ORIGINAL ARTICLE

Epidemiological Aspects of *Ascariasis* and Associated Risk Factors Among Primary School Children in Lambata Community, Niger State, Nigeria During 2019-2020

Gideon. I.A. Okoroiwu, PhD

Department of Public Health Science, Faculty of Health Sciences, National Open University of Nigeria, Plot 91, Cadastral Zone, University Village, Nnamdi Azikiwe Expressway, Jabi, Abuja, Nigeria

Correspondence:
Gideon. I.A. Okoroiwu, PhD;
Department of Public Health Science, Faculty of Health Sciences, National Open University of Nigeria, Plot 91, Cadastral Zone, University Village, Nnamdi Azikiwe Expressway, Jabi, Abuja, Nigeria
Tel: +234 8036677539
Email: okoroiwugia@yahoo.com
Received: 24 April 2021
Revised: 6 May 2021
Accepted: 5 June 2021

Abstract

Background: *Ascaris* worm, as one of the commonest helminthic infections, constitutes a major public health challenge and concern in the majority of developing countries. This study was conducted to assess the prevalence of *Ascaris* worm infection and its associated risk factors among primary school children in Lambata community to determine the prevalence of *Ascaris* infection, age, gender and associated risk factors among them to create awareness and effective management program.

Methods: This is a cross-sectional descriptive study conducted between January 2019 and November 2020, in nine selected primary schools in Lambata community. A total of 303 stool samples were collected using random sampling to determine the prevalence of *Ascaris* infection using stool smear technique. The socio-demographic data were collected, using a structured interview questionnaire. The collected data were analyzed using simple percentages, OR and chi-square analytical methods.

Results: Out of the 303 screened stool samples, 156 (51.5%) had *Ascaris* infection. The most infected age-groups were 11-12 years old (73.8%; OR=2.11) and 9-10 years (57.1%; OR=2.01), while 6-8 year old subjects had the lowest rate (42.3%; OR=1.00) of infection. Males (65.9%; OR=2.00) were more infected than their female (39.9%; OR=0.09) counterparts ($P<0.05$). Age, educational status / occupational status of parents, and defecation habits were significantly ($P<0.05$) associated with the prevalence of *Ascaris* infection.

Conclusion: With the overall prevalence of 51.5% of *Ascaris* infection among the subjects, there is an indispensable need for health education promotion and coordinated de-worming of the primary school children in this community

Please cite this article as: Okoroiwu GIA. Epidemiological Aspects of Ascariasis and Associated Risk Factors Among Primary School Children in Lambata Community, Niger State, Nigeria During 2019-2020. J Health Sci Surveillance Sys. 2021;9(3):191-198.

Keywords: Epidemiology, *Ascaris*, Stool, Health, Helminth, Children, Promotion, Education

Introduction

Ascaris worm infection, also known as ascariasis, is the most common helminthic infection caused by *Ascaris lumbricoides* (*A. lumbricoides*) and *Ascaris suum* (*A. suum*) with an estimated worldwide prevalence of 804 million cases.[1] Ascariasis caused by *A. lumbricoides* is one of the most common intestinal worm infections and is found where access to personal hygiene and proper sanitation practices are not available and in places where human feces is used as fertilizer. Moreover, *A. suum* is more widespread where there are pigs and people who raise them or use raw pig manure as fertilizer.[2] Usually, asymptomatic ascariasis is mostly prevalent in children of tropical and developing countries,[3] where they are perpetuated by contamination of soil by human feces or use of untreated feces as fertilizer.[4]

Ascaris constitutes a major public health and developmental challenge in the vast majority of developing tropical and subtropical regions of the world.[5] It belongs to the Ascarididae family and is transmitted via soil; one becomes infected by ingesting fertilized eggs picked up from soil and food or drink contaminated by human faeces.[6] It is a common infectious disease worldwide; nevertheless, its prevalence is higher in developing countries with poverty, poor living conditions, illiteracy, and ignorant population. Furthermore, it is noted that young children are reported to be disproportionately affected by intestinal parasitic infections including *Ascaris*, compared to adults due to their increased nutritional requirements and a less developed immune systems. Intestinal parasitic infections in this age group have been linked with significantly reduced growth, increased risk of protein-energy malnutrition, iron deficiency anemia, and reduced cognitive/psychomotor development.[7]

