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Mass Deworming Program in Indonesia as A Strategic Tool to Reduce Soil-transmitted Helminth (STH) Burden in High-Risk Population: A Systematic Review

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ABSTRACT

Introduction : Mass deworming program is one of the major preventive measures to reduce the Soil-transmitted helminth (STH) burden in the high-risk population. In Indonesia, the enactment of WHO recommends regularly administering anti-helminthic medication based on STH prevalence has been conducted since 2017 and notably STH prevalence decreased significantly yet no data has demonstrated its efficacy

Methods : This review was made based on a reporting system for systematic reviews and meta-analyses review protocol or PRISMA. Databases used in this review included Pubmed, Google Scholar and Clinicalkey for a total of 828 articles.

Results : There were only four included studies with a total of 842 participants, consisting of young, preschool and school-aged children. No further quantitative analysis could be performed to analyze mass deworming efficacy in this population but STH prevalence has been reduced following mass deworming programs in several study locations; two last studies could not be determined since no baseline infection status has been evaluated. The other two studies proved the low STH prevalence based on pre- and post-tests following mass drug administration.

Conclusions : All studies demonstrated mass deworming programs could be an efficient mode to reduce STH prevalence in Indonesia, particularly among school-age children. Nevertheless, improving outcomes of interest is still inconsistent in the literature.

INTRODUCTION

Soil-transmitted helminth (STH) is a part of intestinal parasitic infection alongside intestinal protozoa. STH infect more than 1.5 million people or 25% of the world's population making it the most prevalent neglected tropical diseases (NTDs) (Hotez & Lo, 2020). Those prevalences are concentrated in the areas of poor sanitation and hygiene, spanning across sub-Saharan Africa, South America and Southeast Asia. This infection also infects 260 million preschool-age children and 654 million school-age children making this population mostly affected by the presence of infection. Therefore, urgent eradication of STH is mandatory to prevent the reduced quality of life and economic loss due to complications, such as anaemia, fatigue, reduced performance status, gastrointestinal disturbances, and cognitive growth retardation (Becker et al., 2018).

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Three main species of STH could infect humans, first roundworm or *Ascaris lumbricoides*, whipworm or *Trichuris trichiura*, and lastly hookworm which consists of *Necator americanus* and *Ancylostoma duodenale*. The infective stage of this helminth involves directly ingested fertilised egg following soil contact, while hookworms could be transmitted by infective larvae stage infiltrating skin without coverings (Jourdan, Lamberton, Fenwick, & Addiss, 2018). Meanwhile, *Strongyloides stercoralis* is a distinct species within the STH group that requires different diagnostic approaches and could be the reason frequently underdiagnosed among the population but it still needs a similar therapeutic approach (Krolewiecki et al., 2013). Consequently, management and preventive measures of all STH share similar characteristics, mainly improving hygiene and sanitation and anti-helminthic drug administration.

Mass deworming programm is a mass eradication and preventive method to administer anti-helminthic medication aiming in reducing overall prevalence of STH infection, particularly among high risk population (Bundy et al., 2018). STH as a part of neglected tropical diseases has contributed to significant proportion of morbidity among its sufferers. Indonesia has been long troubled with major neglected tropical diseases and is categorised as having the highest prevalence of STH infection (Wibawa & Satoto, 2016). A mass deworming program was also launched to tackle the STH burden among young (12-23 months of age), preschool (24-59 months of age), and school-age children in hopes of reducing Disability-Adjusted Life Years (DALYs) in this specific group since Indonesia is a supportive climate in prompting STH incidence and larvae maturation making this country inevitably grappled by this parasite. Therefore, the Ministry of Health of Indonesia ratified the World Health Organization recommendation to perform biannual mass deworming in high prevalence areas (more than 50% prevalence) and annual anti-helminthiasis administration in the moderate prevalence of STH, between 20-50% (Dunn, Turner, Tun, & Anderson, 2016). This regulation has been enacted in the official regulation of the Ministry of Health No.15 Year 2017 about helminthiasis control (Adrizain, Setiabudi, Faridah, Fauziah, & Setiabudiawan, 2020). Therefore, this review aims to demonstrate the mass deworming program in Indonesia as well as its implementation throughout regions.

