Intestinal helminths in Luweero district, Uganda

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Abstract

Background: Intestinal helminthiasis is a debilitating parasitic disease found in many parts of Uganda including Luweero district. In the district, the disease causes as high as 9% morbidity in children below five years. There was very scanty district information on the disease based mainly on hospital records despite this figure. The current study was carried out to provide data to plan for its effective control.

Objective: To investigate risk factors that promote helminth infections among children under five years of age in Luweero district.

Methods: Stool samples from 727 children were examined for presence of helminth ova using Kato-Katz technique. The subjects' parents or guardians were interviewed using a semi-structured questionnaire to establish their demographic, social-cultural characteristics; information on water accessibility and usage; child toileting practices and knowledge about helminthiasis.

Results: Risk factors strongly associated with helminth infections included methods of anal cleaning, how compounds and latrines were maintained, keeping of pigs and age of the subjects, ($P < 0.001$). In addition, methods of hand washing after latrine visits, the respondents' education level, type of house floor and household compound as well as accessibility to water were associated with worm infection.

Conclusion: The hygiene practices of the parents/guardians and environmental surroundings in which the child grows play a big part in determining his or her helminth status. The District Health workers, community leaders and extension staff should educate the community on the importance of personal hygiene and environmental sanitation to minimize the risks of helminth infections.

Key words: Helminth infections, hygiene practices, risk factors and Luweero district.

Running head: Risk factors for helminth infections

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Introduction

Intestinal helminthiasis is one of the major health problems in Luweero district. It is ranked 3rd or 4th among the top 10 diseases of the district in the under five[1]. The helminth infections of children consist of 82.1% *Ancylostoma duodenale* and/or *Necator americanus*, 18.9% *Ascaris lumbricoides*, 7.0% *Trichuris trichiura*, 1.0% with *Enterobius vermicularis*, and 0.5% with *Hymenolepis nana*[2]. This study was carried out to establish risk factors that contribute to helminth infections. To date, the district still has many of its physical and social-economic aspects lagging behind those of the national characteristics. It has low pit latrine coverage of 54%. Most latrines are locally made with uncovered squat holes. Some are temporally structures with walls and roofs constructed from dry banana leaves and grass. Health facilities in the district are few, poorly staffed and ill equipped. Accessibility to a health facility offering basic curative and preventive services is poor, with only 53% of the population living within 5-km radius from such health units. This study investigated such underlying factors as possible causes that promote intestinal helminth infections in pre-school children in the area to facilitate planning for its control.

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Materials and methods

The study was conducted in Luweero district, Uganda, which is 30 kilometers north of Kampala, the capital city of the country. It was a cross-sectional descriptive survey that was carried out in 19 villages in 2 randomly selected sub-counties. The sampling unit was a household and only one child was selected from each of the 727 households. As there was very scanty district information on prevalence of helminthiasis at the time of study, calculation of sample size was based on the high hospital out-patient figures assuming 50% prevalence using the equation given by Walpole (1982)[3]. When the children were identified, the purpose, objectives and benefits of the study were explained to the parents or guardians and consent for participation sought. Those who consented were interviewed using a pre-tested semi-structured questionnaire. The questionnaire addressed the demographic and social-cultural characteristics of parents/guardians and children. Characteristics included age, marital status, religious affiliations, hygiene practices and level of education. Given that 19% of the respondents were not parents, (the 19% included child

minders, grandparents and other relatives) some information bias could have been introduced, particularly concerning the children's characteristics. This was minimized by careful interrogation. All households were inspected to assess the type and condition of latrine, status of the compound, absence or presence of refuse dumps, soiling of the compound and whether the home reared cows and/or pigs. The type of water sources from which respondents collected water and their accessibility was also noted. Respondents were then given labeled stool containers with tight covers bearing serial numbers of the subjects and were asked to put about 5g of children's stool the following morning. All the stool samples were received the following day at an organized central place and processed using Kato-Katz smear technique[3]. Two slides with the subjects' serial numbers were prepared from each stool sample and examined for presence of helminth ova. The arithmetic mean egg count of the two slides was recorded as the count in the stool specimen delivered by the 41.7-mg templates. The laboratory results were recorded using the child assessment form. The data was entered into a computer using both EPIINFO and SPSS (8.0 version) statistical packages and analysis was done using Chi-square test. Odds ratios (OR) were calculated for risk factors significantly associated with presence of ova and later multivariate analysis done using binary logistic regression model.