It, however, affects all humans, especially children aged six to twelve years and one billion people, or 25% of the world population harbor *Ascaris* worm.[8] It is usually a mild disease with relatively low morbidity and mortality rates; more so, it is on record that Neglected Tropical Diseases (NTDs) including *Ascaris* infects one in six people, including more than half a billion children around the world,[9, 10] who particularly get infected when playing in polluted surroundings, get worm eggs from the soil into their fingernails; they eventually put them into their mouth or eat with contaminated food or drink.[11] It is also reported that the high global prevalence of *Ascaris* ultimately results in 20,000 deaths per year, mainly due to intestinal obstruction.[12] This is why one of the sustainable development goals of the United Nations (2030 agenda: Goal 3.3) is to end, among others, the epidemics of NTDs which *Ascaris* worm is one, through the control of transmission of intestinal parasitic infections and the mitigation of possible risks.

The high prevalence of Ascaris worm in developing countries depends on several factors such as educational status of parents, defecation habit, hand washing habits, consumption of raw vegetables and unwashed fruits, dirty fingernails, and residence.

In Nigeria, there have been quite a number of epidemiological surveys based on school children.[13] Several studies have also shown that intestinal *Ascariasis* is quite common in Nigeria.[14-21] The pathological effects of this worm reported in the studies are enormous and grave. *Ascariasis* is involved in slowing growth, leading to loss of appetite and poor absorption of digested foods.[15, 16] Hence, the children with this worm are at the risk of not getting enough nutrients. They suffer intestinal blockage and perforation causing severe abdominal cramping and vomiting.

Lambata community in Niger state is one that lacks basic amenities; most parents are poor and uneducated. The peasant farmers and cattle ranchers have poor sanitation. Despite the risk factors associated with *Ascaris* infections, there is paucity of report on the prevalence of *Ascaris* worm infection and associated risk factors in the area. Therefore, the present study was an attempt to assess the prevalence of *Ascaris* worm infection and associated risk factors among the primary school children in Lambata community in order to close the gap, create more awareness, and ascertain the current status of this infection.

Methods

Study Design

This is a cross-sectional descriptive study on the prevalence of *Ascaris* worm infection and associated risk factors among primary school children in Lambata Community, Niger state.

Study Area

Lambata Community is a local village in Niger state with an estimated population of 31,116. It has 15 mosques and 10 churches. The population is made up of numerous indigenous tribes such as Nupe, Gbagyi, Kamuku, Kambari, Dukawa, Hausa and Koro, and the dominant culture is Gwari. Lambata community has only one federal medical center in Bornu Boku and Kwakwa Kwachipe hospitals with a few health staff. The community share boundaries with Tufa, Kunga, Lefu and Boku. The people in this area are mostly illiterate, cattle ranchers, and uneducated.

The community is in a longitude of 7°10'E and latitude of 9°16'N and spreads into various neighboring villages with a large ratio of the inhabitants engaging in local farming and small-scale mining. Farming activities is carried out mostly during the rainy season, with a few irrigated lands with cultivated crops such as sorghum, millet, soybeans, cowpeas, and maize. The temperature is highest with 28.7°C on average in April and with a lowest average value of 23.9°C around August annually. The study area has 1341mm of precipitation falls annually and is highest in September with 9.5mm/day. Soil texture concentration levels are within the World Health Organization permissible levels and ranges from

±2.35% to ±8.69% with pH of 4.0 to 8.0. The relative humidity of the area is 51.43% and is highest in August with a value of 80.00% (Figure 1).