MATERIAL AND METHODS

This systematic review was conducted based on the review protocol of preferred reporting items for systematic reviews and meta-analysis (PRISMA). Initially, the research question of the implementation program and evaluation of the outcome of interest regarding the mass deworming program was established. The PICO formulation consists of patients in high-risk groups, including young children, preschool and school children), intervention of mass deworming program in alleviating STH burden, and comparison in the population without receiving anti-helminthic drugs. Lastly, outcomes are based on the outcome of interest regarding the preventive measures for STH. Following the formulation of the research question, the research database from three major sources has been evaluated for any suitable articles included in this study, such as Pubmed, Clinicalkey, and Google Scholar.

Inclusion criteria were as follows: eligible papers must cover STH local prevalence and mass drug administration should be recorded without acknowledging infection status, the study evaluating other control strategies could be included in the study, reported infection status only for STH, not other helminthiasis, and single evaluation of outcome of interest not only limited by

study design. Meanwhile, exclusion criteria include the study that was not conducted in Indonesia and did not cover a minimum of one outcome of interest.

Based on the WHO document of preventive measures against STH, outcomes of interest regarding of mass deworming program should cover infection burden, nutritional aspect (including anthropometric measurement and growth, anaemia, and iron deficiency), morbidity (diarrhoea, all-cause morbidity, and all-cause mortality), cognitive development and school performance, and maternal and infant for specific to pregnant women (includes maternal mortality, birthweight, and perinatal mortality).

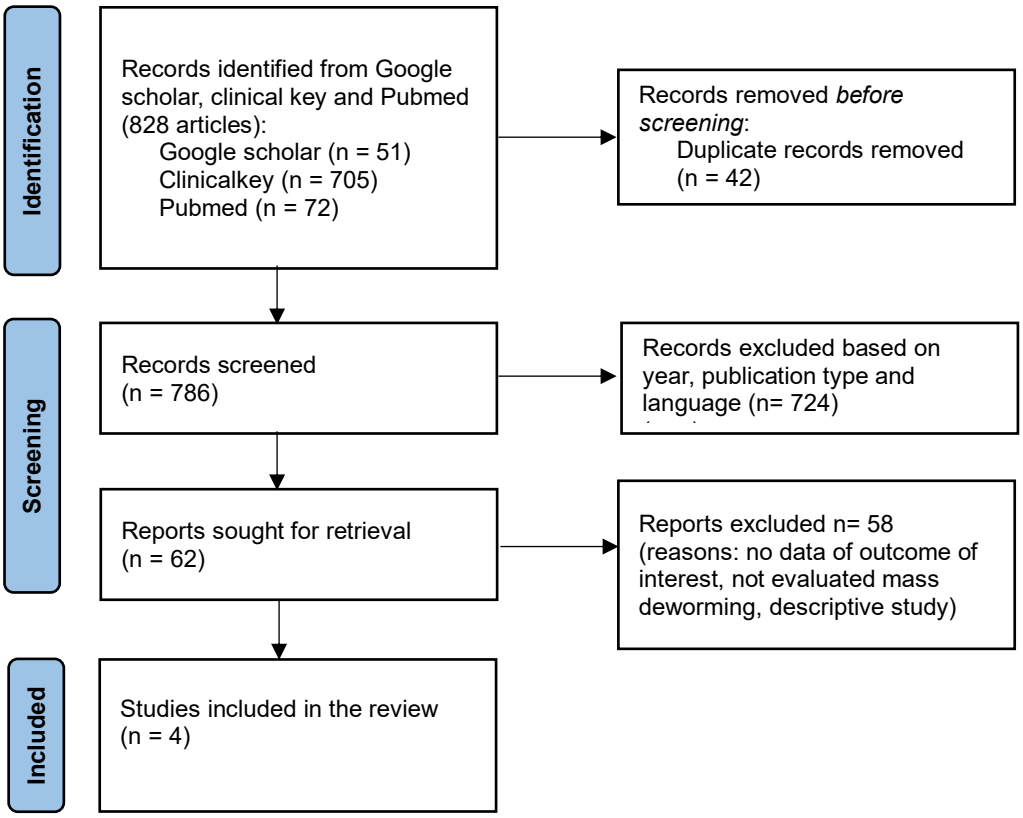

Figure 1. PRISM flow chart of systematic review

The term searches through three databases on January 10, 2024, with limitations of publication year (2015- 2023), study location (Indonesia), and language (English only). The following search terms were utilized in this study: "soil-transmitted helminth" or "STH" or "helminth" or "hookworm" or "whipworm" or "Trichuris" or "Ascaris" or "Ancylostoma" or "Necator" AND "deworming" or "mass drug administration" or "mass deworming" AND "Indonesia". Two authors were responsible for direct review until the final study was selected. Relevant studies were also included in the Endnote version X7 and the study title and abstract were initially screened by the first two authors.

