Original Article

Prevalence and Risk Factors For Intestinal Nematodes Infections among Primary School Children at Kigeme Refugee Camp, Southern Province, Rwanda

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Abstract

Background
Intestinal parasitic infections are common in camps of internally displaced people or refugees. Although, much has been done in Rwanda for their control in the general population, little is known about the prevalence among children in refugees' camps.
Objective
The aim of this study was to determine the prevalence of intestinal nematodes infections and associated risk factors among primary school children at Kigeme refugee camp, southern province of Rwanda in 2021.
Methods
A cross sectional study was conducted; a total number of 383 stool samples were collected and examined using formal ether concentration technique.
Results
Approximately, one out of two participants (48.0%) were found to be infected with at least one intestinal nematode. Ascaris lumbricoides was found to be most prevalent (81%), followed by Trichirus trichiura (7.1%) and hookworm (3.8%). Parental illiteracy was identified as a risk factor, while knowledge on transmission roots of intestinal nematodes was seen as a protective factor.
Conclusion
Family members and parental education in particular is key as far as prevention of intestinal nematodes infections is concerned. Enhancement of public health education about hygiene and sanitation as well as regular mass drug administration could be important in fighting against intestinal parasitic infections.

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Keywords: Rwanda, Prevalence, intestinal nematodes infections, primary school children, refugee camp

Introduction

Human intestinal nematode infections are a global public health problem. They are responsible for causing considerable morbidity and mortality especially in developing countries due to inadequate sanitation and limited resources.[1] Factors associated with intestinal parasites include but are not limited to: overcrowding, few toilet facilities, poor hygiene, poor sewage disposal, and inadequate water supply which may contribute to the serious burden of intestinal nematodes in refugee camps. [2]

According to UNHCR, at the end of 2021, 89.3 million individuals worldwide were forced to flee their homes due to various

reasons including persecution, conflict, violence, human rights violations or events seriously disturbing public order.[3]

In the same context, Rwanda has received refugees from neighboring countries like Democratic Republic of Congo and Burundi due to the recurrent instability in the region .[4] Findings have shown that, intestinal parasitic infections are common in camps of internally displaced people or refugees. In a study that was done in south Korea on north Korean refugees, it was revealed that 50% of them were infected with intestinal helminths and 45% were infected with *Trichirus Trichiura*, it was claimed that since *Trichirus Trichiura* w which is a soil transmitted intestinal parasite, the findings were a reflection of poor general hygiene and inadequate medical care.[5] In another study conducted in Nigeria, 79.5% of 332 internally displaced people, were infected by intestinal parasites. Among these, 144 were children of less than 10 years of age and 93.1% of them were infected. This study concluded that poor socioeconomic status and environmental conditions which were prevalent this camp were the major contributing factors to these infections.[6]

Although much has been done in Rwanda to control intestinal parasites, they are still highly prevalent among children.[7] Kigeme refugee camp which is one of the overcrowded camps in Rwanda, it's incidence of poverty is 18 which is above the incidence of national level of 16.[8] The only study available from Kigeme refugee camp was limited to intestinal protozoa.[2] The aim of this study is to determine the prevalence of intestinal nematodes infections and associated risk factors among primary school children at Kigeme refugee camp.

Methods and Materials

Study design and setting

A cross sectional study was carried out at Kigeme refugee camp. This camp is located in southern province, Nyamagabe district about 150km from the capital city of Rwanda, Kigali. The camp whose 49% of the population are children, was established in 2012 and hosts above 20,000 refugees on 34 hectares.[8] The study population was composed of primary school children having 6 to 14 years of age.

Study sample size

Convenient sampling method was used to select a study sample of 383 participants. Those who were under anthelminthic drugs therapy within three months were excluded in the study. The Sample size was calculated using Bill Godden formula as below:

$N=Z^2\times P(1-P)/d^2$, in the formula: **N**: Sample size, **Z**: level of significant or confidence interval at 95%, which is equal to 1.96, **P**: means prevalence of intestinal nematodes which is equal to 47.5% ,[7] **d**: margin of error which is equal to 5%.

N= $(1.96)^2\times 0.475(1-0.475)/(0.05)^2$ =383

Data collection methods and procedures

After consulting the refugee's camp administration, the permission was granted to meet the study participants. After explaining the reason and the purpose of the study, children's consent form was signed by the parent or guardian, and grown-up children signed an assent form. Detailed identifications of children were recorded in the log book. Questionnaires designed to assess risk factors associated with intestinal nematodes infections were distributed to the parents or guardians of selected children to be filled with the help of community health workers in the camp. Putting questions in local languages, using multiple choice related questions and closed ended questions were considered in designing the questionnaire. This tool was tested by few individuals before being administered to the study participants.