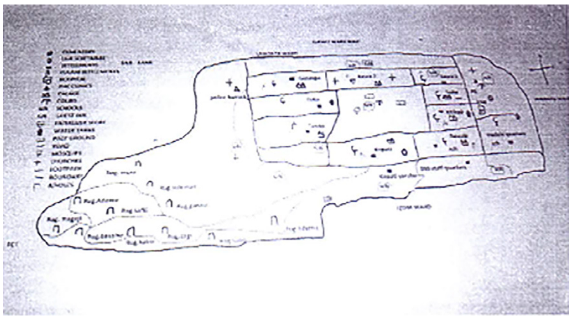

Figure 1: Map of Lambata Community in Gurara LGA, Niger state

Study Population

The study population consisted of 303 primary school boys and girls between the ages of 6 years and 12 years in Lambata community, Niger state. These children were from nine schools comprising Gifted Nursery and primary school, Yaweh Shama Nursery and primary school, Mercy Land Academy Nursery and primary school, Guara First Nursery and primary school, Dugapi Nursery and primary school, Gbamita UBE Nursery and primary school, Baptist Nursery and primary school, Gods time Nursery and primary school, and Alinisar Nursery and primary school.

Sample Size Determination

A suitable sample size of 303 primary school children of aged 6-12 years who were studying in major primary schools in Lambata community in Niger state was determined using the formula below, according to:[22]

$n=N^2P\ (1-P)/d^2$; where n=sample size; N=1.96 (statistical constant); P=chosen prevalence 27.0% (0.27) since there was no similar study previously conducted in this area; d=marginal error of 5.0% (0.05).
$n=N^2P\ (1-P)/d^2= (1.96)2 \times 0.27\ (1-0.27)/\ (0.05)^2=3.8416 \times 0.27\ (0.73)/0.0025=302.87176=303$.

Cluster Random Sampling Technique

The children were randomly selected. This started by dividing the children met in each primary school chosen into groups or clusters and each cluster is a representative of the population like the children under consideration. Then, within each group, I randomly selected the entire cluster to sample, and their stool samples were collected. The samples collected were sent to Lambata Community Federal Medical Center Diagnostic Laboratory for testing to determine the presence or absence of *Ascaris* ova or larvae.

Sample Collection and Processing

A structured questionnaire was developed based on known risk factors. Parents of the children chosen (participants) were interviewed to obtain the socio-demographic data, behavioral and hygienic practices. The questionnaire was pre-tested using 50 people outside the study population.

For *Ascaris* worm, a suitable stool sample size of 2.0gr of each child was collected using clean dry wide mouthed sample containers with tight covers or lids. The parents and teachers of primary schools were instructed on how the children should collect the samples, so that the samples would not mix with urine samples. The stool samples were submitted and taken to the Lambat community FMC diagnostic laboratory for the determination of the presence or absence of *Ascaris* ova.

Saline Direct Smear and Concentrated Brine Floatation Techniques.

Saline Direc Smear Technique

In the laboratory, stool samples were examined by mixing loopful (small amount) of each sample with a drop of normal saline in a clean grease-free dry slide, covered with a cover slide, placed on a microscope stage, and examined using X10 and X40 objectives under the light binocular microscope for the presence or absence of Ascaris ova.

Concentrated Brine Floatation Techniques

About 1.0gram to 2.0 grams of feces of each sample was emulsified with 3-4 mls of saturated salt solution in a 20ml clean upright plastic container. It was stirred well to achieve a homogenous mixture and more salt solution was added till the container was nearly full while stirring continued. Any coarse matter which floated up was removed and the container was placed on a levelled surface with a glass slide being placed over the top of the plastic container, which was in contact with the salt solution. It was allowed to stand for 30 minutes; after that, the slide was removed, covered with a cover slip, and observed for the presence or absence of *Ascaris* ova. The presence of *Ascaris* ova in either or both of the techniques is regarded as positive for *Ascaris* worm infection, either with one plus (+), two pluses (++), or three pluses (+++).
NOTE: +=scanty infection; ++=moderate infection; +++=severe infection.

