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PREVALENCE AND INTENSITY OF INTESTINAL PARASITIC INFECTIONS AND FACTORS ASSOCIATED WITH TRANSMISSION AMONG SCHOOL GOING CHILDREN
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ABSTRACT

***Objective*: To determine the prevalence and intensity of intestinal parasitic infections and factors associated with transmission among primary school going children.**
***Design*: Cross-sectional descriptive study.**
***Setting*: Muthithi Location situated in Murang'a County, Kenya.**
***Subjects*: Multi-stage sampling was used to select 418 children. Stool specimens were examined using Kato-katz technique to determine the number of helminthes eggs per gram of stool and formol ether concentration technique to detect the different protozoan cysts. Data were analysed using Statistical Package format (SPSS version 20.0). Pearson's Chi-square test was used to establish the association between categorical variables. Multivariate analysis was used to determine the factors associated with the infections.**
***Results*: The study established that 53.8% (225 out of 418) were infected with one or more of intestinal parasite. Five species of helminthes were identifiedwith prevalence of 11.5%; the predominant helminth parasite identified was *Ascaris lumbricoides* 9.1% (38 cases). Intestinal protozoan identified in this population was *Entamoeba histolytica* with prevalence of 42.3% (177 cases). The factors established to be independently associated with presence of intestinal parasitic infection were: age 11-15 years P<0.001, use of plain water for hand washing P<0.05, eating food without spoon P<0.05, consuming raw vegetables P<0.001, untrimmed finger nails P<0.001 and source of drinking water [river P<0.001 and mixed sources (river, well and tap) P<0.05].**
***Conclusion*: This study revealed that intestinal parasites still pose a public health problem to school going children. Despite lack of school based deworming programme in this area, treatment combined with health education and other interventions in school age children is recommended as a way of controlling transmission.**

INTRODUCTION

Intestinal parasites of medical importance to man are *Schistosoma mansoni, Enterobius vermicularis*, the soil transmitted helminthes (STH) also known as geo-helminthes - *Ascarislumbricoides, Trichuristrichiura,* hookworms(*Ancylostomaduodenale / Necatoramericanus*)and *Strongyloides stercolaris*, and the protozoa. The protozoans known to infect man are *Entamoeba histolytica, Giardia lamblia* while *Cryptosporodium spp. andIsospora spp*. are becoming important in causing prolonged diarrhoea in immune compromised patients (1). The burden of disease caused by intestinal parasitic infections is enormous; more than 2000 million people are affected worldwide of whom more than 300 million suffer from associated severe morbidity, an estimate of 155,000 deaths is reported annually (2).

The common helminth species infecting man are *Ascaris lumbricoides*, *Trichuristrichiura* and hookworms, and there are now approximately one billion infections worldwide (3). Trematodes or flukes that cause intestinal schistosomiasis are *Schistosoma mansoni,S. japonicum, S. mekongii* and *S. intercalatum* with estimated 200 million infections worldwide (4).

The prevalence of protozoan infections varies in different places in the world. For example the prevalence of *Entamoeba histolytica* varies from 5% to 81% and is estimated to infect 480 million people worldwide (5). Prevalence of *giardiasis* ranges from 2-5% in developed countries and 20-30% developing countries (6).

A study conducted in Thika District, Kenya on intestinal parasitic infection among school age children revealed that the mean prevalence of helminthic infections was 48.9% while that of protozoan infections was 38.9% in rural public school (7). A case of *Schistosoma mansoni* was detected in the study, however, Thika District has no active transmission. It was concluded that the infection was probably acquired from Mwea irrigation scheme where transmission of *S. mansoni* occurs (7).

