ORIGINAL ARTICLE

Health-Education Package to Prevent Worm Infections in Chinese Schoolchildren

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ABSTRACT

BACKGROUND
Soil-transmitted helminths are among the most prevalent sources of human infections globally. We determined the effect of an educational package at rural schools in Linxiang City District, Hunan province, China, where these worms are prevalent. The intervention aimed to increase knowledge about soil-transmitted helminths, induce behavioral change, and reduce the rate of infection.

METHODS
We conducted a single-blind, unmatched, cluster-randomized intervention trial involving 1718 children, 9 to 10 years of age, in 38 schools over the course of 1 school year. Schools were randomly assigned to the health-education package, which included a cartoon video, or to a control package, which involved only the display of a health-education poster. Infection rates, knowledge about soil-transmitted helminths (as assessed with the use of a questionnaire), and hand-washing behavior were assessed before and after the intervention. Albendazole was administered in all the participants at baseline and in all the children who were found to be positive for infection with soil-transmitted helminths at the follow-up assessment at the end of the school year.

RESULTS
At the follow-up assessment, the mean score for the knowledge of helminths, calculated as a percentage of a total of 43 points on a questionnaire, was 90% higher in the intervention group than in the control group (63.3 vs. 33.4, P<0.001), the percentage of children who washed their hands after using the toilet was nearly twice as high in the intervention group (98.9%, vs. 54.2% in the control group; P<0.001), and the incidence of infection with soil-transmitted helminths was 50% lower in the intervention group than in the control group (4.1% vs. 8.4%, P<0.001). No adverse events were observed immediately (within 15 minutes) after albendazole treatment.

CONCLUSIONS
The health-education package increased students' knowledge about soil-transmitted helminths and led to a change in behavior and a reduced incidence of infection within 1 school year. (Funded by UBS Optimus Foundation, Zurich, Switzerland; Australian New Zealand Clinical Trials Registry number, ACTRN12610000048088.)

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A THIRD OF THE GLOBAL POPULATION, mainly in developing countries, is infected with soil-transmitted helminths, which are intestinal parasitic nematode worms.[1] Infection with these parasitic worms is associated with poverty in rural locations, inadequate sanitation and waste disposal, a lack of clean water, and poor hygiene and is common in areas with limited access to health care and preventive measures.[2] Roundworms (*Ascaris lumbricoides*) are the largest and most prevalent soil-transmitted helminths, accounting for 1 billion infections; whipworms (*Trichuris trichiura*) and hookworms (*Necator americanus* and *Ancylostoma duodenale*) each infect 600 million to 800 million persons. Estimates of the worldwide burden of infection with soil-transmitted helminths range from 4.7 million to 39.0 million disability-adjusted life-years[1,3]; the most recent estimate (2010) is 5.2 million disability-adjusted life-years.[3] The variation in the estimates is due to different emphases placed on the effect of the infection on health (both cognitive function and physical health).[1] Almost half the global disease burden due to these worm infections is borne by children 5 to 14 years of age.[4]

Chronic infection with soil-transmitted helminths can lead to a variety of clinical sequelae, including poor mental and physical development.[1,4] Mass drug administration is the cornerstone of infection control, but this approach does not prevent reinfection. Additional public health measures, such as health education, are required for sustained, integrated control of the infection — a key element in achieving several of the United Nations Millennium Development Goals.[2]

Soil-transmitted helminths are a major problem in China, with 129 million infections across 11 provinces. The rates of infection are highest among children 5 to 14 years of age.[5] We conducted a cluster-randomized intervention trial at rural schools in the southern Hunan province to test the hypothesis that a health-education package targeting schoolchildren can influence behavior in a way that is conducive to the prevention of infection with soil-transmitted helminths. Positive outcomes would have potential implications for control of the infection not only in China but also globally.

