

# Impact of School Based Health Education on Knowledge, Attitude and Practice of Grade Three Primary School Children in Zimbabwe

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## Abstract

**Objective:** Grade three children (9-10 years) are recommended as the optimal study population for assessing community prevalence of schistosomiasis and soil transmitted helminthiasis (STHs). However their knowledge, attitudes and practices (KAP) of these children in relation to schistosomiasis, and malaria is not known.

**Methods:** Using multistage sampling, grade 3 children (n=172) were randomly selected from four primary schools in Shamva and Mutare districts in Zimbabwe. And were interviewed using a pre-tested interviewer administered questionnaire. The urine filtration technique was used to determine *S. haematobium* infection status. Infection with *S. mansoni* and STHs was determined using a combination of results from the Kato Katz and formol ether concentration techniques. *P. falciparum* was diagnosed by examination of Giemsa stained thick blood smears.

**Results:** The baseline knowledge proportions about the disease causes among the children were schistosomiasis (32.0%), STHs (19.2%) and malaria (4.1%) which increased after intervention to 67.4%, 71.5%, and 55.8%, respectively. Knowledge of school children about prevention measures of the same diseases improved from schistosomiasis (22.1%), STHs (19.2%), and malaria (5.8%), respectively at baseline to schistosomiasis (69.2%), STHs (66.3%) and malaria (59.3%), respectively. Prevalence of *S. haematobium*, *S. mansoni*, hookworms and *P. falciparum* declined from 61.2%, 17.7%, 7.3% and 21.2% at baseline to 15.9%, 3.4%, 4.1%, and 6.8% respectively. Mean infection intensities for *S. haematobium* and *S. mansoni* decreased by 94.8% and 96.6% respectively.

**Conclusion:** School based health education improves knowledge of children about disease transmission and control measures. However lack of enabling amenities such as soap, safe and clean water, ITNs in schools and the involvement of the community are yawning gaps that deserve urgent filling.

**Keywords** School health promotion; Knowledge; Attitudes and practice; Malaria; Helminthiasis

## Introduction

The World Health Organisation (WHO) recommends that, baseline data collection has to be collected before the control strategy is selected in areas where schistosomiasis and soil transmitted helminthiasis (STHs) control programmes are to be initiated, as this would allow monitoring and evaluation of control strategies [1]. It also recommends that, a group of students in grade 3 (9 and 10-year-olds) should normally be considered as the study population for baseline surveys and for the periodic evaluations throughout the programme, because of the epidemiological importance of this age group with respect to intestinal helminth and schistosome infections [1]. On the other hand, Guyatt et al. recommended that school ages children are the best target population for the estimation of community prevalence

of Helminths, since the prevalence of helminths in this age group is slightly above that at community level [2]. These recommendations are based on the field based studies indicating that children aged 9-10 years harbour the highest prevalence of schistosomiasis in the community, because of their water conduct activities [2-4]. The same age group is also at high risk for infection with STHs [2,5,6].

Overlap of schistosomiasis, STHs and malaria exist among primary school children in Sub-Saharan African countries [7,8] and coincidentally the age group 9-10 is depicted as more susceptible to helminthes-plasmodium co-infections [9]. However, whilst this age group is the most vulnerable to schistosomiasis-STHs and malaria infection or helminths-Plasmodium co-infection with devastating consequences to affected children in areas with co-endemicity [9-12], surprisingly little attention has been given to investigate knowledge attitudes and practice of this specific age group in relation to schistosomiasis, STHs and malaria. The impact of school based health education on knowledge and extend of behaviour modification among

this target population is not known, yet modification of human practice, a product of health promotion is among the mainstays of schistosomiasis, STHs and malaria control [1,13,14]. Health Promoting Schools also helps to improve students' health knowledge and practices to combat the challenge of communicable diseases [15].

