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Ascaris lumbricoides: prevalence and associated factors among pre-school children in Rukiga district, Uganda: a cross-sectional study

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Abstract

Background *Ascaris lumbricoides* infestation remains a public health problem worldwide. It mainly affects children resulting into undernutrition, impaired growth and physical development, intestinal obstruction and death. We aimed to determine the prevalence and factors associated with *Ascaris lumbricoides* infestation among children aged 6–59 months in Rukiga district, Uganda.

Methods In this cross-sectional study, we recruited 739 children aged 6–59 months and their caregivers between September and October 2023. Semi-structured questionnaires were used to collect data on sociodemographic characteristics of the caregivers. We examined children's stool for *Ascaris lumbricoides* ova using the Kato-Katz method. We estimated adjusted odds ratios using multivariable logistic regression to determine the factors associated with *Ascaris lumbricoides* infestation.

Results The prevalence of *Ascaris lumbricoides* infestation was 2.7% ($n = 20/739$), (95% CI. 1.7–4.1). Factors associated with *Ascaris lumbricoides* infestation were: Child-related characteristics including: the child having not been dewormed 6 months prior to the study (AOR 2.04, 95% CI: 1.04–4). Household characteristics including: disposal of child's stool in the compound/ garden (AOR 12.53, 95% CI: 3.44–45.64), if there are more than two children under 5 years living in the household (AOR 0.24, 95% CI: 0.11–0.52). Care-giver characteristics including the primary caregiver being: the father (AOR 6.09, 95% CI: 1.21–30.61), a Christian (AOR 0.04, 95% CI: 0.01–0.17).

Conclusion and recommendations *Ascaris lumbricoides* infestation was 2.7% among preschool children. We recommend the inclusion of male partners in health interventions targeting children under the age of five years especially the immunization programs. Community health programs should consider targeted messages in health education campaigns especially the handling and disposal of feces and the importance of deworming children. The association between religion and *Ascaris lumbricoides* infestation needs further studies.

Keywords *Ascaris lumbricoides*, Preschool children, Uganda

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Introduction

Background

Ascaris lumbricoides infestation (Ascariasis), remains a significant public health concern worldwide especially in sub-Saharan Africa, particularly among vulnerable populations like pre-school children. Despite global strategies to control and eliminate ascariasis, *Ascaris lumbricoides* infestation persists in many regions, posing a threat to children's health, growth, and development. The World Health Organization (WHO) recommends preventive chemotherapy (deworming), using annual or biannual single-dose albendazole (400 mg) or mebendazole (500 mg) for all children [1] including preschool children define as children who are less than 5 years of age; relates to a time in their life before they are old enough to go to school [2].

Ascaris lumbricoides (round worms), are intestinal parasites that are acquired through ingestion of infective eggs [3]. At least 11% of the world's population (more than 0.7 billion) is infested with *Ascaris lumbricoides* [4] with sub-Saharan Africa being one of the most affected regions worldwide [5]. The World Health Organization (WHO) lists preschool children among at-risk populations for *Ascaris lumbricoides* infestation in endemic areas as evidenced in several studies. Several studies in Ethiopia, Kenya and Uganda have reported varying prevalence of *Ascaris lumbricoides* infestation among preschool children [6–8].

A study among preschool children in Ethiopia showed that 19.6% of the children were infested with *Ascaris lumbricoides* in 2017 [6]. In Kenya 2018, an evaluation of a 5-year countrywide deworming program found that 9.7% of school children had ascariasis [7]. In Uganda, a study among preschool children, in rural Kigezi found a very high prevalence of *Ascaris lumbricoides* infestation of 80.2% in 1973 [8]. Another nationwide study done in Uganda among school children found that 6.3% had ascariasis in 2005 [9]. In 2016 after a decade of nationwide deworming, the prevalence of *Ascaris lumbricoides* infestation was 0.5% among school children [10]. A recent multicentred study done in 2022 reported high prevalence in two of its sites: Rubanda had 11.1% and Kisoro 24% among preschool children [11]. In 2020 a study among school children in Kamuganguzi [12], in Kabale district, south western Uganda found the prevalence of *Ascaris lumbricoides* infestation to be 21.9%.