METHODS

STUDY DESIGN

We conducted the study in rural Linxiang City District, Hunan province, China, where there is limited awareness of soil-transmitted helminth infection and limited educational activity aimed at its prevention (see Fig. S1 in the Supplementary Appendix, available with the full text of this article at NEJM.org). The study was an unmatched, cluster-randomized intervention trial involving 38 schools (38 clusters) and was conducted over the course of 1 school year (September 2010 through June 2011) (Fig. 1A). The schools were randomly assigned, in a 1:1 ratio, to an intervention package (19 schools) or a control package (19 schools) (Fig. 1A, and Table S1 in the Supplementary Appendix). Intervention schools were provided with a health-education package (Table 1), whereas control schools received the health-education poster that was normally displayed in schools (Fig. S2 in the Supplementary Appendix). The primary end points were the incidence of infection with soil-transmitted helminths, knowledge about and attitude toward parasitic nematode worms (transmission, symptoms, treatment, and prevention), and self-reported hygiene practice. The secondary end point was a change in hygiene practice, with hand-washing after use of the toilet at school, as observed by research staff, used to assess hygiene. Only the incidences of ascaris and trichuris infections were assessed; the incidence of hookworm infection was not measured as part of the study, owing to the very low prevalence of such infection in Linxiang City District.

STUDY OVERSIGHT

The human ethics committees at the Queensland Institute of Medical Research, Australia, and the Hunan Institute of Parasitic Diseases, China, gave written approval for the study. Before commencement of the intervention, written informed consent was obtained from the parents or legal guardians of all the student participants. All the authors assume full responsibility for the design of the study; the collection, analysis, interpretation, and completeness of the data; and the fidelity of this report to the study protocol, which is available at NEJM.org.

