The Bioscientist Journal Vol. 12 (2): 170 – 181, March 2024
Journal of the Faculty of Biosciences, Nnamdi Azikiwe University, Awka, Nigeria
Available online at *http://www.bioscientistjournal.com*
DOI 10.54117/the_bioscientist.v12i2.176



OPEN ACCESS

Full Length Research Article

INTESTINAL HELMINTH INFECTION AND NUTRITIONAL STATUS OF SCHOOL CHILDREN IN ENUGU STATE, NIGERIA

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Article History: *Received: 4th November, 2024 Accepted: 3rd December, 2024*

Abstract

The public health importance of intestinal helminths in endemic communities cannot be overemphasised. This study was done to investigate the effect of intestinal helminths infection on nutritional status of school children in Enugu State, Nigeria. Stool samples were collected from 2411 pupils of randomly selected primary schools and examined using direct smear and Kato Katz techniques to determine prevalence. Malnutrition among intestinal helminths infected pupils were assessed using standard anthropometric measurements. Data obtained was analysed using SPSS version 23. Of the 2411 pupils examined, 333(13.8%) were positive for various intestinal helminths parasites. Anthropometric measurements of height for age and gender revealed that 37.2% of infected pupils had heights below the normal heights. More infected males (44.9%) were below the normal heights, than the females (27.7%) (P = 0.000). Pupils aged 14years and above were the most under height than other age groups (P = 0.000). In the weight-for-age result, 51.9% infected pupils were underweight. More infected females (56.8%) than males (48.1%) were underweight (P = 0.000). All infected pupils aged 14 years were underweight (100%). Result also showed that 45.0% were malnourished, while 14.1% and 40.8% were severely malnourished and well-nourished respectively (P = 0.172). Infected male (47.9%) pupils were more (42.6%) malnourished than their female counterparts (P = 1.29). Result on body mass showed that 70.3% were severely stunted, while 18.3% had normal body mass index (BMI) (P = 0.466). The burden of Intestinal helminths infection is of public health importance mainly among children, negatively affecting their growth and development. Improved mass drug administration, proper sewage disposal, health education, improved environmental and personal hygiene are recommended for control and possible elimination.

Key words: Nutritional Status, Intestinal helminths, weight, height, Pupils

Introduction

Intestinal parasitic infections are commonly observed in developing nations (Elom *et al*., 2013). These infections are largely attributed to inadequate water supply, poor sanitation, poverty, and lack of education. The global burden of intestinal helminth reaches over 1.5 billion and account for over 450 million annual morbidities and over 200,000 mortalities (WHO, 2020). Heavily populated areas with significant social and economic progress tend to have a higher prevalence of these infections, particularly among school-aged children, women of childbearing age, adolescent girls, and pregnant women (WHO, 2006).

Infections with intestinal helminth may not be life-threatening but are responsible for substantial morbidity in affected population, such as anaemia, chronic malnutrition, reduced immunity and stunted growth. These heminths increase malabsorption of nutrients and at times compete for vitamin A in the intestine (Onyemelukwe *et al*. 2021; Merem *et al*., 2017). Intestinal helminths cause loss of appetite and therefore a reduction in nutritional intake and physical fitness. Large burden of intestinal helminth can result to symptoms like diarrhoea, abdominal pain, malnutrition, general malaise, weakness, impaired growth, impaired physical development and in rare cases intestinal obstruction (WHO, 2023). These infections can cause a range of symptoms, including nausea, vomiting, diarrhoea, malabsorption, malaise, fatigue, depression, weight loss, fever, and gastrointestinal obstruction. Specific presentations are seen in *Ancylostoma duodenale* infection, where the parasite can suck approximately 0.25 ml of blood per day, leading to microcytic hypochromic anaemia (Rzepecka *et al*., 2013). Giardiasis can cause severe malabsorption syndrome, and untreated *Entamoeba histolytica* infection can lead to intestinal and extraintestinal manifestations (Nematian *et al*., 2004). Large helminthic parasites can also precipitate intestinal obstruction and other related complications (WHO, 2006).

Documented impact of chronic intestinal helminth infection is mainly linked to malnutrition and stunted growth (Hall *et al*., 2008; Albonico *et al*., 2008). There are established links between STH infection and issues like iron and vitamin A levels, anaemia, and growth, caused by factors such as malabsorption, inflammation, and decreased food intake due to reduced appetite (Stolzfus *et al*., 2004; Albonico *et al*., 2008; Hall *et al*., 2008). Our aim therefore, was to study intestinal helminth infection and nutritional status of school children in parts of Enugu State, Nigeria.

