Reducing the Exposure of Children in Rural Indonesia to Environmental Contamination by Human Waste

A pilot study

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ABSTRACT

Background: In many parts of Asia, rural children's development is hindered by gastrointestinal diseases. Those diseases can result from environmental contamination with human waste.

Purpose: Our objective was to pilot-test a combined structural-behavioral intervention to prevent contamination of rural children's environment with human waste. The intervention combined latrine construction with health education. One concern was the feasibility of collecting data regarding children.

Methods: For this pilot study, children in two Indonesian rural villages were asked whether they saw human feces around their homes. Then the intervention (latrine construction and health education) was implemented in only one of the villages. Eight months later, the children's observations of contamination around their homes were assessed again in both villages.

Results: No children were lost to follow-up. Between baseline and follow-up, the percentage of children who reported seeing feces around their homes increased in the control village (from 53.1% to 65.3%), but it decreased in the intervention village (from 62.0% to 42.0%). The two villages did not differ at baseline (odds ratio 0.70, 95% confidence interval 0.31-1.56), but they differed markedly at follow-up (odds ratio 2.57, 95% CI 1.14-5.92).

Conclusions: With data provided by children, we documented a reduction of fecal contamination of the home environment. Scaling up to a village-cluster-randomized trial including multiple villages in each arm will give more precise information about the intervention's effectiveness. To the extent that these results are reproduced, this intervention can improve rural children's health.

Key words: Children, Health education, Latrines, Sanitation, Indonesia

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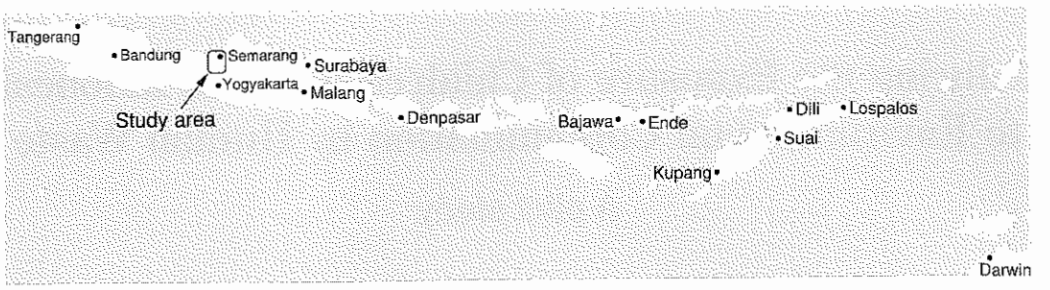

Fig. 1 Map showing the area where the study was done
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INTRODUCTION

Children's health requires their living standards to meet or exceed the Millennium Development Goals (MDG) published by the United Nations, but the environmental conditions in and around many children's homes worldwide do not meet those goals. Regarding sanitation in particular, it is regrettable but true that "the world has missed the MDG target"[1]. In Indonesia, for example, as recently as 2010 many households had no family latrine, [1] and more than half of the poorest people practice open defecation[2].

Environmental contamination resulting from open defecation near a dwelling leads to the spread of pathogens, causing soil-transmitted helminthiases and other gastrointestinal diseases[3]. Children are particularly at risk. For example, one of the social consequences of soil-transmitted helminthiases is absence of children from school. However, using "improved sanitation" (which is defined as hygienic separation of human excreta from human contact) can prevent the spread of disease, not only under usual circumstances but also in emergency situations[4,5]. Previous research has shown that education regarding latrine use, hygiene, and environmental contamination can reduce gastrointestinal infections among children[6]. Control of these diseases in a sustainable way requires an integrated approach, that is, it requires a combination of latrines and health-promotion education[7,8].

As we prepared to study the effectiveness of such a combined intervention, one of our concerns was the feasibility of collecting data regarding children, including, when possible, data reported by children themselves. We therefore conducted a small pilot study, focusing on the prevention of fecal contamination of rural children's home environment. Here we report the results of that pilot study.

PARTICIPANTS and METHODS

1 Location and participants

The study was conducted in two villages, one identified as a control and the other for the intervention, in Indonesia (Central Java Province, Semarang, Gunungpati sub-district, see **Fig. 1**). These two villages are in wooded areas with high hills and although they are in the same sub-district, they are not near each other. Children were eligible to participate in the study if they lived in one of the two villages and were aged between 3 and 13 years at the time of the baseline measurement.

2 The intervention

As a general principle, latrines must suit the local environment, and the resources used for their construction must be locally available. The model used in this study is Budi's Amphibious

Latrine (the 'BALatrine'), which had been used previously in rural Central Java[9,10].

The educational component of the intervention focused on gastrointestinal health, the causes and symptoms of gastrointestinal diseases, and methods for preventing infection by the viruses, bacteria, and parasites that can cause those diseases. Emphasis was placed on the adverse consequences of open defecation and on how to prevent disease by appropriately using latrines. The health education was provided not only to the children but to all residents of the intervention village.

3 Data collection and analysis

At baseline, all participants in both villages were surveyed with regard to demographic characteristics as well as hygiene-related knowledge and behavior. They were also asked about contamination of the local environment caused by open defecation: whether they see human feces around their home. The children were interviewed with a caretaker present (usually a parent or grandparent), and for children who were too young to understand and respond to the questions (generally those less than 6 years old) the caretaker's response was taken as a proxy.

The data were collected by trained research assistants. They included nurses, nursing students, midwives, and public-health employees from that part of Indonesia. Their training lasted a total of 28 hours, and it included familiarization with the questionnaire as well as interview practice. Because many of the research assistants spoke not only Bahasa Indonesia (the official national language) but also the local Javanese language, and because many had personal experience in villages such as those being studied, the research assistants were able to ensure that the children understood the questions before they responded.

