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Original Research Article

Behavioural effect of soil transmitted helminths control programme among school going children in Meru County, Kenya

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ABSTRACT

Background: Intestinal parasitic infections are major public health problems mostly among children contributed in part by adults in developing countries. Despite the effort of World Health Organization (WHO) to eradicate intestinal parasitic infections, the infection continues to be the most common of tropical diseases in developing countries.
Methods: This study adopted a mixed methods design, specifically the convergent parallel mixed methods research design. Data was collected using questionnaires, key informants guide, observation and stool examination for intestinal parasitic infections which were administered to both the experimental groups and the control groups. Data analysis was carried out with the aid of statistical package of the social sciences (SPSS) version 26.0, using descriptive statistics to describe the characteristics of the studied population. Qualitative data was analyzed by thematic content analysis.
Results: Washing hands after visiting the toilet ($p<0.05$), washing hands before eating ($p<0.05$) and washing hands after playing ($p<0.05$) were significantly associated with intestinal parasitic infections in both intervention and control groups. Further, at post intervention, in the intervention group, the overall prevalence of protozoan infections reduced from 28.0% to 14.7% before and after intervention respectively as well the overall prevalence of helminthic infections reduced from 40.3% to 13.7% before and after intervention respectively.
Conclusions: Public health interventions influenced the reduction of the prevalence of intestinal parasites. The county government should play a role in interventions to improve sanitation and hygiene in communities. Public health offices should enforce skills training and enhancement at the household level, and multiple targeted interventions focused on intestinal parasite infections should be implemented.

Keywords: Hand hygiene, Soil transmitted helminths, Disease outbreak, Handwashing facilities

INTRODUCTION

Rural homes often lack proper latrines for small children, leading to low use and increased risk of diarrhea and egg counts for soil transmitted hemorrhagic disease (STH). Adequate sanitation at the community level has been associated with a reduction in soil transmitted helminths transmissions, with studies showing that latrines can reduce the odds of infection.[1] However, efforts to combat health and nutritional problems among children in these settings often do not effectively incorporate water, sanitation, and hygiene (WASH) interventions. Lack of access to safe water remains a significant risk factor for poor health in developing countries, with over 780 million people lacking access to an improved water source.[2] Universal access to improved sanitation could reduce diarrhoea-related morbidity in preschool children by more than a third. Improved water sources include piped water, rainwater, protected springs, and protected wells, which are less likely to be contaminated with pathogens.[3]

Water, sanitation, and hygiene play a role in soil transmitted helminths infection, with household water sources being a potential risk factor. In Kenya, efforts to

integrate preventive chemotherapy, health education, and environmental sanitation are needed to interrupt STH transmission.[4] A population-based cohort study in Iraq found that soap use was significantly associated with maternal infection, while hand hygiene plays a significant role in reducing soil transmitted helminths. However, there is no association between lack of sanitation and reduction in STH, as the species have different modes of transmission and risk factors. Adequate WASH are crucial in preventing environmental contamination and preventing the transmission of STH. In rural Dembiya, WASH education was implemented to reduce intestinal parasitic infections. The baseline prevalence of infections was 25.8%, with *Ascaris lumbricoides* being the most prevalent. The proportion of children with good hygiene increased from 1.3% to 34.4%, and the percentage of mothers/care givers who washed hands at different pick times increased from 24.4% to 68.2%. The proportion of households practicing home-based water treatment and using sanitary latrine increased from 32% to 49%.[4-6]

Hookworm is transmitted through contact with infected feces through the sole of the foot, legs, and buttocks. Children without shoes are more vulnerable to hookworm infection, and walking barefoot is associated with increased risk. Factors such as foot wear, dirty nails, and poor hand-washing habits also contribute to parasite infestation rates. Interruption of the intestinal parasitic infection cycle is crucial, as poor populations in developing countries often have low purchasing power and political influence.[7] Strategies include hand-washing, personal hygiene, family hygiene, and chemotherapeutic control. Hand-washing can interrupt parasite transmission by acting as a primary or secondary barrier. However, hand-washing after defecation or stool contact is not universal, and dirty nails in school children can increase parasite infestation. Chemotherapy is a public health promotion that has been shown to reduce the incidence of intestinal helminth/protozoan diseases. It is a rapid-impact intervention method for controlling intestinal parasite infestation in households and communities. However, conflicting results have been reported, such as in northern Bangladesh where chemotherapeutic intervention had no significant long-term impact. In South Korea, efforts to control soil-transmitted helminths (STH) using chemotherapy were successful, with the incidence rate dropping from 84% to less than 3% over a quarter century.[8,9]

Parasitic infections impair physical growth and cognitive development, leading to micronutrient deficiencies, poor school performance, reduced work productivity, and adverse pregnancy outcomes. Hookworm infections cause anemia in women and children, while acute roundworm obstruction can result in death among children.[10] Infestation with *Taenia saginata* can result in intestinal obstruction and in rare cases appendicitis. The ideal prevention and control methods for intestinal parasites include public-health interventions such as clean water, community health education, food hygiene observation, and sanitation systems. Implementation and sustainability of these interventions are complex and variable between local contexts and learning institutions.[11,12] Health education should discourage open defection and emphasize hygienic measures, while reducing eggs in the environment through cleaning bed rooms and beddings.

