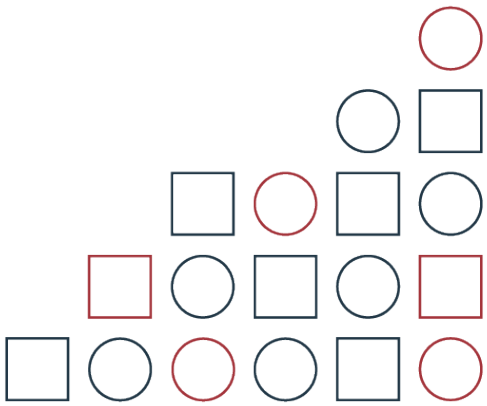
NUTRITION INTERNATIONAL

Nourish Life

FREQUENTLY ASKED QUESTIONS

Preventive Chemotherapy (Deworming) for Soil-Transmitted Helminth Infections Among Adolescents and Women of Reproductive Age

Disclaimer: Nutrition international is not a medical reference agency. Reference to or mention of any medicines in the document are taken verbatim from WHO documents.[1,7]



January 2021

NutritionIntl.org

Table of Contents

Section 1: Soil-Transmitted Helminth (STH) Infection ***4***

1. What are the most common intestinal parasitic worms infecting humans? **4**
2. How do people get infected with worms? How do STH infections spread? **4**
3. What are signs and symptoms of light and heavy STH infections? What are the consequences if STH infections are left untreated? **4**
4. What is the recommended treatment for STH among adolescents? **5**
5. How can STH infections be prevented? Can STH infections be eliminated from a country? **5**
6. How is a prevalence survey for STH conducted? **5**

Section 2: Drug dosage and effects among adolescents ***6***

1. What are the most commonly used drugs for treatment/prevention of STH infection? **6**
2. What is the difference in the protocol for treatment and prevention? **6**
3. Is there any drug which is contraindicated or should not be taken together with deworming? Can albendazole or iron/folic acid tablets be administered together? **6**
4. Is there any diet restriction or which food items should not be consumed during or after deworming? 7
5. What are the side effects of deworming tablets? Are there alternative drugs for pregnant adolescents? 7
6. Are there any contraindications (sickle cell anaemia, menstruation, pregnancy) for deworming treatment? 7
7. What can be done if adolescents complain about the taste of deworming tablets? 7
8. How should the tablets be stored? **8**
9. For how long is deworming effective and can a person get re-infected by STH after deworming? **8**

Section 3: Recommended guidelines and policies: ***8***

1. What is WHO's recommendation on deworming for adolescents? **8**
2. What are the recommended guidelines for pregnant adolescents? What is the available evidence on deworming and its effect on pregnancy? **9**
3. When, and why, should there be mass administration of deworming tablets? **9**
4. What is National Deworming Day? What other national deworming programs exist? **10**

Section 4: Evidence on benefits of deworming among adolescents: ***10***

1. What is the available evidence on deworming and its relation in increasing student performance and attendance at school? Is there any direct effect on IQ levels? **10**
2. What is the available evidence-based research data on the impact of deworming on adolescent health and nutritional status? **10**
3. What is the available evidence to show deworming helps in improving iron levels and reducing anaemia among adolescents? **11**
4. What is the cost effectiveness of deworming intervention in adolescents? **11**
5. What is the effect of deworming on DALYs for the adolescent age group? **11**
6. Are livelihoods affected by deworming? **12**

Section 5: Programmatic questions: ***12***

1. Why engage teachers and frontline workers to distribute the deworming tablets to children and adolescents? **12**
2. What should the teacher do if a student shows adverse reactions to deworming? **12**
3. How can weekly iron folic acid supplementation (WIFAS) and nutrition education be integrated with deworming? **13**

References ***14***

Acknowledgements ***17***

Section 1: Soil-Transmitted Helminth (STH) Infection

1. What are the most common intestinal parasitic worms infecting humans?

The most common intestinal parasitic worms infecting humans are **roundworms** (*Ascaris lumbricoides),* **whipworms** (*Trichuris trichiura)*, and **hookworms** *(Ancylostoma duodenale* and *Necator americanus*). Together, these worms are referred to as the soil-transmitted helminths (STH). In 2017, the World Health Organization (WHO) provided the following numbers of people globally infected with STH on an annual basis: an estimated 820 million people from roundworms; 460 million from whipworms; and 440 million from hookworms.[1] Over 100 countries are endemic for STH, mostly in the tropical and sub-tropical regions of Africa, Asia and Latin America.

