Science World Journal Vol. 17(No 2) 2022
www.scienceworldjournal.org
ISSN: 1597-6343 (Online), ISSN: 2756-391X (Print)
Published by Faculty of Science, Kaduna State University

Full Length Research Article

ASCARIS LUMBRICOIDES: THE RISK FACTORS AND EFFECTS ON GROWTH OF SCHOOLCHILDREN WITHIN SAMARU, ZARIA, NIGERIA

*[1]Bishop H.G., [2]Azeez Z.., [1]Ujah A.O., [1]Momoh S.J. and [1]Barwa J.

[1]Department of Microbiology, Faculty of Life Sciences, Ahmadu Bello University, Zaria, Nigeria

[2]Department of Microbiology, Faculty of Natural Sciences, Prince Abubakar Audu University, Aniygba, Nigeria

*Corresponding Author Email Address: gabrielhenrybishop@gmail.com +2347064608775

ABSTRACT
Intestinal helminthiasis affects children's health and physical growth. Finding the prevalence of *Ascaris lumbricoides*, risk factors and effects on growth of children in Samaru, Zaria were the foci of this study. Fresh faecal samples were collected from 203 consented children in seven selected schools. Weight and height data were measured and body mass index was calculated for each child. Samples were processed by formol-ether concentration technique and examined for ova of *Ascaris lumbricoides* with light microscope. Data were analyzed by statistical tools. Overall prevalence of *Ascaris lumbricoides* was 2.0%. The infection was absent in children from private schools, but those from public schools were significantly infected (P=0.042, OR >1). Male children were more infected (2.1%) than females (1.9%). Children below 10 years old had no ascariasis, while children of 10-11 and 12-13 years old had 2.5% and 2.9% infections respectively. Children who eat raw vegetables (OR =1.021) or work on farms (OR =2.636) were more at risk of ascariasis. No sign/symptom was associated with ascariasis. *Ascaris lumbricoides* was present only in children whose body weights were ≤38.0kg with significantly low body mass index of <18.50 (OR >1). Ascariasis is preventable given proper environmental sanitation, safe water and adequate sanitary facilities.

Keywords: *Ascaris lumbricoides,* body mass index, growth, schoolchildren, risk factors, Zaria.

INTRODUCTION

Ascaris lumbricoides is the largest and very common human intestinal roundworm. It is one of the soil-transmitted helminths (STHs), also called geohelminths (Amechi *et al.*, 2013; Wrights *et al.*, 2015; Bishop and Yohanna, 2018). Intestinal helminths affect about half of the world's population (Hall *et al.*, 2008), but children are the most vulnerable group (Saathof *et al.*, 2004). Schoolchildren are exposed to ascariasis during play on contaminated sand, licking faecal-contaminated fingers, eating of contaminated fruits and vegetables, and geophagy (Montressor *et al.*, 2002; Cheesbrough, 2009). *Ascaris lumbricoides* can damage the intestinal wall and affect nutrient absorption and appetite (Stephenson *et al.*, 2000). Intestinal helminthic infections can cause anaemia, malnutrition, underweight, retarded growth and poor performance in school (WHO, 2002). Intestinal helminthiasis has adverse effects on children's cognitive development, learning abilities, nutritional status and other health problems (Montressor *et al.*, 2002). Children are often unaware of the danger of some of their daily behaviours like playing on contaminated soil, eating of sand, and consumption of fruits, vegetables and water from doubtful sources. It is of critical importance to decipher the relationships between parasitic infections and nutritional status of children in order to proffer better intervention strategies (Scott, 2008).

MATERIALS AND METHODS

Study Area and Population

Samaru in Zaria is a rural area in Kaduna State, Northern Nigeria. It is located on latitude 11.1667° N and Longitude 7.6333° and 2398 feet above the sea level (Bishop and Inabo, 2015). The study population comprised of children from selected three public and four private primary schools in Samaru, Zaria. The pupils (including males and females) were randomly selected between the ages of 6-13 years. Approval was obtained from each school management, as well as, written consents from parents of the children before enrolling them in the study. Enlightenment talk on intestinal helminthiasis and the objectives of the study was given. Participation was voluntary.