The public health significance of intestinal parasitic infections is measured by the prevalence, intensity of the infection and the association of these factors on human nutrition, growth and development of children and work productivity of the adults (1). A study conducted in Kilifi on the Kenyan coast revealed that anaemia was significantly worst in children with heavy hookworm infection (8). Other symptoms of intestinal parasitic infections include stomach ache, vomiting, loss of weight, fever, itching around the anus due to active re-infection by larvae of *Enterobius vermicularis*, itching around the throat and dry cough (9). Given that the National school based deworming is not involved in Mass Drug Administration (MDA) in Murang'a County, it is imperative that surveys be carried out in these areas where transmission is thought to be low. The results will inform the Government to be aware of any other pockets of helminthes transmission that may warrant MDA.

MATERIALS AND METHODS

Setting: The study was conducted in Muthithi location, Murang'a County, Kenya, from May to July 2014.

Design: This was a descriptive cross-sectional study.
Study population: The study population included male and female school children attending public Primary schools aged 7-15 years. Informed written consent was obtained from the children's parents or legal guardians. Sample size was determined using the single population proportion formula (10) working with known prevalence around Thika District of 48.9% among school children (7).

Sampling frame: Multi-stage sampling was used, where first; five public primary schools were randomly selected from the study area. Sequential sampling was applied in the second stage where children were selected using a computer generated random number.

Parasitological Examination: Helminthes screening was based on double 47.1mg Kato-Katz smear (11). Each stool sample was passed through 250 μm metal sieve to remove fibrous material and using a spatula, some amount of stool was collected and filled in a template. Cellophane soaked in glycerinemalachite green solution was then placed and turned upside down, pressed and allowed to spread evenly. The slides were then examined within one hour under the microscope for hookworms. *Schistosoma mansoni, Ascaris lumbricoides* and *Trichiuristrichiura* eggs were examined later. The total numbers of eggs were expressed as eggs/g of feces (epg). Quality control was performed by systematic random examination, by the team leader for 10% of the daily examined Kato-Katz slides. Formol-ether concentration method was used to examine protozoan cyst (12). One gram of faeces was emulsified in 7 ml of 10% formalin in a centrifuge tube. The suspension was strained through a brass wire sieve, and collected in beaker. The filtrate was poured into a 15 ml boiling tube and 3 ml of ether added, then mixed well. The ether- formalin suspension was transferred back into centrifuge tube, and centrifuged at 3,000 rpm for one minute. The fatty layer on top of tube was loosened with an applicator stick and the supernatant discarded. A few drops remaining were mixed with the sediment plus lugols iodine, one drop of the deposit was transferred onto a glass slide and covered with a cover slip and examined under the microscope for cysts.

Data analysis: Data were analysed using Statistical Package for Social Scientists (SPSS) version 20. Descriptive statistics were computed. Pearson's Chi-square test was used to establish the association between categorical variables. Odds ratio (OR) with the 95% Confidence intervals (CI) were also computed. The variables established to be statistically significantat bivariate stage were included in step-wise multivariate analysis. This enabled the selection of a set of predictor variables associated with the infection status. Results were presented in text and tables.

RESULTS

A total of 418 school children participated in the study, provided stool specimens and completed information required on the questionnaire. Out of the 418 selected school children, 53.8% of them were infected with one or more of the intestinal parasites.

The helminth identified were as follows; *Ascaris lumbricoides* 9.1%(38 cases), hookworm 1% (4 cases),

Hymenolepsis nana 1%(4 cases), *Enterobius vermicularis* (1 case) and 1 case of *Schistosoma mansoni*.The protozoan identified in this population was *Entamoeba histolytica* with a prevalence of 42.3%(177).
Co-infection was also observed in 9.3% (21 out of 225) of the cases among those children who were infected with intestinal parasites. The most frequent combination of co-infection was *E. histolytica* and *A. lumbricoides* 7.1% (16 cases out of 225) and two cases of co-infection with *A. lumbricoides* and hookworm. The rest were single cases of co-infection with *E. histolytica* and hookworm, *A. lumbricoides* and *H.nana,* and *A. lumbricoides* and *E.vermicularis.*

The helminthes observed in this study had varied level of intensity, Table 1.