METHODS

This was an intervention study using mixed methods design with before and after assessments. Mixed methods research is a type of research in which a researcher or team of researchers combine elements of qualitative and quantitative approaches (for instance use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques) for the purpose of breadth and depth of understanding and corroboration. The intervention involved stool examinations to assess intestinal parasitic infections prevalence in both intervention and control sites. Infected children were treated with Albendazole suspension and tablets, and hand washing stations were established with poly pots. Health promotion programs were conducted, including training on personal hygiene, crop rotation, and environmental conservation. soap and detergent were provided for toilet cleaning, and proper hand washing training was provided to household members, especially children and caregivers with the training cascaded to other absent household members. The intervention aimed to prevent intestinal parasitic infections and promote hygiene. Qualitative methods (use of Key Informant Interviews from sub county health facilities in-charge comprising senior subcounty public health officers and community health volunteer in each subcounty) of data collection that was carried out between December,2022 to May 2023. Systematic random sampling method was used among 11 sub counties in Meru County, with Igembe North, Buuri East Imenti North, Imenti Central, Tigania East, Tigania West as intenvention group and Buuri West, Igembe Central, Igembe South, Imenti South, Tigania Central as control group. Interviewer-administered structured questionnaires were used to collect quantitative data while Key Informant Guide was used to collect qualitative. Quantitative data was analyzed using statistical package for social science (SPSS) version 26.0. Descriptive data was presented using frequencies, percentages, means and standard deviation while inferential statistics used Chi-square test to measure association between independent and dependent variables. P values less than 0.05 were considered statistically significant.

RESULTS

Socio-demographic characteristics of study respondents

The children age ranged from 5 years to 15 years, the findings showed that children in control group 63 (29.9%) were more than 13 years, and 49 (23.2%) were between 5-7 years with 59 (28.0%) being between 11-13 years in intervention group. Slightly more than half 110 (52.1%)

and 106 (50.2%) of children were females in control and intervention group respectively (Table 1).

The effects of interventions on intestinal protozoan infections

In the intervention group, the overall prevalence of protozoan infections reduced from 28.0% to 14.7% before and after intervention respectively. In the control group the overall prevalence of intestinal protozoan infections reduced from 28.9% to 28.4% before and after intervention respectively as Figure 1.

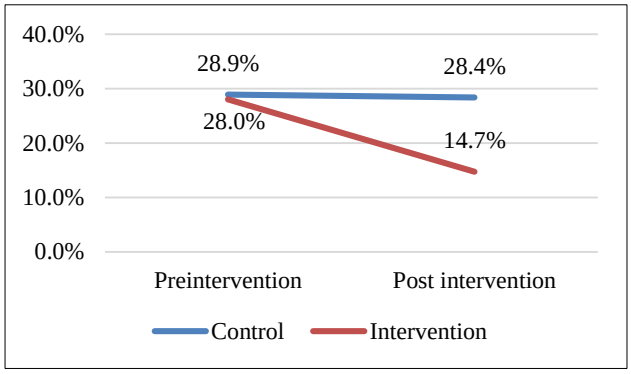

Figure 1: The effects of interventions on intestinal protozoan infections.

In the intervention group, the overall prevalence of helminthic infections reduced from 40.3% to 13.7% before and after intervention respectively. In the control group the overall prevalence of intestinal helminthic infections increased from 31.3% to 37.0% before and after intervention respectively (Figure 2).

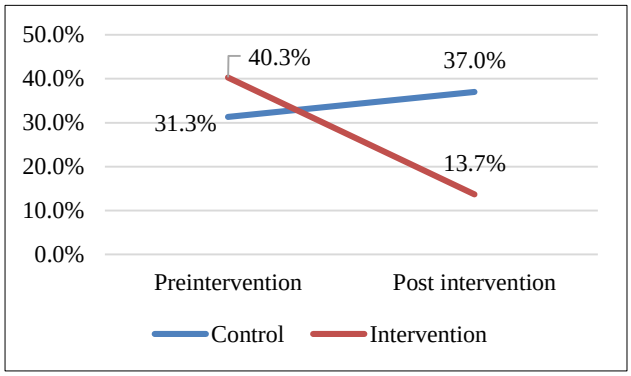

Figure 2: The effects of interventions on intestinal helminthic infections.