Data Analysis

The collected data were analyzed using simple percentages, frequency, odd ratios, and Chi-square analytical methods. Chi-square (X^2) test was performed to verify the possible association between the prevalence of *Ascaris* worm infection and socio-demographic characteristics, behavioral factors, hygienic practices, and educational and occupational status of the parents. The degree of the association between the prevalence of infection and risk factors was measured using odds ratio (OR). Values were considered significant at P<0.05.

Ethical Approval

Ethical clearance (The code of ethics in this context include Five Codes of Ethics (confidentiality, professional competence, objectivity, integrity and professional behavior) was obtained from the Public Health department of Lambata Federal Medical Center and with the approval of Lambata school Head, while the informed consent was obtained from the teachers/parents/caretakers of children after explaining the importance and what they were to gain.

Inclusion and Exclusion Criteria

The study considered all the primary school children between 6-12 years in Lambata community schools chosen, while those outside these criteria were excluded from this study.

Validity and Reliability of Instrument

The instrument, method and reagents used in this study were pre-used and found to be reliable and valid; hence, all the data harvested within 5% marginal error were reliable and valid.

Results

The parents/guardian of all 303 primary school children selected in this study filled out the questionnaires on associated risk factors and all children (100%) submitted their fecal samples for *Ascaris* worm examination. The school name, participants, the number selected from each school, and prevalence of *Ascaris* worm were as stated below (Table 1). Out of 303 primary school children in the age range of 6-12 years and mean age of 9.3 years that participated in the study, 44.6% were males, while 55.4% of them were females. A total of 156 (51.5%) primary school children had *Ascaris* worm infection. The most infected ones were children between the ages of 11-12 years (73.8%; OR=2.11), followed by 9-10 year old ones (57.1%, OR=2.01), while 6-8 year old cohort had the least frequency of infection (42.3%; OR=1.00). The educational and job/occupational status of parents, defecation habits, age, unwashed hands, and consumption of raw vegetables and unwashed fruits were strongly associated with *Ascaris* worm infection in the community. The study of this infection was considered in this community due to the poverty level, low level of education in parents, and refractory attitude of the entire population towards environmental cleanliness.

DNPS and ANPS children had the highest infection with 60.6% prevalence each, followed closely by GFNPS (57.6%). BNPS and GNPS had the least infection prevalence with 42.4% and 42.9%, respectively.

Table 2 displays the gender-related prevalence of *Ascaris* infection among children. Out of 135 male children, 89 (65.9%) were infected, while 67 (39.9%) out 168 of their female counterparts were infected.

Table 3 is the age-related prevalence of *Ascaris* worm infection of school children in Lambata Community. The prevalence of *Ascaris* infection was higher in children between the ages of 11-12 years with 31 (73.8%; OR=2.11), followed by 9-10 year age cohort with 56 (57.1%; OR=2.01) and 6-8 year group with 69 (42.3%; OR=1.00)

Table 1: Prevalence of Ascaris worm infection among school children in as to the schools studied

School	No examined	No Negative (%)	No Positive (%)
GNPS	35	20 (57.1)	15 (42.9)
YSNPS	34	18 (52.9)	16 (47.1)
MLANPS	35	17 (48.6)	18 (51.4)
GFNPS	33	14 (42.4)	19 (57.6)
DNPS	33	13 (39.4)	20 (60.6)
GUNPS	34	16 (47.1)	18 (52.9)
BNPS	33	19 (57.6)	14 (42.4)
GNPS	33	17 (51.5)	16 (48.5)
ANPS	33	13 (39.4)	20 (60.6)
Total	303	147 (48.5)	156 (51.5)

GNPS: Gifted Nursery and Primary School; YSNPS: Yaweh Shama Nursery and Primar School; MLANPS: Mercy Land Academy Nursery and Primary School; GFNPS: Gurara First Nursery and Primary School; DNPS: Dugapi Nursery and Primary School; GUNPS: Gbamita, UBE Nursery and Primary School; BNPS: Baptist Nursery and Primary School; GNPS: Godstime Nursery and Primary School; ANPS: Alinisar Nursery and Primary School

