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## Mitigation of Soil-Transmitted Helminthiases Resurgence in The Era of Covid-19 Disruption: a Literature Review

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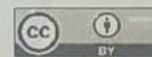
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### ABSTRACT

**Background:** Interruptions and postponements are influencing people's desire for soil-transmitted helminthiases (STH) services as all countries are fighting the Covid-19 pandemic. The risk of spreading STH in high-transmitting areas increases with increased disturbance. Indonesia is a compatible host country for STH because it is a tropical country. The STH impacts the population's nutrient status and disturbs their cognitive processes. **Objective:** To describe the issue and how best efforts had been made to mitigate the possibility of a resurgence of intestinal worms during the disruptions caused by the Covid-19 pandemic. **Material and Method:** Search for the most recent articles in a database of research in January 2022 on Google Scholar, Science Direct, and PubMed. Qualifying articles were then extracted and synthesized qualitatively. **Discussion:** The interference and postponement of the deworming control program due to COVID-19 had a tentative effect on the progress of achieving the elimination of STH as a public health problem by 2030. **Conclusion:** Best practices show that revitalization efforts to control STH by strengthening integrated interventions and collaborations through the expansion of POPM, PHBS, and STBM in line with COVID-19 prevention efforts with mitigation innovations shifting from controlling morbidity to terminate the transmission of STH.



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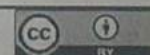
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### BACKGROUND

The Covid-19 pandemic has marginalized many other illnesses because of interruptions (Gluchowska, et al., 2021; Hotez, et al., 2021). Before the pandemic, the World Health Organization (WHO) classified several infectious diseases as neglected tropical diseases (NTD) (World Health Organization & United Nations Children's Fund, 2020). There are at least twenty types of NTDs, but only five of them are endemic diseases in Indonesia, namely soil-transmitted helminthiases (STH), elephantiasis, snail fever, yaws, and leprosy (Fauziyah, et al., 2021).

This literature review focused on STH because STH is an infectious disease that continues to be a public health concern in Indonesia, that is widespread in most parts of Indonesia and can lead to

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decreased health, nutrition, intelligence, and productivity conditions. The STH is a disease caused by infection with geohelminths in the human body and transmitted through the soil, which includes *Ascaris lumbricoides* (roundworms), *Trichuris trichiura* (whipworms), *Necator americanus* and *Ancylostoma duodenale* (hookworms) (Regulation of The Minister of Health, Republic of Indonesia, 2017). STH often occurs in tropical countries with low socioeconomic levels, high population density, and poor sanitation and hygiene conditions (Freeman, et al., 2019).

Before the Covid-19 pandemic, the STH had contributed to the global disease burden. This disease has infected 1.5 billion humans, equivalent to 24% of the world's population, and 70% of these infections occur in Asia. The STH remains endemic, especially in Indonesia's rural areas. Several cross-sectional studies have found the prevalence of STH to range from 71% to 91% in school-age children (Mau, 2017; Kurniati, et al, 2019).

These geohelminths are transmitted by eggs that are excreted with fecal matter from infected persons. These eggs can contaminate areas in which sanitation is inadequate. Individuals living in contaminated environments and having poor hygiene practices are at risk of accidentally ingesting these infective eggs through contaminated food, drink, and hands and direct contact with infective larvae (World Health Organization, 2022).

Symptoms of soil-transmitted helminthiases are typically so mild that they are ignored. Symptoms depend on the life cycle stage and the infection's intensity. People infected with mild to moderate STH have nonspecific symptoms or even no symptoms. Signs of the patients' complaints include loss of appetite, stomach bloating, and diarrhea which results in weight loss. The STH can cause anemia if ignored and untreated. The migration of geohelminths to internal organs, such as the pancreas and central nervous system, can cause serious problems. These parasites impact pregnant women, causing birth disorders and stunting babies (Jourdan, et al., 2018). Furthermore, the involvement of the Type 2 response in the immunopathology of Covid-19 raises concerns about the negative impact of co-infection of STH (Bradbury, et al., 2020).

