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Integration of health education intervention to improve the compliance to mass drug administration for soil-transmitted helminths infection in Bangladesh: An implementation research

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ABSTRACT

Introduction: In Bangladesh, the prevention and control strategy of soil-transmitted helminthiasis (STHs) is based on the mass drug administration (MDA) program. Despite bi-annual MDA since 2008, the reported compliance is still below the target, and the STH prevalence is high in several areas. This study was done to assess the feasibility and barriers of integrating health education (HE) intervention to achieve the target MDA compliance in the local context of Bangladesh.

Materials and methods: A mixed-method study, utilizing PRISM (Practical Robust Implementation Sustainability Model) framework, was conducted between July 2017 to March 2018 in Dhaka and Sylhet divisions of Bangladesh. A total of 640 school-aged children selected from four different schools were divided into intervention and control groups. Eight focus group discussions (FGDs) and eight in-depth interviews (IDIs) were also conducted among 56 adults, including parents of school-aged children, school teachers, and health officers.

Results: Quantitative findings revealed that HE intervention had a significant role ($P < .05$) to improve the mean knowledge score in the intervention group (3.35) compared to the control group (0.29). STH preventive behaviours and MDA participating attitudes were also significantly increased in the intervention group ($P < .05$) compared to the control group. Some of the major barriers associated with HE integration identified in the qualitative study were budget deficiencies, inadequate training of program implementers, and information gaps. In contrast, the school environment and positive community attitudes were observed as supportive factors for the integration of HE.

Conclusion: Increased knowledge score and behaviour changes due to HE intervention demonstrated in this study hint that integration of HE with MDA is feasible and can be promising to promote MDA compliance and to reduce STH prevalence in this setting. However, the alloca-

Abbreviations: MDA, Mass Drug Administration; STHs, Soil-transmitted Helminthiasis; HE, Health Education; NTDs, Neglected Tropical Diseases; PRISM, Practical Robust Implementation Sustainability Model; FGDs, Focus Group Discussion; IDIs, In-depth Interviews; HIs, Education-based health promotion intervention; WHO, World Health Organization.

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tion of adequate budget, as well as coordination and collaboration with local political context, should be addressed for the sustainability of integration.

1. Background

Soil-transmitted helminthiasis (STHs) is one of the most burdensome diseases among the 20 neglected tropical diseases (NTDs) that are included in the world health organization (WHO) list and compromise the health of more than 1.2 billion people worldwide (World Health Organization, 2012). Worm infection saps energy, impairs learning in children and working capacity in adults, and diminishes physical and mental performance in all life activities that holds back the economic development of communities and contributes to the cycle of poverty and malnutrition (Chung et al., 2015). Like several other developing countries, STHs is one of the major public health problems in Bangladesh, and the main risk groups are socio-economic disadvantaged populations. The sources of intestinal parasite infections from the host and in the environment like contaminated soil and vegetables resulted in the continuous active transmission of diseases in the area. In recognition of the global health importance of STHs, there is a global commitment to implement control strategies to reduce STHs and other helminths burden with a focus on school-based chemotherapy programs. As part of a comprehensive response, the government of Bangladesh has also implemented bi-annual MDA of mebendazole (500 mg) to control STH since 2008. The MDA is now being implemented every May and November across all primary-level institutions in the country for all school-age children aged five to twelve years. School-based deworming of school-aged children has been shown to decrease the infection burden, especially cost-effectively reducing high burden infections (Hafiz et al., 2015; http://pdf.usaid.gov/pdf_docs/pnady849.pdf/, 2011), however, the several empirical evidence from both multi-year deworming programs and modelling studies suggest that preventive chemotherapy alone is insufficient for sustainable control and elimination of STHs infection (Truscott et al., 2016; Coffeng et al., 2018; Adeniran et al., 2017). While there has been a significant improvement in the control of STHs in Bangladesh, findings of high STH prevalence by several studies (Chung et al., 2015; Hossain, 2015; Banu et al., 2011) indicate that ongoing MDA is failing to reach all target populations. Besides, there are some other factors also which hinder the STHs control like poor efficacy of MDA drugs for *T. trichiura* (Moser et al., 2017; Emdadul et al., 2014) and age distribution of infection for hookworm. Alternative methods of awareness creation and information dissemination about MDA need to be explored to reach all community peoples for increasing compliance and adherence to the MDA program (Feldstein & Glasgow, 2008). By addressing the issue, integration of MDA with health education was suggested as a cost-effective and potential approach for effective MDA implementation. This integrated approach has been successfully implemented in various countries for achieving the compliance of the wider community of the target population. The study aimed to access and quantify the feasibility of health education (HE) to accelerate compliance of existing MDA in the context of sustainable STHs control and elimination through an effectiveness-implementation trial. Perceptions of this integrated intervention, barriers, and implementation outcomes were assessed in this study.

