Current Status and Risk Factors of Intestinal Parasitic Infections among School Children in Katsina Local Government Area, Katsina State, Nigeria

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Abstract: **- A survey of the prevalence of current status and risk factors of intestinal parasitic infections among schoolchildren in Katsina local government area, Katsina state, Nigeria were carried out. The objective of the study was to determine the prevalence of intestinal parasitic infections among the study children. To determine the prevalence by age and gender of the children and to assess the major risk factors for the infections among the children. The design of the study was a cross-sectional investigation involving a sample of population of 266 schoolchildren from Primary one to Primary six in Shinkafi model primary school. Structured Questionnaires were used to obtain the socio-demographic information of the children and their parents before the commencement of the survey. Stool samples were collected and analyzed using direct wet-mount technique. The overall prevalence of intestinal parasitic infection was 29.3%. *Ascarislumbricoides* was the most prevalent parasite with a prevalence of 15.4%. The result further showed that, the males are more infected (34.4%) compared with females (24.4%). Moreover, the children age 4-9 years were significantly more infected (40.2%) compared to their elder ones aged ≥10 years (19.4%). Some of the major risk factors of infection among the children were, Age group, mothers' educational status and playing without shoes (P<0.05). Efforts to curtail the prevalence among the children in the study area should include more enlightenment regarding the knowledge and dangers of the infections and public health significance of the disease. Government should create deworming programme among school children, improvement of safe water supply, health facilities, as well as health education are needed so as to reduce the rate of intestinal parasitic infection.**

Key words: **School children, Intestinal parasitic infection Prevalence, Current status, Risk factor.**

I. INTRODUCTION

Parasitic diseases are still a major public health problem in both developing and developed countries. Several factors such as over-crowding, weather conditions, lack or absence of health facilities, poverty and in some cases special political situations and regional conflicts are factors affecting the spread of parasitic diseases in different regions of the world. In some cases, developed countries are not safe from the destructive impacts of parasites and many outbreaks have been reported (Alum *et al*., 2010 and Kia *et al*., 2008). Factors such as weather conditions, population density, high water level, high humidity and rainfall, extensive agricultural activity, the large number of tourists and the existence of animals in various human environments provided suitable condition to distribution of intestinal parasites (Rostami*et al*., 2016 and Haque R, 2007).

Intestinal parasitic infection represents a large and serious medical and public health problem in developing countries. It is estimated that some 3.5 billion people are affected, and that 450 million are ill as a result of these infections, the majority being children (WHO, 2015). Apart from causing morbidity and mortality, infection with intestinal parasites has known to cause iron deficiency anemia, growth retardation in children and other physical and mental health problems (Evans *et al.*, 1994). Furthermore, chronic intestinal parasitic infections have become the subject of speculation and investigation in relation to the spreading and severity of other infectious diseases of viral origin, tuberculosis and malaria (Actor *et al.*, 1993).

Several factors like climatic conditions, poor sanitation, unsafe drinking water, and lack of toilets facilities are the main contributors to the high prevalence of intestinal parasites in the tropical and sub-tropical countries (WHO, 2004). In addition, intestinal parasitic agents increase in polluted environments such as refuse heaps, gutters and sewage units in and around human dwelling and living conditions of the people in crowded or unhealthy situations (Yimam *et al*., 2016). Hence, a better understanding of the above factors, as well as how social, cultural, behavioral and community awareness affect the epidemiology and control of intestinal parasites may help to design effective control strategies for these diseases (WHO 2010, Olusegun *et al*., 2011). Intestinal parasites are widely distributed in poor rural communities largely due to the low level of environmental and personal hygiene, contamination of food and drinking water that results from improper disposal of human excreta (Dejenie T and Asmelash T. 2010; WHO 1987). In addition, lack of awareness of simple health promotion practices is also a contributing factor (Kloos, 1993). According to the Ethiopian ministry of Health (Gelaw *et al*., 2013) more than half a million annual visits of the outpatient services of the health institutions are due to intestinal parasitic infections.

