



DEWORMING: A BEST BUY FOR DEVELOPMENT

Inexpensive, school-based deworming treatment improves health and school attendance in the short term, improves productivity in the long term, and even benefits untreated neighbors and siblings.



PHOTO BY AUDE GUERRUCCI

Ask children why they are not in school and you will get a variety of responses: cost, distance, and the lack of a school uniform or other necessities. Very few of them will mention intestinal worms, such as soil-transmitted helminths (STH) and schistosomes.

But rigorous evidence has shown that treating children for worms—which affect an estimated 600 million school-aged children worldwide—improves school attendance, health, and long-run productivity. While mild infections often go unnoticed, more severe worm infections can lead to abdominal pain, listlessness, iron-deficiency anemia, malnutrition, stunting, and wasting. Oral deworming drugs are extremely effective at killing most varieties of worms with a single dose, at a cost of a few cents. Rapid reinfection means that the drugs must be taken every 6–12 months to keep worm infections at bay, so finding sustainable approaches to delivering these drugs is a pressing issue.

This Bulletin describes the lessons from a series of studies evaluating the Primary School Deworming Project (PSDP), a school-based deworming program run in western Kenya between 1998 and 2001. These studies form one of the first long-

term evaluations of a health and education intervention in a developing country. The verdict from this body of evidence is clear: deworming treatment is not only highly effective and inexpensive, it is easy to administer through public schools and brings benefits to children years after treatment. **With hundreds of millions of children still at risk of worm infection worldwide, providing free school-based deworming treatment is an easy policy “win” for health, education, and development.**

- **Deworming treatment improved health and reduced absenteeism.** Among children in the treatment schools, moderate-to-heavy worm infections decreased dramatically, and other health indicators, such as anemia and self-reported illness, improved. Deworming increased the attendance rate by 7.5 percentage points at treatment schools.
- **Even untreated children benefited from deworming.** Children who attended comparison schools that were physically close to treatment schools also experienced fewer worm infections and higher school attendance.
- **Deworming improved cognitive outcomes for infants who were not treated directly.** A decade later, children who had been infants when the deworming program started in their community showed cognitive gains equivalent to 0.5–0.8 years of schooling.
- **Treated students continued to benefit a decade after the program.** Young adults who had more exposure to deworming treatment as children worked more hours and ate more meals per day. Among those who worked for wages, adults who had more exposure to deworming treatment earned over 20 percent more.

EVALUATION

In 1998, the NGO International Child Support (ICS) launched the Primary School Deworming Project (PSDP) in Busia District, a poor and densely settled region in western Kenya. The program provided deworming treatment for children on a school-by-school basis. The World Health Organization (WHO) has recommended that deworming drugs (albendazole or mebendazole to treat STH and praziquantel to treat schistosomiasis) be given to all children in areas with high worm prevalence rates.

In partnership with the district's Ministry of Health office, ICS reached nearly all rural primary schools in southern Busia, the area of the district with the highest worm infection rates. The 75 project schools had a total enrollment of over 30,000 pupils between ages six and eighteen.



PHOTO BY AUDE GUERRUCCI

A RANDOMIZED DESIGN. Due to administrative and financial constraints, ICS phased the schools into the program in three groups, dividing the schools randomly by listing them in alphabetical order and assigning every third school into a given group. Groups 1, 2, and 3 began the deworming program in 1998, 1999, and 2001, respectively. The randomized assignment ensured that the schools in each group were not systematically different before the intervention, allowing researchers to obtain unbiased estimates of the program's impact, even many years after the initial evaluation. Although many other intervening circumstances could have shaped the children's lives, they would have, on average, occurred equally within the treatment and comparison groups. Therefore, any statistically significant differences between the groups can still be attributed to the program.

MEASURING SPILLOVER EFFECTS. Because the program was randomly assigned by school, not by child, the researchers were able to measure the full impact of mass deworming, including the benefits of reduced transmission experienced by neighboring children ("spillover effects"). Had the program been randomly assigned by child, the evaluation would have understated the effects of deworming, because treated children would have been reinfected by their untreated peers more quickly, and the untreated peers would have also received some benefit from having fewer infected classmates.

EVALUATION



INTERVENTION

Treatment schools received deworming drugs and worm prevention education. Due to high absenteeism, parental non-consent, and other factors, not all pupils in the treatment schools received the deworming drugs. Seventy-eight percent of the pupils assigned to receive treatment were provided at least some deworming treatment through the program in 1998, and seventy-two percent received treatment in 1999.