Given the high prevalence of schistosomiasis in Zimbabwe among the age group 9-10 years [3,4] and the observed helminths - Plasmodium co-infection among primary school children [8], we conducted this study with the main aim of undertaking a participatory action research in four primary schools in rural and commercial farming areas in Zimbabwe. The study was conducted in order to improve knowledge of primary school children in relation to schistosomiasis, STHs and malaria so that they would modify their practices relevant for reducing transmission of these diseases. The specific question set up to be answered was: If School based health education improves knowledge of children about disease transmission and control measures. The result would have significant impact on the future planning, implementation and substantiation of health promotion in schools as the country has already drafted a National plan of action for control of schistosomiasis and STHs adopting the school based approach.

## Methods

### Study areas and population

The survey was conducted in grade three children (n=172) living in Nyamaropa rural area (49.4%) that is located in Shamva district, Mashonaland Central Province and Burma Valley commercial farming area (50.6%), located in Mutare district, Manicaland Province. The study areas are described in detail elsewhere [9].

### Study design

This was an intervention follow up KAP study as part of a main longitudinal intervention study that investigated the distribution of polyparasitism with schistosomiasis, STHs and *P. falciparum* among primary schoolchildren in rural and farming areas in Zimbabwe. This study is entitled; Impact on anaemia and the effectiveness of regular school based deworming and prompt malaria treatment [8].

### Sampling scheme and sample size

Using multistage sampling, 172 children were randomly selected from four primary schools in Shamva and Mutare districts in Zimbabwe, the rotary method was used to select randomly the above two districts from seven districts in the province. And this KAP follow up study was based on the sampling scheme of the main study described elsewhere [12].

### Inclusion and exclusion criteria

Only the grade 3 children were included in the KAP study. Their KAP were perceived as proxy of their parents/ guardians since at this level the children's primary school syllabus does not include such diseases (personal communication with grade 3 teachers, 2004). Children who did not respond to the questionnaire were excluded.

### Parasitological investigations:

As part of the main study, participants were screened for *S. haematobium*, *S. mansoni*, soil transmitted helminths (*A. lumbricoides*, *T. trichiura* and hookworms) and *P. falciparum* using quantitative and qualitative parasitological techniques [7]. The urine filtration technique was used to determine *S. haematobium* infection status. Infection with *S. mansoni* and STHs was determined using a combination of results from the Kato Katz and formol ether concentration techniques. *P. falciparum* was diagnosed by examination of Giemsa stained thick blood smears.

### KAP studies and health education

A questionnaire that contained questions on demographic data, sources of water, sanitary facilities, Knowledge of participants about causes and preventive measures for schistosomiasis, STHs and malaria, attitudes and practice of children was designed, pre-tested and administered by the trained research team at the beginning of the main study (June 2004). Results of the baseline KAP study were used to design health education that was administered in schools beginning at 6months follow up survey. Health education material was left in schools for school teachers to continue school health promotion through education whilst the research team was away. At 12 months follow up survey, KAP studies were repeated again.

### School health education

Health education was conducted in two ways.

(1) The research team introduced health education material to the school authorities before introducing it to school children. Teachers were taught how to use the flip chart that contained health education material about schistosomiasis. A single flip chart designed by JICA, was given to each school and the teachers were asked to circulate the chart in turns on weekly bases so that each class would have a chance to learn from the teacher about bilharzia. The lessons would be done during free periods as this intervention had not been formally fitted into the school syllabus.

(2) The research team provided health education to school children each time they visited the schools using the same material prepared after baseline KAP survey. Focus group discussions were conducted by the research team with school children all assembled outside their classes. Health education leaflets about malaria schistosomiasis and STHs written in local language were distributed to all school children irregardless of their participation in the KAP study. Children were asked to read these leaflets and to share the health information with their friends and families.

As part of health education, children were taught about the signs and symptoms of malaria. They were asked to seek prompt treatment from the nearest clinic should they experience malaria symptoms.

### Treatment

Schistosomiasis and STHs were treated in school by the research nurse at baseline, 6, 12 months follow up surveys respectively. A Praziquantel and albendazole was administered to infected children. Combined administration of albendazole and Praziquantel was given at the same time if children had schistosomiasis + STHs co-infection otherwise single drug treatment would be administered in mono-infections.

Malaria was treated based on two indicators of infection (i) Children diagnosed of malaria parasitologically by the research team would be by the research nurse without delay. This procedure was only done when the team was in the field. (ii) In the absence of the research team children were asked to seek prompt malaria treatment from the nearest clinic based on any of the following symptom: cold chills, shivering, muscles and joint pains, nausea and vomiting, head ache and flue like cough.