Intestinal parasites such as *Ascarislumbricoides*, negatively affect the nutritional status of children (Stephenson *et al*., 2000). Children and pregnant women are the main sufferers from these parasitic infections (WHO 2003). Regions with high prevalence of intestinal parasites include Asia, Africa and Latin America (Harhay *et al.,* 2010). The most common intestinal parasites among adult and child groups surveyed were *Entamoeba histolytica*, *Gardia .intestinalis*, *Ascarislumbricoides*, and *Trichuris. trichiura* (Sinniah *et al*., 2012). The state of Chiapas, Mexico, occupies the first place in multidimensional poverty and has had, for almost decade (2000-2008), the highest rate of child death due to diarrheal diseases (ALMEIDA2010). Nearly 76.7% of Chiapas inhabitants live in extreme poverty; this includes severe deficiencies in areas of economic and social wellbeing (CONEVAL 2008). The municipalities of Pantepec, Chanal, and Larrainzar are among the lowest on the human Development index. In 2005 these municipalities had a child death rate of 35.07 deaths per 1000 live births, respectively, above the state and national rates of 23.89 and 16.8 (CONAPO 2005).

However, this report may be an underestimate, because most of the health institutions lack appropriate diagnostic methods to detect low levels of parasite burden. In addition, some of the diagnostic methods for specific intestinal parasites, especially for the newly emerging opportunistic intestinal parasites, are not available to peripheral health institutions. Although several studies have been conducted on the distribution and prevalence of intestinal parasites in Katsina (Usman *et al*., 2019), there are still several localities in the State including the study area, Shinkafi town, Katsina state, for which epidemiological information of intestinal parasitic infections was not available.

Therefore, the objective of this study is to determine the prevalence of Intestinal parasitic infections among the study children. To determine the prevalence by age and gender of the children and to assess the major risk factors for the infections among the children.

II. MATERIALS AND METHODS

Description of the Study Area

The study was carried out in Shinkafi village of Katsina Local Government. Shinkafi village lies between latitude 13°1’37” north of the Equator and longitude 7°38’33” East of Greenwich meridian. Vegetation of Shinkafi is mostly composed of scattered trees and shrubs. The annual rainfall in the village is between 400mm-600mm and lasts April to October.

The study has been carried out in Shinkafi Model Qur’anic Primary School. There is one clinic in the town. The inhabitants of Shinkafi village practice peasant agriculture to make their means of livelihood. Agriculture is one of the sources of income in the area because various cash crops such as beans, sugar beet, potatoes, cassava, etc are also grown by the people.

Sampling Size and Sampling Procedures

Random sampling technique was employed to select students from each classroom by using class attendance register as the sample frame.

Sample Size

A total of 266 schoolchildren were selected for this study. The number was regarded enough to give a reasonable representation of the population of children in the area. The selection was also based on the available data on the prevalence of intestinal parasitic infections among children in the study area as reported by recent surveys.

Ethical Consideration

The objectives of this research were adequately discussed with the school head-teacher, the school staff, the pupils and the parents of the children, before embarking on the data collection. This was done in order to seek for their understanding and cooperation. They were informed that participation was voluntary and that children may decide to withdraw at any point during the survey. Moreover, permission for the research was approved by the Katsina local education Authority headquarters before embarking on the survey.

Methods of Data Collection

Questionnaire Survey

Information on each participating pupil regarding age, gender, height, weight, family size, source of water, presence or absence of latrines in their homes, parent’s educational level, history of geophagy, consumption of raw vegetables and wearing shoes or not were gathered using structured questionnaire. Moreover, each child was allocated a serial number for consistency during data collection and analysis.

Anthropometric Measurements

Anthropometric measurements of weight and height by using standard procedures mention in Gibson,(2005) and body mass index (BMI) was calculated using the WHO, Epi-info software. Weight was taken without shoes using bathroom scale and was recorded to the nearest 0.1kg. The height was measured to the nearest 0.1cm using a meter rule which was drawn on the wall. The scale was re-adjusted after every measurement for certainty. All the data were transformed and expressed in Z-scores and calculated using anthropometry calculating software program Anthroplus (WHO, 2010).

Stool Sample and Examination Techniques

During stool collection, disposable plastic containers were distributed to each study subject along with brief instructions on how to collect the stool. The unique code of the student was labeled on the container. Fresh stool was collected in the

morning and the stool samples were taken to laboratory on the same day of collection for parasitological examination.