Infestation with *Ascaris lumbricoides* leads to diarrhoea, abdominal pain, undernutrition, impaired growth and development [5]. Ascariasis also causes intestinal obstruction that can ultimately lead to death [13–15]. Studies have documented a number of predictors for *Ascaris lumbricoides* infestation including: the child's age, unsafe disposal of stool and no deworming [16, 17]. There are a few published studies on predictors for ascariasis in Ugandan preschool children especially in the Kigezi region. Those that are published have mainly focused on school children [10]. We therefore investigated the prevalence and factors associated with *Ascaris lumbricoides* infestation among pre-school children. Understanding these factors is crucial for developing effective prevention and control strategies to reduce the burden of ascariasis in this vulnerable population.

Materials and methods

Study design

A cross-sectional study was done in Rukiga district found in Kigezi region, southwestern Uganda from 2nd September to 7th October, 2023.

Study setting

Rukiga district is located in Kigezi region and has 6 sub counties, 30 parishes and 293 villages. The district shares borders with Kabale district to the southwest, Rubanda district to the northwest, Rukungiri district to the north, Ntungamo district to the east, and Rwanda to the southwest. The district has over 25,000 households with an estimated population of 134,051. The main economic activity in Rukiga district is subsistence farming.

Sample size estimation

We estimated the sample size using Kish Leslie [18] formula denoted as $N = Z^2P(1\text{-}P)/d^2$. We assumed a prevalence of ascariasis among pre-school children using a study that particularly assessed *Ascaris lumbricoides* infestation using Kato Katz method [19] of 31.3%, 95% confidence interval, and 5% precision and used a design effect of 2 [20]. The sample size was 662 children, and after correcting for 10% non-response, the effective sample size was 729 children.

The sample size for factors associated with *Ascaris lumbricoides* infestation was calculated using the Fleiss formula [21] in OpenEpi. Using the variable of no hand washing (Odds ratio, 2.92) after latrine visit in a similar cross-sectional study in Ethiopia [22]. The sample size for associated factors was 422. Correcting for 10% nonresponse gave a total of 482 children.

Therefore 729 children were taken as the final sample size since this was larger than that of the sample size for associated factors.

Study variables

The dependent variable was *Ascaris lumbricoides* infestation. This was defined as the presence of *Ascaris lumbricoides* ova in the child's stool sample using the Kato-Katz method [23].

Independent variables included (1) child-related characteristics including: demographics such as age, sex, birth order and history of deworming in the 6 months prior to the study (2) Parent/ care giver-related characteristics including: relationship to the child, care giver's age, religion, marital status, level of education, and subcounty of residence. 3)Household-related characteristics including: site of disposal of child's stool and the number of children under 5 years of age living in the household.

Participants

The study included children aged 6 to 59 months residing in Rukiga district. The primary caregivers were merely respondents. We excluded children who failed to provide stool for examination.

Data collection procedures

A total of 52 clusters were chosen from a list of villages in Rukiga district and each cluster contributed 14 children. A sampling interval was obtained by dividing the cumulative population by 52. A random number was generated that fell between 1 and the sampling interval to locate the first chosen cluster. The first cluster chosen was that in which this random number fell. Subsequently clusters were chosen by adding the sampling interval to the starting random number to obtain the second, third… up to the 52nd cluster [20]. The youngest children in the household were selected to reduce recall bias.

Primary caregivers gave written informed consent prior to being recruited into the study. Primary caregivers were interviewed to obtain data on socio-demographic and household characteristics using standardized questionnaires that were researcher-administered.

Fresh stool samples were collected into stool containers, in the morning, by the primary caregiver. Each child provided one fresh sample, that was labelled by the research assistant with a unique identification number, the date and time of collection. Stool samples were delivered to Kabale Regional Referral Hospital laboratory in cold ice boxes. To ensure quality control, samples were processed and examined for *Ascaris lumbricoides* ova using the Kato Katz method within 30–60 min of preparing the slides [23]. To avoid inter-observer errors, two slides for each stool sample were prepared and examined by different technicians. A third laboratory technician acted as a tiebreaker when conflicting microscopic stool examination occurred. We further provided clear printouts of the WHO bench aids for the diagnosis of *Ascaris lumbricoides* ova using he Kato Katz method. The laboratory team consisted of a microbiologist as a team leader with expertise in parasitology who conducted a series of training sessions to the 4 laboratory technicians of the Kato Katz method prior to the study. The microbiologist further re-examined at least 10% of the samples as a measure to ensure high study quality control.

