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## Deworming Children Brings Huge Health and Development Gains in Low-Income Countries

The infections caused by roundworms, whipworms, and hookworms—known as helminth infections—afflict more than 1 billion people worldwide and are responsible for 150,000 deaths annually. The worms impair the hosts far more often than they kill them: They exacerbate iron deficiency in pregnant women and can thwart the physical growth and educational advancement of children. The severe anemia caused by the infections results in disability, pain, and undernutrition, thereby reducing the contributions that infected individuals can make to their communities and economies.

Three major interventions can reduce or eliminate helminth infections. The first, deworming for intestinal worms, requires only one tablet per person that can be given by school teachers or other nonmedical personnel, making it the most practical and cost-effective strategy. In addition, improved sanitation and health education make up part of a broader program to reduce the causes and consequences of helminth infections. The benefits of all three interventions extend well beyond reducing the worm burden in individuals. They improve health and sanitation overall in a community and contribute to higher educational attainment, labor force participation, productivity, and income.

### What Are Helminth Infections?

There are four common types of intestinal helminths: roundworm, whipworm, and two types of hookworms. They are transmitted through soil and become parasites in the intestines of the host individual, thereby causing disease due to blood loss. Helminths are mostly concentrated in low-income communities where hygiene and sanitation are poor, including in Latin America, China and East Asia, and Sub-Saharan Africa. Infections in developing regions are extremely widespread, amounting to more than 1 billion cases.<sup>1</sup>

A related disease, schistosomiasis, is caused by parasites found in water. The eggs of the parasite are transmitted

indirectly through snails and are deposited in blood vessels surrounding the bladder or intestines. Schistosomiasis of the bladder is mainly seen in Africa, while the intestinal form occurs more commonly in the Middle East, South America, and Africa. A few species are also found in Central Africa, Cambodia, and Laos. Worldwide, schistosomiasis is estimated to affect 207 million people.

### Who Is Likely to Have the Infections?

People most at risk of helminth infections are those who:

- Are involved in subsistence farming (commonly associated with hookworm infection).
- Have frequent contact with water (associated with schistosomiasis).
- Live in poor rural areas or urban slums, where households lacking safe water and sanitation are clustered.
- Live in warm and moist climates that are hospitable to worms and parasites.

Worms tend to be highly concentrated in certain areas and among sub-groups of people. As a rule, 20 percent of the host population harbors about 80 percent of the worm population. These people also tend to become reinfected after they are treated. Heavily infected individuals are at high risk of malnutrition, and they are also the source of environmental contamination for other people, because the worms are passed on through feces.

### Health Effects and Other Consequences of Infections

Helminth infections are the most prevalent of all infections in people living in developing countries. But because worms and parasites rarely kill their hosts, mortality data provides only limited evidence of their health impact. Estimates

of disability-adjusted life years (DALYs) lost portray a more accurate picture of the disease burden caused by the infections.<sup>2</sup>

Estimates of DALYs lost differ greatly from one source to another. Because more than 1 billion people are infected, small differences in estimation techniques result in large differences in the burden of disease estimates. Total DALYs lost annually may range from 4.7 million to 39 million. The higher figure would place helminths close to major diseases such as tuberculosis, malaria, and measles.

The health consequences of helminth infections are far-reaching:

- All infected individuals suffer some degree of chronic disability, including anemia, chronic pain, diarrhea, inability to exercise, and undernutrition.
- Pregnant women with severe anemia are more likely to have premature births, babies with low birth weight, and impaired lactation.
- Pre-school and school-age children experience less physical growth, decreased physical fitness, and lower cognitive skills.

Consequences extend well beyond the health effects, because children with impaired cognitive skills have lower school enrollment, attendance, and graduation rates. Additionally, because educational attainment affects the jobs that children acquire later in life, the long-term effects of helminth infections include lower work productivity and lower family income. Limitations in physical growth can also affect economic well-being. Studies have shown that height affects participation in the labor force and the wage-earning capacity of both women and men.<sup>3</sup>

## Cost-Effective Interventions to Reduce Infections

### DRUG TREATMENT (DEWORMING)

Periodic deworming in high-risk groups can ensure that the levels of infections are kept below those associated with ill health. Because reinfection typically occurs, deworming needs to be repeated about once per year, or two to three times per year in highly infected areas. Deworming often results in immediate improvements in child health and development, and because it is also inexpensive (as shown in

the table), it is the most cost-effective approach to reducing ill health associated with helminths.

### DELIVERY COSTS FOR A SINGLE MASS TREATMENT OF DEWORMING DRUGS

STRATEGY	COUNTRY	DELIVERY COST PER TREATMENT IN US\$
Mobile team	Nigeria	\$0.32
	Tanzania	\$0.21
Delivery in schools	Ghana	\$0.04
	Tanzania	\$0.03
Out-of-school children	Egypt	\$.016-0.21

**Note:** The drugs used in these examples were Levamisole, Albendazole, and Praziquantel, either alone or in combination depending on the treatment strategy. The cost of the drugs adds about \$0.01 to \$0.02 to the cost per treatment.

**Source:** Guyatt, H.L. 2003. "The Cost of Delivering and Sustaining a Control Programme for Schistosomiasis and Soil-Transmitted Helminthiasis." *Acta Tropica* 86: 267-74.