Laboratory Parasitological Examination of Stool Samples

Stool samples were diagnosed for the presence of intestinal parasites using direct wet-mount method. The processed stool samples were checked for the presence of intestinal parasite ova or cysts under light microscopy using objectives 10x and 40x. Identification of the parasite species was done on the basis of morphology and size with the assistance of experienced laboratory technicians and referring to the parasitological and medical laboratory manual (Akwori *et al*., 2014).

Direct Mount Techniques

Wet mounting is the simplest and easiest technique for the examination of faeces. Direct wet mount technique was used to assess the overall prevalence of intestinal parasitic infections in the study area. The direct wet mount was processed by conventional iodine to identify the presence of motile intestinal parasites, cysts, egg and trophozoites under light microscope at 10x and 40x magnification. Normal saline was added to the preparation for easy observation of the cysts of intestinal parasites. About 2g of stool sample was emulsified with 3-4ml normal saline, and then a drop of emulsified sample placed on a clean microscopic glass slide, then a few drops of iodine solution was added and it was covered with a cover slip. The presence of intestinal parasite ova and cyst was observed under the microscope (Lindo *et al*., 1998).

Data Analysis

Statistical package for social sciences (SPSS), Windows version 20 (SPSS inc. Illinois, USA) was used for data analysis. Prevalence was calculated as defined by Margolis *et al*., (1987). Pearson chi-square (χ^2) was used in determining the level of association between *A. lumbricoides* infection and age, sex and anthropometric status of the study children.

III. RESULTS

Socio-demographic characteristics of the study population

The result of our findings revealed that from a total of 266 participant selected for this study. The socio-demographic features of the children and their parents showed that majority (50.8%) of them were females. Similarly the data showed that most of the children (52.3%) were aged > 10 years. Further analysis indicated that most of the children (78.6%) belong to large family households of at least 8 members. Socio--economic profile of the parents showed that educated fathers were few (21.8%) compared to the uneducated ones (78.2%). With regard to mother' education level, our findings indicated that educated mothers were (39.1%) and those that are non-educated were (60.9%). Also mother's occupation was considered in this research in which 88.0% were found to be housewives, 11.3% we're business mothers, while only 0.8% were civil servants. The habit of geophagia was also observed among the pupils whereby 22.2% confessed to soil eating. Moreover, regarding the possession of toilet facilities, our findings showed that almost all the houses of the children posses' toilets and so great majority of the children defecate in the toilet. Sources of drinking water for the children was also observed in this research in which 66.4% of the children were found to use tap water, 35.3% used bore hole water, 7.92% used well water, and only 0.4% use pond water for their daily water requirement. Eating habit among the children studied indicated that those that were using fingers were more (91.0%) compared to those using spoon (9.0%). Playing barefooted was also noted among the children and was found that 65.8% of the pupils usually play without shoes, while the rest (34.2%) normally play with shoes (Table 1).

Table 1. General socio-demographic characteristics of the study population (N=266)

VARIABLE	NUMBER (%)
Age group	
4-9 years	127 (47.7)
≥ 10 years	139 (52.3)
Gender	
Male	131 (49.2)
Female	135 (50.8)
Family Size	
2-7 members	57 (21.4)
≥ 8 members	209 (78.6)
Father's education status	
Formal education	208 (78.2)
Non-formal	58 (21.8)
Father's occupation	
Civil service	62 (23.3)
Business	148 (55.6)
Farming/others	56 (21.1)
Mother's education status	
Formal education	104 (39.1)
Non-formal	162 (60.9)
Mother's occupation	
Housewife	234 (88.0)
Business	30 (11.3)
Civil service	02 (0.8)
Geophagia	
Yes	59 (22.2)
No	207 (77.8)
Availability of toilet facility at home	
Yes	265 (99.6)
No	01 (0.4)

Defaecation habit	
Toilet	265 (99.6)
Open bush	01 (0.4)
Main source of water	
Well	21 (7.9)
Borehole	94 (35.3)
Tap	150 (66.4)
Pond	01 (0.4)
Eating habit	
Fingers/hand	242 (91.0)
Spoon	24 (9.0)
Playing bare footed	
Yes	175 (65.8)
No	91 (34.2)

Infection status and identity of parasites isolated

Survey of **STH** infections among the study population (Table 2) showed that infected pupils were 29.3% and those that were un-infected were 70.7%. Parasites that were isolated from the surveyed children include, *Ascarislumbricoides* with the highest prevalence (15.4%), followed by hookworm (4.5%), then *Giardia lamblia*(3.8%), *Entomoeba histolytica* (3.0%) and the lowest was *Entomoeba coli* (2.6%).