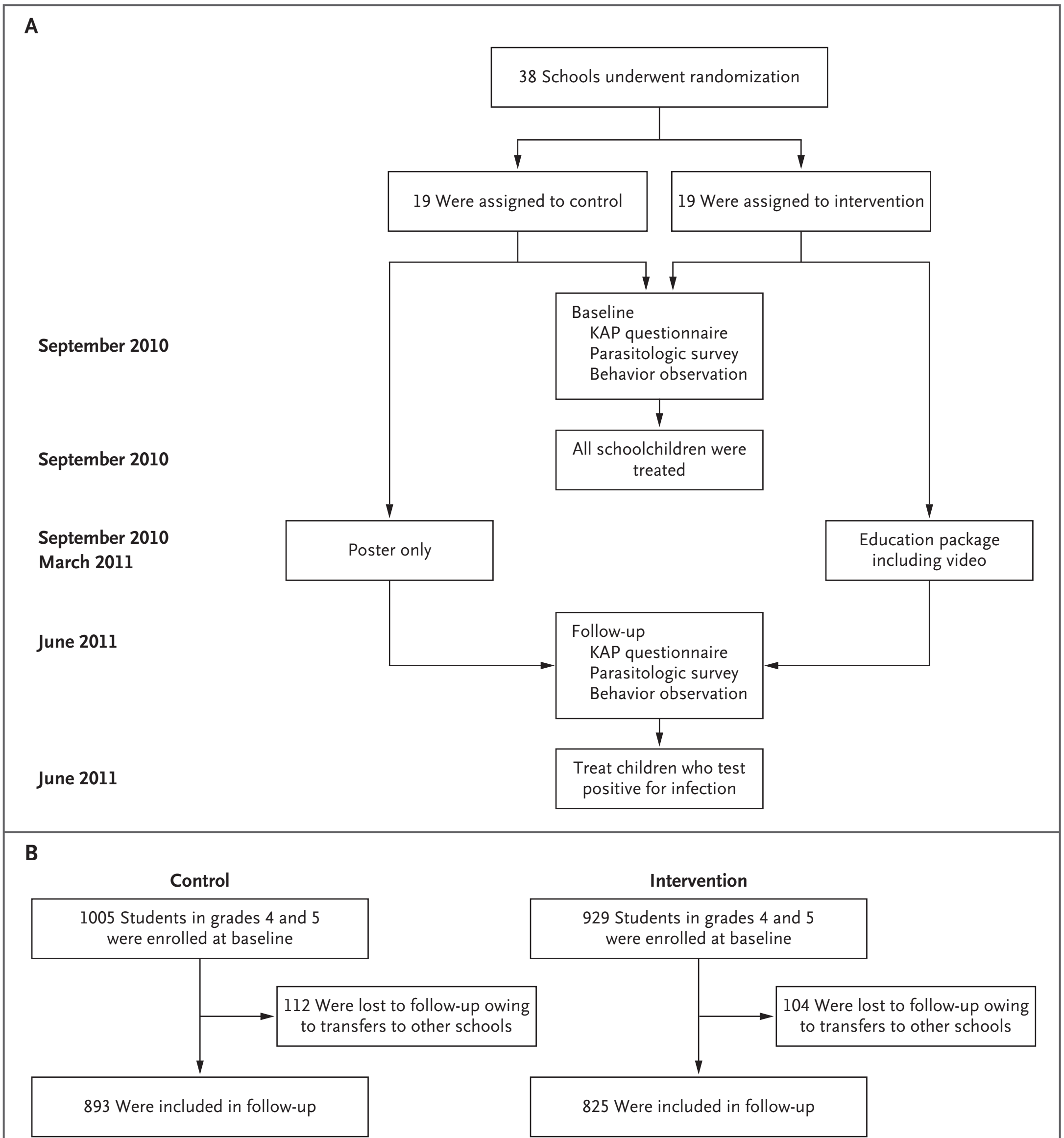

Figure 1. Study Design and Enrollment and Retention of Students.

Rural schools in Linxiang City District, Hunan, China, with more than 15 students in grade 4 were selected to participate in the trial (Panel A). A spatial sampling frame was used for randomization: schools within a radius of 3 km were grouped, resulting in a total of 29 randomization units comprising 38 schools. A total of 1934 students were enrolled in the study, of whom 216 were lost to follow-up (Panel B). During the study period, 103 new students in the intervention schools and 107 in the control schools were registered; data from these students were excluded from the analyses. KAP denotes knowledge, attitudes, and practices.

INTERVENTION PROGRAM

The educational package included a 12-minute cartoon, entitled “The Magic Glasses,” that informed children about the transmission and prevention of soil-transmitted helminths. The presentation of the cartoon was complemented by classroom discussions, display of the same poster that was used for the control group, dissemina-

Table 1. Health-Education Package about Soil-Transmitted Helminths (STH) in Intervention Schools.

Date	Educational Component	Aim
September 2010	Teacher-training workshop	Inform teachers about STH and their role during the intervention
September 2010	Baseline survey	
September 2010	Video shown twice Student questions 10–15 min classroom discussion based on student questions	Inform about STH transmission and prevention Repeat key messages and answer students' questions
October 2010	Handout pamphlet	Key messages as take-home message
	Drawing competition Students draw warning signs for risk areas to warn others about worms Three best drawings are given awards	Practice and reinforce new knowledge
March 2011	Video shown twice Student questions 10–15 min classroom discussion based on student questions	Reinforce knowledge about STH transmission and prevention Repeat key messages and answer students' questions
March 2011	Essay competition Write story about own actions taken to prevent worms Three best essays are given awards	Practice and reinforce new knowledge
June 2011	Follow-up survey	

tion of a pamphlet summarizing the key messages delivered in the cartoon, and drawing and essay-writing competitions to reinforce the messages. Details of the implementation of the educational package are provided in Table 1. A description of the development of the cartoon is provided in the Supplementary Appendix, and the front cover is shown in Figure 2. The cartoon can be accessed at NEJM.org or at www.qimr.edu.au/page/Home/Magic_glasses. A specific teacher-training workshop was held before commencement of the trial (for details, see the protocol, available at NEJM.org).

A video is available at NEJM.org

STUDY PROCEDURES

At baseline, we obtained one fecal sample from each participating student and administered a questionnaire regarding knowledge, attitudes, and practices (KAP questionnaire) related to soil-transmitted helminths. Fecal samples were examined microscopically at the diagnostic laboratory of the Linxiang Center for Disease Control with the use of the Kato–Katz thick-smear technique.[6] For quality control, 10% of the slides were rechecked by independent microscopists at the Hunan Institute of Parasitic Diseases. The agreement between the quality check and the initial data was 99.2% (see the Supplementary Appendix). The KAP questionnaire (see the final protocol) consisted of multiple-choice questions, as well as three open-ended questions, regarding demographic characteristics; medical history; previous health education and knowledge about helminths, the means of transmission, and the symptoms and treatment of infection; the student's attitude toward soil-transmitted helminths; and self-reported hygiene practices with respect to hand-washing, handling food, using the toilet, and wearing shoes. Students were considered to have a positive (or correct) attitude toward soil-transmitted helminths if they were aware of the risk of infection and intended to change their behavior to prevent an infection; students were considered to have a negative (or wrong) attitude if they did not recognize the health risks of soil-transmitted helminths and the importance of correct behavior (e.g., good hygiene). A higher score on the questionnaire indicated a more positive attitude. The questionnaire was developed and piloted in collaboration with Chinese researchers and educators, on the basis of experiences gained in previous trials and observations in the field. Scores on the KAP questionnaire were calculated as percentages of a total of 43 points; differences between groups are expressed as percentage points.

