Effects of Public Health Interventions on Intestinal Parasitic Infections among School-Going Children in Murang'a County, Kenya

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Summary

BACKGROUND

WHO indicates that intestinal parasitic infections form at least of a quarter of all human infections globally, affecting at least 2 billion people. School-going children are the worst affected by these infections with devastating effect on their growth and cognitive development. Following the WHO recommendation to control intestinal parasitic infections by deworming children in schools, the Government of Kenya rolled out School Deworming Program under the School Health Program in 2009. Despite the program, the prevalence of intestinal helminthic and protozoan infections remain high at 53.5% and 14.8% respectively. The main objective of the study was to investigate the effects of Public Health intervention on intestinal parasitic infections among school going children in Murang'a County, Kenya.

MAIN OUTCOMES MEASURES

Reduction of intestinal protozoan and helminthic infections among the pupils in the intervention group

MATERIALS AND METHODS

Six schools randomly selected from the County were assigned into intervention and control arms. Stool samples were collected before from four hundred (400) pupils from both the intervention and control arms. Stool samples were prepared using standard procedures and examined under light microscope to identify intestinal protozoa and helminthes. Public health interventions were implemented in the intervention arm, then stool samples tested again and a comparison of the prevalence compared between the intervention and control arms.

RESULTs

In the intervention schools, there was a significant reduction of intestinal protozoan from 55.1% to 6.0% (t=12.6, P=0.13), and of intestinal helminthic infections from 12.4% to 0.0% (t = -3.78, P<0.001).

CONCLUSIONS

This has led to the conclusion that public health interventions influenced the reduction of the prevalence of intestinal parasites.

***Key words**: Public Health Interventions, intestinal protozoan infections, intestinal helminthic infections, reduction, school health program*

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Introduction

World Health Assembly passed a resolution [1] in 2001 urging member countries to start seriously tackling worms, specifically schistosomiasis and soil-transmitted helminthes. To this end, Kenyan government rolled out a school deworming program in 2008 under the school health program. By 2008 an estimated five million (56.8%) of school going children aged 5-14 years in Kenya were affected by intestinal parasitic worms [2]. The soil-transmitted helminths include *Ascaris lumbricoides*, *Trichuris trichiura*, *Necator americanus* and *Ancylostoma duodenale*, all occurring in areas where sanitation is poor [3].

There has been scanty information on the prevalence of intestinal protozoan infections as most of the studies have investigated them amongst other parasites. However, the available literature shows widespread intestinal protozoan infections in many parts of the country. A study by Nguhiu *et al.*,[4] reported intestinal protozoan parasitic prevalence of 12.6% in Kitui. Kisavi *et al.*, [5] later reported a higher prevalence of 38.6% in the same County. Nyarang'o *et al.*, [6] reported a prevalence of 11.9% of *Entamoeba histolytica* among the food handlers attending Kisii hospital. Another prospective study among children age less than six years found a prevalence of 4% of cryptosporidium [7]. Another study in Thika by Ngonjo *et al.*, [8] found an overall prevalence of protozoan infections was 46.3%, 38.9%, 34.8% and 28.7% for Peri- urban, rural, slum and urban schools respectively.

According to Eldash *et al.*, [9], soil-transmitted helminthes are the main cause of abdominal disease burden in school-age children in developing countries, often resulting in school absenteeism [9]. A study by Opara *et al.*, [10], associates intestinal parasitic infections with malnutrition among children, including anaemia and stunting.

Despite the school health program under which mass deworming of pupils is conducted, Global Atlas for Helminthic Infections (GAHI) had indicated that there is high transmission of intestinal helminthic infections in Murang'a County [11]. Report from Maragua level 4 hospital, one of the main hospital in the County, indicated a high prevalence of intestinal parasites in the study area. This study found that school going pupils were still infected with intestinal protozoan and helminthic infections. Therefore, this study was conducted with an aim to establish the effects of public health interventions on the prevalence of intestinal protozoan and helminthic infections among the school-going children in Murang'a County.