Results

Characteristics of the study population

The study population was composed of 727 pre-school children of whom 50.5% (367/727) were males and 49.5% (360/727) were females. They were aged between 0.8 and 5 years with a mean age of 2.61 and SD 1.04. Ninety one percent of the respondents were females, while 8.4% (61/727) were males. Their mean age was 31.7 years (range 12-86; SD 12.1) and median age was 28 years. Over half of the respondents (52.5%; 381/725*) were between 21-30 years. [*Reasons for variation in the denominator 727 include the following: non-response from respondents on some questions; all questions not being applicable to all respondents; consistent absence of respondents at the time of the visits, having taken submission of the stool sample as a dependent factor.] The majority of the respondents were Baganda by tribe, 55.8% (406/727) while the rest were multi-ethnic groups including Baruli, Banyoro and Tanzanians. Regarding the respondents' marital status, 79% (572/727) were currently married, 13% (97/727) had never married and 8% (58/727) had ever been married.

Factors associated with socio-demographic, cultural and economic characteristics

Thirty eight percent of respondents (276/725) had no education, 51.7% (375/725) had primary education while 10.2% (74/725) had post primary education. Table 1 indicates that education was the only variable among the socio-demographic characteristics associated with helminth infections, (P = 0.006). The rate of helminth infection decreased the higher the education; 34.2% had no education, 23.7% primary education and 21.6% post primary education. The results further reveal that among the socio-cultural and economic characteristics, methods of hand washing after latrine visits and after handling children's faeces as well as methods of anal cleaning were the only variables associated with helminth infections. Overall, 58.6% (425/725) children slid on the ground as a way of cleaning themselves after visiting the latrine; 33.5% (243/724) were using leaves or paper, while 7.9% (57/724) were being bathed. Among the children found with ova, 34.8% (148/425) were sliding on the ground as a means of cleaning themselves after latrine visits compared to 17.7% (43/243) and 15.8% (9/57) of those who were using leaves and being bathed respectively.

Factors associated with household construction characteristics

Table 2 shows that out of 721 homes, 82.0% (591/721) had houses with mud floors while the rest had cemented floors. Of the children found with helminth ova, 29.9% (177/591) were living in houses with mud floors compared to 18.5% (24/130) of those living in houses with mud floors. The type of floor of house was significantly associated with helminth infection, (P = 0.008). Seventeen per cent of the latrines had cemented floors while the rest were constructed with either mud or logs. Out of children infected with helminth ova, only 18.3% (22/120) were living in homes with latrines with cemented floors compared to 29.6% (94/315) or 28.6% (74/259) of those living in homes with latrines with log and mud floors respectively. The type of latrine floor was also significantly associated with worm infection (P = 0.012).

Table 1: Socio-demographic, cultural and economic characteristics

Characteristic	Ova present n (%)	Ova absent n (%)	Total n n (%)	Chi-square$_{df}$ (P-value)
Religion				
Christian	184 (27.9)	475 (72.1)	659 (90.9)	0.406_1
Muslim	16 (24.2)	50 (75.8)	66 (9.1)	(0.524)
Level of Education				
None	94 (34.2)	181 (65.8)	275 (38.0)	10.112_2
Primary	89 (23.7)	286 (76.3)	375 (51.8)	(0.006)*
Post-primary	16 (21.6)	58 (78.4)	74 (10.2)	
Place for easing self				
Own latrine	183 (28.6)	457 (71.4)	640 (88.8)	3.906_2
Shared latrine	12 (17.9)	55 (82.1)	67 (9.3)	(0.142)
Bush/field	5 (35.7)	9 (64.3)	14 (1.9)	
Respondents' hand washing after latrine				
Water with water and soap	32 (17.4)	152 (82.6)	184 (25.4)	13.950_2
Water only	154 (30.4)	352 (69.6)	506 (70.0)	(0.001)*
Nothing#	13 (40.6)	17 (59.4)	33 (4.6)	
Do after handling children's faeces				
Wash with water and soap	37 (18.2)	166 (81.8)	203 (28.9)	14.118_2
Water only	108 (32.6)	223 (67.4)	331 (47.2)	(0.003)*
Nothing#	48 (29.8)	113 (70.2)	161 (22.9)	
Cleaning of child after latrine				
Sliding	148 (34.8)	277 (65.2)	425 (58.6)	27.015_2
Leaves	43 (17.7)	200 (82.3)	243 (33.5)	(<0.001)*
Bathing	9 (15.8)	48 (84.2)	57 (7.9)	