In a randomly selected subsample of 10 intervention and 10 control schools, trained research staff observed students' behavior covertly during morning and lunch breaks on 1 day in each school. The observations were recorded at the school level on a standardized form and focused on handwashing after toilet use. Since a piped-water supply (which provides clean water) was lacking at many locations, a 100-liter water container with a gravity-fed tap was installed at all intervention and control schools to avoid confounding.

After the baseline assessment, all the participants in the intervention and control schools were given albendazole (a 400-mg single oral dose, as recommended by the World Health Organization [WHO]). Albendazole was supplied by the Chinese government and paid for by the Hunan Institute of Parasitic Diseases. Participants were directly observed taking the medication. With this regimen, albendazole results in average cure rates of 98% for ascaris and 47% for trichuris[7]; however, the efficacy can be 100% in persons with a low intensity of infection.[8]

At the follow-up visit at the end of the school year, all the assessments and quality-control measurements that had been performed at baseline were repeated. Any student who had a positive test for soil-transmitted helminths was treated with albendazole. Any adverse events resulting from the drug treatment were recorded after the initial treatment and, in children who had a positive test at the follow-up visit, after retreatment (Table S3 in the Supplementary Appendix).

To monitor potential confounding due to interaction between teachers and students at the intervention schools and at the control schools, a short oral questionnaire consisting of seven questions was administered to the head of each of the intervention schools in March 2011 to assess the degree of interaction between intervention schools and control schools. The monitoring form is provided in the protocol.

Figure 2. Cover of the Cartoon "The Magic Glasses."

STATISTICAL ANALYSIS

We estimated a design effect of 1.1 on the basis of preliminary survey data from 74 students across 4 schools in the study area. We then estimated the sample size that would be required for an individually randomized trial[9] and multiplied the result by the design effect. Assuming an incidence of infection with soil-transmitted helminths of 6% (which is typical of communities in which the prevalence of such infection is 18%), we estimated that we would need to enroll a total of 1639 students for the study to have 80% power to show a relative reduction of 50% in the incidence of infection with the intervention. We enrolled 1934 students at baseline, of whom 1718 students in 38 schools (median, 42 students per school) were included in the final analysis (Fig. 1B).

A Microsoft Access database was used for data management.[10] The statistical analysis was performed with the use of SAS software (SAS Institute). For binary data (e.g., incidence), a logistic-regression model was applied, resulting in an odds ratio for the estimate of the intervention effect. Data from the KAP questionnaire, including the individual components, were analyzed with the use of regression analyses.

Generalized-estimating-equation models, accounting for clustering within schools, were used for the regression analysis and incorporated potential confounders such as school grade and sex. The incidence of infection with soil-transmitted helminths and the scores on the KAP questionnaire are reported as both unadjusted values and values adjusted for sex and school grade. To adjust for baseline knowledge about soil-transmitted helminths, generalized-estimating-equation models for the scores on the KAP questionnaire were extended to include effects of the interaction between time and intervention. A logistic-regression analysis, adjusted for sex and school grade, was used to determine the association between the various components of the KAP questionnaire and infection.

The mean percentage of students observed to have washed their hands after using the toilet was calculated for each school, and a Kruskal–Wallis test was used to calculate differences between

Table 2. Infection Rates in the Control and Intervention Schools.*

Variable	Control Schools	Intervention Schools	Odds Ratio or Ratio of Geometric Mean, (95% CI)†			
			Unadjusted	P Value	Adjusted‡	P Value
Prevalence of infection at baseline — % (95% CI)	10.4 (8.5–12.2)	10.0 (8.1–11.9)	0.95 (0.50–1.84)	0.89	0.99 (0.50–1.99)	0.98
Incidence of infection at follow-up — % (95% CI)	8.4 (6.6–10.2)	4.12 (2.8–5.5)	0.53 (0.38–0.74)	<0.001	0.50 (0.35–0.70)	<0.001
Intensity of infection at baseline — no./g§	143.5 (114.9–179.1)	219.4 (173.0–278.3)	2.25 (0.92–5.49)	0.07	2.87 (0.96–8.58)	0.06
Intensity of infection at follow-up — no./g§	38.3 (34.7–42.3)	44.4 (40.8–48.3)	1.13 (0.98–1.30)	0.09	1.12 (0.97–1.29)	0.12