2. Materials and methods

A mixed-methods ethnographic study protocol combined with qualitative and quantitative analyses was used to develop a complete understanding of the needs, feasibility, and impact of such a design, as well as how to ensure effective implementation. Classroom-based health education sessions, given by the researchers, along with the presence of schoolteacher, were used as the intervention in the study. In total, 640 students were assigned to intervention and control groups. Well-structured pre-tested questionnaires were distributed before and after the intervention. Four (04) FGDs with parents of children and four (04) FGDs with school children were conducted. Each focus group was made up of six (06) members and each FGD lasted for about 50–60 min. The discussion was held in Bangla and further transcribed into the English language. Data was collected in the form of audio recording (wave pad sound editor and sony digital voice recorder) and notes. Besides, four (04) IDIs with the teachers, two (02) IDIs with community opinion leaders and another two (02) IDIs with community health officers were also conducted. Averagely, about 30–40 min, was used for each interview.

2.1. Study areas and study times

Bangladesh is a South Asian country that is divided into eight (8) administrative divisions. The study was conducted in Dhaka and Sylhet divisions of Bangladesh (Fig. 1). Two schools from Dhaka (Mohammadpur located at 23°45.3′N 90°21.8′E and Sheepur located at 24°12′N 90°28′E) and two schools from Sylhet (Sylhet Sadar is located at 24.8917°N 91.8833°E; Jaitapur located at 25°7.5′N 92°7′E) were selected based on the referrals from local education administration (Upazilla Education Office). Sylhet and Dhaka were chosen to conduct the study because these were among the divisions in Bangladesh with a history of a high prevalence of STHs. Current population (2018) of Dhaka and Sylhet divisions are roughly 19 million, and 12 million, respectively (Bangladesh Statistics, 2018. The study was conducted for nine (9) months starting from July 2017 to March 2018.

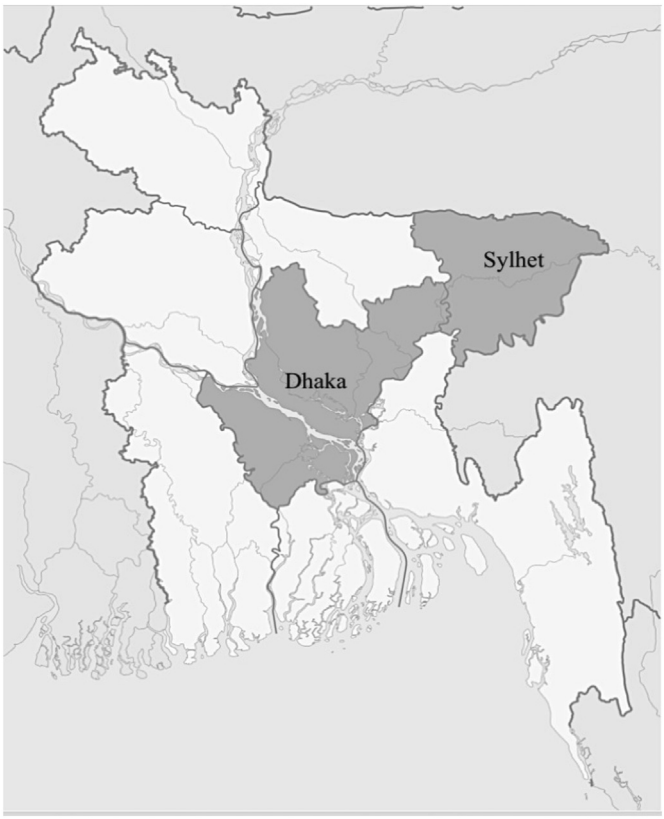

Fig. 1. Study areas (Sylhet and Dhaka).