Materials And Methods

Study Area

The study was carried out in two local government areas (Enugu East and Awgu LGAs) of Enugu State, Nigeria. Enugu East is located at latitude 6.527038^{o}N and longitude 7.522116^{o}E while Awgu is located at latitude 6.079973^{o}N (between 06 00’ and 06 19’) N and 7.469581^{o}E (07 23’ and 07 35’) E. Enugu East LGA has an area of 383km^{2} with an estimated population of about 280,000, while Awgu LGA has an area of 420.8km^{2} with a population of 390,681 as at 2006 census (FGN, 2009).

The climate of the study area is tropical, having a mean annual temperature of 26.7^{o}C and a mean annual rainfall of 1719 mm. The highest humidity of 80 % is between March and November. It has a tropical savannah climate and an average elevation of 172m above sea level. The highest and lowest rainfall occur in September and December

recording about 292mm and 8mm respectively.

Study Design

This study was a cross-sectional study of primary school pupils in the study area to investigate the prevalence of intestinal helminths infection and nutritional status among the pupils in Enugu East and Awgu LGAs of Enugu State. Of 136 primary schools in the study area, 10 schools were randomly selected. A total of 2411 consenting pupils participated in this study.

Study population

The study population consisted of primary school pupils aged from 5 - 17 years in the two local government areas. Enugu East LGA has a total of 63 government-owned primary schools with a total number of 20,760 pupils while Awgu has a total of 73 government-owned primary schools with a total of 8318 pupils as indicated in the data obtained from the Enugu State Universal Basic Education Board (ENSUBEB). The pupils were in the 2023/2024 school year during the study. All pupils with history of deworming within the previous three months were excluded from the study.

Sample size determination

The sample size was determined using the formular for finite population as described by Yamane, (1967). It also helped to improve accuracy level in determining the chunk of a population to sample at a reasonable margin of error. For this study the margin of error/precision used was 5% (0.05).

Ethical Approval

Ethical approval for the study was obtained from the Human Research Ethics Committee of Enugu State University Teaching Hospital, Enugu (ESUTHP/C-MAC/RA/034/VOL.4/103).

Informed Consent

Informed consents (oral) were sought and obtained from the parents and/or guardians of the pupils through their respective schools.

Selection of study participants

Random sampling technique was employed in the selection of study participants from pupils in the 10 participating schools who are willing to be part of the study.

Collection of faecal specimen

All study participants received a clean, sterile specimen bottle with a wide mouth and leak proof design, along with wooden applicator sticks, one day before the collection day. Instructions were given to the participants on how to obtain the stool specimen, starting with placing the faeces on tissue paper or old newspaper, then using the wooden stick to transfer a small amount into the provided container. They were told not to mix the urine with the faeces sample and to only gather a new faecal sample because samples from the previous night would not be suitable. During the stool sample collection process, a preservative of 10% formol-saline was added, and a distinct identification code was assigned to both the specimen bottle and the record sheet. The visible features (colour and texture) were observed and documented in a logbook. Sampling from the pupils took place from 9 am to 12 noon daily. All samples gathered daily were examined same day immediately it is brought to the laboratory.

Parasitological Examination of the stool Specimens:

Direct microscopy of Iodine wet mount

The direct microscopy technique was performed according to the guidelines outlined by the World Health Organization (2020). Two milligrams (mg) of each faecal sample was placed onto a clean microscope slide free of grease, which had a drop of 0.9% normal saline. An applicator stick was used to emulsify the preparation, resulting in a uniform spread. The smear was then placed beneath a cover slide, being careful to prevent

air bubbles. The specimen was observed with ×10 and ×40 objective lenses of the light microscope. Lugol's iodine was applied to the sample as a staining agent to help identify intestinal helminths worms.

Kato-Katz technique

Approximately 3 grams of faecal sample was deposited onto absorbent paper and spread out using an applicator stick. A mesh gauze screen was placed over the loosened faecal sample to allow debris to filter out with the right amount of pressure applied. The applicator stick was used to collect and transfer the sieved faeces to fill the hole in the template on a clean, grease-free glass slide, while ensuring no air bubbles were trapped. The faeces in the hole was smoothed out and any extra faecas was removed using a spatula. The template was lifted up cautiously and placed in a bucket filled with concentrated detergent mixed with water. The faecal sample was covered with a cellophane piece soaked in methylene blue glycerol solution overnight. By gently pressing on the faecal sample with a different glass slide, it was evenly spread in a circular shape. The cover slide was carefully slid to the side to prevent tearing the cellophane. The slide was prepared and then placed on the microscope with the clear side facing up. It was then viewed using the ×10 and ×40 objectives of the light microscope for 30 – 60 minutes. The identified parasite eggs were counted and documented in each positive sample.