RESULTS

There were four included studies in this systematic review which were conducted in several locations in Indonesia. Since there is a huge discrepancy among studies, no further quantitative assessment has been conducted. Therefore, a meta-analysis was also not performed to evaluate the efficacy of mass deworming programs in this country. Four studies only evaluated a single outcome of interest through a variety of study designs, that was nutritional status.

The first study reported a high incidence of STH before the mass deworming program was held in the study location and reduced STH prevalence from 95.4% to 53.4%. This study also confirmed amelioration of nutritional status among primary school-aged children leading to no severely underweight participant following mass drug administration (p-value <0.001). The second study evaluated school-based deworming (SBD) and community-based group (CBD) programs which showed that SBD has more efficacy compared to CBD in primary school children. Nevertheless, both interventions proved to decrease the trend of STH prevalence and egg burdens. SBD had superior efficacy in preventing re-infection, with a total re-infection of 31.8% compared to CBD with 54.1%.

The two last studies have similar study designs which consist of risk factor analysis and history of mass drug administration. In the third study, coverage of mass deworming in the study population was only 29.3% with an STH prevalence of only 7.3% but only one participant was infected with STH in the MDA group. Nutritional status was demonstrated by only a few underweight participants. The last study observed a low incidence of STH following albendazole treatment but no pre-test evaluation for infection status.

Table 1. Summary of included studies.

No	Authors	Study Location	Study Design	Participants	Outcome of Interest
1.	Sungkar, Ridwan, and Kusumowidagdo (2017)	Tambaloka, Sumba Island	Pretest-Posttest of deworming medication	Children aged 1-15 years (n=109)	Nutritional status (height and weight)
2.	Sjafii, Ramayani, Pasaribu, and Pasaribu (2020)	Tigapanah, Karo Subdistrict	Quasi-experimental study	Primary school children (n=511)	Nutritional status (height and weight)
3.	Sari, Nathasaria, Majawati, and Pangaribuan (2020)	North Jakarta	Cross-sectional study	Primary school children (n=82)	Nutritional status using z-score body mass index based on age (BMI/Age)
4.	Budiapsari, Swastika, and Masyeni (2021)	Gelgel village, Klungkung Regency	Cross-sectional study	Primary school children (n=140)	Nutritional status

DISCUSSION

Several helminthic species are grouped in the name of Soil-transmitted helminths even though each species has distinct characteristics. STH grouping aims at infectious disease control, due to four major reasons (Jourdan et al., 2018). First, endemicity is concentrated in a similar geographic location and targeted by similar specific groups; second, STH is a treatable disease with a similar chemotherapeutic agent; third, diagnostic approaches share similar modalities; fourth, all species in the group of STH produce similar negative impact on the health of the general population (WHO, 2017).

There are no specific eradication strategies to alleviate the STH burden yet arranging the timeframe of causal pathways (Fig.2) could delineate components of preventive and therapeutic roles. Consequently, comprehensive intervention should be carried out to eradicate STH in the population (Welch et al., 2017). One major important factor is preventive strategies in the high-risk population group. In recent eras, STH prevalence in the world has been reduced significantly. Since over 500 million children have been treated with anti-helminthic medication in most developing regions; it accounts for more than 60% of the children population, as the most significant population suffered from STH (Ahuja, Baird, Hicks, Kremer, & Miguel, 2018). The total number of DALYs has been reduced by more than 50% following mass drug administration programs held in every country with different strategies (Bundy et al., 2018).

