



Perspective: Opportunities and Scope for Expanded Deworming Programs for Soil-Transmitted Helminths in India

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The current deworming strategy for soil-transmitted helminthiasis (STH) focuses on pre-school and school-aged children and women in the reproductive age to eliminate morbidity. However, mathematical modeling and meta-analysis show that STH could be eliminated if the entire population, including adults, were treated. The Government of India (GOI) has been deworming children through various maternal and child health programs and school health programs. One of the largest initiatives is the school-based biannual deworming program for children aged 1-19 years in the 'National Deworming Day' since 2015. Women of the reproductive age have the opportunity to get dewormed under the Anemia Free India program. Adult men and women have the opportunity to receive Albendazole in the lymphatic filariasis (LF) endemic districts. The gaps in deworming are women above the age of 49 and adult men above 19 years, living in non-LF endemic areas. Understanding gaps in deworming will help plan policy changes and program strategies for STH elimination in India, which has 21% of the global STH burden, as well as in other STH endemic countries.

Keywords: STH program, India, adult deworming, mass drug administration, community-wide MDA, elimination of STH

INTRODUCTION

Soil-transmitted helminthiasis (STH) caused by *Ascaris lumbricoides* (roundworm), *Trichuris trichiura* (whipworm), and *Ancylostoma duodenale* or *Necator americanus* (hookworms) are among the most common infections in humans (1). It is estimated that about 1.45 billion people are infected with STH globally, with a high burden in India - about 21% of these STH-infected individuals live in the country (2). STH is prevalent in several states of India, with some exceeding 50% prevalence; however, most reports are based on surveys of school-aged children (SAC) alone (3). For example, the STH prevalence reported in 2015 among children aged 5-10 years in Uttar Pradesh, a highly populated state of India, was 75.6% (69.6% roundworm, 22.6% hookworm, and 4.6% whipworm) (4).

The World Health Organization (WHO) recommends targeted deworming of pre-school age children (PSAC) of 1-4 years and SAC of 5-15 years, non-pregnant adolescents of 10-19 years, non-

pregnant women in the reproductive age of 15-49 years, and pregnant women after the first trimester (1). The benefit of mass deworming has been long debated. While meta-analysis has shown that school deworming programs do not result in significant improvement in hemoglobin levels, cognition, or school performance in the short term, studies have shown a reduction in stunting among PSAC and, in the longer term, benefits on hourly earnings and standard of living as adults which validates the support for mass deworming programs (5–8). Women of reproductive age benefit from improved hemoglobin levels and a lower proportion of low birth weight babies by deworming (9–12). Given that STH control has progressed between 2008 and 2018, WHO's target of eliminating STH morbidity in pre-SAC and SAC may be achieved by 2030 with sustained STH program implementation (13, 14).

A systematic review and meta-analysis showed that STH reinfections could occur within three months and, at the population level, reach pre-treatment prevalence rates within a year, therefore, treating only at-risk populations may not be enough (15, 16). Mathematical modeling studies show that although controlling and eliminating STH infections with targeted deworming is a cost-effective approach to reduce childhood exposure and morbidity due to worm burden, it could be eliminated by treating the entire population, including adults (17–22). In real-world scenarios, a study in Cameroon showed that the distribution of Albendazole to the whole population rather than only to at-risk populations contributed to STH transmission interruption (15). A recent trial in Kenya showed that community-wide mass drug administration (cMDA) leads to a significantly higher reduction in STH prevalence in children than targeted deworming of SAC (23, 24). Trials are underway, including in India, to study the feasibility and impact of community-wide deworming compared to school-based deworming as a strategy for interrupting transmission of STH (25, 26). Empirical evidence from such trials will provide further evidence to policymakers and other key stakeholders in developing strategic STH control and elimination programs.

DEWORMING PROGRAMS FOR CHILDREN AND ADOLESCENTS IN INDIA

One of the world's largest deworming public health programs is implemented in India primarily by the Ministry of Health and Family Welfare (MoHFW), Government of India (GOI). Implementation of this is in convergence with various ministries under broader umbrella programs to improve nutrition and anemia status and control STH-related morbidity (27). The GOI targeted deworming programs, starting with deworming children and in the last 15 years, have expanded to include adolescents up to 19 years and women in the reproductive age group of 15-49 years (**Figure 1**). We have charted out the various schemes and stakeholders involved in deworming programs in India and identified the scope for expansion of ongoing programs to plan synergistic STH elimination strategies in the future.