2. How do people get infected with worms? How do STH infections spread?

People get infected with worms in areas where sanitation and waste management are inadequate, resulting in fecal contamination of the environment. Feces of infected individuals contain thousands of worm eggs produced by adult female worms in the human intestine. These eggs are excreted through feces and will then go on to contaminate the soil. Infections can't occur from person-to-person contact because the eggs need about three weeks to develop in the soil before they can infect someone.[1]

An individual will become infected when they ingest the eggs, or when the developing larvae become infectious and penetrate the skin. Some examples of ways in which someone could become infected include: (1) consuming a vegetable or fruit that wasn't cooked, washed or peeled and had eggs attached to it; (2) drinking water from contaminated sources; and (3) children touching contaminated soil and putting their hands in their mouths.[2] Roundworms, whipworms, and hookworms cannot multiply in their human host. For an individual to become re-infected, they must come in contact with worm eggs or larvae again in the environment.[1]

3. What are signs and symptoms of light and heavy STH infections? What are the consequences if STH infections are left untreated?

Individuals who have a **light** STH infection will usually have no signs or symptoms. These infections will cause very little, or no, harm to their health if left untreated. On the other hand, individuals who have **moderate** or **heavy** STH infections may exhibit various non-specific signs and symptoms. STH-specific signs and symptoms may develop and intensify over time, if left untreated, as the cumulative number of worms in the intestines increases. The signs and symptoms will vary depending on an individual's state of overall health and nutrition, the species of helminth, the intensity of the infections and if the individual is co-infected with another STH.

Some common signs and symptoms include:[1,2,3]

- Abdominal pain and distention
- Diarrhea or dysentery
- General malaise and weakness
- Malnutrition / nutrition malabsorption
- Nausea and vomiting
- Weight loss
- Fever
- Blood loss in feces
- Rectal prolapse
- Anaemia
- Intestinal ulcers and inflammation
- Pallor / pale appearance
- Allergy and respiratory difficulties

Other consequences associated with STH infection include impairment in an individual's growth and development at different life stages over the lifespan.[1] STH infection can also lead to intestinal obstruction (e.g. caused by a heavy worm burden of *A. lumbricoides*) especially in young children or other intestinal problems (e.g. caused by a heavy worm burden of *T. trichiura*) that may require surgery and can sometimes be fatal.[4]

4. What is the recommended treatment for STH among adolescents?

The recommended treatment for STH infections among adolescents who live in STH-endemic areas is preventive chemotherapy with anthelminthic medicines (i.e. deworming).[1] The World Health Organization (WHO) recommends the single dose medicines **albendazole** and **mebendazole** for large-scale preventive chemotherapy programs. These medicines are easy to administer, inexpensive, and effective.[2] They have both been proven to reduce worm burden and to control associated morbidities when administered regularly (i.e. either once or twice a year, depending on the level of endemicity).[1]

5. How can STH infections be prevented? Can STH infections be eliminated from a country?

STH infections can be prevented in a number of ways. One way is the periodic and targeted administration of **preventive chemotherapy** to at-risk populations on a regular basis. This includes adolescents and women of reproductive age. Preventive chemotherapy has proven to be effective at reducing the worm burden in infected individuals.[1] Other ways include improving **water, sanitation and waste management** infrastructure in communities and providing education on **hygiene practices**. Improving access to facilities for safe human waste disposal is a very effective way of protecting individuals against STH infections. Also, it is less likely for STH infections to be transmitted when communities have access to clean water, use appropriate footwear, and practice handwashing before eating and after defecating.