Data analysis and management

Pretested questionnaires and stool results forms for each participant were used to collect data. Data was entered into IBM SPSS (Statistics version 26) and exported into Stata version 14 (StataCorp; College Station, TX, USA) for analysis. Normally distributed continuous variables were summarized into means and standard deviations. Those that were not normally distributed were summarized into medians and interquartile ranges. Categorical variables were summarized into frequencies and percentages. The prevalence of *Ascaris lumbricoides* infestation among the children in the study was estimated and the 95% confidence interval determined. For bivariable and multivariable analysis, we used the logistic regression model. All variables with P-values less than or equal to 0.2 and those of biological plausibility at bivariable analysis, were exported into the multivariable model to determine adjusted Odds ratios (AOR) and confidence intervals. We used 95% confidence interval to determine the factors associated with the outcome.

Results

Prevalence of *Ascaris lumbricoides* infestation among children aged 6–59 months

Of the 739 children who participated in the study, 20 had *Ascaris lumbricoides* ova recovered from the stool. The prevalence of *Ascaris lumbricoides* infestation was 2.7% (95% CI. 1.7–4.1) (Table 1).

Household and child related characteristics

Child-related characteristics

The median age of children was 28 months (IQR 18, 40) and majority of whom were female (50.9%). The mean birth order was 3 (SD 4.2). Slightly over 50% of the children had ben dewormed in the 6 months prior to the study.

Household-related characteristic

The majority of the households disposed of child's stool in the toilet or latrine 97.4%. There were 70% households with 1 child under 5 years of age, while 30% of the households had at least 2 children under 5 years of age. Only 30% of the households had 2 or more children under 5 years of age residing there (Table 1).

Primary caregiver-related characteristics

Majority of the primary caregivers 82.4% were mothers. The majority of the participants lived in Rwamucucu 25%, Kashambya 24.2% and Kamwezi 24% sub-counties. The least subcounty of residence for the study participants was Mparo town council with 4.87%. The median age of primary caregivers was 30 years (IQR 25, 38). (Table 2).

Table 1 Household and child-related characteristics among study participants

	Total, *N*=739 **n (%)**	**No Ascaris** ***n*** **(%)** **719 (97.3)**	**Ascaris present** ***n*** **(%)** **20 (2.7)**	***P*-value at bivariable level**
Age in completed months				
≤ 12	95 (12.9)	94 (13.1)	1 (5)	
≥ 13	644 (87.1)	625 (86.9)	19 (95)	0.367
Sex				
Male	363 (49.1)	351 (48.8)	12 (60)	
Female	376 (50.9)	368 (51.2)	8 (40)	0.358
Child's birth order				
≤ 5	676 (91.5)	656 (91.2)	20 (100)	
≥ 5	63 (8.5)	63 (8.8)	0 (0)	0.71
History of deworming in the last 6 months				
Yes	380 (51.4)	373 (51.9)	7 (35)	
No	359 (48.6)	346 (48.1)	13 (65)	0.09
Site of disposal of child's stool at the household				
Toilet/ latrine	720 (97.4)	703 (97.8)	17 (85)	< 0.01
Compound/ garden	19 (2.6)	16 (2.2)	3 (15)	
Number of children under 5 years of age in a household				
1	517 (70)	500 (69.5)	17 (85)	
≥ 2	222 (30)	219 (30.5)	3 (15)	0.03

Table 2 Primary caregiver characteristics among children aged 6–59 months in Rukiga district