PHOTO BY ALISSA FISHBANE

EVALUATIONS OF THE PRIMARY SCHOOL DEWORMING PROJECT

- ① The original evaluation, by J-PAL affiliates Edward Miguel and Michael Kremer, used data on children's school attendance, test scores, worm infections, self-reported illness, and other health indicators to assess the effects of deworming treatment. Since school attendance records were often poorly kept, the attendance data were collected by ICS field workers during unannounced school visits.
- ② The long-run study, by Sarah Baird, Joan Hamory Hicks, Michael Kremer, and Edward Miguel, tracked the students who participated in the original deworming program over the following decade. The effective tracking rate was 84 percent of the students from the first study, who by that time were between 19 and 26 years old. Researchers collected data on health, educational attainment, living standards, and employment (including sector, hours, and migration status).
- ③ A study by Owen Ozier collected data in 2009 and 2010 on children who were less than one year old at the time the PSDP reached their communities. By the time of the study, all of the children were between the ages of 8 and 14. Researchers collected data on the children's height and weight, and administered cognitive tests on verbal fluency, vocabulary, short-term memory, and general intelligence.
- ④ Finally, Miguel and Kremer's cost-sharing evaluation examined a supplemental element that was added to the PSDP in 2001. Twenty-five schools from Groups 1 and 2 were randomly selected to participate in "cost-sharing," with each family paying a fixed fee for treatment. This introduced variation among families in the cost per child of deworming, since families had different numbers of children. Despite the fees, the deworming pills were still heavily subsidized: the average charge per child was only one-fifth the program's costs for drug purchase and delivery.

RESULTS

In the short run, deworming improved the health of both treated and untreated children, enabling them to attend school more frequently. Over the long run, these improvements in health and education contributed to significantly improved outcomes: as young adults, treated individuals were healthier, more educated, and more productive. Children who were too young to actually receive deworming treatment also benefited from the program, with long-term improvements in health and cognition. When deworming was offered for free, more than 70 percent of students received treatment, but when a small fee was charged, take-up plummeted, reducing the reach of the program's impacts.

HEALTH IMPROVED AMONG TREATED CHILDREN AND THEIR NEIGHBORS

Miguel and Kremer's initial study ^① found that treated children experienced a range of health benefits and that these benefits spilled over to untreated schools and children. Moderate-to-heavy worm infections fell by 25 percentage points among children in treatment schools, from a base of about 37 percent. Researchers found evidence that both the direct impact of the deworming pills and the indirect effect of reduced transmission contributed to this effect. The infection rate also fell for children at comparison schools located in close proximity to treatment schools. Children at treatment schools had lower rates of self-reported illness and anemia, and they experienced modest gains in height-for-age Z-scores, a measure of nutrition.

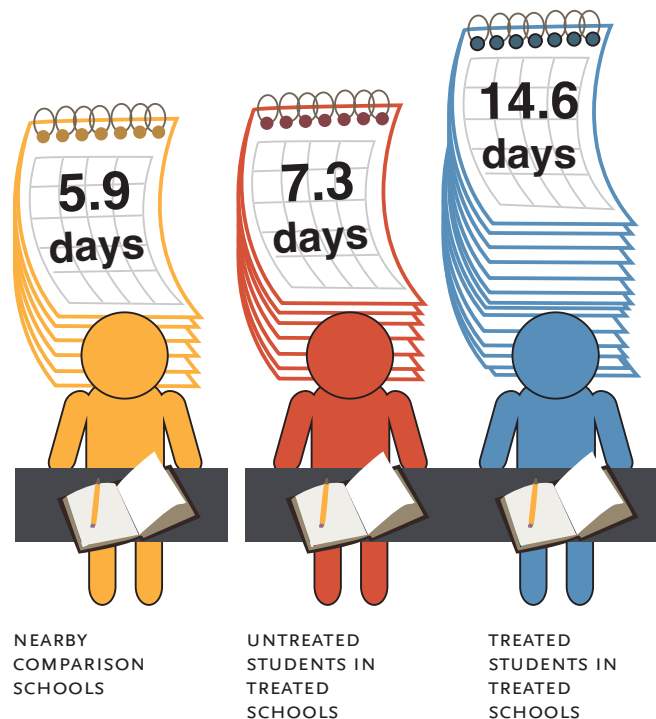
SCHOOL ATTENDANCE INCREASED FOR TREATED AND UNTREATED CHILDREN

Deworming decreased absenteeism at treatment schools by 7.5 percentage points, a one-quarter reduction. Attendance gains were largest for the youngest children, who were between preschool and Grade 2 during the year of treatment. As with the worm infection rate, children at comparison schools located in close proximity to treatment schools also saw a significant increase in school attendance. Miguel and Kremer estimate that treating one child led to an increase of 0.14 school years (about 28 days) in school attendance, accounting for both direct and indirect effects (Figure 1). The researchers did not find significant evidence of gains in test scores for the children who attended the treatment schools.