A combination of these approaches can help prevent, and even eliminate, STH infections from countries.[1]

6. How is a prevalence survey for STH conducted?

STH prevalence is the proportion of individuals in a population who are infected with one or more species of STH.[1] Prevalence surveys are typically organized by government entities (e.g. Ministries of Health), non-governmental organizations, universities, or other institutions. First, a

team of trained individuals collects stool specimens from a representative sample of individuals in a population or community. Once the specimens are collected, they are sent to a laboratory to be examined.[5] In the laboratory, different methods are used to diagnose STH infections. WHO recommends using the **Kato-Katz** method.[5] This consists of examining feces from the stool specimens under a microscope to identify the type and number of eggs per gram of feces. The higher the number of eggs found, the higher the number of adult female worms in an infected individual.[5,6] Once the laboratory tests are completed, the data can be used to calculate the prevalence of STH infection in a population or community.[5]

Section 2: Drug dosage and effects among adolescents

1. What are the most commonly used drugs for treatment/prevention of STH infection?

The most common drugs used to treat and prevent STH infections are **albendazole** and **mebendazole**. Both of these drugs are effective at reducing the worm burden caused by STH. They are also cost-effective and help reduce the morbidity of infected individuals when administered regularly. The current WHO guidelines for preventive chemotherapy recommend both of these medicines.[1] Other medicines used to treat STH infections, that are part of the WHO's Model List of Essential Medicines, are **levamisole** and **pyrantel.**[1,7]

2. What is the difference in the protocol for treatment and prevention?

The protocols for prevention and treatment of STH infections use the same medicines. For prevention, the WHO **preventive chemotherapy** guidelines are intended to reduce the worm burden in an entire at-risk population in as cost-effective a manner as possible. The protocol consists of periodically (i.e. once or twice a year) administering a single dose of either **albendazole (400 mg)** or **mebendazole (500 mg)** to the entire at-risk population (both infected and non-infected individuals). In this situation, after an initial rapid assessment of the level of endemicity in the population, there is no need for individual screening and the entire population receives the preventive chemotherapy.

The treatment protocol for an individual is determined on a case-by-case basis and usually after confirming infection by a positive stool specimen. The treatment is specific to the type of STH infection[1,5] and requires a prescription. The treatment of roundworms, whipworms and hookworms generally consists of administering **albendazole, levamisole, mebendazole**, or **pyrantel** in appropriate dosages and over specified periods of time, following a physician's advice.

3. Is there any drug which is contraindicated or should not be taken together with deworming? Can albendazole or iron/folic acid tablets be administered together?

There are few drug interactions with either **albendazole or mebendazole** and side effects, if they occur, are mild and transient. Large-scale preventive chemotherapy (deworming) programs may be administered together with vitamin A supplements, iron (or iron and folic acid) tablets,

praziquantel (in schistosomiasis-endemic areas), malarial drugs (in malaria-endemic areas), or other public health interventions, as determined by the local Ministry of Health.

4. Is there any diet restriction or which food items should not be consumed during or after deworming?

There are no diet restrictions or food items that should not be consumed during or after deworming with **albendazole** and **mebendazole**. These medicines can be mixed with foods or liquids for administration.[8,9]

5. What are the side effects of deworming tablets? Are there alternative drugs for pregnant adolescents?

Albendazole and mebendazole are safe and well-tolerated medicines used to treat and prevent STH infections in adolescents and women of reproductive age. Some side effects from the deworming medicines have been reported; however, these are usually mild and transient and last less than 48 hours.[1] Symptoms[1,10,11,12] may include:

- stomach pain
- gastrointestinal discomfort
- headache
- nausea
- dizziness
- edema
- muscle pain
- vomiting

There are no other specific treatments or alternate drugs recommended for STH infections in pregnant adolescents. However, WHO recommends that neither medicine be administered to any pregnant woman in her first trimester of pregnancy.[1] Treatment can be delayed until the second or third trimester of pregnancy or administered in the postpartum period.