Behavioural change among control group

During preintervention 34.1%, 39.3% and 28.4% always practiced hand washing after visiting toilets, before eating and after playing and after intervention 33.2%, 35.1% and 35.5% always practiced hand washing after visiting toilets, before eating and after playing and after intervention (Table 2).

Behavioural change among intervention group

During preintervention 41.7%, 32.7% and 33.6% always practiced hand washing after visiting toilets, before eating and after playing and after intervention 50.2%, 48.3% and 44.5% always practiced hand washing after visiting toilets, before eating and after playing and after intervention (Table 3).

Coefficients on association between parasitic infections hand hygiene practices

Variables associated with intestinal parasitic infections were analysed to determine the model for reducing the infections. Indicatively, the intestinal parasitic infections can be determined (predicted) using key risk factors which are namely; age of respondent (p=0.017), washing hands after visiting the toilet (p=0.015), washing hands before eating (p=0.009) and washing hands after playing (p=0.043).

In intervention group, the overall practice on hand washing increased from significantly before and after intervention respectively. This was observed and further confirmed by the community health volunteer in one of the intervention areas who reported.

"The children have again embraced the hand washing practice as was during COVID-19 epidemics and they ensure they follow the steps you have trained them. There is actually a noticeable improvement in the general cleanliness" (KII 5).

From a multi-variate regression using forward stepwise removal (likelihood ratio), the association between the noted reduction of intestinal parasitic infections in children stool of preintervention and after intervention is based on the modifiable risk factors. The driving factors to reduction of intestinal parasitic infections in children stool could thus be linked strongly on gender (p=0.033), healthy eating habits (p=0.022), observing required nutrition (p=0.004), eating properly cooked food (p=0.002), and boiling drinking water (p=0.028) (Table 5).

Table 1: Socio-demographic characteristics of study respondents.

Characteristics	Control group		Intervention group	
	Frequency	Percentage	Frequency	Percentage
Child age (years)				
5-7	49	23.2	48	22.7

Continued.

Characteristics	Control group		Intervention group	
	Frequency	Percentage	Frequency	Percentage
8-10	55	26.1	57	27.0
11-13	44	20.9	59	28.0
More than 13	63	29.9	47	22.3
Gender				
Male	101	47.9	105	49.8
Female	110	52.1	106	50.2

Table 2: Behavioural change among control group.

Behavioural change	Preintervention		Postintervention	
	Frequency	Percentage	Frequency	Percentage
Wash hands after visiting the toilet				
Always	72	34.1	70	33.2
Sometimes	64	30.3	69	32.7
Never	75	35.5	72	34.1
Wash hands before eating				
Always	83	39.3	74	35.1
Sometimes	64	30.3	79	37.4
Never	64	30.3	58	27.5
Wash hands after playing				
Always	60	28.4	75	35.5
Sometimes	81	38.4	80	37.9
Never	70	33.2	56	26.5

Table 3: Behavioural change among intervention group.

Behavioural change	Preintervention		Postintervention	
	Frequency	Percentage	Frequency	Percentage
Wash hands after visiting the toilet				
Always	88	41.7	106	50.2
Sometimes	72	34.1	76	36.0
Never	51	24.2	29	13.7
Wash hands before eating				
Always	69	32.7	102	48.3
Sometimes	72	34.1	80	37.9
Never	70	33.2	29	13.7
Wash hands after playing				
Always	71	33.6	94	44.5
Sometimes	86	40.8	99	46.9
Never	54	25.6	18	8.5

Table 4: Coefficients on association between parasitic infections hand hygiene practices.

Intestinal parasitic infections	Unstandardized Coefficients		Standardized coefficients	t	Sig.
	B	Std. error	Beta		
Constant	1.914	0.206		1.885	0.000
Age of child	0.745	0.201	0.445	1.655	0.017
Wash hands after visiting the toilet	0.626	0.168	0.326	1.382	0.015
Wash hands before eating	0.749	0.192	0.549	2.725	0.009
Wash hands after playing	-0.119	0.108	-0.118	-0.739	0.043

Resulting model: $Y=1.9 + 0.45X_1 +0.33X_2 + 0.55X_3-0.74X_4$ where; Y=intestinal parasitic infections, X_1=age of respondent, X_2=wash hands after visiting the toilet, X_3=wash hands before eating, and X_4=wash hands after playing.

Table 5: Relationship between behavioural related factors and parasitic infections.