* At baseline, there were 1005 students in the control schools and 929 students in the intervention schools. At follow-up, there were 893 students in the control schools and 825 in the intervention schools. CI denotes confidence interval.
† Odds ratios for the intervention schools as compared with the control schools are shown for the prevalence and incidence of infection; the ratios of the geometric mean (intervention:control) are shown for the intensity of infection.
‡ Values were adjusted for sex and school grade.
§ The intensity of the infection was assessed as the geometric mean number of eggs per gram of feces.

the intervention and control schools in observed hand-washing practice. A Pearson test was applied for correlations between observed hand-washing practice and the mean KAP score per school and between observed hand-washing practice and the incidence of infection with soil-transmitted helminths. A Spearman test was used to determine the correlation between observed hand-washing practice and knowledge about soil-transmitted helminths.

RESULTS

PARTICIPANTS

Of 1934 students enrolled, 216 were lost to follow-up because of relocation to another school (Fig. 1B). A total of 1718 participants (88.8%) were included in the final analysis: 893 in the control schools, with a mean of 47 students per school, and 825 in the intervention schools, with mean of 43 students per school. There were 976 boys and 739 girls in the study (information on sex was not available for 3 students); 1641 of the students were in grade 4, and 77 in grade 5. During the study period, 210 new students (103 in the intervention schools and 107 in the control schools) were registered, but data from these students were excluded from the analyses.

PREVALENCE AND INTENSITY OF INFECTION

The rates of infection with soil-transmitted helminths are shown in Table 2. At baseline, the prevalence of infection was 10.4% (95% confidence interval [CI], 8.5 to 12.2) in the control schools and 10.0 (95% CI, 8.1 to 11.9) in the intervention schools (odds ratio in the intervention schools, adjusted for sex and school grade, 0.99; 95% CI, 0.50 to 1.99). Among the approximately 10% of children in each group who were infected, approximately 9% were infected with ascaris, and 1% with trichuris; the intensity of the infection, assessed as the geometric mean number of eggs per gram of feces, was low, according to the WHO categorization.[11] There were no significant differences in the prevalence of infection at baseline between the control and intervention schools (P=0.98), between boys and girls (P=0.83), or between children in grade 4 and children in grade 5 (P=0.64).

After the 9-month intervention, the incidence of infection with soil-transmitted helminths was 8.4% (95% CI, 6.6 to 10.2) in the control schools and 4.1% (95% CI, 2.8 to 5.5) in the intervention schools (odds ratio in the intervention schools, adjusted for sex and school grade, 0.50; 95% CI, 0.35 to 0.70; P<0.001; unadjusted odds ratio, 0.53; 95% CI, 0.38 to 0.74; P<0.001). Thus, the educational intervention was associated with 50% efficacy (95% CI, 30 to 65) in preventing infection with soil-transmitted helminths. All the infections in both groups involved ascaris. The intensity of the infection was lower at the 9-month follow-up than at baseline in both groups, with no significant between-group difference (P=0.12).

Table 3. Differences in Scores on the Knowledge, Attitudes, and Practices (KAP) Questionnaire and in Observed Hand-Washing Practice in the Control and Intervention Schools.