2.2. Study populations

The specific population includes the school-aged children (5–14 years old) either school going (children who attended registered primary schools or madrasah) or non-school going (children who did not go to any schools or attended in informal schools/madrasah or drop out), parents of school-aged children, school teachers (who distribute the drugs among the targeted population), community health workers (including community health officials or staff working in health care facilities). Four schools were chosen from each study area based on permission and referrals from local education administration. Two schools were allocated as the intervention and two schools as control. Participant recruitment was carried out through a mixed sampling approach, including convenience purposive and simple random sampling techniques. By following inclusion and exclusion criteria, school-going children were recruited through simple random sampling, and non school-going children were recruited by purposive sampling. Inclusion criteria were (a) consent to participate and (b) people who had been residents of the areas at least 2 years. Exclusion criteria included a nonresponsive study population, those unwilling to give consent to participate, and recent migrants or temporary residents of the area.

2.3. Intervention modules

The health education intervention module on knowledge, attitude, and practice regarding STHs and MDA were developed through a review of existing literature and consultations with public health researchers. Classroom-based short lecture, games (ladder game), and documentary video (https://youtu.be/e_ZHtLaVdfQ) were included in the HE module. The information component of the module provided information on basic facts about STHs, modes of transmission, risk factors, the importance of MDA, and misconception related to MDA drugs. The STHs ladder game was adopted from Adeniran et al.. (2017), translated to native language, and was included to make the module attractive to children. The documentary video of the model was aimed at an easy understanding of the STHs, and MDA topics. The HE session was conducted two times in each community and one session was conducted at-least 60 min. The researcher, with the help of regular class teacher implemented the sessions.

2.4. Data collection and analysis methods

In this study, IDIs and FGDs were used as qualitative approaches, and a semi-structured questionnaire was used as a quantitative approach. Before the data collection, pre-testing of questionnaires and interview guides were done to evaluate the time required and to establish the accuracy of questions. The post-intervention survey was done after four months of HE implementation to observe the effect of the intervention. Descriptive statistics were used to tabulate and describe the quantitative data, whereas thematic analysis was used for qualitative data. The mean knowledge score was calculated based on Karki et al, (Karki et al., 2018) and Fawole et al, (Fawole et al., 1999). MDA-related knowledge was measured using eleven points. The responses were categorized into three subgroups '1 = yes', '2 = no', and '3 = don't know'. Each response was then assigned a score '0' for 'no' and 'don't know' and '1' for 'yes'. The scores were summarized and evaluated. The same individuals were measured twice (pre-intervention and post-intervention) to assess the impact of HE on four variables between baseline and end-line: (1) causes of STHs, (2) symptoms of STHs, (3) preventive measures of STHs, and (4) importance of participating MDA. Quantitative data were analyzed using STATA 13 software, and McNemar's chi-square test was used to examine the level of knowledge scores. In all analyses, the level of significance was set at $p < .05$. Qualitative data were analyzed using Open Code 4.03 software-based on themes and frequency of themes. After transcription, a two-phase validation of the transcription was done. In the meantime, the translated data were read, reread, and then reviewed for familiarity with the data, to develop codes that identify important and common concepts related to the study objectives. After initial coding, categories and sub-categories were developed, modified and expanded based on patterns, similarities, and differences or contradictions. Categories and sub-categories were developed, modified, and expanded. The data was analyzed simultaneously with data collection and write-ups. Data triangulation was conducted by comparing results extracted from various participant clusters, geographical locations, and data collection instruments to ensure the consistency and reliability of the data.