Variables in the equation	B	S.E.	Wald	df	Sig.	Exp (B)	95% C.I.	
							Lower	Upper
Age	1.54	0.45	1.46	1	0.227	0.58	0.24	1.40
Gender	-1.95	0.91	4.56	1	0.033	7.02	1.17	41.92
Healthy eating habits	2.29	1.88	5.22	1	0.022	4.01	0.00	0.54
Observe required nutrition	3.39	1.17	8.37	1	0.004	2.71	2.99	295.60
Eat properly cooked food	7.28	2.34	9.65	1	0.002	5.06	14.70	25.71
Boil drinking water	2.12	1.27	0.01	1	0.028	2.89	0.07	10.66
Constant	6.98	8182.10	0.00	1	0.997	0.00		

Resulting model: $Y= 6.98+1.54X_1 -1.95X_2+2.29X_3 +3.29X_4 +7.28X_5 +2.12X_6$ where; Y=intestinal parasitic infections, X_1=age of respondent, X_2=gender of respondent, X_3=healthy eating habits, X_4=observe required nutrition, X_5=eat properly cooked food, X_6=boil drinking water.

DISCUSSION

Socio-economic variables on hygiene and sanitation practices among both intervention and control groups such as observing healthy eating habits, observing required nutrition, and eating properly cooked food were not associated with intestinal parasitic infections. Further, boiling drinking water was associated with intestinal parasitic infections. The findings revealed that the socio-economic characteristics of households included presence of young children, having been exposed to household water treatment (HWT) promotion in the past, level of education, type of water source used, access to technology and wealth level. After intervention, the rate of intestinal infections reduced significantly in the intervention group with healthy eating habits (p=0.022), observing required nutrition (p=0.004), eating properly cooked food (p=0.002) significantly influencing the reduction. This concurs with Kamande et al done in Bomet Municipality where 36.2% of respondents had adequate knowledge and practiced boiling drinking water.[13] This low level was attributed to lack of hygiene training reported among the pupils by the teachers in charge of health. This was due to the low training and IEC materials provide to the teachers in charge of health in the schools.

Association between knowledge on how to boiling drinking water and intestinal parasitic infections was statistically significant, implying that this was a risk factor associated with the infections. This concurs with several studies done in Ethiopia, Asia, Kitui Kenya, and India.[14-17] According to Nyakang'o, the history of infectious diseases has shown that changes in this attitude are provoked by highly visible phenomena (incidence/outbreak).[18] A variety of strategies have been used to combat and interrupt the cycle of these diseases and the most commonly reported strategies include hand-washing/personal hygiene/family hygiene and chemotherapeutic control. The increase in knowledge on how to wash hands and boil drinking water among children in intervention areas was attributed to the way in which health promotion was done. Apart from IEC materials provided, training on how to wash hands was done using demonstration songs which were easy for pupils to remember. This contributed to the reduction of intestinal parasitic infections among pupils in intervention group. This agrees with the study by Makata et al where students with a higher level of adequate knowledge on how to wash hands had a lower risk of intestinal parasitic infections.[19] So as to improve the quality of lives of people in Kenya, efforts such as integration of control strategy consisting of preventive chemotherapy combined with health education and environmental sanitation is needed to interrupt transmission of STH.[4]

Comparing the reduction of intestinal protozoan infections with that of helminthic infections, results showed that in the latter, the reduction was more than in the former. The reason for this is that the scope of the intervention in this study could not address some of the factors which contributes to protozoan infections such as water safety. This is however provided for in the school health policy and all it requires is implementation.

Limitations

The study was conducted in only at Meru County. It is highly likely that some of the schools in in the study area do not have hand-washing stations nor tap water in the schools prior to the study, this posed serious challenge to the training of pupils on proper hand washing methods. Secondly, the study is likely to encounter the challenge of none response as some of the sampled participants choose not to respond to the questionnaire for fear of victimization by neighbors. The researcher guaranteed the participants of their protection by assuring them that the data they gave was strictly for academic research only. Another possible limitation is that the target respondents were reluctant to speak to the researcher, or demand incentives, which is counter to the ethics of research. Due to the size, remoteness, and harsh climatic conditions of the study area, the researcher didn't reach as many respondents as preferred, thereby affecting the quality of the findings.

CONCLUSION

It can be concluded from this study that hand hygiene practices were significantly associated with intestinal

parasitic infections in both control and intervention groups. In both intervention and control groups, level of knowledge on prevention of intestinal parasites is below what is expected as per the health policy. The driving factors to reduction of intestinal parasitic infections in children stool could thus be linked strongly gender, healthy eating habits, observing required nutrition, eating properly cooked food, and boiling drinking water. Public health offices within the county should enforce skills training and enhancement at the household level within the community. The study found that the community comprises of individuals of poor behavioural activities and it would be appropriate to enhance their skills in hand hygiene, waste disposal and household water treatment. Post intervention measures showed general improvement on hand hygiene and this should be scaled up or replicated in other communities.

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