Knowledge and Practice of Pinworm Infection in Preschool Children, Jiangsu Province, China, 2019–2020

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We conducted a two-year (2019–2020) longitudinal study in Jiangsu Province, China to analyze risk factors of pinworm infection and evaluate the effect of behavior change communication–based (BCC-based) interventions in preschool children. The positive rate of pinworm infection was higher in private preschool (2%) than in public preschool (0.24%). Poor sanitation behaviors were risk factors among private preschool children. BCC-based intervention could improve knowledge and practice and reduce pinworm infection. This study may help fill in gaps in pinworm control. (*Am J Public Health*. Published online ahead of print October 27, 2022:e1–e5. https://doi.org/10.2105/AJPH.2022.307067)

Enterobiasis, caused by pinworm (*Enterobius vermicularis*) infection, is one of the most prevalent parasitic diseases among children regardless of their socioeconomic level, culture, or race.[1–3] In severe cases, insomnia, weight loss, vomiting, abdominal pain, and appendicitis can appear. Pinworm eggs are transmitted from person to person, directly via anus-to-mouth contamination, finger contamination, or through indirect touch of contaminated objects (e.g., toys and classroom tables). Preventing infection and reinfection may be challenging because of a simple life cycle.[4] Children with poor personal hygiene are susceptible to pinworm infection and reinfection, especially those in crowded organizations.[5] However, enterobiasis in children is considerably neglected by parents and health officials. Enterobiasis is rarely a subject of in-depth epidemiological inquiries, in developed or developing countries, despite its wide occurrence. Screening of key populations, analyzing risk factors, and precise interventions are conducive and necessary to pinworm control. Behavior change communication (BCC) is widely used to promote and sustain healthy changes in behavior through tailored health messages and approaches.[6] BCC-based intervention may facilitate pinworm control at the community or school level.

INTERVENTION AND IMPLEMENTATION

We conducted two preschool-level surveys to implement data collection. Letters of information, informed consent forms, and questionnaires were given to parents or principal caretakers prior to the survey. The BCC-based intervention included health education and providing health consultation services. Health education comprised guiding daily hygiene, developing hygiene habits, holding lectures, distributing leaflets, and providing health consultation services. We recruited experts from municipal-level and province-level Centers for Disease Control and Prevention to provide health consultation services. The parents received feedback on the results of pinworm detection. We told parents of children testing positive to seek medical treatment and advice.

We treated Gulou District and Gangzha District as intervention groups and Haimen District and Guangling District as control groups. The inclusive and exclusive criteria are shown in panel b of Figure B (available as a supplement to the online version of this article at https://www.ajph.org). However, we excluded the Haimen District children from the control group because of the preschool adjustment made by the local government at the beginning of 2020.

BCC-based health education was implemented with the aim of having teachers and parents cultivate conscious hygiene habits in the children studied. Lectures were held four times per year (twice a semester) by health

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workers. Leaflets were given out to children and parents every semester (two semesters a year). Moreover, teachers in these preschools were requested to hold a lecture about pinworm infections and prevention at the parents' meeting.

Considering the low pinworm infection rates in public preschool, we conducted BCC-based intervention in private preschools. Sample collection was performed in the morning, before the children defecated and bathed. Health workers from county- and municipal-level Centers for Disease Control and Prevention took one sample from each child. The adhesive cellophane tape swab (patent number: ZL201420707045.8) was used over the perianal skin and was then inspected by a trained municipal-level microbiologist and checked by an expert from Jiangsu Institute of Parasitic Diseases. One or more eggs found under the microscope indicated a pinworm infection. We invited the child's parents or principal caretakers to complete a questionnaire (Table A, available as a supplement to the online version of this article at https://www.ajph.org); questions included information related to demographics, household sanitary conditions, and knowledge and practice regarding enterobiasis. The content of the questionnaire was the same at baseline and at follow-up.

We used SPSS version 13.0 (SPSS Inc, Chicago, IL) to conduct data analyses. We used the χ^2 test to test significant differences in group outcomes. We conducted multivariate logistic regression by treating the grouping variable (intervention group or control group) as outcome and gender, age, residence, mother's educational level, type of flooring in the home, and hygiene habits among the follow-up population as covariates to achieve the propensity score, which was classified into four groups according to quartiles. We applied the Cochran–Mantel–Haenszel test, adjusted by grouped propensity score, to test statistical differences between the intervention group and control group. We estimated odds ratios and 95% confidence intervals using the Poisson loglinear model of risk factors for pinworm infection at baseline (2019). We applied principal component analysis to detect hygiene factors. The factor of the principal component analysis with an eigenvalue above 1 was retained. A *P* value of less than .05 indicated a statistically significant difference.