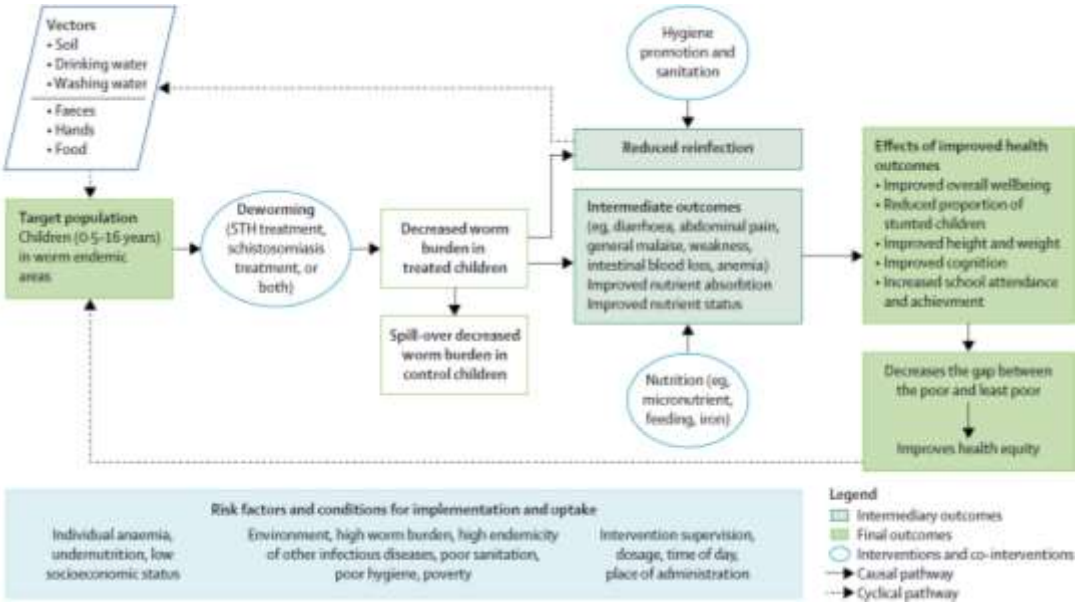

Figure 2. Causal pathways of comprehensive intervention in eradicating STHs (Welch et al., 2017)

Two major preventive strategies for STHs are improved water, sanitation and hygiene, mentioned as WASH strategy, and mass deworming strategy. WASH strategy has been declared by the WHO as the major preventive measure to tackle STH (Strunz et al., 2014). Since STH is environmentally transmitted through fertile eggs directly ingested by humans, therefore improving hygienic practices and sanitation infrastructure could become the pivotal part in alleviating the STH burden among the general population (Vaz Nery et al., 2019). Meanwhile, mass deworming is a strategic tool of mass drug administration regardless of disease status to reduce the STH burden as well as prevent infections (Okoyo et al., 2016).

Recent WHO guidelines also differ in two modalities of mass anti-helminthic drug administration; mass drug administration is the administration of anti-helminthic drugs regardless of infective status, performed at regular intervals and involves the entire population of a certain area (state, province, district or village which has blatant STH epidemiologic measures), and targeted drug therapy is a mass deworming program stratified by specific risk groups in the population, based on age, gender, and other social characteristics. Based on the level of intervention, mass deworming programs are also divided into two; social-based deworming (SBD) and community-based deworming (CBD) (Organization, 2017). In Fig.3, There is the timeframe of mass deworming implementation in Bandung, West Java, held annually and evaluated regularly.

In the included study, four articles demonstrated distinct characteristics while consistently proving reduced burden of STH among participants. In comparison with other studies not conducted in Indonesia, several systematic reviews and meta-analyses confirmed this finding. In a large-scale, meta-analysis study mass deworming has led to the reduction of STH prevalence with greater effect, mass deworming against hookworm with OR 0.72, p-value <0.0001; targeted deworming against Ascaris lumbricoides with OR 0.11, p-value <0.0001; and targeted deworming against Trichuris sp. with OR 0.12, p-value <0.0001 (Clarke et al., 2017).

