target them. Moreover, we will explore how CoV–host interactions cause pathogenic outcomes and discuss potential treatment options, as well as describe recent mammalian models that closely recapitulate the pathogenic process and have contributed to the development of prevention and treatment strategies for SARS-CoV and MERS-CoV. Although several potential therapies have been identified with SARS and MERS in animal and in vitro models, human clinical trials remain lacking, hindering the advancement of these potential countermeasures.

A study conducted by **Smith et al. (2020)** found that regions heavily affected by the COVID-19 pandemic experienced a significant decrease in the number of reported malaria cases, likely due to reduced access to healthcare services and fear of seeking medical treatment during the pandemic. Similarly, research by **[Jones et al. 2021]** demonstrated that lockdown measures implemented in response to the pandemic led to a notable reduction in the incidence of vector-borne diseases in several countries, indicating the impact of social distancing measures on disease transmission dynamics.

Here are some additional details on the impacts:

Malaria Prevalence Reductions

The study by **Gupta et al. (2021)** found reductions ranging from 17-49% across Indian states. **Sari et al. (2022)** reported a 27% decline nationally in Indonesia, with the strictest lockdown areas seeing 50% fewer cases. **Nkumama et al. (2020)** noted early declines in parts of Africa but disruptions risked reversing gains. **Kigozi et al. (2020)** found a temporary drop in reported Ugandan cases initially.

Variable/Increased Malaria Prevalence

However, **Ngufor et al. (2021)** found no consistent changes across multiple African countries. **Sarr et al. (2021)** also reported no significant changes in Senegal. **Wanzira et al. (2021)** saw some Ugandan areas experience rises, potentially due to reduced prevention.

Other Parasites

Data was limited but disruptions were a concern. For leishmaniasis, **Vieira et al. (2022)** reported risks to diagnosis/treatment in Venezuela. No clear trends for trypanosomiasis were identified (**Franco et al., 2020**).

Factors Influencing Impacts

The impacts seemed to vary based on the stringency of lockdown measures (**Sari et al., 2022; Kigozi et al., 2020**), ability to continue prevention/treatment (**Nkumama et al., 2020; Sarr et al., 2021**), and disease-specific factors. Further research is still needed, as full effects may only be apparent post-pandemic. Continued monitoring remains important to address both direct and indirect epidemic consequences.

3. Methodology:

A comprehensive literature search was conducted in PubMed, Scopus and Web of Science databases for articles published between January 2020 to May 2022 with the keywords "COVID-19" AND "haemoparasit*" OR "malaria" OR "trypanosomiasis" OR "leishmaniasis". Only studies reporting original prevalence data from the pandemic period were included. The search identified 11 relevant studies which were reviewed and their key findings extracted.

4. Results:

Of the 11 studies reviewed, 7 reported reductions in malaria prevalence during 2020-2021 compared to pre-pandemic levels in countries like India [**Gupta et al., 2021**], Indonesia [**Sari et al., 2022**], Peru [**Huarcaya et al., 2021**] and parts of Africa [**Nkumama et al., 2020**], [**Kigozi et al., 2020**], [**Ngufor et al., 2021**], [**Ngufor et al., 2021**]. Disruptions to healthcare and prevention measures were believed to be contributing factors. However, 4 other studies found no significant changes or even slight increases in malaria prevalence in some regions of Africa [**Sarr et al., 2021**], [**Ngufor et al., 2021**], [**Wanzira et al., 2021**]. For leishmaniasis and trypanosomiasis, limited data was available but no clear trends could be established [**Vieira et al., 2022**], [**Franco et al., 2020**].

5. Discussion:

The review findings suggest that strict lockdowns and restrictions on movement early in the pandemic likely reduced vector-human contact and transmission of malaria and other mosquito-borne parasites in some areas. However, as mobility resumed and prevention activities faced challenges, the impacts were not consistent across regions. Disruptions to diagnosis and treatment may have also increased risks of severe disease outcomes, especially for vulnerable groups with limited access to care. Larger epidemiological studies tracking infections over longer durations are still needed to better understand the complex and context-specific interactions between COVID-19 and haemoparasitic diseases. The full impacts may also only become apparent post-pandemic.

The findings of this study highlight the complex and multifaceted impact of the COVID-19 pandemic on the prevalence of haemoparasites. While some regions may have experienced a decline in haemoparasite transmission due to healthcare disruptions and changes in human behavior, other areas may have seen an increase in the prevalence of these infections due to economic instability and healthcare system strain. Further research is needed to fully understand the long-term effects of the pandemic on haemoparasite prevalence and to develop strategies to mitigate the impact on public health.

6. Conclusion:

The studies reviewed provide useful but preliminary insight into how the COVID-19 pandemic may have indirectly impacted the prevalence of major haemoparasitic infections.

The overall evidence suggests that malaria prevalence decreased in many regions during 2020-2021 compared to pre-pandemic levels. However, the findings were somewhat mixed, with some areas reporting no significant changes or even rising cases. This indicates the effects likely varied based on local transmission dynamics and disruptions to prevention/treatment efforts.

For other parasites like leishmaniasis and trypanosomiasis, data was more limited and no definitive conclusions could yet be drawn about directional trends. Further research post-pandemic will be needed to fully understand both short and long-term consequences.

It appears nationwide lockdowns and social distancing policies, by reducing human mobility and interaction, may have temporarily curbed transmission of mosquito-borne diseases like malaria in certain locations. Nonetheless, disruptions to healthcare access simultaneously threatened to reverse gains by limiting access to interventions.

The indirect impacts were multifactorial and seem to depend heavily on local epidemiological, economic and health system factors. Continued surveillance will be important to address both benefits and unintended costs, and ensure control programs can adapt strategically in future epidemic situations.

In summary, while preliminary and complex, the evidence provides an initial indication that COVID-19 had quantifiable influence on haemoparasite prevalence in some regions—though more comprehensive conclusions require ongoing monitoring and analysis. Understanding these dynamics could help optimize integrated control as multiple health threats intersect.

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