PLACE, TIME, AND PERSONS

The study included preschool children in six districts of Nanjing, Yangzhou, Nantong, and Yancheng Prefectures (Figure A, available as a supplement to the online version of this article at http://www.ajph.org). The program (Figure B) was conducted September 1, 2019 through October 31, 2020 in Jiangsu Province, China. We made epidemiological assessments and analyzed associated risk factors of pinworm infection after a cross-sectional survey (September–October 2019). We then implemented a BCC-based intervention. The participants were followed up from September to October 2020.

Preschool children aged two to six years, as well as their parents or principal caretakers, were included. In each study site, we selected two types of preschools: public preschools, which only admit children from permanent population families, and private preschools, which only admit children from transient population families. A majority of children came from one-child families. If a family had multiple children aged two to six years attending the selected preschool, all children were recruited as respondents.

PURPOSE

Although enterobiasis was mostly controlled, it was not completely eliminated.[7,8] The aim of this study was to explore risk factors and BCC-based intervention approach for pinworm infection in Jiangsu Province, China.

EVALUATION AND ADVERSE EFFECTS

A total of 3678 preschool children (1697 from public preschool and 1981 from private preschool) aged two to six years were enrolled in 2019 (Table 1). The overall rate of pinworm infection was 1.2%. At baseline (in 2019), 54% were boys, and the mean (±SD) age of the children was 4.4 (±1) years; a majority of children were aged four to five years (65.6% and 64.0% for private preschool and public preschool, respectively); four (0.24%) and 41 (2%) positive cases of pinworm infection were found in public preschools and private preschools, respectively. Hygiene behaviors of *Enterobius vermicularis* infection among preschool children are shown in Table B (available as a supplement to the online version of this article at https://www.ajph.org).

Improvement of Knowledge and Practice

Knowledge improved in the intervention group, whereas it decreased in the control group (Table 2). Moreover, private preschool children showed greater improvement in behavior after BCC-based intervention, especially in relationship to washing hands, sucking fingers, and sucking toys and pens (Table C,

TABLE 1— Baseline Demographic Characteristics of Preschool Children in *Enterobius vermicularis* Infection Intervention: Jiangsu Province, China, 2019

	Private Preschool			Public Preschool		
	No. (%)	No. of Positive Cases (Infection Rate, %)	*P*[a]	No. (%)	No. of Positive Cases (Infection Rate, %)	*P*[a]
Gender			.75			.63
Male	1077 (54.4)	21 (1.95)		923 (54.4)	3 (0.33)	
Female	904 (45.6)	20 (2.21)		774 (45.6)	1 (0.13)	
Age, y			< .001			.99
2	8 (0.4)	0 (0.00)		7 (0.4)	0 (0.00)	
3	398 (20.1)	8 (2.01)		365 (21.5)	1 (0.27)	
4	614 (31.0)	2 (0.33)		528 (31.1)	1 (0.19)	
5	686 (34.6)	18 (2.62)		557 (32.9)	2 (0.36)	
6	275 (13.9)	13 (4.73)		240 (14.1)	0 (0.00)	
Grade			.04			.99
Bottom	554 (28.0)	8 (1.44)		533 (31.4)	1 (0.19)	
Middle	783 (39.5)	12 (1.53)		542 (31.9)	1 (0.18)	
Top	644 (32.5)	21 (3.26)		622 (36.7)	2 (0.32)	
Residence			.99			.58
Urban	1001 (50.5)	21 (2.10)		1224 (72.1)	4 (0.33)	
Rural	980 (49.5)	20 (2.04)		473 (27.9)	0 (0.00)	
Mother's educational level			.52			.052
Primary school or lower	100 (5.0)	2 (2.00)		34 (1.9)	1 (2.94)	
Secondary school	1657 (83.6)	37 (2.23)		1171 (69.0)	3 (0.26)	
Diploma, bachelor's, or higher	224 (11.3)	2 (0.89)		492 (29.0)	0 (0.00)	
Family income level			.023			.001
Low	549 (27.7)	18 (3.28)		236 (13.9)	4 (1.69)	
Medium	1414 (71.4)	22 (1.56)		1447 (85.3)	0 (0.00)	
High	18 (0.9)	1 (5.56)		14 (0.8)	0 (0.00)	
Type of house floor			.056			.21
Brick or wood	1494 (75.4)	26 (1.74)		1598 (94.2)	3 (0.19)	
Cement	457 (23.1)	13 (2.84)		92 (5.4)	1 (1.09)	
Soil	30 (1.5)	2 (6.67)		7 (0.4)	0 (0.00)	
Total	1981	41 (2.01)	NA	1697	4 (0.24)	NA

Note. NA = not applicable.
[a]By the Fisher exact test.

available as a supplement to the online version of this article at https://www.ajph.org).