3. Results

The socio-demographic characteristics of the respondents that participated in the study are shown in Tables 1 and 2. In the qualitative study, most of the study participants were female. The majority of participants in this study were within the age group "30–50 years" and farmer and/or independent by profession. For intervention, there were 640 participants at baseline (intervention = 320 and control = 320) and 622 (intervention = 318 and control = 304) at end line. The mean age of participants in the study population was 12.4 years (±SD 1.5 years), with the majority being from the lower-middle-class economic family and followers of both Islam and Hindu religion.

Exploratory data analysis performed on knowledge scores showed that data was normally distributed among the respondents. At baseline, there was no significant difference ($P = .14$) in mean knowledge scores between the intervention and the control groups (mean = 2.90 ± 1.50 vs. 3.03 ± 1.48). After HE implementation, there was a significant increase ($P = .00$) in mean knowledge scores in the intervention group compared to the control group (6.25 ± 1.44 vs. 3.32 ± 1.46). When assessing the knowledge score, we found a significant change in the mean score of the participants in the intervention group (3.35), whereas, in the control group (0.29), the mean scores were not statistically different at any level. There was a change in the mean of the knowledge score of the participants with a 2.30 mean change that was attributed to the effect of the intervention (Table 3).

Before conducting HE session in the intervention group revealed 108 (33.8%) pupils knew about the source of STHs. However, after HE session, 298 (91.5%) children responded that STHs is caused by parasites that are transmitted via contaminated soil or water bodies. Similar results were also found in knowledge about the symptoms of STH infection and preventive measures for STHs where, after HE intervention, that was increased 52 (16.3%) to 271 (85.2%) and 119 (37.2%) to 301 (93.4%) respectively in the intervention group. The pre-intervention assessment was revealed that 126 (39.4%) pupils did not clear ideas about the importance of participating MDA through most of them participated in the last MDA program. However, after HE intervention, 299 (95.9%) pupils mentioned the importance of participating in MDA regularly. On the other hand, no significant differences were observed before and after the HE intervention in the control group (Table 4).

The pre-intervention assessment of the wash hands with soap after using the toilet in the intervention group revealed that 39 (12.3%) using soap always, 190 (59.4%) using soap usually and 91 (28.4%) of the pupils sometimes using soap after toilet. However, after HE intervention, the number of pupils wash hands with soap after using the toilet al.ways increased to 154 (48.4%) and using soap sometimes reduced to 6 (1.9%). In the control group, no significant changes were observed in any categories of wash hands with soap after using the toilet. Significant changes were observed in the intervention group in both eat uncooked vegetables and wash hands with soap before a meal. Before the intervention, 71 (22.2%) pupils mentioned that they sometimes eat uncooked. However, it declined to 09 (2.8%) after the intervention. Similarly, 165 (51.6%) pupils mentioned that they were sometimes using soap to wash hands before a meal, which reduced to 05 (1.6%) after HE intervention. No significant differences were raveled in control group (Table 5).

The findings from the qualitative study are summarized in Table 6, which shows the minor themes for each of the significant themes generated as well as illustrative quotes from participants that correspond to the minor themes. Identifies community attitude regarding STHs MDA is represented by different sides of a common factor. On the other hand, supportive factors and identified barriers were found independent and unique. In this study, it was found that integration of HE with MDA is influenced by the interaction of contextual factors like knowledge and perceptions, adequate training, trust to program providers, effective policy to create social awareness and community health system structures. Identifying and assessing all of these related factors, which influence implementation outcomes, is crucial to achieving successful and effective implementation.

Table 1
Socio-demographic characteristics of qualitative study participants ($n = 56$).

Variables		Frequency	%
Geographic areas	Rural	46	82.1
	Urban	10	17.9
Gender	Male	11	19.7
	Female	45	80.3
Age (years)	<30	3	5.4
	30–50	44	78.6
	>50	9	16.0
Employment	Agriculture/Independent	48	85.7
	Job	8	14.3

Table 2
Socio-demographic characteristics of quantitative study participants (baseline, $n = 640$).