6. Are there any contraindications (sickle cell anaemia, menstruation, pregnancy) for deworming treatment?

There are no contraindications for adolescents and women of reproductive age who are menstruating or who have sickle cell anaemia. They can fully participate in deworming programs. Adolescents who are in their first trimester of pregnancy should not receive preventive chemotherapy for STH, instead delaying treatment until later in pregnancy or after pregnancy. If a first trimester pregnancy cannot be ruled out, then treatment should be delayed.[1]

7. What can be done if adolescents complain about the taste of deworming tablets?

If adolescents complain about the taste of deworming tablets, various strategies can be used to help the palatability of the medicine. Clean water can be administered along with the medicine. Additionally, managers of large-scale deworming programs may be able to offer albendazole and mebendazole in different formats. Some tablets can be chewed, swallowed whole, or crushed. Flavoured medicines may be available (e.g. for **albendazole**: orange, vanilla, and passion fruit (tablets and suspension),[13] **mebendazole:** orange (tablets), chocolate (chewable

tablets), and banana (suspension)[14]), but these are costly and usually are not able to be purchased within the budgets of deworming programs.

8. How should the tablets be stored?

Albendazole and mebendazole tablets should be stored in a tightly closed container[8,9] and in a dry place that is protected from light.[13,15] The storage temperature should be between 20°C and 25°C (68°F and 77°F) for albendazole[16] and between 15°C and 30°C (15°F to 86°F) for mebendazole.[15] Temperature should not exceed 30°C (86°F).[13,15]

9. For how long is deworming effective and can a person get re-infected by STH after deworming?

Deworming can either cure an infection or reduce the intensity of infection (i.e. the number of worms in the intestines). This means that an infected individual can either become uninfected after treatment or remain infected (but with a lower worm burden) after treatment. Either result will reduce any morbidity caused by the worms. An individual living in an endemic area is continually at risk of being re-infected, even the day after treatment. Re-infection reflects both the individual's underlying vulnerability to new infection (e.g. level of malnourishment, level of immunological susceptibility, among other conditions) and opportunities to be exposed to the parasite's infective stages (i.e. eggs and larvae).

It is important to combine preventive chemotherapy with improvements in water, sanitation and waste management infrastructure, in addition to education on hygiene practices, to help reduce the re-infection rate.[1]

Section 3: Recommended guidelines and policies:

1. What is WHO's recommendation on deworming for adolescents?

WHO recommends that all **non-pregnant adolescent girls** (10 to 19 years old) and **non-pregnant women** (15 to 49 years old) living in areas where the baseline prevalence of STH infection is **20% or higher** receive preventive chemotherapy. This includes individuals who are infected with HIV/AIDS.[1,17]

Deworming treatments consist of a **single dose** of either: **albendazole** (400 mg) or **mebendazole** (500 mg). Treatment should be provided annually or biannually depending on the baseline prevalence of infection. Biannual treatments should be given in areas where the baseline prevalence is **above 50%**.[1]

It is also recommended that school-age adolescent boys (usually those up to 14 years of age), living in at-risk areas, receive preventive chemotherapy. Thereafter, adolescent boys may receive preventive chemotherapy for STH infections if their occupation presents an important STH health risk such that the employer offers a deworming program to its employees.

2. What are the recommended guidelines for pregnant adolescents? What is the available evidence on deworming and its effect on pregnancy?

WHO recommends that all **pregnant adolescents** (10 to 19 years old) receive preventive chemotherapy **after their first trimester,** if they live in areas meeting the following criteria: (1) the baseline prevalence of **hookworm** and/or **whipworm** infection is **20% or higher;** and (2) the prevalence of **anaemia** is **40% or higher** among pregnant women.[1]

Preventive chemotherapy has been found to effectively decrease worm burden in pregnant women. These treatments have proven to be safe during pregnancy, with no additional adverse effects noted on newborn birth weight or perinatal mortality.