FIGURE 1: DEWORMING INCREASED ATTENDANCE FOR BOTH TREATED AND UNTREATED STUDENTS

Treating one child for intestinal worms led to an increase in attendance of almost 28 days in that school year. Due to spillover effects, this impact was spread over the

- *treated student,*
- *untreated students in treated schools,*
- and ● *students in comparison schools.*

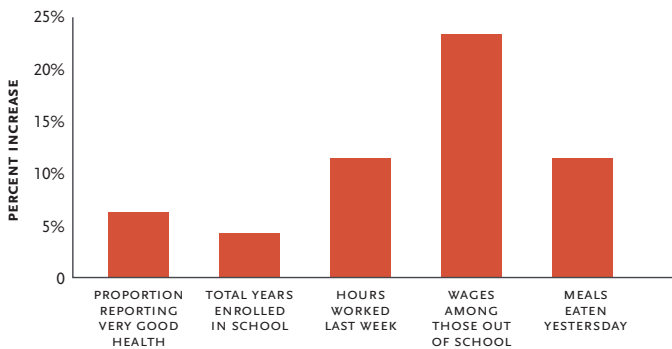


RESULTS

LONG-TERM HEALTH AND PRODUCTIVITY INCREASED AMONG DEWORMED STUDENTS

In the long-term evaluation ②, young adults who had been students at Group 1 and Group 2 schools served as the treatment group. They were exposed to an average of 2.4 more years of deworming treatment than Group 3 students, the comparison group. Since Group 3 schools eventually did receive treatment, the estimated long-term impacts are somewhat understated.

FIGURE 2: TREATED STUDENTS HAD BETTER OUTCOMES AS YOUNG ADULTS



Nevertheless, the study found many significant effects on these young adults' health, education, and productivity (Figure 2). Deworming improved self-reported health, though it did not have a detectable impact on adult height. Total schooling increased by 0.28 years (a 4.2 percent gain), and mean hours worked increased by 12 percent. Treatment also led to shifts into more lucrative employment: from food crops to cash crops in agriculture, and from low-skilled casual labor to better-paid, full-time jobs in fields such as manufacturing. These shifts were the primary driver of a more than 20 percent increase in earnings among out-of-school wage workers. Researchers also found a 0.2 standard deviation increase in profits among self-employed workers. Young adults in the treatment group reported eating an additional 0.1 meals per day on average, providing further evidence of improved living standards.

COGNITION AND HEALTH IMPROVED FOR YOUNG CHILDREN

Mass school-based deworming also had dramatic effects on children who were too young to receive treatment at the time of the PSDP but were at a critical stage of cognitive development. ③ Children who were less than one year old when their community began deworming showed an increase of 0.2 standard deviations in their performance on cognitive tests about a decade later. This effect is equivalent to between 0.5 and 0.8 additional grade levels in school. The impact was twice as large among the subset of children with older siblings in school: these children benefited from more intense spillover effects via the treatment of their siblings, rather than spillovers only from dewormed neighbors.

TAKE-UP OF DEWORMING WAS HIGHEST WITH FREE DISTRIBUTION

The effort to replace free deworming treatment with cost-sharing did not work: the small fee reduced treatment by 58 percentage points, an 80 percent reduction (Figure 3). ④ Sicker pupils were no more likely to pay for the drugs than their healthier classmates, suggesting that the fees did not direct treatment to those who needed it most (a common argument for cost-sharing). These findings are consistent with a number of other randomized evaluations demonstrating that even small fees drastically reduce take-up of basic health and education products. (See J-PAL 2011, "The Price is Wrong.")

