



ORIGINAL ARTICLE

Intestinal Infestations in Under-Five Children in Zambia

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ABSTRACT

Background: Intestinal infestations are of considerable public health importance in Zambia and elsewhere in Africa. Children aged less than 5 years are at the highest risk of infection. Interventions for prevention and control of these infestations require identification of their determinants. This study investigates the determinants of intestinal infestations in children below 5 years of age admitted to a children's hospital and assesses the most prevalent of the helminthes.

Methods: This was a hospital based cross-sectional study conducted at Arthur Davison Children's Hospital, Ndola, Zambia. Socio-demographic data of study participants and possible determinants for occurrence of intestinal infestations were collected using structured questionnaires. Stool samples were collected and examined for presence of parasites using direct techniques. The Pearson's Chi-square and Fisher's exact tests were used to establish associations.

Results: Present study had 148 participants out of the expected 165, making a respondent rate of 89.7%. Over half of the participants were male (50.6%), and 68.9% were above the age of 2 years. Prevalence of intestinal infestations was 19.6%, and the most prevalent parasite was *Ascaris lumbricoides*. Factors independently associated with worm infestation were father's employment (AOR = 0.41; 95 % CI [0.19, 0.90]) and history of prior worm infestation (AOR = 6.54; 95 % CI [3.28, 13.03]).

Conclusion: Intestinal infestations particularly *Ascaris lumbricoides* were more prevalent in this study. There should be policy towards countrywide deworming programs and enhanced hygiene.

Key words: Intestinal Infestations • Under Five Children • *Ascaris Lumbricoides* • Zambia

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Introduction

Healthy children who are a vital resource to ensure future well-being of a community, are at the same time, at the highest risk of intestinal infestations.^[1] Although the public health importance of intestinal infestations are high, it is often overlooked especially

among under-five children who are the most-vulnerable group at the risk of suffering nutritional deficits, cognitive impairment, serious illness, and even death linked to infestations.^[2] Infection with protozoa and helminthes is a major public health problem in developing countries, especially Zambia in both rural and urban poor communities.^[3]

About 3.5 billion people in the world are infected with intestinal infestations, of whom 450 million are ill; majority of these cases are children.^[4] The commonest intestinal infestations reported globally are *Ascaris lumbricoides* (20%), Hookworm (18%), *Trichuris trichuria* (10%) and *Entamoeba histolytica* (10%).^[5] Helminth infections are of a high prevalence and a major cause of disease burden among children in developing countries,^[6,7] especially in sub-Saharan Africa. Parasitic infections are the major problem and mostly affect children aged <5 years with high prevalence rates attributed largely to socio-economic status, poor sanitation, inadequate medical care and absence of safe drinking water supplies.^[8] It is therefore important that determinants of these infestations are identified and policies and strategies for health intervention be focused and appropriate for each community.^[4]

There are a few to no hospital based studies on intestinal parasitic infestations on the Copperbelt and more especially in Ndola. So this study will act as a platform to draw up major surveys covering specific localities in Ndola and the Copperbelt as a whole. It is therefore the aim of this study to investigate the determinants of intestinal infestations in children below the age of 5 years admitted to Arthur Davison Children's Hospital and to assess the parents' knowledge on how intestinal infestations are transmitted in children and the prevalence of parasites in the stool samples collected.

Methods

This was a hospital based cross sectional study carried out on children under the age of five from May to July 2015. This study was conducted at Arthur Davison Children's Hospital (ADCH), the only pediatric hospital in our country with a bed capacity of 250. ADCH is located approximately 2 km from the city center of Ndola. The sample was determined by using single proportion population formula. Since the overall prevalence rate (p) of intestinal parasites is not known in the study area: P was taken as 50%. For calculation a 95% confidence interval (z) and a 5% margin of error (d) were used. Final sample size was 165 participants. Data about socio-demographic characteristics and

other determinants were collected using structured questionnaires. Stool samples were collected using small wide mouthed tight leak proof containers (10-15g). Stool was examined under microscope for parasites using direct techniques (saline and iodine wet mounts). Data entry and analysis were done using Epi Data version 3.1 and Statistical Package for Social Sciences (SPSS) version 16.0. Baseline characteristics of the study population were summarized using tables and frequencies for categorical variables. Logistic regression was used to determine factors independently associated with worm infestation. Odds ratio (OR) and 95% confidence interval (CI) are reported. Cut off point for statistical significance was set at 5% level. This study was approved by the Research Committee of Arthur Davison Children's Hospital (ADCH) and Public Health Unit of the Copperbelt University School of Medicine. Informed written consent was obtained from each study subject's parents.

Results

Present study had 148 participants out of 165 making a response rate of 89.7%. About half of the participants were males (50.6%). Most of the subjects were above the age of 2 years (68.9%). In this study, most mothers were below the age of 25 years (76.4%). Most participants came from urban areas (72.3%). There was a high level of unemployment among the mothers (77.7%). More than half of the subjects were immunized (62.8%). About a third (33.1%) were Retroviral Disease (RVD) reactive, while a significant number had a prior history of worm infestation (75.7%). Almost all of the study participants lived in brick walled houses (95.3%) with concrete floors. More than half of the study participants had no access to clean water supplies (58.1%) and in most homes water was treated (93.0%). In most households, leftover food was stored in shelves (52.7%). A significant proportion of the study participants played in open grounds (80.1%). Most homes had a flushable toilet (80.1%) and most parents disposed off household waste in rubbish pits (63.5%) as shown in Table 1.