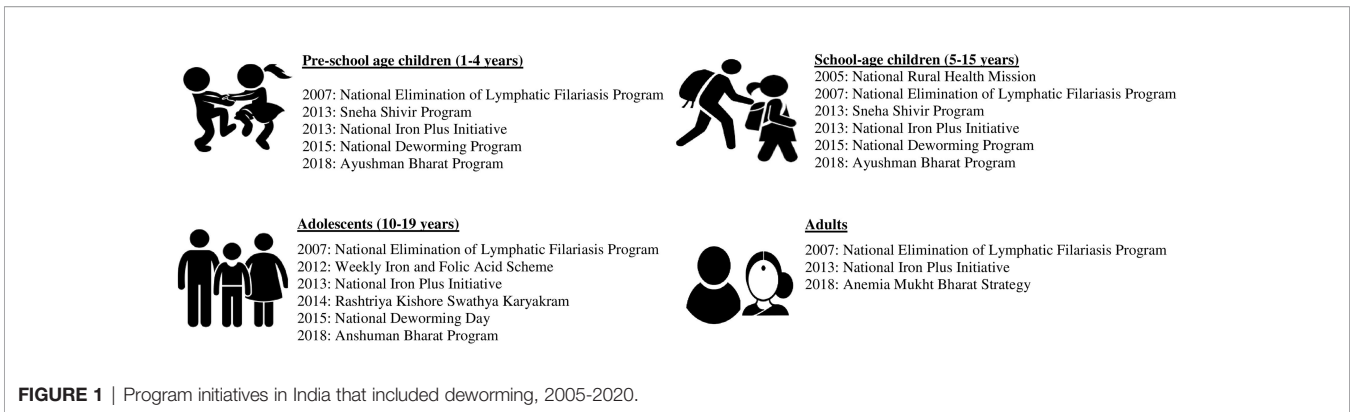
The MoHFW launched the School Health Scheme in 1996-97 to address the health and nutrition needs of children included deworming, and it received fresh impetus under the National Rural Health Mission, 2005 – 2012, as a part of the Reproductive and Child Health Program, which included deworming as one of the key activities along with the provision of other health services¹. The Ministry of Women and Child Development started the Sneha Shivar Program in 2013, which focuses on undernourished children under six years of age through the Integrated Child Development Services (28). This program focused mainly on 200 districts that had a high burden of undernutrition levels. Within the districts, blocks with over 20% level of undernutrition were prioritized. This community-based approach for preventing and managing moderate and severe malnutrition included deworming children, counseling on nutrition and childcare practices, and spot feeding of energy-dense food cooked at the Anganwadi centers.

The Weekly Iron and Folic Acid Supplementation (WIFS) program was launched in 2012 by MoHFW in convergence with the Ministry of Women and Child Development and Ministry of Human Resource Development to reduce the prevalence of anemia in all adolescent girls and boys in the ages 10 – 19 years (29), and it mandated biannual deworming with 400mg of Albendazole with 100mg elemental iron and 500µg folic acid. The strategy was to distribute the tablets to cover 110 million adolescents girls in schools and out-of-school². During the second phase of National Rural Health Mission, 2012-2017, child health and adolescent health received further focus when the MoHFW launched the Reproductive, Maternal, Newborn Child plus Adolescent Health program in 2013, a national program, in convergence with the Women and Child Development and the Ministry of Rural Development as well as in collaboration with various development partners (30). This encompasses biannual deworming children 6-10 years of age and adolescents in the ages 10-19 years with biannual Albendazole as part of the National Iron Plus Initiative. This scheme continued in the Rashtriya Kishor Swasthya Karyakram initiated in 2014 to respond to the health and development requirements of 243 million adolescents (10-19 years) in the country in a holistic manner in convergence with the Ministry of Women and Child Development and Ministry of Youth Affairs and Sports (31). One of the objectives of this program was to reduce malnutrition and iron deficiency anemia in adolescent girls and boys by distributing biannual Albendazole and weekly iron and folic acid.