Reduced Positive Rate, But New Infections

The intervention group consisted of 723 children from Gulou and Gangzha Districts (positive rate: 4.3%), whereas the control group comprised 258 children from Gangling District (positive rate: 0.4%; panel b, Figure B).

In 2020, we followed up 740 children from baseline: 505 children in the intervention group (51.9% boys; 60.2% of children aged four to five years) and 235 children in the control group (50.6% boys; 67.7% of children aged four to five years). Following the one-year intervention, 18 of the children positive at baseline were found to be negative; however, seven new infections were found (positive rate: 1.4%). There was no infection in the control group during follow-up.

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TABLE 2— Knowledge Awareness Rate of Enterobiasis at Baseline and Follow-Up Among Parents of Private Preschool Children: Jiangsu Province, China, 2019–2020

	Intervention Group			Control Group			Intervention – Control	
Parental Knowledge	Baseline (n = 723), %	Follow-Up (n = 505), %	Increment, Percentage Points	Baseline (n = 258)	Follow-Up (n = 235)	Increment, Percentage Points	Percentage Point Difference	P[a]
Knows enterobiasis	58	64	+6	61	44	−17	+20	< .001
Knows it is contagious	62	62	+0	58	58	−0	+4	.3
Knows its route of infection	53	53	+0	61	52	−9	+1	.91
Knows its main parasitic site	47	44	−3	56	48	−8	−4	.04
Knows its symptoms	49	55	+6	53	43	−10	+12	.002
Knows its susceptible population	84	85	+1	85	86	+1	−1	.58
Knows drug used for treatment	45	49	+4	37	33	−4	+16	< .001
Knows prophylactic measures	81	84	+3	80	77	−3	+7	.04

[a]By the Cochran–Mantel–Haenszel test.

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Factors Associated With Infections

We used principal component analysis to develop hygiene factors from nine variables related to personal hygiene behaviors (Table D, available as a supplement to the online version of this article at https://www.ajph.org). We retained four principal components (PCs). PC1 indicated a composite factor of sucking habit; PC2 indicated the habit factor of washing hands; PC3 indicated a composite factor of maintaining personal hygiene and tidiness; PC4 indicated bathing habits. According to the Poisson loglinear model of children from private preschool, risk factors found to be associated with pinworm infections were age (odds ratio [OR] = 1.6; 95% confidence interval [CI] = 1.2, 2.3), PC3 (OR = 1.2; 95% CI = 1.01, 1.5), and PC4 (OR = 1.4, 95% CI = 1.1, 1.8; Table E, available as a supplement to the online version of this article at https://www.ajph.org). Among public preschool children, only brick or wood floor (reference = cement floor) resulted as a risk factor (OR = 19.9; 95% CI = 13.1, 30.4; Table E).

We observed no adverse effects.

SUSTAINABILITY

Children's pinworm infections have been overlooked because there is a serious lack of studies on the topic. This work calls for more attention to be paid to pinworm infections among preschool children, as well as for the sustainable practice of pinworm control. Moreover, in this study, we have developed a protocol of BCC-based intervention approach and control strategy, incorporated in annual parasitological surveys with funding support, which may facilitate the formation and continuity of best practices for pinworm infection control in preschool.

PUBLIC HEALTH SIGNIFICANCE

To the best of our knowledge, the present study is the first report on the prevalence of pinworm infections among private and public preschool children. To better understand the context of this study, it's important to note that the distinction between public and private schools may have different connotations in China compared with other parts of the world. This study provides an in-depth and new insight into preschool-based pinworm risk and intervention efforts worldwide. BCC-based intervention, which could improve knowledge and practice and reduce pinworm infection, could be further applied for pinworm control among children, especially private preschool children. AJPH

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CONTRIBUTORS

J. Cao and Y. Dai conceptualized the study. F. Mao, Y. Yang, and Q. Zhang analyzed the data, drafted the manuscript, and contributed to data analysis and interpretation. X. Ding, X. Xu, and Y. Chen assisted with data collection. All authors critically reviewed and revised the manuscript.

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CONFLICTS OF INTEREST

The authors have no conflicts of interest to declare.

HUMAN PARTICIPANT PROTECTION

The present study was approved by the institutional review board of Jiangsu Institute of Parasitic Diseases (JIPD-2018-002), Wuxi, China.

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