Table 2: Gender-related prevalence of *Ascaris* worm infection among children

Gender	No Examined	No Negative (%)	No Positive (%)
Male	135	46 (34.1)	89 (65.9)
Female	168	101 (60.1)	67 (39.9)
Total	303	147 (48.5)	156 (51.5)

Table 3: Age-related prevalence of *Ascaris* worm infection among children

Age group (Years)	No Examined	No Negative (%)	No Positive (%)
6-8	163	94 (57.7)	69 (42.3)
9-10	98	42 (42.9)	56 (57.1)
11-12	42	11 (26.2)	31 (73.8)
Total	303	147 (48.5)	156 (51.5)

The multilevel analysis of risk factors (predictors) of *Ascaris* worm infection among the school children between 6-12 years in Lambata community showed that *Ascaris* worm infection was strongly associated with age, educational status and job/occupational status of the parents of the children, dirty finger nails, defecation habits, consumption of raw vegetables and unwashed fruits, and hand washing habit before meals; nevertheless, sex had no significant association with *Ascaris* worm infection (P>0.05).

Discussion

Ascaris worm infection, in particular that in primary school children, and its associated risk factors have been a very great concern and an important health problem worldwide. The difficulty in trying to get the solution and prevention has equally been met with brick-wall. In this assessment of Ascaris worm infection and associated risk factors among the primary school children in Lambata Community, the outcome obviously showed a high prevalence (P<0.05) of *Ascaris* infection among the children in the community. This may also speak of the general pattern of this infection among primary school children in Nigeria and other countries since this infection is prominent and is everywhere as evidenced in both foreign[23-25] and local researchers.[26-29]

This result (51.5%) is consistent with earlier reports in Nigeria[27, 29] indicating that Ascaris infection is a common disease among communities in poor resource societies in this country and elsewhere. The overall prevalence of 51.5% observed in this work is high and constitute a major health concern in the community. This value is high when compared with the works.[16, 19-21, 26 27] However, this studycorroborates the finding of[29] who reported 51.8% prevalence of *Ascaris* infection among school children in River state of Nigeria, while in faraway Ethiopia,[23] we detected Ascaris infection among primary school children in one of the poor communities, highlighting the fact that this infection is indeed a major public health problem in poor resource communities, both nationally and internationally.

The relatively high rate of *Ascaris* infection in this survey may not only be the result of educational/job status of the parents but could also be attributed to other factors like warm climate, inadequate water supply, and poor environmental sanitation. Others may include personal hygiene and living standards of the subjects. This study showed that age, level of education, Job/occupational status of the parents, dirty-finger nails, consumption of raw vegetables/unwashed fruits, defecation, and hand washing habits were the factors associated with Ascaris infection among primary school children in Lambata Community, and this is consistent with the reports of [23, 24,25, 26, 19.] Nevertheless, sex was not significantly (P<0.05) associated with *Ascaris* infection among the primary school children (Table 4).

Furthermore, analysis of the predictors of this infection in this survey showed that the children of uneducated/unemployed parents, open field defecation, consumption of raw vegetables/unwashed fruits, and dirty-finger nails had more or twice as much infection; these results highlight the necessity of more awareness and mounting serious health educational campaigns to make sure parents see and appreciate the value of education and cleanliness.

The disparities in the prevalence of this infection could be attributed to several factors including the study area, socio-economic condition of the parents of the school children, educational and job status of the parents as seen in Table 4, ignorance as well as level of exposure in addition to differences in nutritional status (which could be linked to unemployment/illiteracy of the parents of the children) and unhygienic processing, handling, storage, and hawking of foods and the level of water contamination through pipes as well as personal hygiene. All these indicators appear to be the major routes of exposure to parasitic infection (including Ascaris worm infection) and gastro-enteritis and show the need for intensive health education in the community.