Administration of Questionnaires

Structured questionnaires were used to obtain information from the pupils with the help of their class teachers. The questionnaires captured some socio-demographic data of the children, their exposure to some risk factors and presence of signs/symptoms of intestinal helminthiasis.

Measurement of Anthropometric Indices

The weight (kg) and height (m) of each pupil (without shoes and with minimum clothing) were measured using a weighing balance and a meter rule respectively. Each body mass index (BMI) was calculated as weight in kilogrammes divided by the square of height in meters (Bishop and Akoh, 2018). Children's BMI were classified according to WHO (2006) principal cut-off point as: underweight (<18.50), severe thinness (<16.00), moderate thinness (16.00 - 16.99), mild thinness (17.00 -18.49), normal (18.50-24.99) overweight (≥25.00), pre-obese (25.00-29.99), obese (≥30.00), obese class I (30.00-3.99), obese class II (35.00-39.99), obese class III (≥40.00).

Collection of Faecal Samples

Screw-capped, wide mouth containers were given to each participant, with instructions on how to collect fresh early morning stool. A total of two hundred and three (203) faecal samples were

Science World Journal Vol. 17(No 2) 2022
www.scienceworldjournal.org
ISSN: 1597-6343 (Online), ISSN: 2756-391X (Print)
Published by Faculty of Science, Kaduna State University

collected. The stool samples were examined at the Department of Parasitology and Entomology, Faculty of Veterinary Medicine, Ahmadu Bello University Zaria.

Laboratory Examination for Intestinal Helminths

Macroscopic observation of the faeces was conducted to check for the colour and consistency. Using an applicator stick, about 3g of each faecal sample was emulsified in 7mL of 10% formol saline in a test tube. The suspension was sieved using fine mesh gauze into a centrifuge tube to remove large faecal particles. Then 3mL of diethyl acetate was added into the sieved suspension and shaken vigorously for about one minute. The suspension was centrifuged at 3000 revolutions per minute (r.p.m) for five minutes (Cheesbrough, 2009). After the centrifugation, four layers were formed: the top layer of ether and dissolved fats, thin layer of faecal debris, formol water and sediment at the bottom of the tube. The supernatant was decanted carefully leaving the sediment in the tube. The sediment was re-suspended and with the aid of a Pasteur pipette, it was transferred to a clean grease-free glass slide. A drop of Lugol's iodine was added and covered with a cover slip. Parasitological examination was performed under the light microscope using 10x and 40x objectives. A colour parasitological atlas was used as guide for identification (Cheesbrough, 2009).

Statistical Analysis

Data obtained from administered questionnaires along with laboratory findings were subjected to statistical analysis by Chi square (χ^2) and Odd Ratio (OR) using IBM SPSS version 23 at 95% confidence level. The final results were simplified in a chart and tables.

RESULTS

Out of 203 fresh faecal samples examined, 4 were positive for *Ascaris lumbricoides*, giving a prevalence of 2.0% (Figure 1).

As shown in Table 1, ascariasis was found in children from only two out of the seven schools. The highest was in children from School E (5.8%), followed by School D (3.1%). All cases of ascariasis were recorded in children from public/government schools (4.9%), but absent in those from private schools. Children from the public schools were more at risk of *Ascaris lumbricoides* infections (P =0.042, OR =1.041).

Though the male children (2.1%) were more infected than the females (1.9%), the relationship was statistical insignificant (P >0.05, OR <1) as shown in Table 2. Ascariasis was absent in children below the age 10 years. However, the highest prevalence of 2.9% was found in children within the age-group of 12-13 years, followed closely by 2.5% among those of 10-11 years (Table 2).

Habits that could serve as potential risk factors for acquiring *Ascaris lumbricoides* included eating of raw vegetables and involvement in farming activities (OR >1) as shown in Table 3.

In Table 4, none of the signs/symptoms examined was statistically associated with ascariasis (P > 0.05, OR <1). An appreciable number of the infected children presented with diarrhoea (3.7%). Also, faecal samples of infected children were mostly brown in colour (3.8%) with formed consistency (2.6%).