Variables		Control ($N = 320$)		Intervention ($N = 320$)		Total ($N = 640$)	
		n	%	*n*	%	*n*	%
Geographic areas	Rural	230	71.9	230	71.9	460	71.9
	Urban	90	28.1	90	28.1	180	28.1
Gender	Male	134	41.9	164	51.2	298	46.6
	Female	186	58.1	156	48.8	342	53.4
Age (years)	<9	80	25.0	80	25.0	160	25.0
	9–12	160	50.0	160	50.0	320	50.0
	>12	80	25.0	80	25.0	160	25.0
Religion	Islam	258	80.6	274	85.6	532	83.1
	Hindu	62	19.4	46	33.7	108	16.9

Table 3
Effect of intervention on mean knowledge score.

Group	Baseline		End line		Change	*P*-value
	Mean	SD	Mean	SD		
HE Intervention	2.90	1.50	6.25	1.44	3.35	0.00
Control	3.03	1.48	3.32	1.46	0.29	0.14
Difference			2.30		3.06	

Table 4
Effectiveness of HE intervention on STH and MDA knowledge.

KAP score	Baseline (N = 640)				End line ($N = 622$)				*P*-value
	C^B ($n = 320$)		I^B ($n = 320$)		C^E ($n = 304$)		I^E ($n = 318$)		
	n	%	*n*	%	*n*	%	*n*	%	
Cause of STHs	116	36.2	108	33.8	128	42.1	298	91.5	<0.001
Symptoms of STHs	63	19.7	52	16.3	57	18.8	271	85.2	<0.001
Preventive measures for STH	127	39.7	119	37.2	139	45.7	301	93.4	<0.001
Importance of participating MDA	134	41.9	126	39.4	137	45.1	299	95.9	<0.002

4. Discussion

This paper has focused on the field implementation of integrated health education intervention with existing MDA in two culturally different geographical areas in Bangladesh. To the best of our knowledge, this is the first report to assess the feasibility of a HE intervention on the MDA compliance of school-aged children in Bangladesh. While the MDA based strategy to control STHs is proven effective in achieving morbidity control, the government is still facing difficulties in achieving target MDA compliance. In our previous study (Nath et al., 2019), we explored and explained the barriers and gaps of ongoing STHs MDA implementation. Some of the important barriers, such as knowledge gaps, rumors about the side effects of MDA drugs, poor motivation among related stakeholders, and inadequate health promotional activities adversely affected the MDA compliance in Bangladesh (Nath et al., 2019). Misconceptions and knowledge gap concerning the disease, along with prevailing perceptions toward the control program were reported as a key factor for lower compliance by several authors (Njomo, 2012; Devarajan et al., 2016). There is

Table 5
Pre and post-intervention assessment on STH preventive behaviours.

		Intervention group				Control group				*P*-value
		Pre-intervention assessment ($n = 320$)		Post-intervention assessment ($n = 318$)		Pre-intervention assessment ($n = 320$)		Post-intervention assessment ($n = 304$)		
		n	(%)	*n*	(%)	*n*	(%)	*n*	(%)	
Wash hands with soap after using the toilet	Always	39	12.2	154	48.4	42	13.1	49	16.1	*0.000
	Usually	190	59.4	158	49.7	201	62.8	198	65.1	**0.208
	Sometimes	91	28.4	06	1.9	77	24.1	57	18.8	
Eat uncooked vegetables	Usually	16	5.0	00	0	11	3.4	14	4.6	*0.000
	Sometimes	71	22.2	09	2.8	83	25.9	78	25.7	**0.758
	Never	233	72.8	309	97.2	226	70.6	212	69.7	
Wash hands with soap before a meal	Always	52	16.3	281	88.3	65	20.4	61	20.1	*0.000
	Usually	103	32.3	32	10.1	107	33.3	107	35.2	**0.894
	Sometimes	165	51.6	05	1.6	148	46.3	136	44.7	

* *P* value in intervention group.
** *P* value in control group.

Table 6
Identified barriers and supportive operational factors of HE implementation.