### Data collection and analysis

Data collected were entered into SPSS 8.0 and analysed using SPSS 8.0 software package. Chi-square and McNemar's test were used where appropriate. The percentage reduction in prevalence and infection intensities was calculated. Also 95% confidence intervals were calculated to compare different proportions of response regarding the KAP between children living in rural and farming areas and also between pre- and post-intervention surveys. Some sections of our results are reported elsewhere but they are included in this study to demonstrate intervention effect.

### Results

The demographic data included in the (KAP) follow up studies before intervention in June 2004 and in February 2004 after school based health education combined with antihelminthic and prompt malaria treatment is shown in Table 1. The mean age (SD) of children (n=172) included in the study was 9.8 (1.25) years, range (7-15years). The proportion of females (53.5%) was significantly more than that for males (46.5%),  $\chi^2 = 6.699$ ,  $p=0.010$

Variable	Frequency	%
Site		
Farming area	87	50.6
Rural area	85	49.4
Gender		
Male	80	46.5
Female	92	53.5
Age-group (years)		
7-May	3	1.7
10-Aug	133	77.3

13-Nov	35	20.3
≥ 14	1	0.6
Ethnicity		
Shona	140	81.3
Zezuru	16	9.3
Ndau	8	4.7
Ndebele	2	1.2
Others	6	3.5
Religion		
Christian	152	88.4
Traditionalist	14	8.1
Islam	1	0.6
Others	5	2.1

**Table 1:** Distribution of 172 children who participated at pre-and post-intervention surveys

### Impact of combined school based health education and chemotherapy on schistosomiasis, STHs and malaria infection

Table 2 describes the proportions of schistosomiasis, hookworms and malaria among grade 3 children before and 12 months after combined school based health education and chemotherapy. The overall effect of the intervention strategy on the prevalence of schistosomiasis, hookworms and malaria is shown by the corresponding percentage prevalence reductions. McNemar's test revealed a significant reduction in proportion of children with *S. haematobium* and *S. mansoni*, ( $p<0.001$ ), *P. falciparum* ( $p=0.001$ ). Although there was a reduction in hookworm prevalence, it was not significant ( $p=0.180$ ). The overall mean infection intensities for *S. haematobium*, *S. mansoni* and hookworms (pre-intervention vs post intervention) were (64.9e/10ml vs 3.4e/10ml), (26.7epg vs 0.9epg) and (16.6epg vs 18.4epg) respectively. The percentage decrease in mean infection intensities for *S. haematobium* and *S. mansoni* were 94.8% and 96.6% respectively. Hookworm infection intensity increased from pre- to post intervention survey by 10.4%.

Disease	Overall % (95%CI) n	Farming area % (95%CI) n	Rural area % (95%CI) n	$\chi^2$ –test p-value
<i>S. haematobium</i>	61.2(47.6-69.4) 170*	58.8(47.6-69.4)85*	63.5(50.4-73.7) 85*	0.433
Before intervention	15.9(10.5-22.7) 151	15.6 (8.3-25.6)77	16.2(8.7-26.6) 74	0.915
After intervention	73.8	72.9	74.5	
Prevalence reduction (%)				
<i>S. mansoni</i>	17.7(32.3-57.5) 164*	14.5(7.7-23.9) 83* 2.8(0.3-9.7) 72	21.0(12.7-31.5) 81*	0.290
Before intervention	3.4(1.1-7.8) 145	80.7	4.1 (0.9-11.5)73	0.660
After intervention	80.8		80.5	
Prevalence reduction (%)				

Hookworm	7.3(3.8-12.4) 165	14.3(7.6-23.6) 84	0.0 (0.0) 81	<0.001
Before intervention	4.1(1.5-8.8) 145	8.3(3.1-17.3) 72	0.0 (0.0)73	0.012
After intervention	43.1	42.0	N/A	
Prevalence reduction (%)				
<i>P. falciparum</i>	21.2(14.2-29.7) 118*	32.5(22.2-44.1)77*	11.8	0.0 (0.0)41
Before intervention	6.8(3.1-12.5)133	(5.6-21.3)76		0.0 (0.0)57
After intervention	67.9	63.7	N/A	<0.001
Prevalence reduction (%)				0.007