	Total, *N*=739 ***n*** **(%)**	**No Ascaris** ***n*** **(%)** **719 (97.3)**	**Ascaris present** ***n*** **(%)** **20 (2.7)**	***P*-value at bivariable level**
Age of primary caregivers in completed years				
18 to 25	181 (24.5)	177 (24.6)	4 (20)	
26 to 45	442 (59.8)	432 (60.1)	10 (50)	0.97
≥ 46	99 (13.4)	93 (12.9)	6 (30)	0.24
I don't know	17 (2.3)	17 (2.4)	0 (0)	
Religion				
Non-Christian	7 (1)	5 (0.7)	2 (10)	
Christian	732 (99.1)	714 (99.3)	18 (90)	< 0.01
Marital status				
Married	678 (91.8)	659(91.7)	19 (95)	
Single	61 (8.2)	60(8.3)	1 (5)	0.436
Education level				
Primary	460 (62.3)	449 (62.5)	11 (55)	
Secondary	244 (33)	237 (33)	7 (35)	0.69
No schooling	35 (4.7)	33 (4.6)	2 (10)	0.36
Primary caregiver's relationship				
Mother	609 (82.4)	595 (82.75)	14 (70)	
Father	25 (3.4)	23 (3.2)	2 (10)	0.09
Guardian	105 (14.2)	101 (14.1)	4 (20)	0.39

Factors associated with *Ascaris lumbricoides* infestation among children age 6–59 months in Rukiga district

A child who was not dewormed in the 6 months prior to the study (AOR 2.04, 95% CI: 1.04–4) was twice likely to have *Ascaris lumbricoides* infestation when compared to a child who was dewormed in the last 6 months. A child whose primary caregiver was a Christian (AOR 0.04, 95% CI: 0.01–0.17) was less likely to have *Ascaris lumbricoides* infestation when compared with a child whose primary caregiver was non-Christian. A child whose primary caregiver was the father (AOR 6.09, 95% CI: 1.21–30.61) was 6.09 times likely to have *Ascaris lumbricoides* infestation when compared to a child whose primary caregiver was the mother. Site of disposal of child's stool: a child whose stool was disposed in the compound/garden (AOR 12.53(95%, CI: 3.44–45.64) was 12.53 times more likely to have *Ascaris lumbricoides* infestation than

Table 3 Showing the factors associated with *Ascaris lumbricoides* infestation among children aged 6–59 months in Rukiga district (Bivariable and multivariable logistic regression analysis)

	Crude odds ratio 95% CI	*P*-value	Adjusted odds ratio 95% CI	*P*-value
History of deworming in the last 6 months				
Yes	1		1	
No	2 (0.89–4.51)	0.09	2.04 (1.04–4)	0.04
Religion				
Non-Christian	1		1	
Christian	0.06 (0.01–0.37)	< 0.01	0.04 (0.01–0.17)	< 0.01
Primary caregiver's relationship				
Mother	1		1	
Father	3.7 (0.81–16.9)	0.09	6.09 (1.21–30.61)	0.03
Guardian	1.68 (0.51–5.57)	0.39	1.35 (0.44–4.15)	0.6
Site of disposal of child's stool				
Toilet/ latrine	1		1	
Compound/ garden	7.75 (2.08–28.92)	< 0.01	12.53 (3.44–45.64)	< 0.01
Number of children under 5 years of age in a household				
1	1		1	
≥ 2	0.4 (0.18–0.91)	0.03	0.24(0.11–0.52)	< 0.01

a child whose stool was disposed of in a toilet or latrine. Number of children under 5 years of age in a household: a child from a household with two or more children under 5 years (AOR 0.24 (95%, CI: 0.11–0.52) was 0.24 less likely to have *Ascaris lumbricoides* infestation when compared to a child from a household with only one child under 5 years of age (Table 3).

Discussion

The prevalence of *Ascaris lumbricoides* infestation was low in this study. Different studies have reported varying prevalences of ascariasis in Africa. One study done in Uganda reported a prevalence of 9.8% of ascariasis among preschool children [16]. Studies in Ethiopia have reported higher prevalences of ascariasis among preschool children [6, 24]. Okeke in Nigeria [25], reported a prevalence of 2.4% among children which is similar to results of the current study. In contrast to the above studies, prevalences lower than the current study were reported in Colombia and Brazil [26, 27]. The difference observed in the current study might be due to the variation in sanitation [16], education level, socioeconomic status [6] and deworming which was high in the current study.

In the current study we found that a child who was not dewormed in the last 6 months prior to the day of the interview, was more likely to have *Ascaris lumbricoides* infestation when compared to a child who was dewormed. Studies in Asia [17] and in Africa [16] have reported similar findings. Children below 5 years of age have an increased tendency to put random items into their mouth [28], thus increasing the risk of *Ascaris lumbricoides* infestation.

