

Treating women subsistence farmers for intestinal worms improved fitness and could boost food production

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A new study in the Democratic Republic of Congo (DRC) found that treating women subsistence farmers with just a single dose of a cheap deworming medication significantly improved their physical stamina for the grueling agriculture work needed for their family's survival. The results of treatment could be twofold: improved health for farming women and increased food production by women who have the stamina to farm more efficiently.

The finding, published today online in the *American Journal of Tropical Medicine and Hygiene*, spotlights whether women of child bearing age—who may be especially vulnerable to the harmful effects of an intestinal parasite called [hookworm](#)—should be included in mass drug treatment campaigns targeting the infections, which are acquired from contact with soil contaminated with human sewage. These intestinal worms feed on blood and cause chronic anemia.

More than 500 million people in the world are estimated to be infected with hookworm, according to the U.S. Centers for Disease Control and Prevention. Pharmaceutical companies have provided at low-cost or donated billions of doses of the anti-hookworm drug albendazole in low-income countries where disease is endemic. But [public health](#) campaigns currently target school-age children, for whom hookworms contribute to stunting and learning impairments that have lifelong consequences

"We found that when women farmers infected with hookworms received just one 400 milligram dose of albendazole, their overall physical fitness improved significantly, which could greatly improve their ability to do the hard work required to grow food for their families," said the study's lead author Margaret Salmon, MD, MPH, an emergency medicine specialist and Director of InnovationsCZ, a nonprofit dedicated to improving the lives of people in conflict areas through innovation and technology transfer. "This beneficial effect could be especially important in the food challenged regions of Africa, where a large portion of farmers are women and their physical capacity for growing crops and tending to livestock can determine whether their families eat or go hungry."

The study reports that after treatment with albendazole, infected women farmers who live and work in a region where many struggle to get enough to eat saw their heart rates drop by about 10 beats per minute when doing a simple exercise test. The researchers noted that, in the world of sports medicine, the ability to accomplish an exercise task like running on a treadmill at a lower heart rate is considered a good measure of improved aerobic capacity.

"We think the lower heart rates we observed are also a good indication of an increased capacity for the physical demands of farm labor," said Michael Cappello, MD, a Professor of Pediatrics, Microbial Pathogenesis, and Public Health at the Yale School of Medicine and co-author of the study. "It's all the more impressive because the women who tested positive for infection had a relatively low level of hookworms and were not more anemic than those who were uninfected."

'Agricultural anemia'

Hookworms do their damage by chewing and tearing blood vessels in the intestines and then drinking the blood that spills from them. This blood

loss can contribute to iron deficiency and anemia. Poor women of childbearing age are seen as particularly vulnerable due to the blood loss they already experience from menstruation and, if pregnant, from the demands of the fetus. Cappello's research team at Yale has also linked hookworms to inflammation in the intestines and interference with natural digestive enzymes, which he said may contribute to malnutrition and lead to other maladies.

Cappello notes that the observation that women who registered improvement in the study had relatively light infections could indicate that these other effects of hookworm—the inflammation and impaired digestion—inflict serious harm as well, and can be triggered by even a low level of hookworms in the gut.

In an editorial accompanying the study, former ASTMH President Peter Hotez, MD, PhD, FASTMH, Dean of the National School of Tropical Medicine at Baylor College of Medicine, noted that such stark evidence of hookworms impairing the work capacity of women farmers supports what researchers have casually observed in the field for years. For example, he said some researchers have used the term "agricultural anemia" to describe how co-infections with malaria and hookworm, both of which are common in rural Africa, appear to be especially burdensome for the poor smallholder (small-scale) family farmers who produce most of the food in the region.

The study from the DRC "reinforces the removal of hookworms from the human intestine as a potent antipoverty measure," Hotez said. An estimated 4.7 billion people live in areas with a high prevalence of hookworms and similar parasites, which are technically known as soil transmitted helminths.

"Because of hookworm's unique effect on agricultural worker productivity in resource-poor economies, hookworm prevention needs to

be better prioritized by the world's finance ministers and global leaders who wish to introduce or expand interventions that promote women's health and empowerment," Hotez wrote.

A Simple Treatment, a Complex Problem

In the DRC study, funded through a Grand Challenges grant from the Bill & Melinda Gates Foundation, researchers recruited 250 women farmers via two Safe Motherhood Action Groups operating near the city of Kindu. All 250 women were tested for the presence of hookworm and administered a stair-stepping "exercise tolerance test." The women then were divided equally into two groups of 125 each, with one group receiving a single 400 milligram dose of albendazole and the other a placebo. Neither the researchers nor the women farmers were aware of who had tested positive for hookworm and who received the real drug.

Seven months later, the women were administered the same exercise test in which those who had tested positive for hookworm exhibited the improved performance.

Whether the results validate recent recommendations to expand mass drug treatment campaigns, Cappello said further study will be necessary to confirm the findings of this pilot intervention trial.

Currently, given the low cost and general safety of albendazole, the World Health Organization recommends that school-age children and non-pregnant women of childbearing age in hookworm-endemic communities should receive a single 400 milligram dose of the drug once or twice a year. However, Cappello noted that most countries have not adopted these recommendations yet for women. There is strong evidence that children with moderate to heavy hookworm infections derive significant physical and developmental gains from effective treatment. Far less is known about the benefits of broadly treating people like the

women who participated in this study, who have a lighter burden of parasites, he said.

Cappello noted that there are issues that would need to be considered in light of expanding mass drug treatment campaigns. They include evaluating the risks of deworming drugs administered inadvertently to pregnant women, as albendazole currently is not recommended for women during the first trimester. For the DRC farm worker study, pregnancy tests were administered to volunteers, and [women](#) in their first trimester were excluded, which would not be feasible in the setting of mass drug administration.

Cappello also added that there is legitimate concern that expanding albendazole mass drug campaigns beyond school-age children could hasten the emergence of drug resistant hookworms. Cappello said there already is a puzzling variability in the efficacy of albendazole against hookworm in endemic communities.

"It's important that we take a balanced view of potential costs and risks associated with widespread distribution of deworming medications," he said.

ASTMH President Regina Rabinovich, MD, MPH, of the Harvard T.H. Chan School of Public Health, congratulated the researchers on their study.

"These scientists conducted a complicated study in very challenging conditions and emerged with critically important evidence that could improve treatment for a badly neglected tropical disease," Dr. Rabinovich said. "It's very important to follow up on their findings with additional studies that can help inform decisions about the best way to drive down the burden of hookworm in places like the Democratic Republic of Congo."

Provided by American Society of Tropical Medicine and Hygiene

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