Table 2: Impact of integrated school based deworming, prompt malaria treatment and health education on parasite infection

\*McNemar’s test of significant difference from baseline to 12 months follows up survey, p<0.05

### Impact of intervention on knowledge of grade three children about the causes of schistosomiasis, STHs and malaria

The impact of school based health education on knowledge of participants about causes of schistosomiasis, STHs and malaria is described (Table 3). The results show that of the 172 grade 3 children interviewed at pre-intervention, a small proportion of them knew the causes of schistosomiasis, malaria and STHs. None of children living in the rural area knew about causes of STHs. The results also revealed

that at pre-intervention, children living in the farming area had more knowledge about the causes of the diseases under investigation compared to those living in the rural area. A significant difference in knowledge about causes of malaria was observed between children living in the two areas (Table 3). Knowledge attitudes and practice studies after school based health promotion campaign combined with chemotherapy showed an overall improvement in children’s knowledge about the causes of schistosomiasis, malaria and STHs (Table 3). However the results revealed that compared to the farming area, a greater proportion of children living in the rural area knew about the causes of schistosomiasis, STHs and malaria after the intervention as opposed to the pre-intervention level (Table 3).

Disease	Aspect	Overall % (95%CI) n	Farming area % (95%CI) n	Rural area % (95%CI) n	χ <sup>2</sup> –test p-value
Schistosomiasis	Correct knowledge about causes* before intervention (2004)	32.0 (25.1-39.5) 172	36.8 (26.7-47.8) 87	27.1 (18.0-37.8) 85	0.172
	Correct knowledge about causes after intervention (2006)	67.4 (59.9-74.4) 172	56.3 (45.3-66.9) 87	78.8 (68.6-86.9) 85	0.002
Malaria	Correct knowledge about causes* before intervention (2004)	19.2 (13.6-25.9) 172	26.4 (17.6-37.0) 87	11.8 (5.8-20.6) 85	0.015
	Correct knowledge about causes after intervention (2006)	71.5 (64.1-78.1) 171	66.7 (55.7-76.4) 87	76.5 (66.0-85.0) 85	0.169
STH	Correct knowledge about causes before intervention (2004)	4.1 (1.7-8.2) 172	5.7 (1.9-12.9) 87	2.4 (0.3-8.2) 85	0.084
	Correct knowledge about causes after intervention (2006)	55.8 (48.1-63.4) 172	51.7 (40.8-62.6) 87	60.0 (48.8-74.5) 85	0.260

Table 3: Schoolchildren’s knowledge about causes of schistosomiasis, STHs and malaria before and after intervention

\*McNemar’s test of significant difference, p<0.05

### Impact of intervention on knowledge of grade three children about control measures for schistosomiasis, STHs and malaria

Table 4 describes the impact of intervention on the knowledge of children about the best ways to prevent schistosomiasis, STHs and malaria. The results show an improvement of knowledge of children about the diseases. McNemar’s test showed that twelve months of school based health education and treatment intervention improved knowledge of children about the prevention measures for

schistosomiasis, malaria and hookworms (p<0.001). The results also showed that a greater proportion of children living in the rural area had acquired knowledge about the best practice to control schistosomiasis and STHs compared to those living in the farming area. Although there was no significant difference in knowledge about the preventive measures for malaria between the rural and farming areas, the results demonstrate a greater improvement in the proportion of children who knew the best ways to prevent malaria in the rural area compared to the farming area following health education intervention (76.5%, 95%CI: 66.0-85.0 vs 66.7%, 95%CI: 55.7-76.4)