Assessment on how intestinal infestations were transmitted in children indicated that out

Table 1. Determinants of Intestinal Infestations in Under five Children Admitted to Arthur Davison Children's Hospital, Ndola, Zambia

Characteristic	Total n (%)	Child (n (%))		p-value
		Male	Female	
Age of child				0.135
<2	46 (31.1)	21 (28.0)	25 (34.2)	
2+	102 (68.9)	54 (72.0)	48 (65.8)	
Age (mother)				0.074
<25	113 (76.4)	58 (77.3)	55 (75.3)	
25+	35 (23.6)	17 (22.7)	18 (24.7)	
Age (father)				0.829
<25	65 (45.8)	28 (38.9)	37 (52.9)	
25+	77 (54.2)	44 (61.1)	33 (47.1)	
Place of residence				0.042
Urban	107 (72.3)	56 (74.7)	51 (69.9)	
Rural	41 (27.7)	19 (25.3)	22 (30.1)	
Mothers education				0.048
Up to primary	87 (60.0)	39 (52.7)	48 (67.6)	
Second or higher	58 (40.0)	35 (47.3)	23 (32.4)	
Father's education				0.156
Up to primary	46 (28.4)	17 (23.9)	23 (32.9)	
Second or higher	101 (71.6)	54 (76.1)	47 (67.1)	
Mother's employment				0.902
Employed	33 (22.3)	16 (21.3)	17 (23.3)	
Unemployed	115 (77.7)	59 (78.7)	56 (76.7)	
Father's employment				0.008
Employed	118 (83.1)	58 (79.5)	60 (87.0)	
Unemployed	24 (16.9)	15 (20.5)	9 (13)	
Immunization status				0.118
Complete	93 (62.8)	50 (66.7)	43 (58.9)	
Incomplete	55 (37.2)	25 (33.3)	30 (41.1)	
HIV status				0.011
Non-reactive	99 (66.9)	49 (65.3)	50 (68.5)	
Reactive	49 (33.1)	26 (34.7)	23 (31.5)	
De-worming				0.047
Yes	69 (46.6)	41 (54.7)	28 (38.4)	
No	79 (53.4)	34 (45.3)	45 (61.6)	
History of infestation				0.017
Yes	112 (75.7)	63 (84.0)	49 (67.1)	
No	36 (24.3)	12 (16.0)	24 (32.9)	
Type of housing				0.726
Brick walled	141 (95.3)	71 (94.7)	70 (95.9)	
Mud	7 (4.7)	4 (5.3)	3 (4.1)	
Type of floor				0.904

Continued...

Table 1. (Continued...)

Characteristic	Total n (%)	Child (n (%))		p-value
		Male	Female	
Concrete	99 (66.9)	52 (69.3)	47 (64.4)	
Open/bare ground/	49 (33.1)	23 (30.7)	26 (35.6)	
Water source				0.050
Unclean	86 (58.1)	48 (64.0)	38 (52.1)	
Clean	62 (41.9)	27 (36.0)	35 (47.9)	
Mode of treatment				0.161
Treated	66 (93.0)	36 (92.3)	30 (93.8)	
Untreated	5 (7.0)	3 (7.7)	2 (6.2)	
Food storage				0.346
Shelf	78 (52.7)	36 (48.0)	42 (57.5)	
Fridge	70 (47.3)	39 (52.0)	31 (42.5)	
Mode of play				0.016
Open ground	117 (80.1)	60 (80.0)	57 (80.3)	
House	29 (19.9)	15 (20)	14 (19.7)	
Toilet type				0.921
Flushable	117 (80.1)	60 (80.0)	57 (80.3)	
Pit-latrine	15 (10.3)	8 (10.7)	7 (9.9)	
Open defecation	14 (9.6)	7 (9.3)	7 (9.9)	
Garbage disposal				0.071
Pit	94 (63.5)	49 (65.3)	45 (61.6)	
Surrounding	54 (36.5)	26 (34.7)	28 (38.4)	

of 148 parents/caregivers, 45.9% identified eating of soil as one mode of transmission; 27.0% of the respondents identified drinking water from an unclean source as the mode of transmission; while 17.6% identified eating of improperly cooked meat and eating of raw and unwashed vegetables. In all, only 9.5% identified playing without shoes as the mode of transmission (Table 2).

A prevalence of (19.6%) of worm infestations was obtained in the study. Of this 19.5%, *Ascaris lumbricoides* recorded highest frequency 65.5%, hookworm 20.7%, *Microsporidium* 6.9% and *Isospora* 3.4% as shown in Table 3.