Then, a well labeled stool container was given to collect samples. To ensure the appropriateness of the stool samples, the procedure for sample collection was explained to the participants so as to avoid self and cross-contamination. Up on the arrival, the stool samples were assessed macroscopically and later preserved in 10% formalin prior to the microscopic examination.

After collecting 383 stool samples, they were examined microscopically after formal ether concentration techniques as explained in the previous publication.[9] Well-prepared microscopic slide was first scanned with 10× objective and 40× objective was used to clearly identify the parasite. The laboratory results were either positive or negative for the presence of intestinal nematodes. Every parasite specie present in a positive sample was recorded in order to know the most prevalent parasites. Data extracted from questionnaires and laboratory results were analyzed using SPSS version 21 developed and licensed by Linux on IBM Z from Chicago, United State of America (USA). Pearson's chi-squared test and Fischer's exact tests were used to determine whether there is a statistically significant association between the sociodemographic characteristics and intestinal nematodes infections among the study participants. To assess the nature of the association, univariate and multiple logistic regression analysis were used for factors revealed by Chi-squared tests.

Ethical considaration

This study was ethically approved by the Institutional Review Board (IRB) of the College of Medicine and Health Sciences, University of Rwanda. Confidentiality was ensured by the use of unique identification numbers instead of names, parents or guardians signed the informed consent before data collection was started. An assent form was signed for each child who was able to understand the nature and the purpose of the study. Children who were positive for parasites, were treated for free in collaboration with Kigeme Health Center. All the procedures were in accordance with the declaration of Helsinki.[10]

Results

With the aim of determining the prevalence of intestinal nematodes infections, a total number of 383 primary school children were chosen from Kigeme refugee camp located in Nyamagabe district in the Southern province of Rwanda. Table 1 depicts the sociodemographic characteristics of study participants.

Of 383 selected children, 60.8% were female and 39.2% were male. The most prevalent age group was 6 to 8 years with 167 (43.6%) participants. On parental education, the big number had the primary education with 181 (47.3%). In relation to knowledge on roots of transmission of intestinal nematodes for family members, the majority said yes with 344 (89.8%).

Table 1. Sociodemographic characteristics of primary school children (n=383) at Kigeme refugee camp, southern province, Rwanda (2021)

Sociodemographic variables	Categories	Frequency	Percent
Sex	Male	150	39.2%
	Female	233	60.8%
Age	6-8 years	167	43.6%
	9-11 years	143	37.3%
	12-14 years	73	19.1%
Parental education	None	121	31.6%
	Primary	181	47.3%
	Secondary	81	21.1%
	University	0	0.0%
Participation of parents in meetings about hygiene and sanitation	Always	253	66.1%
	Sometime	130	33.9%
	Never	0	0.0%
Children on washing hands with soap and clean water before eating or after visiting toilet	Always	276	72.1%
	Sometimes	106	27.7%
	Never	1	.3%
Drinking boiled water	Sometimes	274	71.5%
	Always	107	27.9%
	Never	2	.5%
Washing vegetables and fruits before eating	Always	273	71.3%
	Sometimes	109	28.5%
	Never	1	.3%
Availability of toilets	Public	383	100.0%
	Private	0	0.0%
	Other means	0	0.0%
Wearing shoes habits to the children	Always	280	73.1%
	Sometimes	102	26.6%
	Never	1	.3%
Knowledge on roots of transmission of intestinal nematodes for family members	Yes	344	89.8%
	No	39	10.2%

Prevalence of intestinal nematodes infections

Of 383 participants, intestinal nematodes were prevalent in 184 (48.04%). The most prevalent parasite was *Ascaris lumbricoides* with 149 (81.0%) of the total positivity. Participants infected with more than one parasite were also noted with 9 (4.9%) cases of *Ascaris lumbricoides* and *Trichuris trichiura* and 6 (3.3%) cases of *Ascaris lumbricoides* and *Hookworm* (Table 2).