Key themes	Illustrative quotes (FGDs & IDIs)
Supportive operational factors	
Positive attitude from parents	*"If this intervention is organized frequently, positive health messages would spread and the community get benefit from it. This could be used as a channel for community sensitization."* (Parents of school-aged children, FGDs)
Boldness to participate	*"The class was exciting. I learned so many things, played games and watched movie. All of my also happy and want to attend again."* (School children, FGDs)
Community support	*"The intervention has been beneficial because most of the peoples do not know about the harmful effects of parasites, and that is why they do not take MDA seriously. This program can solve this problem"* (Community opinion leader, IDIs)
School facilities	*"Yes, we have enough classrooms and classroom facilities. Every school also have 'khudhe doctors' team, and we can incorporate HE with this team."* (School teachers, IDIs)
Barriers	
Budget deficiencies	*"For implementing any intervention, money is important. The school doesn't have enough money for extra program implementation."* (School teacher, IDIs) *"Sometimes it hard gets sufficient support from the school teachers. Whatever they do for implementing MDA is enough, and you can not ask for more work without any incentives or rewards…"* (Community health officer, IDIs)
Teacher turnover	*"The overall facilities for primary school teachers are very poor. Most of the teachers are engaged with other works or extra business along with the job. It's quite difficult to motivate them and get maximum concentration to implement such an important intervention without any incentives."* (Community health officer, IDIs)
Inadequate human resources	*"Number of health assistant as well as school teachers is deficient almost in all areas. It's very difficult to manage time or to arrange a lecture or class with our routine duties…"*(Community health officer, IDIs)
Inadequate training	*"Till today, I did not get any training regarding the MDA program. As we know very little about the disease, we do not have sufficient confidence to conduct HE session (School* teachers, IDIs)
Family income	*"At least 15% children of this area are non-school going and engaged various works. Trying to catch up and arranging HE session for them will not be an easy job…"* (Community opinion leader, IDIs)

a need for additional public health measures like health education, which influence the different implementation stages, especially compliance. Therefore, this study was designed to evaluate the feasibility of integrating health education intervention with an ongoing MDA program to achieve target compliance.

Proper knowledge about the disease's consequences promotes preventive practices among the susceptible community and enhanced compliance of the control program. Amarillo et al. (2008) in the Philippines reported that persons who knew that disease was more likely to have participated in MDA than persons who did not. In our study, prior to HE intervention, we observed insufficient STHs preventive knowledge in both control and intervention groups. However, after implementation of HE, we found a significant increase in knowledge among the study participants. Poor knowledge and preventive behaviours might affect the community responses to MDA participation as well as compliance. HE interventions can successfully modify risk behaviours, thus participating in MDA and intake of drugs that can reduce the risk of STHs infection. Nasr et al. (2013) suggested that educating community people about the disease specifics is more efficient than implementing control intervention. The lack of proper and adequate communication led to decrease trust in providers and eventually led to a poor implementation outcome. Authenticating a change in knowledge is critical for proving that there was some improvement in attitude and behaviour, which shows that their actions resulted in a positive impact on disease prevention. The results of several studies in different settings also showed a similar increased effect in the post-intervention scores of the participants due to the health education (Moshki et al., 2017; Fawole et al., 1999; He et al., 2015). In this study, we assessed the feasibility of the integration of HE with MDA, especially for awareness

creation and information dissemination, and thus to achieve comprehensive community compliance. Our study also explored the opportunities and barriers of HE integration and, therefore, suggested investing more effort in educating community. There is a need for health promotional activities to make community sensitization (awareness, behavioural change, ownership, and partnerships) about MDA and the importance of participation. Establishing a collaboration between local health offices and education offices could increase program implementers' comfort with their role.