FIGURE 3: COST-SHARING LED TO SHARP DROP IN DEWORMING TREATMENT

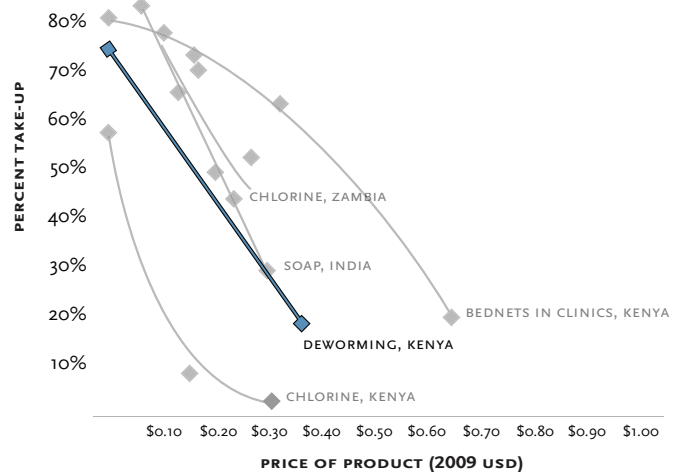




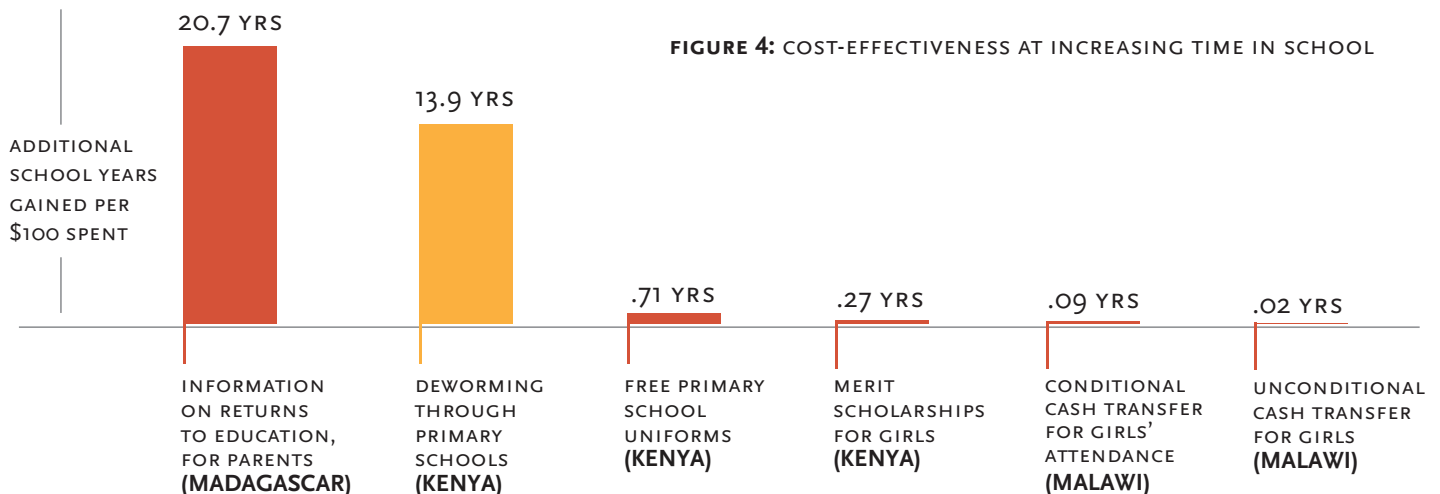
PHOTO BY AUDE GUERRUCCI

DEWORMING IS EXTREMELY COST-EFFECTIVE

Among interventions that have been rigorously tested by randomized evaluations, school-based deworming is one of the most cost-effective means of increasing school attendance. The two drugs used in the PSDP, albendazole and praziquantel, cost approximately 4 cents and 18 cents per annual dose, respectively. Incorporating the costs of delivering and administering the treatments, J-PAL estimates that each year of additional schooling gained through the PSDP cost only US\$7.19. That works out to almost 14 additional years of education per US\$100 spent (Figure 4). This calculation is based on a small-scale implementation through an NGO; a large-scale national program would likely cost even less per child and hence would be even more cost-effective.

Deworming also cost-effectively delivers health benefits. Using cost projections for a large-scale treatment program, J-PAL estimates that deworming costs US\$4.55 per Disability Adjusted Life Year (DALY) averted. (DALYs are a common measure of the burden of disease, expressed as years of life lost to illness and premature death.) For comparison, the World Health Organization considers an intervention to be “highly cost-effective” if it costs less than the national GDP per capita for each DALY averted; the relevant threshold for Kenya was US\$1,560 in 2009.