Table 2: Infection status and identity of parasites isolated.

Variable	**No. infected (%)**
Infection status	
Infected	78 (29.3)
Un-infected	188 (70.7)
Parasites isolated	
Ascarislumbricoides	41 (15.4)
Entamoeba coli	07 (2.6)
Entamoeba histolytica	08 (3.0)
Giardia lamblia	10 (3.8)
Ancylostomaspp	12 (4.5)
Total	**78 (29.3)**

Prevalence of infection by gender and age groups

Based on the gender group the result (Table 3) showed that the males had higher prevalence of infections with 34.4% of them being infected as compared to females with prevalence of 24.4%. Moreover, in terms of age groups, our findings revealed that the children aged 4-9 years had a higher prevalence rate with 40.2% of them infected by the intestinal parasites, as compared to those aged >10 years who had a prevalence of infection by gender and age among the study population is shown on table 4.3.

Table 3: Prevalence of infection by gender and age groups

Variable	**No. Infected (%)**
Gender	
Male	45 (34.4)
Female	33 (24.4)
Age group	
4-9 years	51 (40.2)
≥ 10 years	27 (19.4)

Association of some possible risk factors with infections among the children (266)

Association of some possible risk factors with infections among the children the Table 4 shown below express that several factors could be responsible for the high rate of infection among the study population involved in the survey. For instance, the result of the survey as analysed using the chi-square statistics indicated that age 4-9 years (OR, 1.61; CI, 4.82; *P*=0.000), Mother's education (OR, 0.34; CI, 1.05; *P*=0.048) and playing barefooted (OR, 0.98; CI, 3.17; *P*=0.038) were the main risk factors of infection among the children.

Table 4: Association of some possible risk factors with infections among the children

Variable	**Intestinal Parasitic Infections**		
	Prevalence (%)	**OR (95% C.I.)**	***P*-value**
Age group			
4-9 years	51 (40.2)	2.78 (1.61;4.82)	0.000*
≥ 10 years	27 (19.4)	1	
Gender			
Males	45 (34.4)	1.62 (0.95;2.76)	0.050
Females	33 (24.4)	1	
Family size			
2-7 members	15 (26.3)	0.83 (0.43;1.60)	0.349
≥ 8 members	63 (30.1)	1	
Father's education status			
Formal education	56 (26.9)	0.60 (0.33;1.11)	0.073
Non-formal	22 (37.9)	1	
Mother's education status			
Formal education	24 (23.1)	0.60 (0.34;1.05)	0.048*
Non-education	54 (33.3)	1	
Geophagia			
Yes	22 (37.3)	1.60 (0.87;2.95)	0.088
No	56 (27.1)	1	
Eating habit			
Fingers	74 (30.6)	2.20 (0.73;6,67)	0.114
Spoon	04 (16.7)	1	

Playing bare footed			
Yes	58 (33.1)	1.76 (0.98;3.17)	0.038*
No	20 (22.0)	1	

IV. DISCUSSIONS

Current status and risk factors of intestinal parasitic infections among school children in Katsina local government area, Katsina State, Nigeria. According to the present study (Table 1), age group of 10–14year old and not having habit of hand washing after toilet were significantly associated with intestinal parasitic infection. Together with age group of 10–14 years old are said to have increased frequency of environmental exposure (soil, water) compared to younger children. Moreover, children will be engaged in agricultural activities at this age. Hence children of age 10–14 were 2-5 times at higher risk of acquiring intestinal parasitic infection compared to those 5–9 years old. Many previous studies failed to show this difference, might be, due to other confounding factors (Habtamu, 2015, Gebretsadik, 2016, Hailegebriel, 2017, Alemu *et al*., 2018). Many of the intestinal parasites are transmitted via the feco-oral route. As a result, family members, who share toilet, are usually primary sources of infection. In order to avoid such transmissions, frequent and proper hand washing after toilet is strongly recommended. In the present study, children who do not wash their hands after toilet were almost 4.5 times more likely to be infected. Similar association was reported from Homesha district that children who lack hand washing habit before meal and after defecation were 5.45 times at higher risk (Gebretsadik, 2016, Getaneh *et al*., 2019). Recent studies indicated that shoe wearing habit (Habtamu, 2015, Gebretsadik, 2016, Workneh 2014), consumption of raw/unwashed fruits and vegetables (Alemu 2018, Gebretsadik, 2016), habit of swimming (Gebretsadik, 2016), family size (Hailegebriel, 2017), were significantly associated with IPI. However, these factors were not associated with intestinal parasitic infection and some factors were not assessed in the present study. Washing of fruits and vegetables before consumption reduces the risk of acquiring parasite infection (Abdi *et al*., 2017). Hence these parasites can be transmitted across family members. However, data for the present study was collected at school that students have frequent contact with their class children in addition to their family. Hence, family size alone might not have significant role for the transmission of intestinal parasites. Cleanness of finger nail and trimming, and waste disposal habit were not assessed in the present study.