After the baseline survey, in the intervention village only, the latrines were constructed and the health education was provided. The health education was provided by some of the research assistants, and, as mentioned above, it was given not only to the children but to all residents of the intervention village.

Follow-up data were collected in both villages 8 months after baseline. Odds ratios were computed as tests of the differences between the control-village children and the intervention-village children, with regard to the data collected at baseline and also at follow-up. Data were analyzed with IBM SPSS 22, and with the tools at< www.openepi.com>.

4 Ethical considerations

This study was performed in accordance with the ethical standards of the authorities of Semarang City (ref. 070/613/IV/2011) and the human research ethics committee at Griffith University (ref. PBH/17/11/HREC). Informed consent was obtained from the parents of all participants in the study.

RESULTS

The numbers of participants in the two villages were nearly the same, as were their age and sex distributions. The control village had 49 children. Their mean age (±SD) was 8.35±3.02 years, and among them 32 (65.3%) were girls. The intervention village had 50 children. Their mean age was 7.06±3.20 years, and among them 27 (54.0%) were girls. In both villages, data were collected from all of the participants both at baseline and also at follow-up. That is, there was no loss to follow-up.

At baseline, environmental contamination in the two villages was almost the same. Specifically, 53.1% of the children in the control village reported that they saw feces around their homes 'often' or 'sometimes,' as did 62.0% of those in the intervention village, and there was no statistically

Table 1 Reported human-feces contamination of children's environment in the two villages at baseline and at follow-up (control $n=49$, intervention $n=50$)

Seeing feces around the house		Often or sometimes	Never	Odds ratio (95% CI)	p value*
At baseline	Control	26 (53.1%)	23 (46.9%)	0.70 (0.31-1.56)	0.378
	Intervention	31 (62.0%)	19 (38.0%)		
At follow-up	Control	32 (65.3%)	17 (34.7%)	2.57 (1.14-5.92)	0.022
	Intervention	21 (42.0%)	29 (58.0%)		

CI: confidence interval *: Mid-P exact

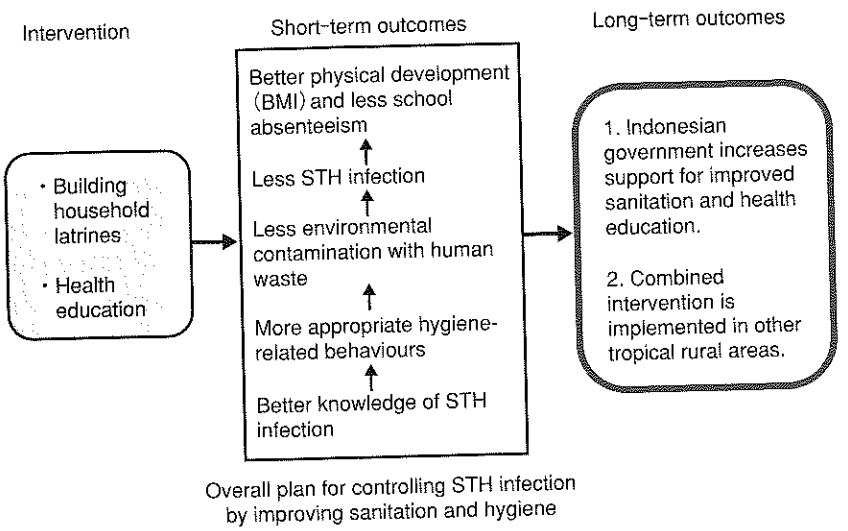

Fig. 2 Anticipated short-term and long-term outcomes of this intervention, particularly with regard to control of soil-transmitted helminthiases (STH)

BMI: Body Mass Index

significant difference between the two villages (**Table 1**). Eight months after the construction of latrines and provision of health education, only 42.0% of the children in the intervention village reported that they saw feces around their homes 'often' or 'sometimes,' whereas the comparable percentage for the control village was, at 65.3%, considerably higher. Unlike the baseline values, the follow-up values were statistically significantly different between the two villages (**Table 1**).

DISCUSSION

Data collection from the children was successful. Environmental contamination around the home caused by open defecation decreased in the intervention village but not in the control village. In the control village there was no improvement at all from baseline to follow-up, and in fact there appeared to be some deterioration. Unlike the situation at the time of the baseline measurement, at the time of the follow-up measurement

there was a large and statistically significant difference between the two villages. The most likely explanation is that the residents of the intervention village used the new latrines in ways consistent with the content of the health education. Thus, construction of latrines and health education reduced the exposure of the children in the intervention village to environmental contamination caused by open defecation. To the extent that children and also adults then had less contact with human feces, they would have been protected against soil-transmitted helminthiases and other diseases[11].

On the basis of the results of this pilot study, further research on the effectiveness of this intervention is now warranted. This study also demonstrates the feasibility of collecting data through interviews with rural children. Following-on from this study it would be reasonable to scale-up to a cluster-randomized trial with clustering at the village level and multiple villages in each arm, to measure the effects in a much larger number of children and thus with greater precision.

CONCLUSION

By preventing environmental contamination due to open defecation, this intervention holds promise as a way of reducing soil-transmitted helminthiases and thus reducing anemia, promoting children's physical growth, and preventing absence from school. All of those outcomes can be measured in scaled-up follow-on research based on this pilot study, and that research can include collection of data directly from children's self-reports. If the likely biological benefits and social benefits are achieved, then a major step is taken to overcome the "vicious cycle of disease and poverty"[12]. The overall plan for this intervention and its anticipated outcomes is shown in **Fig. 2**.

CONFLICTS of INTEREST: The authors have no conflicts of interest to declare.

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