Variable	No. of Students	Control Schools	Intervention Schools	Intervention Effect, Intervention vs. Control (95% CI)*			
				Unadjusted	P Value	Adjusted	P Value
KAP score†							
Baseline	1934	26.3 (25.5 to 27.0)	30.7 (29.8 to 31.5)	5.1 (2.1 to 8.0)	<0.001	5.7 (2.6 to 8.7)	<0.001
Follow-up	1718	33.4 (32.5 to 34.4)	63.3 (62.3 to 64.4)	32.6 (28.7 to 36.6)	<0.001	32.8 (28.9 to 36.8)	<0.001
Hand-washing‡							
Baseline	366	54.0 (37.6 to 70.4)	46.0 (14.7 to 77.3)	−8.0 (−25.4 to 41.4)	0.40§		
Follow-up	377	54.2 (19.7 to 88.7)	98.9 (97.4 to 100.3)	44.6 (10.1 to 79.1)	0.005§		

* The intervention effect is the difference in model-based estimated scores, accounting for clustering. The adjusted values were adjusted for sex and school grade.
† Scores on the KAP questionnaire were calculated as percentages of a total of 43 points on the questionnaire; the scores shown are mean scores. Differences between the groups are expressed as percentage points.
‡ The values for hand-washing are the mean percentages of children who were observed to have washed their hands after using the toilet.
§ The P value was calculated with the use of a Kruskal–Wallis analysis of variance.

The incidence of infection at the follow-up assessment was higher among boys than among girls (P=0.002), but there was no significant difference in the incidence between children in grade 4 and those in grade 5 (P=0.20).

KNOWLEDGE, ATTITUDES, AND PRACTICES

Overall changes in scores on the KAP questionnaire are shown in Table 3; changes at the school level and the results with respect to components of the questionnaire are shown in Tables S1 and S2 in the Supplementary Appendix. At baseline, the scores, calculated as percentages (±SD) of a total of 43 points on the questionnaire, were higher by 5.7 percentage points (95% CI, 2.6 to 8.7) in the intervention group than in the control group (30.7±12.7 vs. 26.3±11.5; P<0.001, with adjustment for sex and school grade). There was no significant difference in baseline scores on the KAP questionnaire between boys and girls (P=0.55), whereas children in grade 5 scored, on average, 7 points higher than did children in grade 4 (P<0.001). At the follow-up assessment, students who were exposed to the intervention scored, on average, 32.8 percentage points (95% CI, 28.5 to 37.1) higher on the KAP questionnaire than did students in the control group (63.3±15.1 vs. 33.4±14.4; P<0.001, adjusted for sex and grade). After adjustment for the baseline score on the knowledge component of the questionnaire, the intervention effect (difference in differences) was 24.9 percentage points (95% CI, 23.4 to 26.4; P<0.001). Girls scored 1.7 percentage points higher than did boys (P=0.02), but there was no significant difference between the scores of children in grade 4 and those of children in grade 5 (P=0.25).

In an analysis of the entire study population, the overall score on the KAP questionnaire was higher by 9.9 percentage points (95% CI, 5.8 to 14.0) among uninfected students than among infected students (P<0.001), and the correlation between the score on the KAP questionnaire and observed hand-washing practice was moderate but significant (Pearson correlation coefficient, 0.64; P=0.008). In an analysis according to group assignment, there was a moderate but significant correlation between the score on the KAP questionnaire and hand washing both in the intervention schools (0.66; P=0.05) and in the control schools (0.77; P=0.04).

The score on the knowledge component of the KAP questionnaire was associated with both self-reported behavior (beta=0.13, P<0.001) and observed behavior (Spearman rank-correlation coefficient rho=0.57, P=0.02). Overall, knowledge was a significant predictor of the incidence of infection: the risk of infection decreased by 20% for each increase of 10 percentage points in the knowledge score (P<0.001). Attitude was also a significant predictor of the incidence of infection: the risk of infection decreased by 10% for each increase of 10 percentage points in the attitude score (P=0.005). We did not observe a significant association between attitude and self-reported behavior or between self-reported behavior and the incidence of infection — findings that may be due to measurement error in self-reports.

Changes in Observed Hand-Washing

Changes in hand-washing practice are shown in Table 3. At baseline, 54.0% of students in the control group and 46.0% of those in the intervention group washed their hands after they used the toilet (P=0.61). The rate of hand-washing increased to 98.9% in the intervention group at the follow-up assessment but remained nearly the same as the baseline rate in the control group (54.2%) (P=0.005).

Monitoring of Potential Confounding

The oral questionnaire administered in March 2011 showed that in 14 of the 19 intervention schools, the head of the school did not mention the project to teachers in other schools. Four schools exchanged project-related information either with other intervention schools or with schools that were not participating in the study; only one intervention school interacted with a control school.