Nothing - Respondents used not wash their hands

* - Statistically significant P-value

Factors associated with household hygiene

Out of children infected with helminth ova, 32.3% (135/418) were living in homes with latrines in poor condition compared to 13.8% (12/87) of those living in homes with latrines in good condition. There was a highly significant association between condition of latrine and helminth infection, ($P < 0.001$). Out of the children found with ova, 33.9% (101/298) were living in homes with soiled compounds compared to 23.3% (99/424) living in homes with compounds which were not soiled. The soiling of compound was significantly associated with helminth infection, ($P = 0.002$). Overall, out of the children found with ova, 35.3% (89/252) were living in homes with poorly maintained compounds compared to 9.8% (5/51) of those living in homes with well maintained compounds. The association between compound status and helminth infection was highly significant, ($P < 0.001$).

Factors associated with water sources and availability

In total, 69.9% (503/720) of the respondents used protected water sources, while only 38.9% (280/719) accessed water easily. Out of the children infected with helminth ova, 31.2% (137/439) belonged to parents who found difficulties in accessing water compared to 22.1% (62/280) who easily accessed it. There was an association between how easily respondents accessed water and worm infection, ($P = 0.008$).

Factors associated with domestic animals

Overall, only 20.9% (150/719) homes kept cows while 34.3% (247/720) kept pigs. Of the children found with helminth ova, 36.0% (89/247) were living in homes that kept pigs compared to 22.8% (108/473) of those who did not. Out of 36.0% helminth infections found in homes that kept pigs; 83.1% were composed of hookworms, 16.9% *Ascaris lumbricoides*, 5.6% *Trichuris trichiura* and 1.1% *Enterobius vermicularis*. Whereas keeping pigs was highly significant with helminth infection, keeping of cows was not, ($P < 0.001$; $P = 0.074$ respectively). Other factors not associated with helminth infections included respondents' age, marital status, religion, occupation and type of latrine used by the household.

Bivariate and multivariate analysis

Odds ratios and 95% confidence intervals were calculated to assess risk factors associated with intestinal worm infection at bivariate level and adjusted by binary logistic model at multivariate level of analysis, Tables 3a and 3b.

Table 2: Factors related to home environment, latrine facilities and water availability

Variable	Ova present		Ova absent		Total		Chi-square$_{df}$ (P-value)
	n	(%)	n	(%)	n	(%)	
Type of floor of house							
Mud	177	(29.9)	414	(70.1)	591	(82.0)	6.994_1
Cemented	24	(18.5)	106	(81.5)	130	(18.0)	(0.008)*
Latrine floor							
Logs	94	(49.5)	221	(43.9)	315	(45.4)	10.963_2
Mud	74	(38.9)	185	(36.7)	259	(37.3)	(0.012)*
Cemented	22	(11.6)	98	(19.4)	120	(17.3)	
Condition of latrine							
Good	12	(13.8)	75	(86.2)	87	(12.4)	16.153_2
Fair	43	(21.9)	153	(78.1)	196	(28.0)	(<0.001)*
Poor	135	(32.3)	283	(67.7)	418	(59.6)	
Soiling the compound[q]							
Yes	101	(33.9)	197	(66.1)	298	(41.3)	9.714_1
No	99	(23.3)	325	(76.7)	424	(58.7)	(0.002)*
Status of compound							
Poorly maintained	89	(35.3)	163	(64.7)	252	(35.0)	17.338_2
Fairly maintained[‡]	103	(24.8)	313	(75.2)	416	(57.9)	(<0.001)*
Well maintained	5	(9.8)	46	(90.2)	51	(7.1)	
Water sources							
Unprotected sources[Þ]	67	(30.9)	150	(69.1)	217	(30.1)	1.775_1
Protected sources[§]	131	(26.0)	372	(74.0)	503	(69.9)	(0.183)
Accessibility to water							
Easy	62	(22.1)	218	(77.9)	280	(38.9)	7.017_1
Difficult	137	(31.2)	302	(68.8)	439	(61.1)	(0.008)*
Keep cows							
Yes	50	(33.3)	100	(66.7)	150	(20.9)	3.190_1
No	148	(26.0)	421	(74.0)	569	(79.1)	(0.074)
Keep pigs							
Yes	89	(36.0)	158	(64.0)	247	(34.3)	14.224_1
No	108	(22.8)	365	(77.2)	473	(65.7)	(<0.001)*

[Þ] - Wells, streams, springs and rivers

[§] - Wells and bore holes

* - Statistically significant P - value

[q]Soiled compounds - Compounds made dirty with human or animal excreta.