The main objective of the study was to establish the effects of public health interventions of the prevalence of intestinal helminths and protozoan infections among the school-going children in Murang'a South Sub-County, Murang'a County, Kenya.

Materials and methods

This was a quasi-experimental study conducted in three phases; baseline, intervention and post-intervention phases. At the baseline six primary schools randomly selected assigned to intervention and control arms. A total of 400 pupils from all the schools were invited to provide stool samples for examination of intestinal parasitic infections. Participating pupils were asked to collect a stool sample in a poly pot in hygienic manner. The pupils were trained on how to put the specimen in the poly pots hygienically, and were supplied with sufficient toilet paper. A research assistant accompanied each pupil to ensure reliability as well as offer any necessary assistance. Graduate medical laboratory technologist examined the specimen using Ritchie formol-ether concentration technique which has been used in other similar studies [12]. All pupils with intestinal parasitic infections from all schools

were treated and some of them referred to health facilities.

In the intervention phase, tippy taps were set up in strategic positions for hand washing, soap was provided for hand washing and detergent provided for cleaning latrines in the intervention schools. Hygiene lessons were conducted twice a week in each intervention school for a period of three months. The lessons included, among other things, demonstration of how to wash hands using songs and role-plays. Information Education and Communication (IEC) materials such as flyers and posters were provided in those schools.

A post intervention phase, an evaluation was conducted to assess the effect of these interventions in the reduction of intestinal protozoan and helminthic infections among the pupils in both arms. Data was analyzed using SPSS version 20. To determine the prevalence of intestinal helminthic infections, we analyzed stool sample results by computing percentage of infected pupils from each school. The same procedure was followed to determine the prevalence of intestinal protozoan infections. To establish the effects of public health interventions on parasitic infections t-test was used to compare prevalence of infections before and after interventions, in both intervention and control groups.

Results

Demographic data

Out of 400 pupils who participated in the study, 48.8% were males and 51.2% females. They were between 5 years to 15 years old. Sixty-nine percent (69%) of the pupils had both of their parents, while 22.3% of them lived with their mothers only; 2% lived with fathers only and 6.8% lived with grandparents/ uncles/ aunties or siblings. Majority of their guardians were farmers as summarized in table 1.

Prevalence and Distribution of Intestinal Protozoan and helminthic infections before intervention

Fifty-nine (14.8%) pupils were found to be infested with helminths while 214 (53.5%) were infested with intestinal protozoan infections as summarized in table 2.

Table 1: Demographic Characteristics of the Pupils Examined

Characteristic		No. of Examined
Sex	Male	195 (48.8%)
	Female	205 (51.2%)
Age	5-6	10 (2.6%)
	7-8	61 (15.2%)
	9-10	104 (26.0%)
	11-12	119 (29.7%)
	13-15	106 (26.5%)
Guardianship	Father and mother	276 (69%)
	Mother only	89 (22.3%)
	Father only	8 (2%)
	Others	27 (6.8%)
School	Kianjiru-ini	78 (19.5%)
	Matanya	52 (13.0%
	Kimorori	69 (17.3%)
	Ichagaki	77 (19.3%)
	Kagaa	54 (13.5%)
	Peter Kariuki	70 (17.5%)

Table 2: Prevalence and Distribution of Infections

Characteristic		Helminth infected	P value	Protozoa infected	P value
Sex	Male	23 (31.0%)	0.104	109 (50.9%)	0.348
	Female	36 (69.0%)		105 (49.1%)	
Age	5-6	5 (8.5%)	0.049*	9 (4.2%)	0.503
	7-8	8 (13.6%)		37 (21.0%)	
	9-10	11 (18.7%)		56 (26.2%)	
	11-12	20 (33.9%)		61 (28.5%)	
	13-15	15 (25.3%)		51 (23.8%)	
School	Kianjiru-ini	18 (30.5%)	0.230	47 (22.0%)	**0.006***
	Matanya	7 (11.9%)		29 (13.6%)	
	Kimorori	9 (15.3%		26 (12.1%)	
	Ichagaki	11(18.6%)		39 (18.2%)	
	Kagaa	4 (6.8%)		25 (11.7%)	
	Peter Kariuki	10 (16.9%)		48 (22.4%)	