Disease	Aspect	Overall % (95%CI)n	Farming area % (95%CI)n	Rural area % (95%CI)n	χ <sup>2</sup> –test p-value
Schistosomiasis	Correct knowledge about preventive* measures before intervention (2004)	22.1 (16.1-29.0) 172	26.4 (17.6-37.0) 87	17.6 (10.2-27.4) 85	0.165
	Correct knowledge about preventive measures after intervention (2006)	69.2 (61.7-76.0) 172	54.0 (43.0-64.8) 87	84.5 (75.3-91.6) 85	<0.001
Malaria	Correct knowledge about preventive* measures before intervention (2004)	19.2 (13.6-25.9) 172	25.3 (16.6-35.7) 87	12.9 (6.6-22.0) 85	0.040
	Correct knowledge about preventive measures after intervention (2006)	66.3 (58.7-73.3) 172	64.4 (53.4-74.4) 87	68.2 (57.2-77.9) 85	0.630
STH	Correct knowledge about preventive* measures before intervention (2004)	5.8 (2.8-10.4) 172	8.0 (3.3-15.9) 87	3.5 (0.7-10.0) 85	0.206
	Correct knowledge about preventive measures after intervention (2006)	59.3 (51.6-66.7) 172	50.6 (39.6-61.5) 87	68.2 (57.2-77.9) 85	0.022

Table 4: Schoolchildren’s knowledge about prevention measures for schistosomiasis, STHs and malaria before and after intervention

\*McNemar’s test of significant difference, p<0.05

### Impact of school based health education on practice of children in relation to schistosomiasis and STHs transmission

#### (i) Hand washing before eating food and after toilet

Practices of children in relation to schistosomiasis and STHs before and after school based health education are described in table 5. The results revealed that of 172 respondents, a greater proportion reported that they would always wash their hands before eating food at pre-intervention compared to those who reported a similar practice after intervention (75.6%, 95%CI: 68.5-81.8 vs 48.8, 95%CI: 41.2-56.6 respectively). Among those who indicated that they sometimes or always washed their hands before eating food, only 11.6 % (95%CI: 7.2-17.4) reported that they would always wash their hands with soap, 44.8% (95%CI: 37.2-52.5) of the respondents reported that they never used soap when washing hands and 43.6% (95%CI: 36.1-51.4) reported that they used soap sometimes. After intervention, a majority of the respondents (69.8%, 95%CI: 62.3-76.5) indicated that they sometimes washed their hands with soap before eating food and only 6.4% (95%CI: 3.2-11.2) stated that they would always use soap when washing their hands before eating food.

Among those children who said they would always or sometimes wash their hands after toilet, a greater proportion of respondents (47.1%, 95%CI: 39.5-54.8) indicated that they did not use soap to wash their hands and only 9.9% (95%CI: 5.9-15.4) said they would always wash their hands with soap after toilet following school based health education.

#### (ii) Swimming and disposing of excreta near the river

Table 5 also describes the practice of respondents in relation to schistosomiasis transmission. Before school based health education about schistosomiasis causes and its control measures, 53.5% (95%CI: 45.7-61.1) indicated that they swam in streams, rivers or dams.

However after intervention there was a significant decrease in the proportions of children who still reported that they swam in the same water reservoirs (25.0%, 95%CI: 18.7-32.2) whilst the proportion of children who reported that they did not swim in the river or dams significantly increased from 46.5% (95%CI: 38.8-54.3) to 75.0% (95%CI: 67.8-81.3). The respondents also demonstrated that they reduced their frequency of swimming in the rivers or dams after school health educations (Table 5). Similar trends in reduction of pre-disposing practice to schistosomiasis were observed when respondents were asked if they urinated or defecated near the river before and after intervention.

Practice	Before intervention		After intervention	
	n	%	n	%
Hand washing before eating food				
Every time	130	75.6	84	48.8
Sometimes	42	24.4	88	51.2
Hand washing with soap before eating food				
Always	20	11.6	11	6.4
Sometimes	75	43.6	120	69.8
Not at all	77	44.8	41	23.8
Hand washing after using toilet				
Always	74	43	70	40.7
Sometimes	69	40.1	79	45.9
Not at all	29	16.9	23	13.4