Providing preventive chemotherapy to pregnant adolescents should be done with extra caution because the trimester of pregnancy might not be known. Some policymakers may choose not to administer these medicines during pregnancy for various reasons. These include: (1) in cases where a woman's stage of pregnancy is unclear; and (2) in regions where there are high rates of unplanned pregnancies and very low prenatal care coverage. Service delivery should be tailored for each region.[1]

3. When, and why, should there be mass administration of deworming tablets?

Mass administration of deworming tablets may be an effective and cost-effective way of treating an entire population at risk in endemic areas. It should be used in regions where the baseline prevalence of infections is **20% or higher.** The reason for this is that the prevalence of STH infection relates to the intensity of infections. In areas where the prevalence of infections is below 20%, the intensity of infections is expected to be mild and associated with low, or no, morbidity. On the other hand, in areas where the prevalence is 20% or higher, a certain proportion of infections are expected to be moderate or heavy and associated with higher morbidity. By implementing preventive chemotherapy for STH using a mass drug administration (MDA) approach, the entire population will be treated, dramatically reducing the worm burden in infected individuals and reducing the overall prevalence in the population to a low level.[1]

It is important to keep in mind that mass administration of deworming tablets alone will reduce the overall STH prevalence in a population only temporarily. Therefore, periodic deworming is required to maintain health benefits. To achieve a more sustainable reduction in prevalence and intensity of infection, efforts to improve sanitation and waste management and to promote hygiene education must also be undertaken. In this way, the cycle of STH transmission can be interrupted.

In areas where lymphatic filariasis is endemic, regular annual doses of albendazole are given to the whole community. When these programmes phase out, some protection from the mass drug administration of albendazole will be removed, highlighting the need for new approaches.

4. What is National Deworming Day? What other national deworming programs exist?

National Deworming Day is a government-led national campaign to mobilize a country's resources around providing deworming medicines to its at-risk populations. Initially, National Deworming Days targeted school-age children, including adolescents, but other high-risk groups (i.e. preschool-age children and women of reproductive age), and even entire communities, are now included in some countries.

As early as 2007, Ghana initiated a national school-based deworming program which continues today. Many other countries now have policies and programs in place to implement nation-wide deworming programs. Countries report the numbers at risk, and those treated, to WHO on an annual basis. In 2018, based on these reports, the WHO Databank for STH listed over one billion children living in 97 endemic countries where preventive chemotherapy for STH infection was required.

Section 4: Evidence on benefits of deworming among adolescents:

1. What is the available evidence on deworming and its relation in increasing student performance and attendance at school? Is there any direct effect on IQ levels?

There is currently limited evidence on the effects of deworming specifically on **adolescent** student performance, attendance and IQ. Recent studies have examined the topic for **school-age children** overall. This evidence is also mixed, and sometimes contradictory, with some studies reporting benefits while other studies do not. Some of the controversy has resulted from methodological differences and limitations in performing the studies such that no overall appreciation of effect can be ascertained. However, what is clear is that treatment does reduce the prevalence and intensity of the worm infections and some studies with large enough sample sizes and rigorous methodology have been able to associate this reduction with health and educational benefits.

2. What is the available evidence-based research data on the impact of deworming on adolescent health and nutritional status?

STH infections can impact nutritional status in various ways. One review found that STH infections impact child growth rates, nitrogen balance, and intestinal transit. Infections were also found to impair vitamin A absorption, lactose digestion, and fat digestion. Some STH infections lead to iron deficiency anaemia.[18,19] Furthermore, STH have also been reported to lead to a loss of appetite which reduces nutritional intake. These findings demonstrate that STH infection impairs the body's ability to obtain and utilize the nutrients it needs to maintain good health, leading to malnutrition. As a result, there is an impact on child growth and development.[2] It has also been found that, when the prevalence of STH infection is 50% or higher, deworming treatment can lead to significant improvements in weight gain and height. However, it has also been highlighted that deworming alone is not sufficient to enable adequate growth and development. Extra nutrients and energy need to be provided to children after deworming to

allow “catch-up” growth.[19] Specific evidence related to the impact of deworming on adolescent health, nutrition and education is a research gap and needs to be addressed.

3. What is the available evidence to show deworming helps in improving iron levels and reducing anaemia among adolescents?