The high prevalence of intestinal parasites recorded in our study (Table 2) is similar to that reported in western Tajikistan by (Matthys *et al*., 2011), North-east Ethiopia by (Missaye*et al*., 2013) and North central Nigeria by (Ikeh *et al*., 2006) and (Kabiru *et al*., 2015) in Northern Nigeria. Higher prevalence was also reported by (Damen *et al*., 2011). The higher prevalence might be attributed to the presence of resistant cyst found in the study area which can withstand adverse environmental conditions. The most common intestinal parasitic infection identified in the study area communities include amongst others *Ascarislumbricoides*41 (15.4%) followed by *Ancylostomaspp* 12 (4.5%), *Giardia lamblia* 10 (3.8%), followed by *Entamoeba coli* 07 (2.6%) and *Entamoebahistolytica* 08 (3.0%). A statistical significant difference was observed in all the common intestinal parasites study $p<0.05$ (Table 2). This finding was similar to those reported by (Gelaw *et al*., 2013) in Ethiopia.

The present study revealed that males gender are more susceptible to infection 45 (34.4%), 1.62 (0.95; 2.76) p-value 0.05*); than the females 33 (24.4%) (Table 3). This finding was found to be similar with that reported by (Missaye *et al*., 2013), and (Abou-EL *et al*., 2009). The higher prevalence in relation to gender are probably due to the fact that males are mostly engaged in animal husbandry and this might be the reason for the higher significant difference.

The result of the present study revealed an overall prevalence of 78 (29.3%). Table 1 however, aged group 4-9 years had a prevalence of 51 (40.2%) [OR; 2.78 1.61; 4.82, 95%C.I; p-value 0.000] age group 10-14 years of age had a prevalence of 27 (19.4%) [OR 1 95%C.I; p-value 0.000]. This finding was consistent with reports by (Akimbo *et al*., 2011).

V. CONCLUSION

Based on our findings, intestinal parasitic infection was found to be among the highest neglected tropical disease affecting school children in rural areas and has therefore cause a serious public health problem. Children playing in an unhygienic environment and subsequently contaminating their hands are considering one of the factors associated with the infections. Both State and Federal Ministry of health should control intestinal parasitic by creating deworming programme among school children, improvement of safe water supply, health facilities, as well as health education are needed so as to reduce the rate of intestinal parasitic infection. However, the high prevalence of intestinal parasites in the present study alarms the ministry that more effort is needed in order to reduce the spread of the infection. Consistent implementation of wash program in integration with deworming seems indispensable strategy.

REFERENCES

[1]. Abdi, M., Nibret, E., & Munshea, A. (2017). Prevalence of intestinal helminthic infections and malnutrition among schoolchildren of the Zegie Peninsula, northwestern Ethiopia. *Journal of infection and public health*, *10*(1), 84-92.

[2]. Abou El-Soud, F., Salama, R. A., & Taha, N. S. (2009). Predictors of the intestinal parasitic infection among pre-school children in rural lower, Egypt. *Egypt J Community Med*, *27*, 17-34.

[3]. Actor, J. K., Shirai, M., Kullberg, M. C., Buller, R. M., Sher, A., & Berzofsky, J. A. (1993). Helminth infection results in decreased virus-specific CD8+ cytotoxic T-cell and Th1 cytokine responses as well as delayed virus clearance. *Proceedings of the National Academy of Sciences*, *90*(3), 948-952.