A child whose primary care giver was a Christian, was less likely to have *Ascaris lumbricoides* infestation when compared to a child whose primary caregiver was non-Christian. Findings from a recent study in Africa have not established an association between *Ascaris lumbricoides* infestation and religion [29]. However our findings are consistent with evidence from Asia that found an association between religion and *Ascaris lumbricoides* infestation [30]. Various religions may have different behavioral practices that could potentially influence the transmission of *Ascaris lumbricoides* infestation. There is need for further exploration to explain this association.

A child whose primary caregiver was the father was more likely to have *Ascaris lumbricoides* infestation when compared to a child whose primary caregiver was the mother. Routine deworming that is embedded in the immunization program for children is a key intervention against ascariasis. Evidence from elsewhere demonstrates that uptake of child health services is associated with higher levels of male partner involvement, support and joint decision making [31, 32]. Probably, male partners (fathers to children in this study area) have irregular interface with the healthcare system particularly for child healthcare services.

A child from a household that disposed of stool in the compound/ garden was more likely to have *Ascaris lumbricoides* infestation, when compared to a child whose stool was disposed of in a toilet/ latrine. This finding is not unique to our study because others [16, 33] found a similar association between poor disposal of child's feces and *Ascaris lumbricoides* infestation. Disposal of stool in the compound/ garden contaminates the child's immediate environment, and this increases the risk of infestation. In contrast to the findings of the current study, researchers in Argentina found no significant association between *Ascaris lumbricoides* infestation and disposal of feces [34].

A child from a household with 2 or more children under 5 years of age was less likely to have *Ascaris lumbricoides* infestation when compared to a child from a household with 1 child under 5 years of age. This is surprising given that studies in Ethiopia and Colombia found that children from households with 2 or more children under 5 years of age were more likely to have *Ascaris lumbricoides* infestation than those from household with less number of children [6, 26]. The risk of *Ascaris lumbricoides* infestation increases with age [16], while participants in the current study were the youngest in the household and likely to be breastfeeding. Breast feeding provides protection against *Ascaris lumbricoides* infestation [35] and more over 1 in 4 of the children in the current study were still breastfeeding. Thus, the youngest children in these families were chosen as the participant. Its likely that the youngest child is still breast feeding and is protected by breastfeeding. Thus, households with more than 2 children appeared protected as compared to households with more than 2 children.

Strength and limitations

The study was able to meet its intended objectives and reports the prevalence and factors associated with ascariasis among preschool children in Rukiga district. We used Kato Katz method, which is the current gold standard laboratory method for investigating ascariasis in field studies [23]. A cross sectional study design was employed, which inherently is unable to establish the causal effect. There was potential of recall bias however we tried to minimize this by only including the youngest child in each household.

Conclusion and recommendations

Ascaris lumbricoides infestation was 2.7% among preschool children. We recommend the inclusion of male partners in health interventions targeting children under the age of five years especially the deworming processes achieved through the expanded program on immunization in Uganda. Community health programs should target messages on handling and disposal of fecal waste and the importance of deworming among children. The association between religion and *Ascaris lumbricoides* infestation needs further study

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12879-025-10697-w.

Supplementary Material 1

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Author contributions

MK, SB, JKT conceptualized the study and supervised it. MK collected the data. MK, JKT and AN analyzed the data. MK and AN drafted the 1st manuscript. All authors revised and approved the final manuscript. JKT is the guarantor of the work.

Data availability

The datasets used in the current study is available on reasonable request to the corresponding author (MK).

Declarations

Ethics approval and consent to participate

Ethical approval for the study was granted by Kabale University Research and Ethics Committee (KAB-REC): Ethical approval number; KABREC-2023-12/ADM 109/496/01. Administrative clearance was obtained from the District Health Officer, Chief Administrative Officer of Rukiga district and from the local council chairperson of each village. Voluntary informed consent was obtained from parents/ guardians of eligible children prior to data collection. Participant information was handled in confidence. All the research procedures reported in this paper were done in accordance with the Declaration of Helsinki,

Competing interests

The authors declare no competing interests.

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