Ascaris lumbricoides was absent in children with body weight greater than 38.0kg as compared to those of 19.0-28.0kg and 29.0-38.0kg who had 1.6% and 2.6% occurrences of the infection (P > 0.05) as shown in Table 5.

Based on height of the schoolchildren, only two groups were found with ascariasis. Those who were 1.30-1.39m tall had 1.3% infections, but 4.3% infections occurred among 1.40-1.49m tall children. Weight-related and height-related distributions of *Ascaris lumbricoides* among the children were insignificant (P > 0.05) as shown in Table 5.

Though all the cases of ascariasis were found among children with low body mass index, the relationship was insignificant. Moderately underweight children had the highest infection (4.4%) than those with either mild or severe underweight (Table 5)

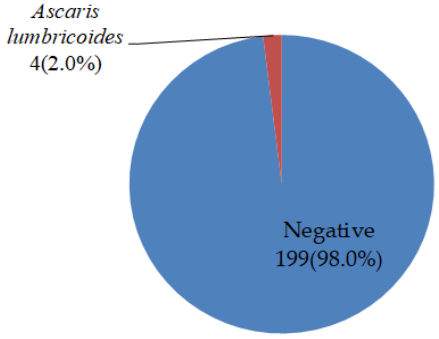

Figure 1: Overall prevalence of *Ascaris lumbricoides* among schoolchildren in Samaru, Zaria.

Table 1: Distribution of *Ascaris lumbricoides* in children from different schools in Samaru, Zaria

Parameter	Category	Number Examined	Number Positive (%)
School*	A	17	0 (0.0)
	B	26	0 (0.0)
	C	34	0 (0.0)
	D	32	1 (3.1)
	E	52	3 (5.8)
	F	23	0 (0.0)
	G	19	0 (0.0)
Ownership**	Private	102	0 (0.0)
	Public	101	4 (4.0)

*χ^2=6.498, df=6, P=0.370; **χ^2=4.121, df=1, P=0.042, OR=1.041

Table 2: Gender and age distributions of *Ascaris lumbricoides* among schoolchildren in Samaru

Demographic Factor	Category	Number Examined	Number Positive (%)
Gender[a]	Female	107	2 (1.9)
	Male	96	2 (2.1)
Age-group[b] (years)	6 – 7	12	0 (0.0)
	8 – 9	36	0 (0.0)
	10 – 11	120	3 (2.5)
	12 – 13	35	1 (2.9)

[a]χ^2 =0.012, df = 1, P = 0.913, OR = 0.895; [b]χ^2=1.282, df = 3, P = 0.734

Table 3: Risk factors of *Ascaris lumbricoides* infection among schoolchildren in Samaru

Risk Factors	Category	Number Examined	Number Positive (%)	Statistics
Eating of raw vegetables	No	5	0 (0.0)	$\chi^2 = 0.130$, df = 1, P=0.748, OR=1.021,
	Yes	198	4 (2.0)	
Washing of vegetables	No	76	1 (1.3)	$\chi^2 = 0.270$, df = 1, P=0.604, OR=0.551
	Yes	127	3 (2.4)	
Farming	No	109	2 (1.8)	$\chi^2 = 2.286$, df = 1, P=0.131, OR=2.636
	Yes	94	2 (2.1)	

Table 4: Signs/symptoms of *Ascaris lumbricoides* among the schoolchildren in Samaru, Zaria

Signs/ Symptoms	Category	Number Examined	Number Positive (%)	Statistics
Abdominal pain	No	161	4 (2.5)	χ^2=1.064, df=1, P=0.302, OR=0.975
	Yes	42	0 (0.0)	
Diarrhoea	No	176	3 (1.7)	χ^2=0.484, df=1, P=0.486, OR=0.451
	Yes	27	1 (3.7)	
Fever	No	170	4 (2.4)	χ^2=0.792, df=1, P=0.373, OR=0.976
	Yes	33	0 (0.0)	
Vomiting	No	175	4 (2.3)	χ^2=0.653, df=1, P=0.419, OR=0.977
	Yes	28	0 (0.0)	
Colour of stool	Black	52	0 (0.0)	χ^2=2.473, df=2, P=0.290
	Brown	80	3 (3.8)	
	Yellow	71	1 (1.4)	
Stool consistency	Formed	117	3 (2.6)	χ^2=0.557, df=2, P=0.757
	Loose	7	0 (0.0)	
	Semi-formed	79	1 (1.3)	