National Level: Department of Health, Indonesia • In endemic areas, mass drug administration is given annually for those aged 2-70 years old • In stunting areas, mass drug administration is given for those aged 1-12 years old and pregnant women twice a year • In other areas, deworming is carried out annually with supplementation of Fe tablets • Lack of compliance in society
Regional level: Bandung district • The deworming program has been conducted annually since 2009. The program focuses on population ageing 1-65 years old • Last evaluation for the program was done in 2016 by stool sample examination employing Kato-Katz technique - The stool sample collection was done through complicated relay of information: from program holders to teachers, from teachers to students, and from students their parents - Through the study, they found a rather low prevalence of STH in Bandung district (1.97%)
Local level: Primary health care across Bandung district • In some areas, mass drug administration was last carried out in 2017 as part of lymphatic filariasis program • In other areas, mass drug administration was last carried out in 2019 as part of stunting program

Figure 3. Execution of the Deworming Program in Indonesia, in this instance this study observes the implementation in Bandung (Adrizain et al., 2020).

In contrast, one meta-analysis study observed no significant association between mass deworming programs against STH and nutritional status, school attendance, cognition improvement, and mortality (Welch et al., 2017). Through comprehensive search, this study demonstrated that using wide arrays of interventions could improve STH status in one region, timeframe of intervention and outcome measured as represented in Fig.2. Although the outcome of interest categorized as primary outcome, intermediate outcome or symptomatic burden in a high-risk population has been reduced by the use of mass deworming program. It indirectly affects the primary outcome yet not proved in the meta-analysis.

It is confirmed in another meta-analysis study, that treating intestinal nematode leads to significant improvement of nutritional status among treated-group limited to the local epidemiological context, and not all affected children benefit in similar degree following anti-helminthic administration (Hall, Hewitt, Tuffrey, & De Silva, 2008). In the Cochrane review, there were 45 trials included in the analysis of mass deworming programs and nutritional status as well as other outcomes. Authors recommend that only infected children had nutritional status improvement following anti-helminthic medication. Mass deworming programs in endemic areas, although not all studies concluded similar findings, demonstrate that overall analysis observing average nutritional status, haemoglobin cognition, school performance, and survival were not affected by this intervention (Taylor-Robinson, Maayan, Soares-Weiser, Donegan, & Garner, 2012).

CONCLUSION

This systematic review has validated the successful strategies of mass deworming programs in Indonesia aiming to reduce STH burden among young, pre- and school-age children. However, it has not yet confirmed its effect in improving outcomes in the treated population group. Mass deworming and reduced STH prevalence could be because of the high coverage and regular administration of anti-helminthic medication as well as enacted by the Indonesia Health Ministry. Recently, STH was predominantly affected by poor hygienic practices and unimproved sanitation infrastructure in the era where mass deworming programs were annually held.

REFERENCES

Adrizain, R., Setiabudi, D., Faridah, L., Fauziah, N., & Setiabudiawan, B. (2020). Challenges for national deworming policy in Indonesia: experience from Bandung district West Java province. *Journal of Public Health*, 1-6.

Ahuja, A., Baird, S., Hicks, J. H., Kremer, M., & Miguel, E. (2018). Economics of mass deworming programs.

Becker, S. L., Liwanag, H. J., Snyder, J. S., Akogun, O., Belizario Jr, V., Freeman, M. C., . . . Krolewiecki, A. (2018). Toward the 2020 goal of soil-transmitted helminthiasis control and elimination. *PLoS Neglected Tropical Diseases, 12*(8), e0006606.

Budiapsari, P. I., Swastika, I. K., & Masyeni, S. (2021). Prevalence of Soil-transmitted Helminths Infection in Students of Klungkung, Bali, after Mass Treatment with AlbendazolePrevalence of Soil-transmitted Helminths Infection in Students of Klungkung, Bali, after Mass Treatment with Albendazole. *Open Access Macedonian Journal of Medical Sciences, 9*(A), 433-439.

Bundy, D. A., Appleby, L. J., Bradley, M., Croke, K., Hollingsworth, T. D., Pullan, R., . . . de Silva, N. (2018). 100 years of mass deworming programmes: a policy perspective from the World Bank's disease control priorities analyses. *Advances in parasitology, 100*, 127-154.

Clarke, N. E., Clements, A. C., Doi, S. A., Wang, D., Campbell, S. J., Gray, D., & Nery, S. V. (2017). Differential effect of mass deworming and targeted deworming for soil-transmitted helminth control in children: a systematic review and meta-analysis. *The Lancet, 389*(10066), 287-297.