Periodic deworming is the recommended course of action in areas where infections are intensely transmitted and health resources are limited. Drug treatment can be administered in several ways: to a whole population without regard to people's characteristics (also known as mass drug treatment); to everyone in targeted communities without identifying who is infected; or to people who are diagnosed with or show signs of an infection.

The best delivery strategy depends on how widespread the infections are in the communities concerned. WHO recommends the second approach described above, in which individuals living in targeted, high-risk communities are treated regardless of their infection status. This strategy is justified both because deworming drugs are simple and safe to deliver and because diagnosing individuals is costly.

School-age children have the highest intensity of worm infection of any age group; thus, regular deworming of children in schools is a highly cost-effective strategy. Teachers need only a few hours of training to understand the rationale for deworming and to learn how to give out the pills and keep a record. Delivering the drugs in schools takes advantage of existing infrastructure, making it more cost-effective than distributing drugs through mobile clinics or to out-of-school children (see table and box).

## DEWORMING IN SCHOOLS IN GHANA AND TANZANIA PROVES SUCCESSFUL

In 1999, the London-based Partnership for Child Development (PCD) evaluated the delivery of deworming drugs to children in schools in Ghana and Tanzania. Their principal findings were:

- Deworming children through the simple distribution of tablets has the potential to improve children's health and educational achievement, especially for those worst affected and most disadvantaged children.
- Delivering services through schools is efficient and cost-effective. There is widespread support in schools and communities for teachers to play a role in providing services, as long as the procedures are simple, safe, and familiar.
- Providing health services in schools does not require long or complex training, nor does it add significantly to teachers' or administrators' workloads.
- Delivering services through schools should not require any additional infrastructure as long as the existing school system functions well.

The evaluation also highlighted the need for deworming to be carried out in the context of a broader school health program, including activities such as providing safe water, sanitation, and health education, as well as maintaining nondiscriminatory health practices.

School-based distribution does not eliminate the need for other modes of delivery, however. In vulnerable communities, women of reproductive age and children not attending school are still at risk and may need deworming drugs, which could be offered along with other health services.

### IMPROVED SANITATION

When improvements in sanitation are made alongside deworming, the results obtained last longer. Adequate sanitation removes the underlying cause of communicable diseases and benefits communities beyond eliminating worms and parasites. But the investment in sanitation needed to interfere with the transmission of helminths may be high. Improving hygiene is a huge undertaking that requires the cooperation of society as a whole.

### HEALTH EDUCATION

Increasing people's health awareness is always beneficial, but its effectiveness in reducing the transmission of worms is unclear. Few studies have measured the effects of health education on helminth infection rates or determined the cost-effectiveness of this approach in isolation. Nevertheless, health education builds trust and engages communities and therefore can be critical to the success of public health initiatives.

## Large Payoffs From Reducing Helminth Infections

The health, educational, and economic consequences of helminth infections can be avoided through early intervention to treat the infections, particularly in women of reproductive age and children. Studies of pregnant women showed that deworming treatment reverses anemia and improves birth weight and child survival. In preschool children, use of deworming drugs can improve motor and language development and reduce malnutrition. Treating children of school age improves their nutritional status, physical fitness, appetite, growth, and intellectual development.

A study in Kenya showed that deworming children reduced primary-school absenteeism by at least one-fourth in the first two years of the project. The gains were largest among young children, who suffered the most intense worm infections. In terms of cost-effectiveness as an educational intervention, deworming proved to be far more effective at improving school attendance than other educational interventions.<sup>4</sup> Additionally, because education has a high return on investment, deworming offers large payoffs.

## Prospects for the Future

In 2001, the World Health Assembly called for the regular deworming of hundreds of millions of children over the next several decades. The obstacles to achieving this are

substantial and depend in large part on whether countries have reliable and sustainable systems for delivering deworming drugs. A focus on using school systems may be key to achieving the worldwide goal. However, preschool and out-of-school children and pregnant women risk remaining untreated. Regular treatment for these groups is less cost-effective because it cannot “piggyback” on school systems, but the treatment is still badly needed.

Scientists are still investigating the possibility of a vaccine (some are in early stages of development now) and whether resistance to deworming drugs will emerge. Until new technologies become available, deworming of school-age

children remains the most practical and effective means of controlling worms in the developing world.

### For More Information

Hotez, Peter J., Donald A.P. Bundy, Kathleen Beegle, et al. 2006. “Helminth Infections: Soil-Transmitted Helminth Infections and Schistosomiasis.” In *Disease Control Priorities in Developing Countries*, 2nd ed., ed. D. T. Jamison, J. G. Breman, A. R. Measham, G. Alleyne, M. Claeson, D. B. Evans, P. Jha, A. Mills, and P. Musgrove, 467-82. New York: Oxford University Press.

### References

1. Hotez, P., Paul J. Brindley, Jeffrey M. Bethony, et al. 2008. “Helminth Infections: The Great Neglected Tropical Disease,” *The Journal of Clinical Investigation* 118 (4): 1312.
2. disability-adjusted life year (DALY) is a composite measure that combines the number of years lived with a disability and the number of years lost to premature death.
3. Thomas, D. and J. Strauss. 1997. “Health and Wages: Evidence on Men and Women in Urban Brazil.” *Journal of Econometrics* 77: 159-85.
4. Miguel, E.A. and M. Kremer. 2003. “Worms: Identifying Impact on Education and Health in the Presence of Treatment Externalities.” *Econometrica* 72 (1): 159-217.