Table 1
Distribution of the intensity among those infected with intestinal helminthes

Helminth Status eggs per gram (EPG)	Frequency	Percent
A. lumbricoides		
Light (1-4999 EPG)	23	60.5
Moderate (5000-49999 EPG)	15	39.5
Total	38	100
Hookworms		
Light (1-1999 EPG)	3	75
Moderate (2000-3999 EPG)	1	25
Total	4	100
E. vermicularis		
Light (1-4999 EPG)	1	100
S. mansoni		
Heavy (>400 EPG)	1	100

Logistic regression analysis was conducted to assess possible independent relationship between intestinal parasite infection and the risk factors. Ten variables with p-value <0.05 in the bivariate analysis were included in the multivariate analysis to determine which factors best explained or predicted intestinal parasite infestation. Upon fitting these factors using binary logistic regression and specifying 'backward LR' step wise method with removal at P<0.05, six (6) factors were retained in the final analysis. Children aged 11-15 years had three fold odds risk [95%CI=1.65-5.79; P<0.001] of being infected with intestinal parasites than those aged 7–10 years. Children using plain water for hand washing had 3.69 fold odds risk of being infected with intestinal parasites [95%CI=1.65-8.26;P< 0.05].Children who did not use spoon while eating had 2.04 fold odds riskof being infected with intestinal parasites [95%CI=1.31-3.19; P<0.05].Children consuming raw vegetables had 2.36 fold odds risk of being infected with intestinal parasites[95%CI=1.46-3.81;P<0.001]. Those children who had untrimmed finger nails had 2.46 fold odds risk of being infected with intestinal parasites [95%CI=1.51-4.01 P<0.001]. Children who used water from river only had 6.18 fold odds riskof being infected with intestinal parasites [95%CI=2.71-14.09; P<0.001] and those drinking water from mixed source (river, well and tap) had 2.96 fold odds riskof being infected with intestinal parasites [95%CI=1.51-5.80; P<0.05].

Table 2
Multivariate analysis of factors associated with intestinal parasitic infections among school going children

Predicators	AOR	95%CI Lower	Upper	P value
	Final	Model		
Age in years				
7 to10	1.00			
11 to 15	3.09	1.65	5.79	<0.001
Mode of hand washing				
Plain water	3.69	1.65	8.26	0.002
Water and soap	1.00			
Use of spoon while eating				
No	2.04	1.31	3.19	0.002
Yes	1.00			
Eating raw vegetables				
Yes	2.36	1.46	3.81	<0.001
No	1.00			
Source of drinking water				
River only	6.18	2.71	14.09	<0.001
Well only	1.11	0.49	2.47	0.809
Pipe, well and river	2.96	1.51	5.80	0.002
Piped water only	1.00			
Finger nail status				
Not Trimmed	2.46	1.51	4.01	<0.001
Trimmed	1.00			

DISCUSSION

Prevalence and intensity of intestinal parasitic infections: Murang'a County has not been surveyed for parasitic infections for many years, this study therefore has shown that 53.8% of school going children are infected with either worms or protozoa which cause disease and interfere with their cognition. Recently high prevalence of intestinal parasites has been reported in Bondo district where prevalence of intestinal parasites was 68% (13). While another survey done by Kabaka *et al*., 2011 in Kenya showed that, intestinal parasitic worms affect an estimated 56.8% school children (14).

The two most common intestinal parasites were *Entamoeba histolytica*(42.3%) and *Ascaris lumbricoides* (9.1%). The others were hookworm (1%), *Hymenelopis nana* (1%), *Enterobius vermicularis* (0.2%) and *Schistosoma mansoni* (0.2%). Low prevalence of intestinal helminthes has been reported in other studies such as one conducted in Ethiopia by Tadese 2005, where the highest prevalence of helminth was *H. nana* 10.1% (15). Protozoan infections notably *Entamoeba histolytica* have been reported to have high prevalence in rural and slum areas due to poor sanitary conditions and lack of safe drinking water (17). High prevalence of amoebic infections has been reported in other places such as Abeokuta, Nigeria that showed *Entamoeba histolytica* 72% (16).