In this study, participants from both IDIs and FGDs stated that lack of resources was one of the foremost barriers to the sustainable implementation of HE. Swerissen and Crisp (2004) argued that consistent resources are required to ensure the sustainability of any control intervention. In the case of HE component of STHs control programs, these resources could include health-related training of school teachers. Unfortunately, the resources necessary to provide bi-annual or annual training sessions to schoolteachers may not be available as part of large-scale STHs control programs in impoverished areas. Many school teachers, especially in rural areas, were unaware of the severity of STHs infection. Moreover, our study also illustrated how financial constraint and teacher turnover could undermine the effectiveness of MDA. However, most school teachers expressed a positive reaction that could be a supporting factor in overcoming the limitation and positively impacting the program's implementation. Operational strategies should be taken to persuade school teachers to adopt regular health education practices. These findings are consistent with those of other studies conducted in resource-poor settings, where insufficient resources hindered the proper implementation of school-based health education interventions (Okoyo et al., 2016; Renju et al., 2010). The study conducted by Karki et al. (2018) focusing on factors that affect MDA compliance of *lymphatic filariasis* in Nepal, also described further evidence for the need for an adequate budget for any control intervention. Thus, our study's findings suggest the need for financial support to enhance treatment coverage and maintain a high level of consent during successive MDA implementation. To achieve the target MDA compliance, the government should seriously consider providing subsidy for “health education” alike other sectors that have received motivation during program implementation. The teachers might benefit from their additional works as well as support from local health and education administration.

By following these, reducing the difficulties in achieving target compliance of MDA in Bangladesh would require adopting HE intervention as an integrated framework approach. This work has the potentiality to be a framework for other NTDs because it illustrates the direct impact that HE can have on improving knowledge and awareness, and in changing preventive behaviour, thereby reducing the chances of re-infection and sustainable control. Strategic partnerships and collaborations are essential for effective integration because it requires sustained administrative and political commitment. Strengthen linkages and collaboration between other control program partners were focused on by the respondents of this study. The involvement of various partners would help to consider iteratively and efficiently, the connections between MDA for STHs and HE within the local health system. Further, it will provide insight into the public health outcomes of a multi-component integrated control program, where health education prevents re-infection, and periodic drug treatment is used to reduce prevalence and morbidity. Despite several limitations, including limited resources and time, the present study provides valuable findings regarding the feasibility of integration of HE interventions to promote compliance toward MDA of STHs among the target populations in Bangladesh. Once the intervention is established, it will be a very valuable program for replicating it in other areas of NTDs control, including dengue and malaria.

5. Conclusion

The study provided new insights into the feasibility, strengths, and limitations of integrating health education intervention to MDA targeting STHs in four rural communities of Bangladesh. Due to HE intervention, significantly increased mean knowledge score and behaviour changes were observed in this study. The findings hint that integration of HE with MDA is feasible in the local context of Bangladesh and its potential to improve compliance of ongoing MDA and reduce risks of STHs transmission. However, several factors like lack of capacity building, resource mobilization, inadequate monitoring, and teacher turnover could lessen the impact of integrated interventions in resource-poor settings. Careful consideration should be given to local political context when for the programmatic improvement and sustainability of the intervention. Despite these barriers and challenges, there are clear opportunities for using the HE intervention to effectively guide ongoing MDA and achieve target compliance to STHs control in Bangladesh and elsewhere with similar settings. With limited time and financial support, the present study has gathered valuable knowledge about the development of effective STHs elimination strategy. The study will serve as a base for conducting a full-scale implementation study intended to evaluate the effect of this integrated intervention.

6. Study limitations

The major limitation of this study is potential recall bias, particularly in school-aged children that could affect the accuracy and generalizability of its results. Social inequality and the economic status of a family might also have a concern for the observed effect. It should be noted that the choice of intervention group and control group from the same school might have a strong influence, as there is a possibility of cross-communication between intervention group and control group, which can reduce the power of the conclusion. Further fidelity studies with a large sample and different cultural settings are needed to validate the findings.

7. Research ethics

Permission to conduct the study at study areas was obtained from the local education and health administration of Bangladesh. There were no anticipated risks or discomforts. All respondents completed an informed consent form before the

interview. In the case of school-age children, consent was taken from their parents or local guardians. Local language (Bengali) was used during all levels of data collection. This study protocol was reviewed and approved by the Department of Parasitology, Chungbuk National University, South Korea and Department of Parasitology, Sylhet Agricultural University, Bangladesh.

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Availability of data and materials

The datasets used during the current study available from the first author and corresponding author on reasonable request.

Author contributions

All authors reviewed and provided feedback for this manuscript. The final version of this manuscript was vetted and approved by all authors.

Declaration of Competing Interest

There is no conflict of interest declared by any of the authors.

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