Mitigation of intestinal worms during a pandemic is not easy. The extended pandemic has had significant health and economic impacts (Hotez, et al., 2021). Various efforts have been made to tackle STH. Short-term measures is conducted by chemoprevention in the form of annual or biennial Mass Preventive Drugs (POPM) with albendazole (400 mg) or mebendazole (500 mg) as a single dose for at-risk populations, for example, preschool children, school-age children, adolescent girls, mothers childbearing age, and pregnant women. Long-term efforts include providing clean water, improved sanitation and latrines, and a ban on the use of stool as fertilizer, as well as counseling on a Clean and Healthy Lifestyle accompanied by Community Based Total Sanitation actions (Regulation of The Minister of Health, Republic of Indonesia, 2017; The Ministry of Health Republic of Indonesia, 2021).

Twenty-three countries with chemoprevention coverage until 2018 are still under the target, one of them is Indonesia (Montresor, et al., 2020). Freeman, et al. (2019) explain the various challenges for post-2020 worm mitigation are as follows: 1) inconsistent oversight of mitigation programs; 2) extension of chemoprevention coverage to at-risk groups other than school-aged children; 3) the possibility of drug resistance; 4) Weak diagnostic methods; 5) Available anthelmintics are inefficient and have insufficient supply; 6) Inadequate of cross-sectoral cooperation (clean water, sanitation, and hygiene); 7) Develop new targets for the post-2020 phase-out of dewormers.

## OBJECTIVE

To describe the issue and how best efforts had been made to mitigate the possibility of a resurgence of intestinal worms during the disruptions caused by the Covid-19 pandemic.

## MATERIAL AND METHOD

This literature review used a search methodology for the most recent papers through a database of research papers. The research was conducted in January 2022 on Google Scholar, ScienceDirect, and PubMed. The keywords used a combination of the words "mitigation of soil-transmitted helminthiasis resurgence in the era of Covid-19 disruption". The inclusion criteria were articles in English containing explanations related to mitigating worm resurgence in the era of Covid-19 disruption and reports from reputable international journals published since 2021. The exclusion criteria were the



articles containing duplication and those that could not be downloaded. The selected articles were then extracted using a tabulation containing data on the author's name, year of publication, name of the journal, Scimago Journal and Country Rank (SJR), Impact Factor (IF), and the conclusion of the article. The author obtain 23 articles to identify, but only six articles were eligible. The six articles were then synthesized qualitatively.

## RESULT AND DISCUSSION

A critical article review was conducted on six selected articles published by reputable international journals based on SJR and IF. Journal analysis related to mitigating STH resurgence in the era of disruption of Covid-19 is presented in Table 1 as follows.