[‡]Fairly maintained compound - Area of flat ground outside a house whose maintenance is just average, i.e. not well swept or with few pieces of rubbish.

Factors significantly associated with helminth infections after being adjusted are indicated in the tables and these comprise five variables. Of the children infected with ova, those whose parents washed without soap or who did not wash at all after handling children's faeces were significantly more likely to be infected with intestinal infections than those whose parents/guardians washed using soap (Adj. OR = 1.79; 95% CI = 1.03 - 3.11). In regard to anal methods of cleaning, the results revealed that children who slid on the ground were less likely to be infected than those who used leaves or anal washing (Adj. OR = 0.46; 95% CI = 0.30 - 0.70). Out of the children infected with helminth ova, those who lived in homes keeping pigs were significantly more likely to be infected with worms than those in homes without pigs, (Adj. OR = 1.73; 95% CI = 1.17 - 2.58). Children who lived in homes with poorly maintained latrines were almost two times more likely to have worm infections than those in homes with fairly maintained latrines (Adj. OR = 1.90; 95% CI = 1.17 - 3.10). Finally, children between 0.8 - 2.3 years were two times less likely to be infected with worms than those between 2.4 - 4.9 years, (Adj. OR = 2.52; 95% CI = 1.57 - 4.05).

Discussion

The study reveals that the key factors associated with helminth infections are mainly poor hygiene practices and environmental hygiene. This is supported by Kloss and Zein[4], who reported that ignorance of simple health promotion practices, poor sanitation, plus low economic standard favour wide distribution of intestinal helminths. Usually, most people with low economic standard are those who lack or have low education and do not value simple health promotion practices.

Table 3a: Bivariate and multivariate analysis for factors significantly associated with presence of ova

Variable	Bivariate analysis	Multivariate analysis	
	Crude OR (95% CI)	ß Estimate	Adjusted OR (95% CI)
Level of Education			
None	1.54 (1.11 - 2.15)	0.061	1.06 (0.70 - 1.63)
At least primary education			
Respondents' hand washing after latrine			
Nothing[#]/Water only	2.13 (1.40 - 3.25)	0.029	1.03 (0.55 - 1.94)
Wash with water and soap			
Do after handling children's faeces			
Nothing[#]/Water only	2.08 (1.39 - 3.11)	0.584	1.79 (1.03 - 3.11)[¥]
Wash with water and soap			
Cleaning of child after latrine			
Sliding	2.23 (1.57 - 3.80)	-0.774	0.46 (0.30 - 0.70)[¥]
Leaves/Bathing			
Type of floor of house			
Mud	1.89 (1.17 - 3.04)	0.131	1.14 (0.62 - 2.09)
Cemented			
Soiling the compound			
Yes	1.69 (1.19 - 2.38)	0.052	1.05 (0.68 - 1.64)
No			
Presence of refuse dumps			
Yes	1.73 (1.21 - 2.45)	0.110	1.12 (0.73 - 1.71)
No			
Status of compound			
Poorly maintained	1.82 (1.30 - 2.54)	0.204	1.23 (0.79 - 1.90)
Fairly maintained			

OR - Odds ratio
CI - Cornfield 95% confidence limits for OR
[#] - Respondents did not wash hands
[¥] - Significant at Multivariate analysis

Table 3b: Bivariate and Multivariate analysis for factors significantly associated with presence of ova

Variable	Bivariate analysis	Multivariate analysis	
	Crude OR (95% CI)	ß Estimate	Adjusted OR (95% CI)
Keep pigs			
Yes			
No	1.87 (1.30 - 2.63)	0.550	1.73 (1.17 - 2.58)[¥]
Latrine floor			
Logs/Mud	1.84 (1.12 - 3.03)	0.280	1.32 (0.76 - 2.32)
Cement			
Condition of latrine			
Poor	1.98 (1.38 - 2.83)	0.643	1.90 (1.17 - 3.10)[¥]
Fair			
Accessibility to water			
Difficult	1.60 (1.12 - 2.26)	-0.244	1.28 (0.82 - 1.99)
Easy			
Age group of children (years)			
0.8 - 2.3	2.76 (1.93 - 3.96)	0.923	2.52 (1.57 - 4.05)[¥]
2.4 - 4.9			