In the univariate analysis, residence ($p=0.042$), father's employment (0.008), HIV status ($p=0.011$), De-worming ($p=0.047$), history of infestations ($p=0.017$), water source ($p=0.050$), mode of play ($p=0.016$) and household garbage disposal ($p=0.071$)

Table 2. Modes of Transmission of Intestinal Infestations Transmitted in Children

Variable	Frequency	Percentage
Eating soil	68	45.9
Playing without shoes	14	9.5
Contaminated water	40	27.0
Improperly cooked meat and vegetables	26	17.6

Table 3. Frequency of Parasites in Fecal Specimens

Organism	Number of positive samples	Percentage
<i>Ascaris lumbricoides</i>	19	65.5
<i>Hookworm</i>	6	20.6
<i>Microsporidium</i>	2	6.9
<i>Isospora</i>	1	3.4

were statistically significantly associated with worm infestations, as shown in Table 1.

Father's employment and history of infestations were independently associated with worm infestations. Children with fathers who were employed were 59% (AOR = 0.41, 95% CI [0.19, 0.90]) less likely to be infected compared with children with an unemployed father. Compared with children who had no history of worm infestation, those with a history of infestation were 6.54 (AOR = 6.54, 95% CI [3.28, 13.03]) times more likely to be infected as shown in Table 4.

Discussion

In Zambia, there has been little or no documentation on hospital based surveys on child intestinal infestations. Intestinal parasites account for much of the morbidity and mortality among young infants and children. This study had a prevalence rate of infestations at 19.6%, father's employment and child's prior history of worm infestations were the factors independently associated with worm infestations. *Ascaris lumbricoides* was the most common parasite isolated in the current survey.

In this study, frequency of parasites in the stool samples was 19.6%. Higher rates of infestations were reported in Morocco (34.5%),^[9] and Pakistan (68.8%).^[10] Most common parasite in this survey was *Ascaris lumbricoides*, but the common parasite in Morocco was *Enterobius vermicularis*.^[11] Meanwhile in Pakistan, it was *Giardia lamblia*.^[10] Hospital studies done in different parts of Pakistan as Abbotabad, Neelum valley and Bagh showed prevalences of 81%, 18.02% and 21.75% respectively among all these areas *Ascaris lumbricoides* and *Giardia lamblia* were the most common.^[12-14]

Table 4. Factors Independently Associated with Worm Infestation

Factor	AOR (95% CI)
Father's employment	
Employed	0.41 (0.19, 0.90)
Unemployed	1
History of worm infestation	
Yes	6.54 (3.28, 13.03)
No	1

According to the present study one of the factors independently associated with worm infestations was the employment status of father. Children whose fathers were employed were less likely to be infected compared with children of unemployed fathers. Studies in Iran have shown that the better the economic score, the lower the infestations.^[15] In Mexico, unemployment and low income represented a high risk for infection in Children.^[16] Unemployment shows strong correlation with intestinal infestations, a study in Gaza city, Palestine showed that 72% of children infected had unemployed fathers.^[17] This can be explained in such a way that there is absence of awareness and measures to minimize exposure of children to hazards, among unemployed fathers. A study done in Salvador, North East Brazil, showed that helminth infections in children were strongly correlated with unemployment and low income.^[18]

Another statistically significant factor associated with worm infestation was a prior history of worm infestation in the children. Compared with children who had no history of worm infestation, those with a history of infestation were 6.54 times more likely to be infected. Studies done in South Africa revealed that re-infection has been reportedly to start shortly after treatment even reaches and even exceeds pre-treatment levels.^[19] Studies done in the urban slums of Nigeria have shown that it is more typical of children growing in these areas to be infected and re-infected constantly for the rest of their lives.^[20] About half (51.4%) of primary school children in Akwa Ibom State, Nigeria, were infected with intestinal parasites.^[21] A hospital study in a pediatric department revealed that previous infection was strongly correlated with current infection.^[10]

In the present survey, mothers' and caregivers' knowledge was assessed on the mode of transmission of intestinal infestations. Unlike separate studies from Nigeria,^[21] present observation showed that parents with their children admitted to Arthur Davison Children's Hospital had some knowledge on how intestinal infestations are transmitted, 45.9% said through ingestion of soil, 27% through contaminated water, 17.6% by eating improperly cooked meat, vegetables, and 9.5% by playing without shoes. In agreement with a study from Egypt.^[22]

Limitations of the Study

This study had some limitations. Some mothers and caregivers came without under five cards, while others could hid stool samples and could not submit them for analysis. The Nurses on duty did not adequately inform them, and requests for stool examination were made after anti-helminthic medication was already given. Another challenge was that the hospital laboratory was not fully stocked with reagents to view specific parasites, and lastly there was inadequate time to prepare for the study as ethical approval was granted late. Prevalence in this study does not reflect the true picture as the results cannot be generalized to the entire country.

Conclusion and Global Health Implications

Intestinal infestations particularly *Ascaris lumbricoides* were more prevalent in this study. There should be policy towards countrywide deworming programs and enhanced hygiene.

Key Messages

- Infestations are common among children whose fathers are not employed and not able to provide clean environment.
- Children are likely to be re-infected and need periodic deworming.

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