Adverse Events

No adverse events were observed immediately (within 15 minutes) after the administration of albendazole according to the WHO protocol.[12] However, in the follow-up questionnaire, some adverse events were reported (Table S3 in the Supplementary Appendix), all of which could have been attributable to any childhood illness.

Discussion

The educational package in our study resulted in 50% efficacy in preventing infection with soil-transmitted helminths among Chinese schoolchildren. The reduction in the rate of infection was associated with an increase in knowledge and improved hygiene practice and establishes proof of principle that the health-education intervention increases students' knowledge about transmission of the infection and changes their behavior, with the new behavior resulting in fewer infections. A clear correlation between scores on the KAP questionnaire and the incidence of infection with soil-transmitted helminths was evident, since across the entire study population, uninfected students scored 10 percentage points higher on the KAP questionnaire than did infected students. Knowledge was the major factor influencing hygiene practice. A correlation was also observed between scores on the KAP questionnaire and observed behavior in both the intervention and control groups.

Baseline scores on the KAP questionnaire were slightly higher among students in the intervention schools than among students in the control schools. This finding may be attributable to the sharing of information with students in the intervention schools after their teachers attended the teacher-training workshop, which was held before commencement of the trial. After adjustment for the baseline score, the difference in the adjusted knowledge scores between the two student groups at the follow-up assessment remained significant. Monitoring of potential confounding resulting from the sharing of information between intervention and control schools suggested that no relevant exchange had occurred between teachers and children in the intervention schools and those in the control schools.

Children are at major risk for infection with soil-transmitted helminths, and programs at schools are a cost-effective means of delivering interventions, a feature that was recognized by the WHO through the launch of the Global School Health Initiative.[11-13] Video-based interventions targeting schoolchildren have been shown to have a positive effect on knowledge and attitudes,[14-22] but few studies have evaluated their effect on the incidence of disease or have quantified their efficacy as an independent control tool.[16,18,22] This randomized, controlled trial provides data on the effect of a health-education package, incorporating a cartoon, in changing behavior and lowering the risk of infection with soil-transmitted helminths.

Critical in the development of the package was the early community involvement of health and education officials, health workers, teachers, parents, and students and our thorough assessment of the risk factors, knowledge, attitudes, and practices regarding soil-transmitted helminths[23] — all of which enabled us to develop a culturally tailored, informative, and engaging package.[17,24,25] This package shows that improving hygiene practice is in the hands of the target group and can result in a positive health outcome.[26,27]

Mass drug administration is effective for the control of infection with soil-transmitted helminths, but once the treatment is terminated, the prevalence of the worms returns to pretreatment levels within 6 to 18 months.[2,28,29] The WHO advocates mass drug administration in all preschool and school-age children, women of childbearing age, and adults who are at high risk, but health education is not part of the WHO roadmap for the control of these neglected tropical diseases.[30] Extensive coverage has been achieved with the help of generous drug donations by pharmaceutical companies and the successful incorporation of deworming programs in school health initiatives in low-income countries.[31]

There is considerable debate about the ability to sustain control of helminth infection solely by means of mass drug administration.[2,28,29,32-36] Furthermore, there is concern about the development of drug-resistant parasites as a result of continued treatment pressure.[37] It is considered inevitable that drug resistance will develop in nematodes that infect humans, given the number of species infecting livestock that are now resistant to anti-helminth agents owing to continuous and extensive drug use.[38-40] Indeed, this may already have happened in the case of some hookworm infections that have not responded to albendazole therapy.[41] Efforts to reduce the overall incidence of infection with soil-transmitted helminths require an integrated approach consisting of pharmacologic treatment to reduce morbidity and the prevalence of the infection and other interventions (e.g., improvements in hygiene achieved through health education) to prevent reinfection. This approach will limit the number of treatment cycles required, reduce treatment pressure, and result in a more sustainable long-term approach to control.

The effective health-education package that we have developed for use in schools complements the current approach to control of infection with soil-transmitted helminths advocated by the WHO. It can readily be incorporated into future deworming programs, as well as ongoing programs, such as those in sub-Saharan Africa[42] and the Chinese national program for the control of soil-transmitted helminths. Future programs could involve the integration of chemotherapy and health education in combination with efforts to ensure clean water, good sanitation, and improved personal hygiene.[5]

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