Table 2. Distribution of parasites in stool samples

Parasites	Frequency	Percent
Ascarislumbricoides	149	81.0%
Trichuris trichiura	13	7.1%
Hookworm	7	3.8%
Ascaris lumbricoides and *Trichuris trichiura*	9	4.9%
Ascaris lumbricoides and Hookworm	6	3.3%
Total	**184**	**100.0**

Intestinal nematodes infections with associated factors

Pearson Chi-square tests and Fisher exact tests were used accordingly in order to verify a possible association between the presence of intestinal nematodes and sociodemographic characteristics. During this study, a certain number of factors were found associated with intestinal nematodes infections. These are: parental education (P = 0.012), attitude of children on washing hands with soap and clean water before eating or after visiting toilet (P = 0.012), drinking boiled water (P = 0.0001), washing vegetables and fruits before eating (P = 0.0001), wearing shoes habits to the children (P = 0.0001), knowledge on roots of transmission of intestinal nematodes for family members (P = 0.0001) (Table 3). Logistic regression analysis was used to determine the nature of the association and parental education was identified as a risk factor with OR = 2.172, CI = (1.212, 3.894), P=0.009 for non-educated parents and OR = 2.161, CI = (1.251,3.732); P = 0.006 for children having parents with Primary education. On the other hand, knowledge on roots of transmission of intestinal nematodes for family members was seen as a protective factor with OR = 0.243, CI = (0.112, 0.528), P = 0.0001. This factor was also confirmed as an independent protective factor on multiple regression analysis with OR=0.395, CI = (0.16, 0.973), P = 0.040 (Table 4).

Table3. Chi-square test for association between sociodemographic factors and Intestinal nematodes

Variables	Categories	Total	Negative n %	Positive n %	p value
Sex	Male	150	70 (35.2%)	80 (43.5%)	0.060
	Female	233	129 (64.8%)	104 (56.5%)	
Age	6-8 years	167	97 (48.7%)	70 (38%)	0.107
	9-11 years	143	68 (34.2%)	75 (40.8%)	
	12-14 years	73	34 (17.1%)	39 (21.2%)	
Parental education status	None	121	58 (29.1%)	63 (34.2%)	0.012*
	Primary	181	87 (43.7%)	94 (51.1%)	
	Secondary	81	54 (27.1%)	27 (14.7%)	
	University	0	0 (0%)	0 (0%)	
Participation of parents in meetings about hygiene and sanitation	Always	253	135 (67.8%)	118 (64.1%)	0.255
	Sometime	130	64 (32.2%)	66 (35.9%)	
	Never	0	0 (0%)	0 (0%)	
Children on washing hands with soap and clean water before eating or after visiting toilet	Always	276	156 (78.4%)	120 (65.2%)	0.012*
	Sometimes	106	43 (21.6%)	63 (34.2%)	
	Never	1	0 (0%)	1 (0.5%)	

*Statistically significant at P<0.05

Table3. Chi-square test for association between sociodemographic factors and Intestinal nematodes

Variables	Categories	Total	Negative n %	Positive n %	p value
Drinking boiled water	Sometimes	274	168 (84.4%)	106 (57.6%)	< 0.001
	Always	107	30 (15.1%)	77 (41.8%)	
	Never	2	1 (0.5%)	1 (0.5%)	
Washing vegetables and fruits before eating	Always	273	165 (82.9%)	108 (58.7%)	< 0.001
	Sometimes	109	34 (17.1%)	75 (40.8%)	
	Never	1	0 (0%)	1 (0.5%)	
Availability of toilets	Public	383	199 (100%)	184 (100%)	
	Private	0	0 (0%)	0 (0%)	
	Other means	0	0 (0%)	0 (0%)	
Wearing shoes habits to the children	Always	280	166 (83.4%)	114 (62%)	< 0.001
	Sometimes	102	33 (16.6%)	69 (37.5%)	
	Never	1	0 (0%)	1 (0.5%)	
Knowledge on roots of transmission of intestinal nematodes for family members	Yes	344	190 (95.5%)	154 (83.7%)	< 0.001
	No	39	9 (4.5%)	30 (16.3%)	

*Statistically significant at P<0.05

Table 4. Logistic regression analysis of potential risk factors associated with Intestinal nematodes

Factors	Categories	Univariate logistic regression		Multivariable logistic regression	
		O.R (95% C.I.)	*P* value	O.R (95% C.I.)	*P* value
Parental Education status	None	2.172 (1.212, 3.894)	0.009*	1.711 (0.883, 3.313)	0.110
	Primary	2.161 (1.251, 3.732)	0.006*	1.606 (0.852, 3.027)	0.140
	Secondary	reference		reference	
Participation of parents in meetings about hygiene and sanitation	Always	0.848 (0.555, 1.294)	0.444		
	Sometimes	reference			
Children on washing hands with soap and clean water before eating or after visiting toilet	Always	0.000	1.000		
	Sometimes	0.000	1.000		
	Never	reference			
Drinking boiled water	Sometimes	0.631 (0.039, 10.195)	0.746		
	Always	2.567 (0.155, 42.365)	0.510		
	Never	reference			

*Statistically significant at P < 0.05; OR = Odds ratio.