These efforts converge as the National Deworming Day (NDD) initiative, one of the largest deworming programs of the Government (27). This was initiated in 2015 with an overall objective to control STH infections by biannual deworming of pre-school and school-aged children (1-19 years) using the platform of schools and Anganwadi centers. This program has increased its reach from nearly 89 million children in the first

¹ School Health Program. Accessed May 12, 2021: <http://www.ihatepsm.com/blog/school-health-program>.

² Government of India. Weekly Iron and Folic Acid Supplementation Programme. Accessed May 12, 2021. <https://nhm.gov.in/index1.php?lang=1&level=3&sublinkid=1024&lid=388>.



round of NDD in February 2015 to almost 256 million children receiving Albendazole in the eighth round of NDD in August 2019³. In 2018, as a joint initiative of MoHFW and the Department of School Education & Literacy, Ministry of Human Resource & Development, the School Health Program, which included WIFS and NDD programs, was brought under the Ayushman Bharat Program (32).

DEWORMING PROGRAMS FOR ADULTS IN INDIA

Adult women were included in the deworming program along with children and adolescents in the National Iron Plus Initiative in 2013, which aimed to improve the status of anemia. This national program included deworming women in the reproductive age 15–45 years 400mg of Albendazole (33). Building on the technical and operational evidence from the Weekly Iron and Folic Acid programs and the National Iron Plus Initiative, the Anemia Mukht Bharat Strategy (Anemia Free India program) was designed in 2018, which is the intensified National Iron Plus Initiative, to reduce the prevalence of anemia among children, adolescents and women in the reproductive age group (15-49 years) by 2022 and this also includes deworming all pregnant women once in the second trimester and deworming all women in the reproductive age twice a year (34). This program is implemented at all the health system levels that women come into contact with - ranging from the Village Health and Nutrition Days at the community level to primary, secondary, and tertiary government health centers.

The scope for adult men and women of all age groups receiving Albendazole increased when the National Elimination of Lymphatic Filariasis Program started co-administration of Albendazole with Diethylcarbamazine in 2007 to interrupt transmission of filariasis (35). In this program, 400mg of Albendazole was added for all ages above two years⁴. As of

2017, over a decade, the Lymphatic Filariasis (LF) program covered 256 endemic districts targeting a population of about 630 million spread over 21 states and union territories included Albendazole (36). Of these 256 districts, 94 have cleared the transmission assessment survey, and the program is continuing in 133 districts, with some receiving more than five rounds of treatment, including Albendazole. In 2018, Ivermectin was also added as Triple Drug Therapy in the Accelerated Plan of Elimination of Lymphatic Filariasis, implemented in 21 districts spread across five states⁵. LF programs have a synergistic effect of reducing STH prevalence (37).

WATER, SANITATION, AND HYGIENE PROGRAMS AND STH

A systematic review and meta-analysis of studies from 94 countries, including India, showed a decrease in STH infections associated with improved Water, Sanitation, and Hygiene (WASH) practices (18). Decreased odds of *Ascaris* infection associated with treated water and sanitation facilities were observed in Kenya (38). In contrast, cluster-randomized trials from Odisha and Madhya Pradesh conducted about a decade after the Total Sanitation Campaign launched by GOI in 1999 showed no effect of the increase in sanitation facilities on STH infections (39, 40). The Swachh Bharat Mission or the Clean India Mission of the Ministry of Drinking Water and Sanitation, GOI, launched in 2014, while aiming to improve WASH practices and quality of life, also aims to prevent STH infections and other enteric infections by making communities open defecation free through solid and liquid management activities. Studies show that even in households having a working toilet facility, open defecation by anyone from that household can range from 41% to 66% in some larger states like Bihar, Uttar Pradesh Madhya Pradesh, and

³Government of India. National Health Portal. Accessed November 23, 2021. https://www.nhp.gov.in/national-deworming-day_pg.

⁴Government of India M of H& FW National Vector Borne Disease Control Programme. Accessed May 28, 2021. <https://nvbdcp.gov.in/index4.php?lang=1&level=0&linkid=462&lid=3740>.

⁵Government of India NVBDCP. Elimination of Lymphatic Filariasis. Accessed June 12, 2021. <https://nvbdcp.gov.in/index4.php?lang=1&level=0&linkid=461&lid=3739>.