The highest prevalence of *Ascaris* worm infection was seen in children attending DNPS and ANPS (60.6%) respectively, followed by GFNPS with 57.6%; nevertheless, other children in the rest of the schools also had the infections. This may be attributed to the fact that some of the schools are surrounded by overgrown grasses which could predispose them to defecating in the bushes coupled with the facts that they play around in the school fields with their hands which could lead to their infection with the parasite since the mode of infection is fecal-oral.

The relationship between the age of the children and *Ascaris* worm infection is shown in Table 3; there was a high prevalence of *Ascaris* worm infection (73.8%; OR=2.11) in the age group of 11-12 years, while the 9-10 year cohort had 57.1% (OR=2.01)

Table 4: Prevalence of *Ascaris* worm infection among school children as to socio-demographic characteristics in Lambata Community/ Multilevel Analysis of Risk factors of *Ascaris* worm infection among children

Variables	No Exam	No Positive (%)	No Negative (%)	OR	Chi-square	P value
Age						
6-8 years	163	69 (42.3)	94 (57.7)	1.00		
9-10 years	98	56 (57.1)	42 (42.9)	2.01	72.01	0.002
11-12 years	42	31 (73.8)	11 (26.2)	2.11		
Gender						
Male	135	89 (65.9)	46 (34.1)	2.00	60.30	0.092
Female	168	67 (39.9)	101 (60.1)	0.90		
Educational status of Parents						
None	80	58 (72.5)	22 (27.5)	3.800		
Primary	72	50 (69.4)	22 (30.6)	2.900	74.3	0.001
Secondary	76	32 (42.1)	44 (57.9)	1.011		
Tertiary	75	20 (26.7)	55 (73.3)	0.83		
Job/Occupational status of Parents						
Unemployed	70	56 (80.0)	14 (20.0)	3.200		
Farmer	77	49 (63.6)	28 (36.4)	2.700	78.0	0.002
Trader	76	50 (65.8)	26 (34.2)	3.00		
Civil Servant	80	31 (38.8)	49 (61.2)	0.92		
Dirty finger nails						
Yes	203	155 (76.4)	48 (23.6)	2.500	71.0	0.013
No	100	40 (40.0)	60 (60.0)	1.00		
Defecation habits						
Open field	180	120 (67.7)	60 (33.3)	2.20	81.0	0.022
Latrine	123	45 (36.6)	78 (63.4)	1.10		
Eating raw vegetables and unwashed fruits						
Yes	200	130 (65.0)	70 (35.0)	2.90	76	0.001
No	103	48 (46.6)	55 (53.4)	1.20		
Hand washing habit before meals						
Always	159	51 (32.1)	108 (67.9)	1.00		
Sometimes	144	96 (66.7)	48 (33.3)	3.10	65	0.032

and 6-8 year old ones showed 42.3% (OR=1.00). This constitutes an eloquent testimony that ascaris worm infection is endemic in Lambata community and mostly affect vulnerable groups such as children and this is in line with the works of [18] who recorded the highest prevalence of 59.1% among the age group of 10-12 years; another study[16] revealed the highest prevalence among the age group of 7-12 years. Also, a research[19] reported the highest prevalence of 32.0% among >10 years, 29.5% for 6-9 years, and 29.6% in the <6 year group. The report of this study, however, did not corroborate the works of[17, 20] who recorded the highest prevalence of 85.7% and 0.8% among the 6-8 year age group in their various studies. The high infection prevalence reported in this age cohort (11-12 years) may be attributed to age-related changes in diet, hygiene, and daily activities with regard to the exposure to parasite infective stages.[19] Furthermore, it could be the result of the general contamination of the environment as well as their poor personal hygiene[18] as age is significantly associated with ascaris worm infection (P=0.002) in the community. It is, therefore, absolutely necessary that the community pay adequate attention to environmental sanitation and organize it from time to time to health education and create more awareness.