Table 5: Effects of *Ascaris lumbricoides* on anthropometric indices of schoolchildren in Samaru Zaria

Anthropometric index	Number examined	Number Positive (%)	Statistics
Weight (kg)			
19.0 – 28.0	61	1 (1.6)	
29.0 – 38.0	117	3 (2.6)	χ^2=0.751, df=4, P=0.945
39.0 – 48.0	20	0 (0.0)	
49.0 – 58.0	2	0 (0.0)	
59.0 – 68.0	3	0 (0.0)	
Height(m)			
1.10 – 1.19	7	0 (0.0)	
1.20 – 1.29	28	0 (0.0)	
1.30 – 1.39	80	1 (1.3)	χ^2=3.319,df=5, P=0.651
1.40 – 1.49	69	3 (4.3)	
1.50 – 1.59	14	0 (0.0)	
1.60 – 1.69	5	0 (0.0)	
BMI Category			
Normal weight (18.50 – 24.99)	26	0 (0.0)	χ^2=0.599, df=1, P=0.439, OR=1.023
Underweight (<18.50)	177	4 (2.3)	
Type of underweight			
Mild (17.0 – 18.49)	45	1 (2.2)	
Moderate (16.0 – 16.99)	45	2 (4.4)	χ^2=2.260,df=3, P=0.520
Severe(<16)	87	1 (1.1)	

DISCUSSION

The detection of *Ascaris lumbricoides* eggs in stool samples of schoolchildren in Samaru, Zaria was an indication of intestinal helminthiasis among them. Though 2.0% prevalence of the parasite in this study is low, it is still significant in terms of morbidity and if not controlled it can spread to other members of the community. Higher prevalence of ascariasis had been reported by other researchers in many parts of the world: 4.9% among schoolchildren of Igbo-Eze, Enugu State, Nigeria (Ekpenyong and Eyo, 2008), 8.2% among children of Abia state, Nigeria (Amechi *et al.*, 2013), 2.96% among schoolchildren in Calabar, Nigeria (Esiet and Ita, 2017), 12.2% among Brazilian children (Carneiro *et al.*, 2002), 54.4% among children in Northern Samar of the Philippines (Papier *et al.*, 2014), 22.2% among the population of University of Guyana in Guyana (Wrights *et al.*, 2015), and 37.8% among preschool children in Sri Lanka (Galgamuwa *et al.*, 2016). *Ascaris lumbricoides* infections were found in only two out of the seven schools, which were all public/government schools. There was also a significant association in the occurrence of *Ascaris lumbricoides* and the type of school: children from public schools were most prone to ascariasis (P=0.042). Higher prevalence of intestinal parasites occurs more often in public schoolchildren (Esiet and Ita, 2017; Ajayi *et al.*, 2017). Children whose parents are financially buoyant mostly attend private schools. These private schools have better hygienic environments and teaching conditions; but are often expensive, such that most parents may not be able to afford for their kids. The public schools on the other hand are often over-populated and ill-equipped. In some public schools, children's daily activities are poorly monitored at school and at home, which predispose them to many parasitic diseases. Poor level of sanitary facilities coupled with inadequate health education and poor socioeconomic status are promoting factors for intestinal helminthiasis (Abah and Arene, 2015; Galgamuwa *et al.*, 2016).

The occurrence of *Ascaris lumbricoides* among the male children was only slightly higher than that in the females. In northern part of Nigeria, male children indulge more in risky behaviours like going into the bushes to pick and eat unwashed vegetables and fruits, bathe in unsafe water bodies and drink the water. These can predispose them to intestinal helminthiasis among other infections. However, Galgamuwa *et al.* (2016) reported a higher occurrence of ascariasis in female children instead.