[4]. Adefioye, O. A., Efunshile, A. M., Ojurongbe, O. L. U. S. O. L. A., Akindele, A. A., Adewuyi, I. K., Bolaji, O. S., ... & Adeyeba, A. O. (2011). Intestinal helminthiasis among school children in

Ilie, Osun state, southwest, Nigeria. *Sierra Leone Journal of Biomedical Research*, *3*(1), 43-48.

[5]. Akinbo, F. O., Omoregie, R., Eromwon, R., Igbenimah, I. O., & Airueghiomon, U. E. (2011). Prevalence of intestinal parasites among patients of a tertiary hospital in Benin City, Nigeria. *North American journal of medical sciences*, *3*(10), 462.

[6]. Alemu, G., Abossie, A., &Yohannes, Z. (2019). Current status of intestinal parasitic infections and associated factors among primary school children in Birbir town, Southern Ethiopia. *BMC infectious diseases*, *19*(1), 270.

[7]. Alemu, G., Aschalew, Z., &Zerihun, E. (2018). Burden of intestinal helminths and associated factors three years after initiation of mass drug administration in ArbaminchZuria district, southern Ethiopia. *BMC infectious diseases*, *18*(1), 435.

[8]. ALMEIDA, E. (2010). *O papel de professoressurdos e ouvintesnaformação do tradutor e intérprete de línguabrasileira de sinais. 2010. 104 f* (Doctoral dissertation, Dissertação (MestradoemEducação), UniversidadeMetodista de Piracicaba, São Paulo).

[9]. Alum, A., Rubino, J. R., &Ijaz, M. K. (2010). The global war against intestinal parasites—should we use a holistic approach?.*International Journal of Infectious Diseases*, *14*(9), e732-e738.

[10]. Damen, J. G., Luka, J., Biwan, E. I., &Lugos, M. (2011). Prevalence of intestinal parasites among pupils in rural North Eastern, Nigeria. *Nigerian medical journal: journal of the Nigeria Medical Association*, *52*(1), 4.

[11]. Dejenie, T., &Asmelash, T. (2010). Schistosomiasismansoni among school children of different water source users in Tigray, Northern Ethiopia. *Momona Ethiopian Journal of Science*, *2*(1).

[12]. Evans, A. C., & Stephenson, L. S. (1995). Not by drugs alone: the fight against parasitic helminths. In *World health forum 1995; 16 (3): 258-261*.

[13]. Gebretsadik, G. (2016). Prevalence of intestinal Parasites and associated risk factors among schoolchildren of Homesha District (Woreda) in Benishangul-Gumuz regional State, western Ethiopia. *Journal of Family Medicine and Health Care*, *2*(4), 57-64.

[14]. Gibson, R. S. (2005). *Principles of nutritional assessment*. Oxford university press, USA.

[15]. Hailegebriel, T. (2017). Prevalence of intestinal parasitic infections and associated risk factors among students at Dona Berber primary school, Bahir Dar, Ethiopia. *BMC infectious diseases*, *17*(1), 362.

[16]. Haque, R. (2007). Human intestinal parasites. *Journal of health, population, and nutrition*, *25*(4), 387.

[17]. Harhay, M. O., Horton, J., &Olliaro, P. L. (2010). Epidemiology and control of human gastrointestinal parasites in children. *Expert review of anti-infective therapy*, *8*(2), 219-234.

[18]. Ikeh, E. I., Obadofin, M. O., Brindeiro, B., Baugher, G., Frost, F., Vanderjagt, D., &Glew, R. H. (2006). Intestinal parasitism in Rural and Urban areas of North Central Nigeria: an update. *The Internet Journal of Microbiology*, *2*(1), 1-12.

[19]. Ketema, H., Biruksew, A., &Mekonnen, Z. (2015). Prevalence of Necatoramericanus infection and risk factors among school-age children in Mirab Abaya District, South Ethiopia. *Asian Pacific Journal of Tropical Disease*, *5*(5), 363-368.

[20]. Kia, E. B., Hosseini, M., Nilforoushan, M. R., MEMAR, A., &Rezaeian, M. (2008). Study of intestinal protozoan parasites in rural inhabitants of Mazandaran province, Northern Iran.