Hookworms and whipworms feed on the blood of their human host, leading to blood and iron losses.[2] This is of concern for adolescents and women of reproductive age who have increased iron requirements because of menstruation, growth spurts,[20] and pregnancy.[21] Hookworm infection can lead to anaemia in women of reproductive age. Even relatively light hookworm infections in pregnant women can significantly lower haemoglobin levels.[22] It has also been found that, as infection intensity increases, haemoglobin levels decrease.[22,23]

These effects have not routinely been observed in studies of **non-pregnant** adolescents and women of reproductive age. Part of the explanation lies in studies being conducted in countries having different levels of STH endemicity, especially with respect to hookworm and whipworm infections, so that direct comparisons cannot be made. Also, it should be noted that **pregnant** women, in general, are anaemic in their third trimester, whether they have received deworming treatment during pregnancy or not.[1] Care should be exercised in reviewing such studies as deworming programs are implemented in populations having both infected and uninfected individuals. If the proportion of uninfected individuals is large, then this will result in a dilution of effect for the population as a whole.[1,24]

4. What is the cost effectiveness of deworming intervention in adolescents?

Preventive chemotherapy interventions targeting at-risk populations are the most cost-effective approach to treat STH infections. First, it costs more to screen and treat an individual than to treat without screening through a preventive chemotherapy deworming program. Second, it is more cost-effective to treat individuals in communities with a higher prevalence of infection than in communities with lower prevalence of infections. Some countries (e.g. India, Peru, Sri Lanka) include deworming within routine preventive interventions during pregnancy. Cost estimates regarding the expansion of deworming programs to include adolescents and women of reproductive age are currently being developed.

5. What is the effect of deworming on DALYs for the adolescent age group?

Disability-adjusted life years (DALYs) is a comprehensive metric combining information on both morbidity and mortality.[25] It is calculated as the sum of years lived with disability and years of life lost prematurely. In 2013, it was estimated that STH infections in children under 15 years of age resulted in 1.46 million DALYs.[26] Between the years 2021 and 2030, deworming programs are expected **to prevent** 119.5 million DALYs globally.[25] In order to provide accurate epidemiological information on the impact of deworming, WHO and other data collecting organizations are promoting the reporting of age and sex disaggregated data. These data will be helpful in understanding the impact of deworming on adolescents and can be used to inform future intervention programs and platforms.

6. Are livelihoods affected by deworming?

Deworming programs have the potential to improve the livelihood of adolescents and women of reproductive age. Country-specific research has documented increased productivity following deworming.[27] Beginning during the second year of life and continuing into adulthood, in many endemic countries, periodic deworming is implemented as a public health intervention which aims to reduce the morbidity and mortality of children and improve overall health and productivity.

Section 5: Programmatic questions:

1. Why engage teachers and frontline workers to distribute the deworming tablets to children and adolescents?

The WHO-recommended single dose medicines – albendazole (400 mg) and mebendazole (500 mg) – are effective and easy to administer by non-medical personnel (e.g. teachers).[28] Teachers and frontline workers need minimal training: 1) to understand the rationale for deworming; 2) to learn how to administer the tablets (and monitor any side effects, if present); and 3) to keep a record of their distribution. Schools provide a ready platform for deworming programs targeting preschool-age and school-age children. Parents, teachers and the children themselves actively participate in 'deworming days' in the school. Teachers and community-based health workers have been successfully deworming children in many countries worldwide, over decades.

2. What should the teacher do if a student shows adverse reactions to deworming?

Side effects to deworming are rare and, if present, usually mild and transient. It may also be that a child/adolescent has other medical condition(s) which contribute to an apparent side effect. Children who experience discomfort or other side effect should be given clean water to drink and be permitted to rest in the shade until able to resume normal activities. If symptoms do not resolve in a timely manner, the child/adolescent may need to be taken to a health facility. The school principal and teachers involved in the deworming program should have on hand the exact ways in which local Ministry of Health representatives can be contacted should medical advice need to be sought. The local Ministry of Health representatives are usually aware of the day on which the deworming tablets will be distributed in the district schools as they have provided the deworming tablets to the schools. Consideration should be given to administering the deworming tablets to the children/adolescents early in the school day, so that reporting can be completed, and any side effects observed before the end of the school day.