Hand washing with soap after toilet				
Always washes hands with soap	24	14	17	9.9
Sometimes washes hands with soap	29	16.9	59	34.3
Do not wash hands with soap after toilet	90	52.3	81	47.1
Do not wash hands after toilet	29	16.9	15	8.7
Swimming in the river/ dam				
Yes	92	53.5	43	25
No	80	46.5	129	75
Participants' frequency of swimming				
Does not swim in the river/pond	80	46.5	116	67.4
Once/twice per week	50	29.1	15	8.7
Every other day	18	10.5	15	8.7
Once/twice per month	9	5.2	16	9.3
Everyday	8	4.7	2	1.2
Once every two months	7	4.1	8	4.7
Urinating near the river				
Yes	71	41.3	39	22.7
No	101	58.7	133	70.3
If participants defecate near the river				
Yes	51	29.7	23	13.4
No	121	70.3	149	86.6

**Table 5:** Participants' practice in relation to STHs and schistosomiasis transmission before and after school health education

### Impact of school based health education on practice of children in relation to hookworms and malaria transmission

The impact of health education on children's practices in relation to malaria and hookworm transmission is described in Table 6. There was an insignificant increase in the proportion of children who reported that they used ITNs from base line (15.7%, 95%CI: 10.6-22.0) to post intervention survey (22.1, 95%CI: 16.1-29.0). This was

regardless of children's improved knowledge about causes and preventive measures for malaria (Tables 3 and 4).

Of the 172 participants 82.6% (95%CI: 76.0-87.9) reported that they helped their families farming at home before intervention. There was a slight decrease in the proportion of children who gave a similar response after school based health education (79.7%, 95%CI: 72.9-85.4). Also an insignificant increase in proportion of respondents who reported that they wore shoes from pre-intervention (72.1%, 95%CI: 64.8-78.7) to post intervention (78.5%, 95%CI: 71.6-84.4) was observed. The respondents who said they would sometimes wear shoes or always wear shoes were asked when they would not wear shoes. Of 172 respondents 59.3% (95%CI: 51.6-66.7) and 54.1% (95%CI: 46.3-61.7), 30.8 % (95%CI: 24.0-38.3) and 16.3% (95%CI: 11.1-22.7), 25.6 (95%CI: 19.2- 32.8) and 22.1% (95%CI: 16.1-29.0) reported that they removed shoes when at home, during recreation and during farming at both pre- and post intervention surveys respectively (Table 6).

Practice	Before intervention		After intervention	
	n	%	n	%
Use of ITNs				
Yes	27	15.7	38	22.1
No	145	84.3	134	77.9
If participants help families farming at home				
Never helped parents farming	30	17.4	35	20.3
Helped parents farming	142	82.6	137	79.7
If participants' have shoes				
Yes	124	72.1	135	78.5
No	48	27.9	37	21.5
Conditions when participants do not wear shoes (Multiple responses)				
When at home	102	59.3	93	54.1
During recreation	53	30.8	28	16.3
During farming	44	25.6	38	22.1
In classroom	24	14	2	1.2
When fishing	12	7	4	2.3

**Table 6:** Participants' practice in relation to hookworms and malaria transmission before and after school health education

### School amenities

None of the schools included in our study had a functioning water point with running water and soap for children to wash their hands after toilet or before eating food.

## Discussion

Our study has shown that consolidating treatment with health education in schools have a potential to reduce the prevalence of schistosomiasis, STHs and malaria (Table 2, 4 and 5). Health education encouraging children to seek prompt malaria treatment based on signs and symptoms taught in school could have contributed to the observed decline in prevalence of malaria (Table 2). These observations are corroborated with studies conducted elsewhere [16-18].

The observed better improvement of knowledge in the rural area compared to the farming area at post intervention could be due to the more formal nature of education in the rural area as compared to the farming schools. In the farming area, children are most often absent from school. The school teachers, furniture and classroom complement, is inadequate (personal observation 2004-2007). These conditions have a negative influence on the learning behaviour of children leading to reduced school performance.