The future income gains accruing to treated children further bolsters the cost-effectiveness of deworming. The authors of the long-term study estimate that the small initial investment in deworming generated a return of 82 percent per year through higher earnings—an attractive investment by almost any standard. ②



POLICY ACTION

School-based deworming is not only an effective, inexpensive, and easy-to-implement anti-poverty program, it also offers a case study in how scientific evidence can contribute to policy change.

In January 2007, J-PAL affiliates Michael Kremer (co-author of three of the studies featured in this bulletin) and Esther Duflo presented the evidence on school-based deworming to the Young Global Leaders Education Task Force at the World Economic Forum Annual Meeting in Davos, Switzerland. In response, the Task Force launched Deworm the World (DtW), a joint initiative of Innovations for Poverty Action and the Partnership for Child Development. DtW advocates for school-based deworming treatment with policymakers and development partners, and provides technical assistance to governments to support the development and launch of sustainable, large-scale, school-based deworming programs.



PHOTO BY ALISSA FISHBANE

DtW has coordinated strategic support for school-based deworming in 27 countries and has facilitated the distribution of 117 million deworming tablets to these country programs. DtW's technical assistance and advocacy efforts have contributed to the following large-scale deworming efforts:

KENYA: The Kenyan government, informed by the research on the effectiveness of deworming in their country, launched a school-based deworming program in 2009 with technical assistance from DtW. This program treated 3.6 million children across 8,200 schools in its first year. In January 2012, the government announced the second phase of the program, which is expected to treat five million school-aged children annually.

BIHAR, INDIA: In 2011, the State Government of Bihar, India conducted a massive deworming campaign, with technical assistance from DtW and policy support from J-PAL. In September 2011, the government announced that over 17 million school-aged children in the state were treated that year for intestinal worms.

WORLD FOOD PROGRAMME: The World Food Programme (WFP) announced in 2009 that it would incorporate deworming treatment in all of its school feeding programs in locations where parasitic worms are prevalent.

FEATURED PUBLICATIONS

Baird, Sarah, Joan Hamory Hicks, Michael Kremer, and Edward Miguel. 2011. "Worms at Work: Long-Run Impacts of Child Health Gains." Working paper, Harvard University. ②

J-PAL Policy Bulletin. 2011. "The Price is Wrong." Cambridge, MA: Abdul Latif Jameel Poverty Action Lab.

Kremer, Michael and Edward Miguel. 2007. "The Illusion of Sustainability." *Quarterly Journal of Economics* 122(3): 1007-1065. ④

Miguel, Edward, and Michael Kremer. 2004. "Worms: Identifying Impacts on Education and Health in the Presence of Treatment Externalities." *Econometrica* 72(1): 159-217. ①

Ozier, Owen. 2011. "Exploiting Externalities to Estimate the Long-Term Effects of Early Childhood Deworming." Working paper, University of California, Berkeley. ③



PHOTO BY ALISSA FISHBANE

Deworming is a “best buy” for health, education, and development. Deworming is a highly cost-effective way to improve health and increase school attendance in areas where intestinal worms are endemic. Deworming would be a worthwhile investment on the strength of these short-term benefits alone, but it also results in large gains in earnings and living standards years after children receive treatment.

Free delivery of deworming treatment through school systems is a proven approach. Because treated children may rapidly become reinfected by others, deworming treatment must be administered widely for maximal effectiveness. Leveraging the existing educational infrastructure helps minimize the cost of delivery per child and maximize the reach of programs. Considering that cost-sharing dramatically reduces participation and that entire communities benefit

from reduced transmission of worm infections, free provision of deworming treatment is well justified by the evidence.

Deworming shows the potential for research to be translated into action. A rigorous evaluation of school-based deworming contributed to policy change in many countries. Deworming is an excellent case study in how scientific evidence can be used to successfully promote policy change that improves people’s lives.

Scaling up school-based deworming should be an urgent policy priority. Scientific evidence on the efficacy of deworming has led to scale-ups in many countries, including India and Kenya. However, hundreds of millions of children continue to suffer needlessly from worm infections and their long-term consequences on health, education, and productivity. School-based deworming is an extremely cost-effective program that works at scale and is ready to implement wherever intestinal worms are endemic.

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Suggested citation: J-PAL Policy Bulletin. 2012. “Deworming: A Best Buy for Development.” Cambridge, MA: Abdul Latif Jameel Poverty Action Lab.



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