Table 4. Logistic regression analysis of potential risk factors associated with Intestinal nematodes

Factors	Categories	Univariate logistic regression		Multivariable logistic regression	
		O.R (95% C.I.)	*P* value	O.R (95% C.I.)	*P* value
Washing vegetables and fruits before eating	Always	0.000	1.000		
	Sometimes	0.000	1.000		
	Never	0.000	1.000		
Wearing shoes habits to the children	Always	0.000	1.000		
	Sometimes	0.000	1.000		
	Never	reference			
Knowledge on roots of transmission of intestinal nematodes for family members	Yes	0.243 (0.112, 0.528)	.0001*	0.395 (0.16, 0.973)	0.040*
	No	reference		reference	

*Statistically significant at P < 0.05; OR = Odds ratio.

Discussion

The study findings reveal a prevalence of 48.0%. This shows that intestinal nematodes infections are common among primary school children living in Kigeme refugee camp, southern province of Rwanda. These results are comparable with the ones reported among children in the general population of Eastern province (Bugesera district, Rwanda) with a prevalence of 47.5%,[7] and they appear to be lower than that reported in the survey of intestinal parasitism among schoolchildren in internally displaced persons camp, Benin City, Nigeria, where 70.3% of the study population were infested with intestinal nematodes.[11] This variation could be due to the different geographical location as well as implementation of preventive and control measures.[12]

Ascaris lumbricoides was found to be the most prevalent nematode by 81% of the total positive cases. This finding was in agreement with the study done in an internally displaced persons (IDPs) camp in Nigeria, Nasarawa state,[6] and with the results reported in children of the general population of Bugesera district, Rwanda. [7] It is in contrast with the study done in children attending Princess Marie Louise Children's hospital in Accra, Ghana where hookworm infection was the most abundant followed by *A. lumbricoides*.[13] This difference could be due to different social behaviours like wearing or not wearing shoes, as this can have a preventive impact on the parasitic infection,[14] as admitted in the present study that 83.4% of the study participants wore shoes always.

During this study, participants infected with more than one parasite were 8.2%, which is twice as high as that reported in rural children in Bangladesh where the prevalence of was 3.4%.[15] This may be attributed to the difference in sample size. As for the present study, this coinfection was seen in cases where individuals would have *Ascaris lumbricoides* with *Trichuris trichiura* or *Ascaris lumbricoides* with Hookworm. This is very unfortunate to this group of population because it is known that Ascaris lumbricoides can cause malnutrition by feeding itself on nutrients that were supposed to be important to the host or by interfering with absorption process,[16] while *Trichuris trichiura* is known to cause anemia. Thus, in addition to malnutrition caused by *Ascaris lumbricoides*, individuals who also have *Trichuris trichiura* or Hookworms may develop anemia if they are not treated early. [17]

Chi-Squared tests results showed that a number of factors were associated with intestinal nematodes infections among primary school children living in Kigeme refugee camp. Logistic regression analysis identified two important factors which are parental education and knowledge on roots of transmission of intestinal nematodes for family members. During this study it was revealed that children whose parents had no primary education were 2 times (OR = 2.172, P = 0.009) more likely to be infected with intestinal nematodes when than those with at least secondary education. This finding is in agreement with other studies where parental education, with mother's higher literacy level being negatively associated with children's parasitic infections.[18,19]. In another study, the participant's educational level was statistically associated with intestinal parasitic infections (IPIs) whereby illiterate individuals were 2.87 times more likely to be infected with IPIs than the others. [20] On the other hand, knowledge on roots of transmission of intestinal nematodes for family members was seen as a protective factor in both univariate logistic regression OR = 0.243, P = 0.0001 and multiple logistic regression analysis OR = 0.395, P = 0.040. This means that knowing the roots of transmission of intestinal nematodes is a stand-alone protective factor with regard to parasitic preventions, this has also been reported elsewhere.[21]

This study reiterates the fact that family members and parental education in particular is key as far as prevention of intestinal nematodes infections is concerned. This study may serve as baseline on prevalence of intestinal nematodes infection among primary school children at Kigeme refugee camp. It is recommended that Ministry in charge of Emergency Management (MINEMA) in Rwanda and other partners including UNHCR enhance public health education about hygiene and sanitation as well as regular mass drug administration. Insufficiently clean and public tap water don't satisfy daily volume of water the camp population needs due to overcrowdings, hence the high risk of acquiring intestinal parasitic infections. So, increase of public water taps and adequate clean water are highly needed in the camp.. Future researchers are also encouraged to expand this type of study in other refugee camps in Rwanda.

Conflict of interest

None

The authors' contribution

JAT, JBU, DM, ED contributed equally in this work and were involved in research design, data collection, analysis. PK co-supervised this work whereas AN was the main supervisor and assisted in drafting the manuscript.

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