The gender analysis of this result showed that *Ascaris* worm infection is more (65.9%) seen in the males than in their females (39.9%) counterparts and this is consistent with the works of; [16, 26, 27, 29,] it is however, not in the same line with the results of[20, 18, 19] who variously reported more ascaris infection in females than their male counterparts, arguing that the females are more exposed, play more in groups on sand, hawk, share their food with unwashed hands, and other domestic chores. Nevertheless, gender is not significantly associated with ascaris worm infection in Lambata community and this is in agreement with some reports in Nigeria[18, 19] and elsewhere [24]. It is now very recommended that the government authorities, teachers, parents and guardians of these children should rise up and organize vigorous health education for the community.

Limitations

This study was limited by selecting only nine primary schools in that community; it could have been better to have chosen more of the schools and include children outside the chosen primary schools to broaden the scope of the study and get a larger picture of the prevalence of Ascaris worm infection in the community. More so, stool specimen were collected once from each of the participating children, whereas for standard diagnosis of Ascaris ova or larva, at least three samples in three alternate days are necessary.

Strengths

All the teachers, parents and guardians of the school children were friendly and cooperative throughout the study and this helped the resaerchers in this study. Furthermore, the results of this study are consistent with the reports of previous studies in the country.

In conclusion, the results of this study indicated the high prevalence of Ascaris worm infection among the primary school children in Lambata community, Niger state, as well as certain risk factors of the infection which are common in developing countries in the tropical areas such as illiteracy, unemployment, contamination of living environment and open field defecation. Hence, knowledge of these factors may help facilitate implementation of public health intervention designed to reduce *Ascaris* worm and other parasitic infections in the community, and, more so, in the developing countries with similar environmental conditions and sanitary practices. Community-based mass anti-helminthic therapy on a regular basis can meet short-term objectives of ascaris infection reduction. Health education promotion, adoption of hygienic practices, and school based de-worming programs can have long-term benefits.

Conflict of Interest: None declared.

References

1 Jourdan, PM, Larnberton, PHC, Fenwick, A, Addiss,DG. Soil-transmitted helminth infections. Lancet. 2017.DOI:10:1016/50140-6736 (17).

2 Center for Disease Control (CDC). Global Health: Parasitic diseases and malaria. cdc.gov/parasites/ascariasis/index.html,2020

3 Wright,JE, Werkman,M, Duun,JC & Anderson,RM. Current epidemiological evidence for predisposition to high or low intensity human helminth infection:A sustainable review Parasit. Vectors, 2018; 11 (1):65

4 Walker, M, Hall, A, Basanez,MG. Individual predisposition, household clustering and risk factors for human infection with Ascaris lumbricoides: new epidemiological insights. PLos Negl Trop Dis. 2011; 5 (4): e1047.

5 World Health Organization (WHO). Control of Ascariasis: Report of WHO Committee. Technical series,2002;379,1967, pp. 1e39.

6 Aguilar, I, & Galbes, H. Encyclopedia of Health and Education for the family,2012;pp:130-131.

7 Yimam,Y, Degarege,A, Erko,B. Effect of antihelminthic treatment on helminth infection and related anaemia among school-age children in Northwestern Ethiopia. BMC Infect Dis. 2016; 16 (1):613.

8 Easy, AT. Crompton community control of Ascaris lumbricoides in rural Oyo state, Nigeria: mass targeted and selective treatment with levamisole. Parasitology,2020; 103: 291e298.

9 World Health Organization (WHO). Preventive chemotherapy in human helminthiasis: coordinated use of antihelminthic drugs in control interventions; a manual for health Professionals and Programme managers, WHO, 2013; eneva, 2006.

10 Global Network. Intervention for the control of soil-transmitted helminthiasis in the Community. Adv. Parasitol. 2006; 61:311e348

11 Sayer WA. Factors that influence the rate of incidence of ascaris infection. Am. J. Hyg. 1995; 5: 790-817.

12 Chijioke, IR, Ile, C, Ilechukwu, GCA, Okafor, CI, Ekejindu, IM, Sriddiar,MK. A Community based survey of the burden of Ascaris lumbricoides in Enugu. Ann. Med. Health Sci. 2011; 1 (2): 165-171.