OR - Odds ratio
CI - Cornfield 95% confidence limits for OR
[¥] - Significant at Multivariate analys

The results revealed that the level of education of respondents was significantly associated with helminth infection; the lower the parents' education, the poorer the children's helminth status. The findings are comparable with the Uganda Demographic Health Survey[5] which reported that while 40% of Ugandan mothers had never attended school; under-nutrition was considerably higher among children of mothers with no education or only primary education than among mothers with secondary or higher education.

Furthermore, the level of hand washing and method of anal cleaning of children after latrine use were found to be significantly associated with helminth infection. Washing hands using soap after visiting a latrine is a hygienic practice that controls the faecal-oral transfer of germs to the mouth. Evidently, the hands of those who did not wash hands or washed without soap could have contaminated the food children were eating. It might be that these respondents either lacked awareness on the usefulness of proper hand washing and/or neglected this vital practice. The current findings point to the need of washing as an important barrier to worm infection and that it has to be done properly if it is to be effective. Thus, promotion of personal hygiene practices is very vital as a preventive measure in controlling helminth infection.

Regarding the method of anal cleaning after visiting the latrine, the children who slid had a higher risk of being infected with worms than those who were using leaves or who were being bathed at bivariate level. Whereas soiled leaves are normally properly disposed of in the latrine, thereby posing less danger to helminth transmission, sliding has a dual effect. Firstly, it is likely to leave the ground contaminated with helminth eggs that later develop to infective stages. Secondly, it contaminates the slider's hands. Once the hands are contaminated, there is a high possibility of the child getting directly re-infected through the mouth. According to Chandler and Read[6], infection of *Ascaris lumbricoides* ordinarily results from swallowing embryonated eggs, which are more frequently conveyed to the mouth by fingers than by other methods. However, the situation of the sliders was the reverse at multivariate level, (Adj. OR = 0.46; P = 0.000). This requires further investigation.

Inspection of homes with sampled children revealed that those living in houses with uncemented floors had a higher infection rate than those in houses with cemented floors. The mud floors, evidently, provided a suitable medium that encouraged development of soil-mediated helminths in these homes. On the other hand, when all these environmental factors were subjected to multivariate analysis, only children living in homes with poorly maintained latrines were found to have high risk of acquiring helminth infections. The results reveal that these latrines, which in most cases were wet and soiled, had the potential to transmit hookworms. This is not a surprise as the majority of children in the area walked barefooted. Such a condition was compounded by the fact that, most of the latrines were made up of mud and log floors thus providing an ideal environment for worm development. These results concur with Mubiru[7] who reveals that the wetness of the area near the squat area renders traditional pit latrines clumsy and lucrative places of hookworm transmission. Furthermore, children in homes keeping pigs were significantly more likely to get infected with worms than those in houses without pigs. As pigs normally eat human faeces, it is possible that pigs dispersed undeveloped helminth eggs by eating them in human faeces and excreting them at another place.

There was no statistically significant relationship between type of water sources and worm infection. This could have been due to the fact that the majority of water sources were protected, posing no serious danger to the community. There was, however, a statistically significant relationship between accessibility to water and helminths infections. Of the children infected with worms, those whose parents found difficulties in accessing water were more likely to get infected than those whose parents accessed it easily. Apparently, the prevalence rates were directly linked to the quantity of water available for domestic use. It is possible that respondents, especially those, who did not have easy access to water, were economizing it at the expense of practicing satisfactory personal hygiene. One of the difficulties they had was long distance from the water source. This agrees with Ofumbi[8], who found out that in Iganga, eastern Uganda, one of the major constraints to water use were inadequate domestic water supply because of distance. Cairncross[9] also noted that improvements in hygiene become possible when water is available in greater quantity for use in the house to wash hands, plates and other things.

The present study identified that the practices of the parents/guardians as well as the status of the environment played the biggest part in determining the helminths status of the children. Education sessions should therefore be conducted to guide the community to internalize important roles personal hygiene and environmental sanitation play in promoting health. Furthermore, all efforts should also be made by the district authorities to provide the community with clean and safe water.

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