Table 3: Types of Helminthic Infections

School	*Hookworms*	*Ascaris lumbricoides*
Kianjiru-ini	6 (1.0%)	6 (1.0%)
Matanya	2 (0.5%)	2 (0.5%)
Kimorori	2 (0.5%)	1 (0.3%)
Ichagaki	1 (0.3%)	6 (1.0%)
Kagaa	-	4 (1.0%)
Peter Kariuki	1 (0.3%)	2 (0.5%)

Table 4: Types of Pathogenic Intestinal Protozoan Infections

School	*Entamoeba histolytica*	*Giardia lamblia*
Kianjiru-ini	10 (2.5%)	7 (1.8%)
Matanya	6 (1.5%)	4 (1.0%)
Kimorori	11 (2.8%)	3 (0.8%)
Ichagaki	11 (2.8%)	2 (0.5%)
Kagaa	7 (1.8%)	3 (0.8%)
Peter Kariuki	29 (7.3%)	5 (1.8%)

Types of intestinal parasitic infections

In all the schools, hookworms and *Ascaris lumbricoides* were the most common types of helminths found as summarized in table 3. The types of intestinal protozoan infections mainly found in these schools were *Entamoeba histolytica* and *Giardia lamblia* as summarized in table 4.

Post Intervention Results

In the intervention group, the overall prevalence of protozoan infections reduced from 55.1% to 6.0% before and after intervention respectively. The highest reduction was found in Peter Kariuki from 68.6% to 4.3% before and after intervention respectively (Figure 1). There was statistically significant association between the intervention and prevalence of intestinal protozoan infections after intervention (χ^2 = 114.6, df = 1, P <0.001).

In the control group the prevalence of the overall prevalence of intestinal helminthic infection reduced from 51.3% to 49.3% before and after intervention respectively as summarized in figure 4.16 as summarized in figure 2. This difference in the prevalence was not statistically significant (t = 5.2, P = 0.91).

In the intervention group, the overall prevalence of intestinal helminthic infections reduced from 12.0% to 0.0 (figure 3) before and after intervention respectively. This was the case in all the schools also.

The association between intervention and the prevalence of intestinal helminthic infections after intervention was statistically significant (χ^2= 114.6, df = 1, P < 0.001).

In control schools there was an overall reduction of the prevalence of intestinal helminthic infections from 16.5% to 10.6% before and after intervention as summarized in figure 4. The difference in the prevalence was not statistically significant (t = 6.1, P < 0.74).

Effects of public health interventions on intestinal parasitic infections

In the intervention group, the prevalence of intestinal protozoan infections reduces from 55.1% to 6.0% before and after intervention respectively.