Table 1 Review articles

Author's Name and Year of Publication	Article Title and Journal Name	SJR/IF	Article's Conclusion
Fauziyah et al., (2021)	How Should Indonesia Consider Its Neglected Tropical Diseases in the Covid-19 Era? Hopes and Challenges (Review). <i>Biomedical Reports</i> , 14 (53). Doi: 10.3892/br.2021.1429	0.607/1.94	Deworming mitigation challenges in Indonesia include 1) inconsistency in monitoring mitigation programs; 2) expansion of chemoprevention coverage in at-risk groups; 3) occurrence of drug resistance; 4) and weak diagnostic methods. The era of the Covid-19 pandemic allowed coinfection of STH and Covid-19 patients who required special treatment. Provision of Mass Preventive Drugs (POPM) to communities is at risk of delays due to drug distribution gaps.
Toor et al., (2021)	Predicted Impact of Covid-19 on Neglected Tropical Disease Programs and the Opportunity for Innovation. <i>Clinical Infectious Diseases</i> , 72(8): 1463-1466. Doi: 10.1093/cid/ciaa933	3.44/8.313	Delayed POPM can cause STH resurgence, especially in high-transmission areas. It is recommended to integrate the expansion of POPM coverage and the program's implementation to increase access to clean water, sanitation, and hygiene (WASH) which focuses on supporting the Covid-19 health protocol.
Hollingsworth et al., (2021)	Evaluating the Potential Impact of Interruptions to Neglected Tropical Disease Programmes Due to Covid-19. <i>Trans. R. Soc. Trop. Med. Hyg.</i> , 115: 201-204. Doi: 10.1093/trstmh/trab023	0.725/1.73	Obstacles to mitigating STH due to the Covid-19 pandemic must be minimized, and the program should be restarted immediately. The POPM program will become a biennial treatment intervention starting in 2021, including adults in school-based programs, to reduce the impact of delays related to Covid-19. Increasing the number coverage of POPMs reduces infection rates more quickly. This allows mitigation strategies to catch up and accelerate achieving the 2030 goals.
Brooker et al., (2021)	Neglected Tropical Disease Control in a World with Covid-19: An Opportunity and a Necessity for Innovation. <i>Trans. R. Soc. Trop. Med. Hyg.</i> 115: 205-207. Doi: 10.1093/trstmh/traa157	0.725/1.73	The impact of delaying POPM on STH can be minimized and adequately compensated by a community-based biennial follow-up program for POPM. Mitigation innovation shifts from controlling morbidity to terminating the transmission of STH. However, every effort to increase the frequency and scale of POPM must be accompanied by programs to increase access to clean water, sanitation, and hygiene.
Mationg et al., (2021)	The Control of Soil-Transmitted Helminthiases in the Philippines: The Story Continues. <i>Infect. Dis. Poverty</i> , 10 (85). Doi: 10.1186/s40249-021-00870-z	1.464/3.88	The Philippines has promoted deworming control in the last two decades. However, the prevalence of STH remains high due to the non-optimal coverage of chemo-prevention and limited access to clean water, sanitation, and hygiene (WASH) programs and health

			education. The school-based POPM program and its expansion throughout the community must be strengthened. Future deworming mitigation strategies are based on close monitoring of anthelmintic efficacy, research on developing and using new anthelmintics or drug combinations, and ongoing integrated socialization between WASH programs and health education.
Malizia et al., (2021)	Modeling the Impact of Covid-19-Related Control Programme Interruptions on Progress Towards the WHO 2030 Target for Soil-Transmitted Helminths. <i>Trans. R. Soc. Trop. Med. Hyg.</i> , 115: 253–260. Doi:10.1093/trstmh/traa156	0.725/1.73	The interruption and delay of the deworming control program due to Covid-19 temporarily impacted the progress of eliminating STH as a public health problem by 2030. However, after the termination of chemoprevention, follow-up programs need time to catch up (about three years in areas of moderate endemicity and about five years in areas of high endemicity). Implementation of chemoprevention should be restarted as soon as possible to minimize the time without chemo-prevention as quickly as possible, even if it is before the following chemoprevention schedule under normal circumstances. Covid-19 disruptions can be turned into opportunities to increase the likelihood of achieving targets by implementing appropriate mitigation strategies. A year's period of chemoprevention in the general population after discontinuation could accelerate the achievement of the target for reducing morbidity by 2030.

The disruptions that have occurred during the Covid-19 pandemic have resulted in a variety of disruptions and delays. These interruptions and delays affect the provision of services to populations requiring treatment and care for deworming. Furthermore, programs associated with deworming are not a priority. Interruptions and extended delays have increased the spread of STH in high transmission regions (Hollingsworth, et al., 2021; Toor, et al., 2021). These risks offset the progress made after decades of rigorous application of the enhanced program. The pandemic has taught us about vigilance, not only against Covid-19 but also against future threats.

The positive aspect is adaptation and innovation to help sustain the deworming program, complemented with integrated interventions and collaboration (Fauziyah, et al., 2021; Mationg, et al., 2021). Adaptations made in the context of a pandemic can strengthen efforts to support deworming programs based on primary health facilities and their integration into community-based platforms. Its innovation activities are adapted from a risk-benefit analysis in the context of a pandemic. Certain activities can be held in places where Covid-19 transmission has not occurred, and adjustments are made to other delivery modes that can be safely completed or temporarily postponed only to locations where the Covid-19 outbreak has occurred. In-person visits must be limited. Activities are carried out alternatively by using mobile phone applications, telemedicine, and other digital platforms (World Health Organization & United Nations Children's Fund, 2020).