13 Mafiana RM, Ngwodo, POA. A study of blood and gastrointestinal parasites in Edo State Afri. J. Biotech.2007; 6 (19): 2201-2207.

14 Onwasigwe,CN. Intestinal parasites in Enugu school children. Orient J. Med. 1999; 11 (1-4):56-60.

15 Duaah,ET. Immunohistochemical characterization of hepatic lesions associated with migrating larvae of Ascaris suum in Pigs. J. Comp. Pathol.2008; 124 (2001):200e206.

16 Manir,N, Umar,LM, Abduhadi,BJ. Survey on prevalence of intestinal parasites associated with some primary school aged children in Dutsinmia Area, Katsina state, Nigeria. Moj. Biol. Med.2017;2 (2):197-201.

17 Damen,JG, Luka,J, Biwari,EI, Lugos,M. Prevalence of intestinal parasites among pupils Rural Northeastern Nigeria. Niger. Med. J.2011:52 (1): 4-6.

18 Vincent,PG, Ting-Wu,C, Chien-Wei,L, Yueh-Lun,L, Olaoluwa,PK, Akwaowo,O, Olusola,A, Ajayi,JB. Intestinal parasitic infections: Current status and associated riskfactors among school aged children in an anchetypal African urban slum in Nigeria. J.Microbiol. Immunology& Infection.2019; 52 (1):106-113.

19 Gowon, AI, Baba, OV, Akpu, PA, Linda,AE. Ascaris lumbricoides infection using Microscopy and IgG4 Detection Techniques in a school children population in Central Nigeria: An epidemiological study. J. Infect. Dis. Treat.2018;4 (1): 5.

20 Kizito, UN. Ascaris lumbricoides infection among pupils of primary schools in Uzoagba, Ikeduru, Southeastern Nigeria. J. Health Educ Res Dev. 2018; 6:4.

21 Solomon,NK. Prevalence and distribution of soil-transmitted helminth infections in Nigerian children: a systematic review and meta-analysis. J. Infectious Disease of Poverty,2018; 7:79

22 Naing, L, Winn,T, Rusli,BN. Practical issues in calculating the sample size for prevalence studies. Archives of Orofacial Sciences,2006; 1:9-14.

23 Baye,S, Haiteyesus,M & Destraw,D. Prevalence of intestinal parasitic infections and associated risk factors among Jawa primary school children,Jawa Town,Northwest Ethiopia. BMC Infectious Diseases,2019; 19:341

24 Mohammad,JAA,Maryam,BM, Mostafa,R, Mehdi,M, Vali, B, Somayeh, Mohammad BA, Ruhollah,H, Mohammad,S. Prevalence and associated risk factors of Human intestinal parasitic infections: a population-based study in the southeastern Iran.BMC Infectious Disease,2020; 20:12.

25 Daniel,G, Melkam,T,Anderaw,A& Gashew,Z. Prevalence of intestinal parasitic infection And its associated risk factors among school children in two primary schools in Harbu Town, Northeastern Ethiopia:cross-sectional study.Pediatric Health Med. Ther.2020; 11:179-188.

26 Abednego,SD, Esther,OF, Joy,EF & Francis,IW. Soil-transmitted helminthes and associated risk factors among elementary school pupils in Dadin Kowa, Jos. Niger Med J.2019; 60 (4): 181-185.

27 Dangana,A, Abayomi,RO, Wey,GD & Akobi,OA. Survey of Ascaris lumbricoides among Pupils of primary school in Jos South LGA of Plateau state, Nigeria. Afri Jour Microbiology Res. 2011; 5 (17):2524-2527.

28 Ekpenyong,JP. Dose-dependent impact of larvae of Ascaris suum on host body weight in The mouse model. J. Helminthol. 2008; 38 (2009): 1e5.

29 Abab,AE & Arene,OI. Status of intestinal parasite infections among primary school Children in River state. Journal of Parasitological Res. 2015; 15 (2):8-10.