Rajasthan, indicating that more efforts on behavioral changes and acceptance are required in these communities (41).

GAPS IN COMMUNITY-WIDE DEWORMING

The GOI programs provide an opportunity for all children aged 1-19 years and WRA aged 15-49 years to be dewormed through various programs described above. In addition, the LF program provides an opportunity for adult men above the age of 19 years and women above the ages of 49 years to be dewormed in 133 endemic districts (36). The clear gap in deworming identified are adult men above age 19 years and adult women above 49 years living in non-LF program areas who are not included in any program providing deworming. This is an important gap to address in any program targeting elimination due to the age-intensity profile of hookworm infections which, unlike *Ascaris* and *Trichuris* show higher burden in the adults (42, 43).

DISCUSSION

As the World Health Organization (WHO), in its strategic plan document for STH 2011-2020, called for in-country coordination across ministries to maximize the deworming effort, this scoping exercise shows that GOI is highly committed to addressing STH infections by creating convergence mechanisms across various ministries (20, 21). Over a decade, GOI's has sustained its commitment to deworming with incorporation under various nutrition, anemia reduction, and deworming programs. Albendazole has been the drug of choice in all the deworming activities in GOI's programs and schemes. Efficacy studies conducted in seven countries, including India, showed that even a single dose of Albendazole is effective for STH infections (44).

The WHO NTD Road map 2030 calls for the elimination of STH morbidity in PSAC and SAC and among women in the reproductive age by 2030 (14). In the context of the WHO goal to eliminate STH, the GOI continues to call for collective action across various ministries and makes investments for deworming. Independent coverage surveys of the NDD program based on school reporting forms have shown high coverages in the range of 80-90% in several states (45). The impact of the program on STH prevalence in the PSAC and SAC targeted age group is also being monitored and shown a considerable decrease in prevalence⁶. However, both coverage and impact of deworming programs among women in reproductive age group in India are not reported and require more attention.

Although preventive chemotherapy interventions with Albendazole have reduced STH prevalence, the sustained reduction has not been observed, suggesting reinfection and ongoing transmission (46). Further, greater attention may be required in peri-urban and urban areas of India, which are

estimated to be at increased risk of STH infection due to rapid urbanization and low WASH access (47). For the sustained impact of investments in deworming to prevent STH reinfection and break transmission, cMDA integrated with WASH programs would be needed (18, 23, 24). A WASH-NTD joint strategy is proposed to improve the quality of WASH programs. It is identified as one of the solutions to controlling Neglected Tropical Diseases (NTD), including STH infections (17-20).

Through all its current programs that include Albendazole, children, adolescents, WRA, and all men above the ages of 19 years in the LF districts have the opportunity to get dewormed. The GOI has allocated a budget for these programs to be delivered through schools for children and through frontline health workers in the community. The gap in the program where adults do not have the opportunity to get dewormed are adult men above 19 years and women above 49 years living in non-LF program areas. This age group also has a higher burden of hookworm infections. This is the gap India will need to address if implementing a community-wide MDA to control and eliminate STH. India has the highest STH burden globally, and therefore, it would be of value for GOI to (a) consolidate Albendazole distribution efforts across various health programs and resources allocated, (b) assess the reach of Albendazole distribution to WRA as well as estimate the population not covered by deworming across various health programs, (c) conduct an economic analysis to estimate the cost of additional drug requirement in the timeframe to elimination and cost savings if deworming could be discontinued, (d) identify any missed opportunities for all in the community to get dewormed through the various programs, (e) examine the gains of cMDA for STH elimination compared to the NDD program which is the standard of care, (f) test effectiveness of cMDA on STH prevalence, and (g) consider policy and program revision for STH elimination.

Delivery of community-wide MDA for STH in India is feasible using a two-pronged strategy, the current school-based deworming through NDD programs and community-based deworming through frontline health workers. Community-wide MDA roll-out and evaluation in states with better WASH indicators and ongoing LF programs would have a high probability of demonstrating elimination of STH and could be considered for initial phases. In conclusion, these efforts would be worthwhile due to the high burden of STH in the country as well as the potential to eliminate STH thereby being able to discontinue long running deworming programs.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work, and approved it for publication.

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⁶Government of India. <https://www.pib.gov.in/PressReleaseDetailm.aspx?PRID=1666053>.

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