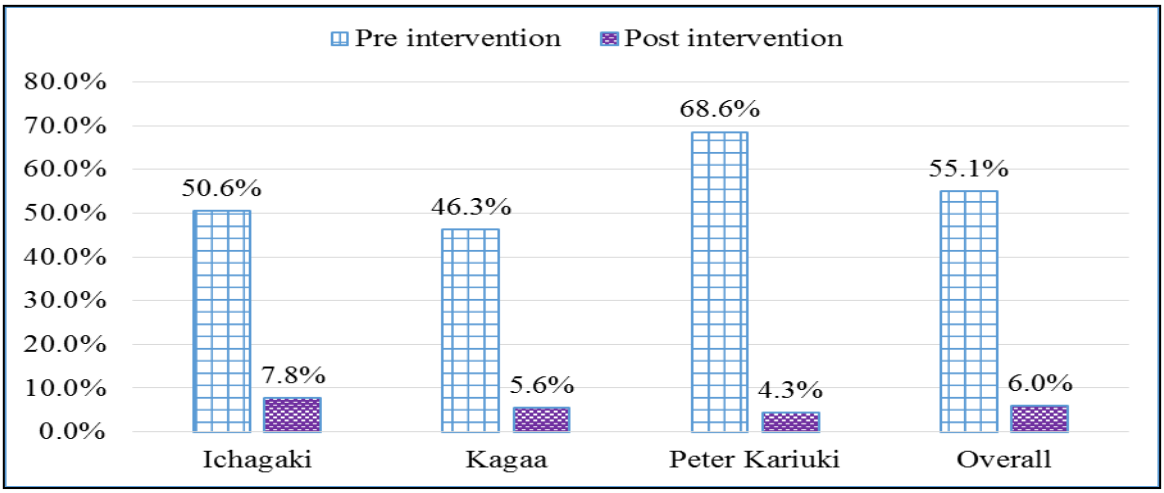

Figure 1 : Prevalence of Intestinal Protozoan Infections Post Intervention

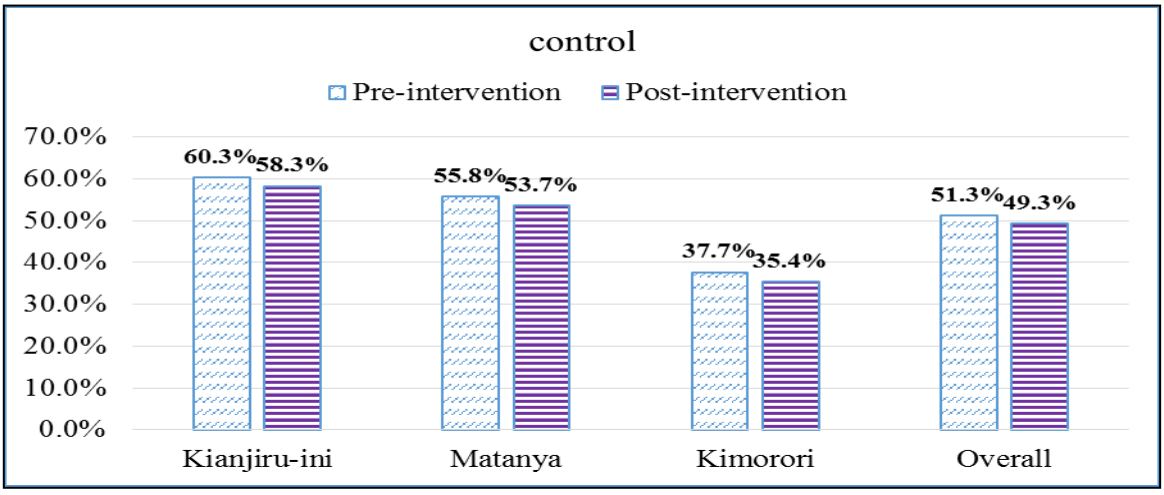

Figure 2: Intestinal Protozoan Infections in Control Schools Post Intervention

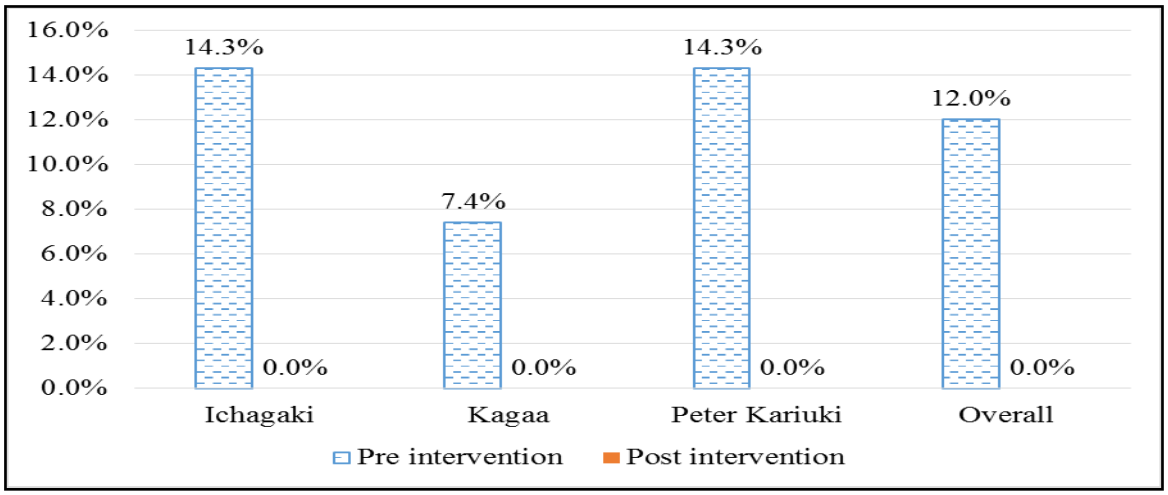

Figure 3: Intestinal helminthic infections in intervention group post intervention

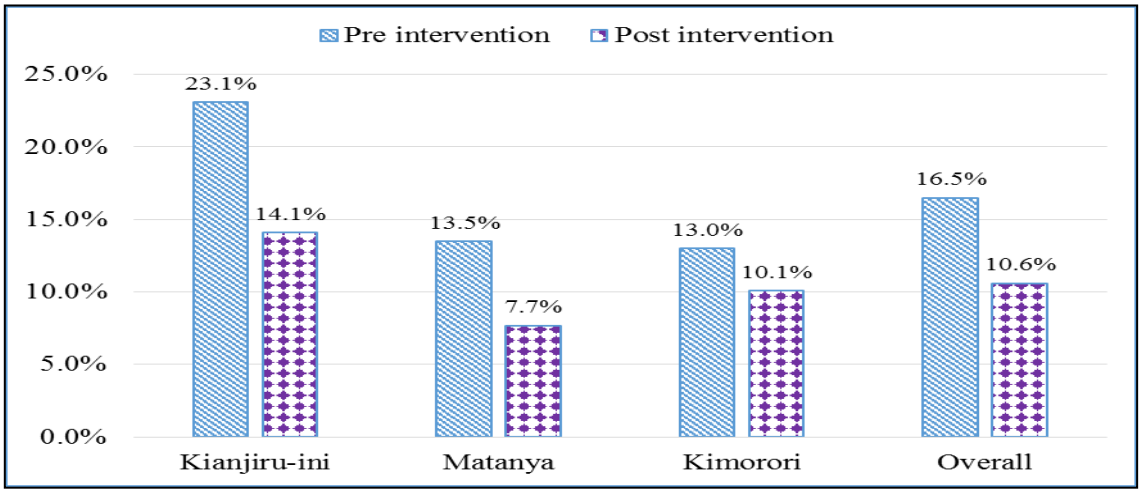

Figure 4: Prevalence of intestinal helminthic infections post intervention

There was a statistically significant difference in the prevalence of intestinal protozoan infections before and after intervention (t =12.6, P<0.001). As summarized in figure 5, the change of prevalence of intestinal protozoan infections in the control group was from 51.3% to 49.3% before and after intervention respectively. This change in the control group was not statistically significant (t = 0.894, P = 0.97). Further tests showed a statistically significant association between intervention and the prevalence of intestinal protozoan infections (χ^2= 23.5, df = 1, P < 0.001}. Odds ratio tests showed this to be a strong relationship {R = 0.051 (0.027 – 0.098)}.