3. How can weekly iron folic acid supplementation (WIFAS) and nutrition education be integrated with deworming?

In several countries, in-school and out-of-school adolescent girls receive weekly iron/folic acid tablets through schools and outreach health centers with the help of teachers and community-based frontline health workers. Adolescent girls can be reached with deworming services through the same platforms and service providers. Also, deworming related messages can be included in the WIFAS and nutrition education sessions, behavior change intervention materials and other mass media activities. Schools provide a particularly effective entry point for deworming activities, as they allow the easy provision of the health and hygiene education component, such as promotion of handwashing and improved sanitation.[2]

References

1. World Health Organization. (2017). Guideline: preventive chemotherapy to control soil-transmitted helminth infections in at-risk population groups. Geneva. License: CC BY-NC-SA 3.0 IGO. Retrieved from https://apps.who.int/iris/bitstream/handle/10665/258983/9789241550116-eng.pdf?sequence=1

2. World Health Organization. (2020). Soil-transmitted helminth infections. Retrieved from https://www.who.int/news-room/fact-sheets/detail/soil-transmitted-helminth-infections

3. Baron, S. (1996). Chapter 90 – Enteric Nematodes of Humans. Medical Microbiology (4th edition. Retrieved from https://www.ncbi.nlm.nih.gov/books/NBK8261/

4. Uysal, E., and Dokur, M. (2017). The Helminths Causing Surgical or Endoscopic Abdominal Intervention: A Review Article. Iran J Parasitol. 12(2): 156-168. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5527025/

5. Montresor, A., Crompton, D., Hall, A., Bundy, D., and Savioli, L. (1998). Guidelines for the evaluation of soil-transmitted helminthiasis and schistosomiasis at community level. Geneva: World Health Organization. Retrieved from https://apps.who.int/iris/bitstream/handle/10665/63821/WHO_CTD_SIP_98.1.pdf?sequence=1

6. Katz,N., Chaves, A., Pellegrino, J. (1972). A simple device for quantitative stool thick-smear technique in *Schistosomiasis mansoni*. Revista do Instituto de Medicina Tropical de Sao Paulo, 14(6), 397-400. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/4675644

7. World Health Organization. (2019). WHO Model List of Essential Medicines (21st Edition). Retrieved from https://www.who.int/medicines/publications/essentialmedicines/en/

8. The International Pharmacopoeia. (2017). Mebendazole chewable tablets (Mebendazoli compressi manducabili). Retrieved from https://apps.who.int/phint/en/p/docf/

9. The International Pharmacopoeia. (2015). Albendazole Chewable tablets (Albendazoli compressi manducabili). Retrieved from https://apps.who.int/phint/en/p/docf/

10. World Health Organization. (1995). Abendazole. WHO Model Prescribing Information: Drugs Used in Parasitic Diseases – Second Edition. Retrieved from https://apps.who.int/medicinedocs/en/d/Jh2922e/3.2.1.html

11. World Health Organization. (1995). Mebendazole. WHO Model Prescribing Information: Drugs Used in Parasitic Diseases – Second Edition. Retrieved from https://apps.who.int/medicinedocs/en/d/Jh2922e/3.2.3.html#Jh2922e.3.2.3

12. World Health Organization. (1999). WHO Model Prescribing Information: Drugs Used in HIV-Related Infections. Retrieved from https://apps.who.int/medicinedocs/en/d/Js2215e/9.2.html#Js2215e.9.2

13. GlaxoSmithKline. (2018). ZENTEL – Albendazole Tablets IP / Albendazole Oral Suspension IP. Retrieved from https://india-pharma.gsk.com/media/701423/zentel.pdf

14. New Zealand Medicines and Medical Devices Safety Authority. (2018). New Zealand Data Sheet – Vermox. Retrieved from https://www.medsafe.govt.nz/profs/Datasheet/v/Vermoxtabsusp.pdf

15. Jassen Pharmaceuticals. (2019). Product Monograph – Vermox. Retrieved from https://pdf.hres.ca/dpd_pm/00050288.PDF

16. GlaxoSmithKline. (2009). ALBENZA (albendazole) Tablets. Prescribing Information. Retrieved from https://www.accessdata.fda.gov/drugsatfda_docs/label/2009/020666s005s006lbl.pdf