Dunn, J. C., Turner, H. C., Tun, A., & Anderson, R. M. (2016). Epidemiological surveys of, and research on, soil-transmitted helminths in Southeast Asia: a systematic review. *Parasites & vectors, 9*(1), 31.

Hall, A., Hewitt, G., Tuffrey, V., & De Silva, N. (2008). A review and meta-analysis of the impact of intestinal worms on child growth and nutrition. *Maternal & child nutrition, 4*, 118-236.

Hotez, P. J., & Lo, N. C. (2020). Neglected tropical diseases: public health control programs and mass drug administration. In *Hunter's Tropical Medicine and Emerging Infectious Diseases* (pp. 209-213): Elsevier.

Jourdan, P. M., Lamberton, P. H., Fenwick, A., & Addiss, D. G. (2018). Soil-transmitted helminth infections. *The Lancet, 391*(10117), 252-265.

Krolewiecki, A. J., Lammie, P., Jacobson, J., Gabrielli, A.-F., Levecke, B., Socias, E., . . . Cimino, R. (2013). A public health response against Strongyloides stercoralis: time to look at soil-transmitted helminthiasis in full. *PLoS Neglected Tropical Diseases, 7*(5), e2165.

Okoyo, C., Nikolay, B., Kihara, J., Simiyu, E., Garn, J. V., Freeman, M. C., . . . Pullan, R. L. (2016). Monitoring the impact of a national school based deworming programme on soil-transmitted helminths in Kenya: the first three years, 2012–2014. *Parasites & vectors, 9*, 1-13.

Organization, W. H. (2017). Guideline: preventive chemotherapy to control soil-transmitted helminth infections in at-risk population groups.

Sari, M. P., Nathasaria, T., Majawati, E. S., & Pangaribuan, H. U. (2020). Soil-Transmitted Helminth Infections, Anemia, and Undernutrition Among School-Children in An Elementary School in North Jakarta, Indonesia. *Majalah Kedokteran Bandung, 52*(4), 2661-2670.

Sjafii, R. P., Ramayani, O. R., Pasaribu, S., & Pasaribu, A. P. (2020). The Effectiveness of School-based and Community-based Deworming Methods in Primary School Children with Soil-transmitted Helminth Infection. *Open Access Macedonian Journal of Medical Sciences, 8*(E), 296-301.

Strunz, E. C., Addiss, D. G., Stocks, M. E., Ogden, S., Utzinger, J., & Freeman, M. C. (2014). Water, sanitation, hygiene, and soil-transmitted helminth infection: a systematic review and meta-analysis. *PLoS medicine, 11*(3), e1001620.

Sungkar, S., Ridwan, A. S., & Kusumowidagdo, G. (2017). The effect of deworming using triple-dose albendazole on nutritional status of children in Perobatang village, Southwest Sumba, Indonesia. *Journal of parasitology research, 2017*.

Taylor-Robinson, D. C., Maayan, N., Soares-Weiser, K., Donegan, S., & Garner, P. (2012). Deworming drugs for soil-transmitted intestinal worms in children: effects on nutritional indicators, haemoglobin and school performance. *Cochrane Database of Systematic Reviews*(11).

Vaz Nery, S., Pickering, A. J., Abate, E., Asmare, A., Barrett, L., Benjamin-Chung, J., . . . Colford, J. M. (2019). The role of water, sanitation and hygiene interventions in reducing soil-transmitted helminths: interpreting the evidence and identifying next steps. *Parasites & vectors, 12*, 1-8.

Welch, V. A., Ghogomu, E., Hossain, A., Awasthi, S., Bhutta, Z. A., Cumberbatch, C., . . . Kristjansson, E. (2017). Mass deworming to improve developmental health and wellbeing of children in low-income and middle-income countries: a systematic review and network meta-analysis. *The Lancet Global Health, 5*(1), e40-e50.

WHO. (2017). *Guideline: preventive chemotherapy to control soil-transmitted helminth infections in at-risk population groups*: World Health Organization.

Wibawa, T., & Satoto, T. B. T. (2016). Magnitude of neglected tropical diseases in Indonesia at postmillennium development goals era. *Journal of tropical medicine, 2016*.