Children below the age of 10 years were not found with ascariasis. Those of 12-13 years of age had more infections than those of 10-11 years. It is obvious that age may play an important role in the acquisitions of ascariasis. The older children are big enough to go out on their own and indulge in indiscriminate activities earlier mentioned.

Children with the habit of eating raw vegetables (OR =1.01), as well as those that were involved in helping their parents on the farms (OR =2.64) were more infected with ascariasis. Vegetables are important part of human diet. They must be processed adequately to avoid contamination. When contaminated vegetables are consumed, they pose risk to health. The use of untreated or improperly treated human and animal wastes as manure on farms in some rural areas directly contaminate vegetables and fruits (Bishop and Yohanna, 2018). Children working on such farms also stand a risk of getting ascariasis among other parasitic infections.

A good number of the infected children passed formed brown stool, but insignificantly presented with diarrhoea. It is well known that abdominal pains, diarrhoea, nausea and vomiting are frequent symptoms of ascariasis due to both developing and mature worms (Cheesbrough, 2009). In this study however, the infected schoolchildren were not found with these symptoms.

There was no significant association between the heights of the children and ascariasis. However, all the cases of ascariasis were found in children whose weights were ≤ 38.0kg. In addition, all the cases of ascariasis were found in those with low body mass index, indicative of underweight. Underweight children are likely to be suffering from malnutrition which could be due to underlying intestinal helminthiasis (OR >1). Majority of them were moderately underweight. Ascariasis can lead to under-nutrition, loss of weight and poor growth (Cheesbrough, 2009; Lamberton and Jourdan, 2015).

Conclusion

Ascaris lumbricoides eggs were detected in stool samples of schoolchildren in Samaru, Zaria, with a prevalence of 2.0%. Children attending public schools were significantly more infected than those attending private schools (P = 0.042, OR >1). The public schools were often over populated with inadequate sanitary facilities. The male children were more infected with *Ascaris lumbricoides* than the females. Children below the age of 10 years were not found with ascariasis. However, older children between 10-13 years of age were considerably infected. Risk factors of ascariasis among the children included eating of raw vegetables and involvement in farming activities (OR >1). No significant sign/symptom of ascariasis was identified among the children in this study. Infected children's weights were all ≤ 38.0kg. The body mass indices of all the infected children were below 18.50. There was significant indication of underweight in the infected children (OR>1), majority of them were moderately underweight.

Ascariasis is preventable. Attention should be drawn to proper environmental sanitation and monitoring of children's daily activities. Playgrounds and the entire school surroundings must be hygienic. Each school must be equipped with adequate sanitary facilities and potable drinking water. Finally, children should be educated on the danger of some common habits that expose them to parasitic infections.

Acknowledgment

We appreciate the managements of schools, teachers, parents and pupils that participated in this research. We equally thank the management of Department of Parasitology and Entomology, Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria for granting us a workbench in Helminthology laboratory. Thank you!

REFERENCES

Abah, A.E. and Arene, F.O.I. (2015). Status of intestinal parasitic infections among primary school children in Rivers State Nigeria. *Journal of Parasitology Research*, 2015 (Article ID 937096):1-7.

Ajayi, E.O., Elechi, H.A. and Alhaji, M.A. and Adeniyi, O.F. (2017). Prevalence and pattern of intestinal parasites among pupils of private and public primary schools in an urban centre, Nigeria. *Nigerian Journal of Pediatrics,* 44(2):56-62.

Amechi, E.C., Ahaeri, C.C. and Upkai, O.M. (2013). Prevalence of helminthiasis among school children in some rural communities of Abia State, Nigeria. *Animal Research International,* (10)3:1817-1825.

Bishop, H.G and Akoh, R.I. (2018). Risk factors, symptoms and effects of urinary schistosomiasis on anthropometric indices of school children in Zaria, Kaduna State, Nigeria. *Open Access Journal of Science*, 2(1):00045.

Bishop, H.G. and Inabo, H.I. (2015). Incidence of *Entamoeba histolytica* in well water in Samaru-Zaria, Nigeria. *International Journal of Scientific Research in Environmental Sciences*, 3(1):0016-0022.