The low utilization of ITN by school children observed in our study before and after school based health education (Table 6), is not at all phenomenal as over the years the global efforts to control malaria has been directed mainly at two most vulnerable groups: children <5years and pregnant women [19] almost neglecting school aged children (5-15 years). In a study carried out to assess bed net use and non-use after ITN distribution in five countries Vanden Eng et al. observed that children 5-15 years were one of the least likely group to sleep under ITNs [20]. Our study was not associated with nets distribution. Also, our study population was drawn from the communities with low socio-economic status, mainly subsistent farmers in the rural area and lowly paid farm workers in commercial farming areas, conditions that could influence ITN ownership and use among dependent school children. Such marginalized but high risk populations could benefit from the universal population coverage for all people at risk of malaria, a recently launched Global Malaria Action Plan [21] if the coverage of this strategy would effectively engulf Sub-Saharan Africa countries that are still bellow RBM targets for ITN ownership [22].

The high proportion of children who reported that they washed hands with soap sometimes after health education intervention compared to a small proportion that reported using soap always when washing hands, and the lack of improvement in hand washing practice before handling or eating food even after health education in schools (Table 5) demonstrate that hand washing with soap is given little attention in homes especially in developing countries where resources are scant. Thus children could have failed to receive the much needed support from their parents to whom they are dependent for soap and water (enabling and reinforcing factors described by Ekeh and Adeniyi) [24]. Our results are corroborated by a study conducted by Curtis and Cairncross in which they observed that in 9 studies reporting rates of hand washing with soap after stool contact in developing countries, the median rate of hand washing with soap after defecation was only 14% and 13% after cleansing up a child.

A weakness on the part of our intervention was that it focused on health education and treatment only without also intervening in provision of enabling and reinforcing factors such as mosquito nets, soap, and running water in schools to facilitate children's participation in school hygienic practices (washing hands after toilet, before eating or handling food) and protection. Whilst children may have gained good knowledge on best practices as taught in school, they are bound not to practice them without parental or school support with the

necessary amenities. Thus provision of knowledge alone without provision of enabling and reinforcing factors will do little in modifying behaviour of children living in poor resource areas.

Our study has shown that whilst improvement of health literacy can help individuals to tackle the determinants of health better as it builds up the personal, cognitive and social skills which determine the ability of individuals to gain access to, understand and use of information to promote and maintain good health, health behaviours are strongly determined by the different social, economic and environmental conditions of individuals. Our intervention strategy managed to improve knowledge of children regarding causes and best practices to control schistosomiasis, malaria and STHs (Tables 3 and 4). Thus in addition to treatment, health education may have contributed to the reduced transmission of schistosomiasis, by reducing exposure of children to contaminated water through reduction of practice of swimming in rivers, dams or streams and prevention of environmental contamination by discouraging urinating or defecating near water reservoirs (Tables 2 and 5). However as with regards to practices aimed at preventing malaria (sleeping under ITNs, access to treatment, wearing of long robes at night and application of repellents), hookworm transmission (wearing of shoes), *A. lumbricoides* and *T. trichiura* (hand washing with soap after toilet and before handling or eating food), reliance was based upon the social norms and socio-economic status of the communities from where the study population was drawn as these had an influence on children's behavioural change.

We therefore conclude that integrated school based health education plays an important role in improving children's knowledge and their adoption of preventive behaviour in relation to helminthiasis and malaria, thus sustaining long term control of these diseases. However more effort is urgently required to implement strategies that incorporate provision of children access to protection such as provision of ITNs to school children, safe water, soap and sanitation in schools and involvement of supportive communities that extend provision of enabling and reinforcing factors (shoes) at home in order to enhance an effective school health promotion and to facilitate replication of behaviour adopted in schools at home. Such a consolidated approach in school health promotion would not only reduce transmission of helminthiasis and malaria but also other life threatening diseases such as respiratory infections, cholera, shigellosis, and dysentery that are cost effectively prevented by adopting simple good hygienic practices. Curtis and Cairncross observed that hand washing with soap was associated with 48% reduction in severe enteric infections and a 59% reduction in shigellosis.

## Competing Interests

The author(s) declare that they have no competing interests

## Authors' Contributions

TM, NM, NK, KCB and GW contributed to the concept and design of the study protocol; NM, DS, SZ, TM and VC carried out the clinical assessment and parasitology; TM, NM, MG; MPM and GN carried out the analysis and interpretation of the data; GN, NM and TM drafted the manuscript. All authors read and approved the final manuscript. GN, NM and TM are guarantors of the paper.

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