Poly-parasitism was also observed in this study where 9.3% among the infected children had co-infection. These results agree with one study done in Machakos district by Chunge *et al*., 1995, where it was established that the occurrence of poly-parasitism is not a rare phenomenon in rural children (19).

This study has shown that among those infected with helminthes, there were only four cases of co-infection. The low prevalence of helminthes and few cases of co-infections could explain the observed light intensity of infections with most of the helminth infections. This has also been reported in astudy conducted in Busia district which demonstrated that the mean egg counts of each geo-helminth species are significantly and increasingly higher in children with multiple infections than children infected with single species (20).

Socio-demographic factors associated with intestinal parasitic infections among the school children: Analyses to compare the socio-demographic characteristics of respondents who had intestinal parasitic infections showed that children aged 11-15 years had 3 fold odds riskof being infected with intestinal parasite [95%CI=1.65-5.79; P<0.001]. A higher prevalence of intestinal parasites among school children aged 14-15 years was also observed in a study conducted in Kenya (14). A study conducted in Equatorial Guinea observed that the prevalence of *Entamoeba histolytica/E. dispar* increased with age while that of other parasites such as *Giardia lamblia* decreased with age (21). In our study, this phenomenon was not investigated and categorised.

Personal hygiene practices associated with intestinal parasites among the school children: In this study, only 13.4% of the school children sampled had access to piped water. It is well known that, washing hands reduces transmission of both parasitic and bacterial infections by 35% (22). Use of soap in hand washing has been demonstrated to be protective against infection with intestinal parasites as most intestinal parasitic infections occur through faecal-oral route (23). In the present study, children who only use plain water while washing hands had 3.69 fold odds riskof being infected with intestinal parasite. Similarly, children who did not use spoon while eating had 2.04 fold odds risk of being infected with intestinal parasite.This could be explained by the fact that the spoon provides a barrier from infection via faecal-oral route from hands that may be contaminated with eggs or cysts of intestinal parasites. It was also observed that those children with untrimmed finger nails had more than 2 fold odds risk of being infected with intestinal parasite. In a case control study conducted in Taiwan revealed that children who did not wash hands before eating or with a habit of biting nails were at a higher risk of ingesting eggs from the environment (18). However, the low prevalence of helminthic infections in this study could be explained by the aggressive control programmes among school children by health workers, where ani-helminthic drugs are offered for free especially during *'malezi bora'*.

Association between food/water hygiene and presence of intestinal parasitic infections: Children consuming raw vegetables had 2.36 fold odds risk of being infected with intestinal parasite[95%CI=1.46-3.81; P<0.001]. Studies have shown vegetables can be contaminated with eggs and cysts of intestinal parasite from the soil contaminated with human faeces. If these vegetables are consumed without being properly washed or cooked the result could be infection with intestinal parasites. In a study conducted in Kisii Municipality, Kenya showed that 75.9% of the vegetables sold at the Municipal market were found to be contaminated with the eggs of intestinal parasites (24). Children consuming water from river only had 6.18 fold odds risk of being infected with intestinal parasite [95%CI=2.71-14.09; P<0.001] while those consuming water from mixed sources(river, well and tap) had 2.96 fold odds riskof being infected with intestinal parasite[95%CI=1.51-5.80; P<0.05].This could be as a result of contamination of these water sources with faecal material from individuals defecating in bushes and fields that are infected with intestinal parasites. When water from these sources (river and well) was consumed without any form of treatment, the result is infection with intestinal parasites. A study conducted in Tehran among school students observed that using piped water and correct method of washing vegetables were among factors that decreased infection rate among school children (25).

In conclusion, this study has revealed that there is low transmission of intestinal parasites and high prevalence of protozoa infection (*E. histolytica*) which pose a public health problem in Murang'a County. Since several factors have been associated with parasitic infection it will be wise to institute control activities before the intensities rise. Therefore, treatment combined with health education to school children is recommended to reduce continuous transmission.

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