There was also a reduction in the prevalence of helminthic infections in the intervention group from 12.4% to 0.0% before and after intervention respectively. This difference in the prevalence was statistically significant (t = -3.78, df = 398, P<0.001). This change was also statistically significantly associated with intervention (χ^2= 23.5, df = 1, P<0.001). In the control group the reduction

was from 17% to 11.1% as summarized in figure 6.

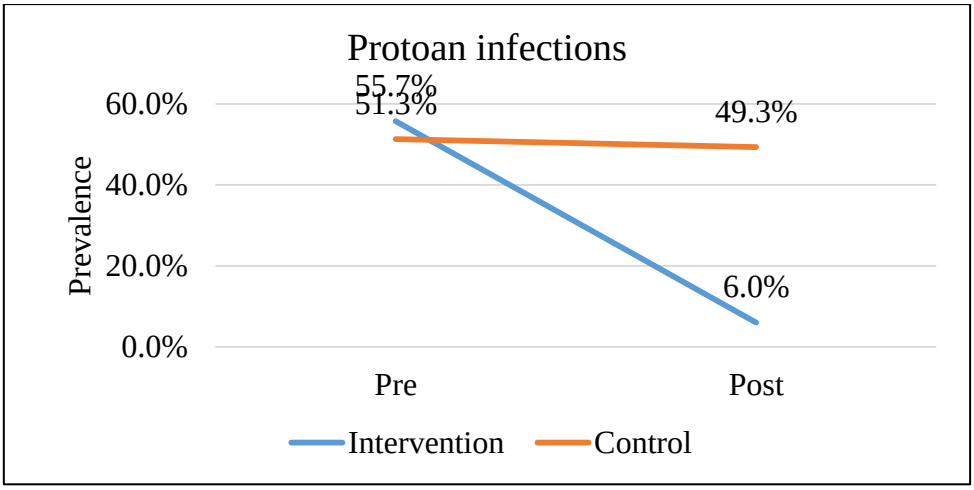

Figure 5: Effects of interventions on intestinal protozoan infections

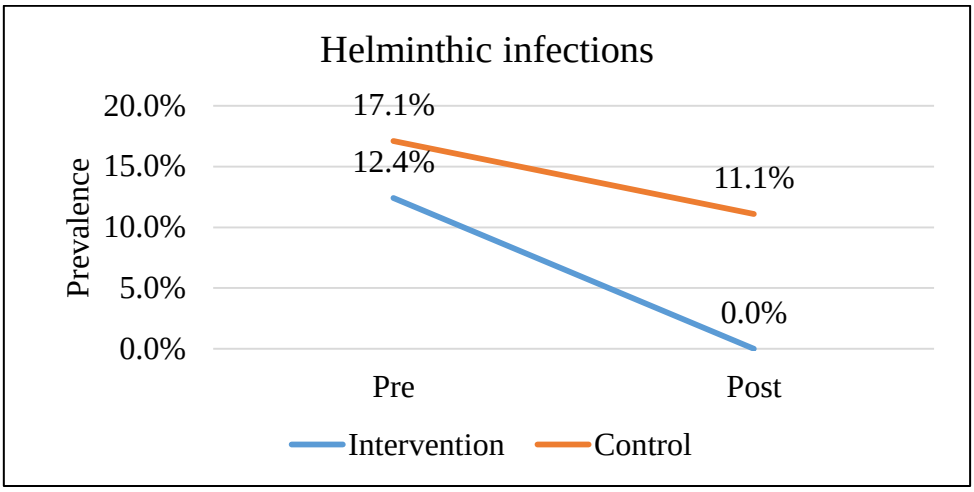

Figure 6: Effects of Interventions on Intestinal Helminthic Infections

Discussion

In all the schools sampled, prevalence of protozoan infections was much higher than the helminthic infections. This finding becomes important because deworming programs usually target the helminthes and disregard the protozoa. A similar study by Gelow *et al* [13] in Gondar University Community School in Ethiopia found Helminthic infections to be higher than protozoan infections at 26.9% and 13.2% respectively. A similar study in Kitui Kenya has shown higher prevalence of 38.6% [5]. In Elbourgon Kenya, Mokua *et al* [14] found a much higher prevalence of 86% among pre-school children aged 6 months to 10 years. Elsewhere in Asia the prevalence of helminths has been found to be lower at 8.6% [15].