17. St-Denis K, Blouin B, Rahme E, Casapia M, Montresor A, Mupfasoni D et al. Ruling out early trimester pregnancy when implementing community-based deworming programs. PLOS Negl Trop Dis 2020;14(1):e0007901. Retrieved from https://journals.plos.org/plosntds/article?id=10.1371/journal.pntd.0007901

18. Crompton, D. (1986). Nutritional aspects of infection. Transactions of the Royal Society of Tropical Medicine and Hygiene, 80, pp.697-705. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.917.9121&rep=rep1&type=pdf

19. 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 and Child Nutrition,* 4, pp. 118-236. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/18289159

20. Beard, J. (2000). Iron requirements in adolescent females. Journal of Nutrition, 130(2), pp: 440S-442S. Retrieved from https://academic.oup.com/jn/article/130/2/440S/4686455

21. Institute of Medicine Committee on Nutritional Status During Pregnancy and Lactation. (1990). Nutrition During Pregnancy – Part II Nutrient Supplements. Washington (DC): National Academies Press. Retrieved from https://www.ncbi.nlm.nih.gov/books/NBK235217/

22. Brooker, S., Hotez, P., and Bundy, D. (2008). Hookworm-Related Anaemia among Pregnant Women: A Systematic Review. PLoS Neglected Tropical Diseases, 2(9), e295. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2553481/

23. Smith, L. and Brooker, S. (2010). Impact of hookworm infection and deworming on anaemia in non-pregnant populations: a systematic review. Tropical Medicine and International Health, 15(7), pp. 776–95. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/20500563#

24. World Health Organization. (2017). Reaching girls and women of reproductive age with deworming. Report of the WHO Advisory Group on deworming in girls and women of reproductive age. Italy: Bellagio. Retrieved from https://apps.who.int/iris/bitstream/handle/10665/259962/WHO-CDS-NTD-PCT-2018.01-eng.pdf;jsessionid=E0D3087EF18DE13168F360662DA3F1C8?sequence=1

25. World Health Organization. (2017). Crossing the Billion. Lymphatic filariasis, onchocerciasis, schistosomiasis, soil-transmitted helminthiases and trachoma: preventive chemotherapy for neglected tropical diseases. Geneva. License: CC BY-NC-SA 3.0 IGO. Retrieved from https://apps.who.int/iris/handle/10665/255498

26. Bundy, D., Silva, N., Horton, S., Jamison, D., and Patton, G. (2017). Chapter 13-Mass Deworming Programs in Middle Childhood and Adolescence. Child and Adolescent Health and Development – 3rd edition, Washington (DC): The International Bank for Reconstruction and Development /The World Bank. Retrieved from https://www.ncbi.nlm.nih.gov/books/NBK525254/

27. Salmon, M., Salmon, C., Masoda, M., Salumu, J., Bozzi, C., NIelburg, P., Harrison, L., Humphries, D., Uvon, N., Wendet, S., Trout, C., and Cappello, M. (2018). Albendazole Treatment Improves Work Capacity in Women Smallholder Farmers Infected with Hookworm: A Double-Blind Randomized Control Trial. American Journal of Tropical Medicine and Hygiene, 98(5), pp.1419-1426. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/29611504

Acknowledgements

Expert review by:

Dr. Theresa W. Gyorkos, PhD
Director, WHO Collaborating Centre for Research and Training in Parasite Epidemiology and Control, Department of Epidemiology, Biostatistics and Occupational Health, McGill University;
Member of the CNNTD
Email: theresa.gyorkos@mcgill.ca

Dr. Alison Krentel, PhD MSc BA
Assistant Professor
Scientist, Bruyère Research Institute;
Member of the CNNTD
Email: AKrentel@bruyere.org

Mandana Arabi, MD, PhD
Vice-President, Global Technical Services and Chief Technical Advisor
Nutrition International
Email: marabi@NutritionIntl.org

CN NTD

The Canadian Network for NTDs is a network of interested Canadian individuals and organizations who aim to mobilize Canadian action to end suffering from NTDs. We thank them for their support in producing this document.