Bishop, H.G. and Yohanna, A.Z. (2018). Contamination of vegetables with geohelminths: prevalence, intensity and roles of hygiene practices in Samaru-Zaria, Nigeria. *International Journal of Academic and Applied Research*, 2(7):8-13**.**

Carneiro, F.F., Cifuentes, E. Ellez-Rojo, M.M. and Romieu, I. (2002). The risk of *Ascaris lumbricoides* infection in children as an environmental health indicator to guide preventive activities in Caparao´ and Alto Caparao´, Brazil. *Bulletin of the World Health Organization*, 80(1):40-46.

Cheesbrough, M. (2009). District Laboratory Practices in Tropical countries, Part I, 2nd ed. updated, London Cambridge University Press, Cambridge, UK, pp. 191-199.

Ekpenyong, E.A. and Eyo, J.E. (2008). Prevalence of intestinal helminths infections among schooling children in tropical semi urban communities. *Animal Research International*, 5(1):804 – 810**.**

Esiet, U.L.P. and Ita, A.E. (2017). Comparative prevalence of intestinal parasites among children in public and private schools in Calabar South, Calabar, Cross River State, Nigeria. *American Journal of Research Communication*, 5(1): 80-97.

Galgamuwa, L., Iddawela, D. and Dharmaratne, S.D. (2016). Factors associated with the prevalence of *Ascaris lumbricoides* infection among preschool children in a plantation community, Kandy District, Sri Lanka. *Southeast Asian Journal of Tropical Medicine and Public Health,* 47(6):1143 -1152.

Hall, A., Hewiit, G., Tuffrey, V. and de Silva N. (2008). A review and meta-analysis of the impacts of intestinal worms on child growth and nutrition. *Maternal and Child Nutrition*, (4):118-236.

Lamberton, P.H.L. and Jourdan, P.M. (2015). Human ascariasis: diagnostic update. *Current Tropical Medicine Reports,* 2:180-200.

Montressor A., Crompton, D.W.T., Gyorkos, T.W. and Savioli, L. (2002). Helminth control in school-age children: A Guide for managers of control programmes, Geneva. World Health Organization. Available online: https://pdfs.semanticscholar.org/d948/fe7918c5b7fdb9618224d2e516f06900cdf7.pdf.

Papier, K., Williams, G.M., Luceres-Catubig, R., Ahmed, F., Olveda, R.M. McManus, D.P, Chy, D., Chau, T.N.P., Gray, D.J. and Ross, A.G.P. (2014). Childhood malnutrition and parasitic helminth interactions. *Clinical Infectious Diseases*, Volume 59, Issue 2, 15 July 2014, Pages 234–243, https://doi.org/10.1093/cid/ciu211.

Saathof, E., Olsen, A., Magnussen, P., Kvalsvig, J.D., Becker, W. and Appleton, C. (2004). Patterns of *Schistosoma haematobium* infection, impact of praziquantel treatment and re-infection after treatment in a cohort of schoolchildren from rural KwaZulu-Natal/South Africa. *BMC Infectious Diseases*, 4:1-10.

Scott, M.E. (2008). *Ascaris lumbricoides:* a review of its epidemiology and relationship to other infections. *Annales Nestlé*, 66: 7-22.

Stephenson, L.S., Latham, M.C. and Otteson, E.A. (2000). Malnutrition and parasitic helminth infections. *Parasitology*, 121:23-38.

WHO (2002). Prevention and control of schistosomiasis and soil-transmitted helminthiasis. Report of WHO expert committee, Geneva. WHO Technical Report Series No. 912. Available on: https://apps.who.int/iris/bitstream/handle/10665/42588/WHO_TRS_912.pdf?sequence=1&isAllowed=y.

WHO (2006). BMI classification: a WHO global database on body mass index. Available online: http://www.assessmentpsychology.com/icbmi.htm.

Wrights, J., Ansari, A.A. and Sukhraj, K. (2015). Prevalence and association of parasitic helminths among the cross section of male and female gender groups at University of Guyana, Georgetown, Guyana. *Research Journal of Parasitology*, 10(2):50-57.