WHO recommend the principal strategies for dealing with the deworming burden, namely chemoprevention, individual case management, integrated vector management, veterinary public health, and water, sanitation, and hygiene (WASH) framework (Gutman, et al., 2020). Deworming interventions are based on each strategy and use an approach-based community to provide services to populations where STH is endemic. WASH community activities need to continue by adapting WASH messages to focus on prevention of Covid-19 transmission (Brooker, et al., 2021; Mationg, et al., 2021; Toor, et al., 2021). In addition, deworming programs can be carried out in schools. The advantage is the resilience of the school program, which is supported by teachers to be reliable in the implementation of worm eradication in classrooms, even if schools are closed repeatedly because of the pandemic.



The STH parasites can alter the immune response to other infectious agents. The regulation of the deworming-associated inflammatory response may reduce the development of immunity or response to vaccines. The Covid-19 pandemic allows coinfection between people with STH and Covid-19, thus requiring monitoring of the potential for syndemics phenomenon (synergistic epidemics) (Gutman, et al., 2020). Moreover, mass treatment for at-risk communities was also delayed due to inconsistencies in anthelmintic distribution. Suppose coinfection between the STH parasites and SARS-CoV-2 increases complications, and there is a change in the comorbid age model at an earlier age. In that case, the burden of Covid-19 in endemic countries may be much worse than expected. Suppose that the transition to Th2 protects the severity of the disease while reducing long-term immunity or increasing the time of virus excretion (Brosschot & Reynolds, 2018). In that case, the epidemiology of Covid-19 in endemic countries is substantially different from that observed in non-endemic countries. It is crucial to carefully monitor the effects of coinfection to be aware of the worse possible effects (Fauziyah, et al., 2021).

Among the programs supporting the control and prevention of intestinal disease in Indonesia is PHBS, that has not yet fully targeted students in schools, and STBM, which is under-implemented in the community (Wibawa & Satoto, 2016). The sustainability of the program requires greater coordination between implementation agencies. Decentralized and multilateral programs can only be successful with the collaboration, co-operation, and long-term support of local government. Government support is very much needed in the procurement and distribution of anthelmintics and prioritizing other control programs such as environmental sanitation improvement activities and health education are needed to accelerate progress towards the 2030 goal of STH Elimination as a Public Health Problem (EPHP). The challenges of the Covid-19 pandemic encourage the continuation of these activities and their integration with ongoing efforts to prevent Covid-19. If these activities are discontinued and disintegrated, it can be predicted that the long-standing control and prevention of STH programs will be in vain and cause a long-term negative impact on public health.

## CONCLUSION

Mitigation of STH during a pandemic is not easy. Mass treatment for at-risk communities has also experienced delays due to disparities in anthelmintic distribution. If coinfection between the STH parasites and SARS-CoV-2 increases complications and there is a shift in the comorbid age pattern to a younger age, then the burden of COVID-19 in endemic countries may be much worse than expected. However, the challenges of the COVID-19 pandemic actually encourage these activities to be continued and integrated into ongoing COVID-19 prevention. Reinvigorating efforts to control STH by strengthening integrated interventions and collaborations through the expansion of chemoprevention, PHBS, and STBM in line with COVID-19 prevention efforts with mitigation innovations shifting from controlling morbidity to terminate the transmission of STH. This method accelerates progress towards the goal of STH Elimination as a Public Health Problem (EPHP) in 2030.

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## Conflict of Interest

All authors have no conflict of interest.

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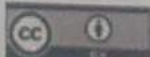
## Author Contribution

Authors has contributed to all processes in this research, including preparation, data gathering, and analysis, drafting, and approval for publication of this manuscript.



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