[21]. Matthys, B., Bobieva, M., Karimova, G., Mengliboeva, Z., Jean-Richard, V., Hoimnazarova, M., & Wyss, K. (2011). Prevalence and risk factors of helminths and intestinal protozoa infections among children from primary schools in western Tajikistan. *Parasites & vectors*, *4*(1), 195.

[22]. Missaye, A., Dagnew, M., Alemu, A., &Alemu, A. (2013). Prevalence of intestinal parasites and associated risk factors among HIV/AIDS patients with pre-ART and on-ART attending dessie hospital ART clinic, Northeast Ethiopia. *AIDS research and therapy*, *10*(1), 7.

[23]. Mohammed, K., Abdullah, M. R., Omar, J., Eugene, I. I., & Ismail, A. (2015). Intestinal parasitic infection and assessment of risk factors in North-Western, Nigeria: A community based study. *International Journal of Pharma Medicine and Biological Sciences*, *4*(2), 141.

[24]. Mohammed, K., Abdullah, M. R., Omar, J., Eugene, I. I., & Ismail, A. (2015). Intestinal parasitic infection and assessment of risk factors in North-Western, Nigeria: A community based study. *International Journal of Pharma Medicine and Biological Sciences*, *4*(2), 141.

[25]. Okwori, A. J., Sidi, M., Ngwai, Y. B., Obiekezie, S. O., Makut, M. D., Chollom, S. C., ... &Adikwu, T. I. (2014). Prevalence of schistosomiasis among primary school children in Gadabuke District, Toto LGA, North Central Nigeria. *Microbiology Research Journal International*, 255-261.

[26]. Prevention, W. H. O. (1987). Control of intestinal parasitic infections. Report of a WHO Expert Committee. *World Health Organ Tech Rep Ser*, *749*, 1-86.

[27]. Rodriguez-Oreggia, E., De La Fuente, A., De La Torre, R., & Moreno, H. A. (2013). Natural disasters, human development and poverty at the municipal level in Mexico. *The Journal of Development Studies*, *49*(3), 442-455.

[28]. Rostami, A., Ebrahimi, M., Mehravar, S., Omrani, V. F., Fallahi, S., &Behniafar, H. (2016). Contamination of commonly consumed raw vegetables with soil transmitted helminth eggs in Mazandaran province, northern Iran. *International journal of food microbiology*, *225*, 54-58.

[29]. Sinniah, B., Sabaridah, I., Soe, M. M., Sabitha, P., Awang, I. P. R., Ong, G. P., & Hassan, A. K. R. (2012). Determining the prevalence of intestinal parasites in three Orang Asli (Aborigines) communities in Perak, Malaysia. *Trop Biomed*, *29*(2), 200-6.

[30]. Stephenson, L. S., Latham, M. C., &Ottesen, E. A. (2000). Malnutrition and parasitic helminth infections. *Parasitology*, *121*(S1), S23-S38.

[31]. Strausbaugh, L. J., &Herwaldt, B. L. (2000). Cyclosporacayetanensis: a review, focusing on the outbreaks of cyclosporiasis in the 1990s. *Clinical Infectious Diseases*, *31*(4), 1040-1057.

[32]. Usman, A., & Aisha, K. S. (2019) Survey on Helminth Parasites Associated With Human Fingernails among Primary School Pupils in Batagarawa Local Government Area, Katsina State, Nigeria.

[33]. Workneh, T., Esmael, A., &Ayichiluhm, M. (2014). Prevalence of intestinal parasitic infections and associated factors among Debre Elias primary schools children, East Gojjam Zone, Amhara Region, North West Ethiopia. *J BacteriolParasitol*, *5*(1), 1.

[34]. World Health Organization. (2004). *Prevention and control of schistosomiasis and soil-transmitted helminthiasis: World Health Organization/Unicef joint statement* (No. WHO/CDS/CPE/PVC/2004.9). World Health Organization.

[35]. World Health Organization. (2010). Workingto overcome the global impact of neglected tropical diseases: first WHO report on neglected tropical diseases (No. WHO/HTM/NTD/2010.1). World Health Organization.

[36]. Yimam, Y., Degarege, A., &Erko, B. (2016). Effect of anthelminthic treatment on helminth infection and related anaemia among school-age children in northwestern Ethiopia. *BMC infectious diseases*, *16*(1), 613

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