Our findings were however comparable to that reported by Stewart [16] in Kenya where intestinal parasitic infection was at 56.8% nationwide. This was the situation before the rolling out of the school health program in 2009. This level of infection has persisted all these five years despite the school deworming program whereby pupils are supposed to be dewormed after every six months [17]. This may be because the

deworming exercise only targets intestinal helminthic infections and not the protozoan infections [18].

Prevalence of helminthic infections was higher in females than in males while the prevalence of protozoan infections was higher among males than females. This was not similar to the findings of Abera and Nibret [19], in a study in Northwest Ethiopia, where males were found to have a slightly higher intestinal parasitic infections than females. There was however no statistically significant difference in prevalence of helminthic across gender (P= 0.348). This was found to be similar with the findings by Kisavi *et al* [5] in a study conducted in Kitui Kenya where gender was not significantly associated with helminthic infections.

Intestinal helminthic infections were highest among the pupils aged between 11 and 13 years at 16%. This finding is similar to the Ethiopia study where pupils aged 10 – 12 years had the highest levels of intestinal parasitic infections [13]. Age was however significantly associated with helminthic infections with the highest percentage of infected pupils aged 11-12 years (p=0.049). The same age group had the highest percentage of protozoan infection though not significantly associated (p= 0.503). These findings were similar to a study by of Abera & Nibret [19] in a study in Ethiopia where age was significantly associated with prevalence of helminthic infections.

Effects of public health interventions on intestinal parasitic infections

In the intervention group, there was a statistically significant difference in the prevalence of intestinal protozoan and helminthic infections before and after intervention, which was significantly associated with public health interventions. This reduction was attributed to the public health interventions, which included chemotherapy, provision of soap and water for hand washing, public health education and training on proper hand washing as well as improved sanitation.

These findings agree with a similar interventional study in Ethiopia by Abdulkader *et al* [20] where children who washed hands with soap and water at the critical times were 68% less likely to contract intestinal parasitic infections. Several observational studies have indicated the impact of hand washing on the prevention of intestinal parasitic infections [21], Gelaw 2013[13] and Absar [22]). A case-control study conducted in Viet Nam demonstrated a significantly reduced risk of E. histolytica infection among individuals who frequently washed their hands with soap [23]. A longitudinal cohort study by Monse *et al* [24] demonstrated decreased rates of reinfection with soil-transmitted helminths among school children who washed their hands with soap. A study by Hosain *et al* [25] demonstrated that health education combined with improved sanitation helped to reduce intestinal parasitic infections.

This reduction of intestinal parasitic infections post intervention is an indication that public health interventions were effective in reducing the rate of these infections. These public health interventions were drawn from the school health policy which has been in place since 2009. It therefore means that should the policy have been implemented as required, prevalence of these infections would have not remained the same as it was at the commencement of the school health program in Kenya. In control group, the slight reduction in intestinal protozoan infections was attributed to the possible reinfection after the treatment given during the baseline study. This is an indication that chemotherapy alone without training pupils on the other ways of preventing intestinal parasitic infections does not confer long term prevention against these infections. This explains the reason why

UNICEF [26] had recommended hygiene and improved sanitation for prevention of intestinal parasites.

Conclusions

From the results, it is shown that intestinal parasitic infections are still prevalent in spite of a deworming program. It would be good to establish what factors contribute to the occurrence of the infections and how to reduce the level of infections in the study area.

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Competing interests

The authors declare that they have no competing interest.

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