Assessment of malnutrition among pupils infected with intestinal helminths

Malnutrition among intestinal helminths infected pupils were assessed using anthropometric measurements as described by WHO (1995). The anthropometric measurements of weight and height of each participant was taken on the sample collection day. The weight was determined by using a weighing scale and measured in kilograms (kg) while the height was determined by use of a stadiometer and measured in meters (m). The body Mass index of the pupils were calculated by dividing the weight in kilograms and the height in meters squared using the formula: BMI = kg/m^2. Values obtained were interpreted as described by WHO, (2007).

Data Analysis

Data obtained from this study was collated, coded and analysed using the Statistical Package for Social Sciences (SPSS) version 23. The statistical tool used for comparing prevalence results from different categories of a given variable was Chi square. Body mass indices were converted to standard deviation SD scores and compared with WHO standard values

Results

Prevalence of Intestinal Helminths in the Study Area

Results obtained revealed 13.8% of the 2411 investigated pupils were infected with intestinal helminthes. Pupils from Enugu East LGA were more infected with intestinal helminths infections 238(14.8%) than those from Awgu 95(11.9%) (p = 0.000). Overall species specific prevalence results were: 11.7% (n = 281) for *Ascaris lumbricoides*, 1.1% (n = 27) for Hookworm, 0.7% (n = 16) for *Trichuris trichiura*, 0.2% (n= 6) for *Strongyloides stercoralis* and 0.1% (n = 3) for *Schistosoma mansoni*. Table 1 shows that Hookworms 10(1.3%) and *Strongyloides stercoralis* 2(0.3%) had slightly higher prevalences, 1.3 % and 0.3% respectively for Hookworms and *Strongyloides stercoralis* respectively, in Awgu LGA than in Enugu East LGA. The differences in the prevalence of these parasites by location were statistically significant (P=0.000; P<0.05) (Table 1)

Table 1: Prevalence of Intestinal Helminths in the Relation to Location

Location	No examined	No. infected (%)	*A. lumbricoides* (%)	Hookworm (%)	*T. trichiura* (%)	*S. stercoralis.* (%)	*S. Mansoni* (%)
Enugu East	1611	238 (14.8)	200(12.4)	17 (1.1)	14 (0.9)	4 (0.2)	3 (0.2)
Awgu	800	95 (11.9)	81 (10.1)	10 (1.3)	2 (0.3)	2 (0.3)	0 (0)
Total	2411	333 (13.8)	281(11.7)	27 (1.1)	16 (0.7)	6 (0.2)	3 (0.1)

P=0.000; P<0.05

Results of Anthropometric Measurements of infected Pupils' Height-for-Age Z-score in relation to Gender.

Anthropometric measurements of height for age and gender revealed that out of 333 infected pupils, 124(37.2%) had heights below the normal heights. 107(32.1%) had heights above the normal heights and 102 (30.6%) were of normal heights. Among 185 infected males, 77(41.6%) had heights above the normal heights, 83(44.9%) had heights below the normal heights, while 25(13.5%) pupils had normal heights. Among the 148 infected females, 30(20.3%) pupils had heights above the normal height, 41(27.7%) had below the normal heights while 77(52.0%) had normal heights. The difference in the rate of infection between the various categories for height for age Z-score in relation to gender was statistically significant (P = 0.000, P < 0.05) (Table 2).

Table 2: Anthropometric Measurements of Infected Pupils' Height-for-Age Z score in relation to Gender

Gender	No infected	Under height (%)	Normal height (%)	Over height (%)
Males	185	83 (44.9)	25 (13.5)	77 (41.6)
Females	148	41 (27.7)	77 (52.0)	30 (20.3)
Total	333	124 (37.2)	102 (30.6)	107 (32.1)

P = 0.000, P<0.05 *Range for nutritional status of height for age Z-score (WHO, 2007) > +2: (Over height) ≥ -2 to +2: Normal height < -2 to -3: Stunted (under height)

Anthropometric Measurements of Infected Pupils' Height-for-Age Z score in relation to Age Group.

Results obtained showed that out of 333 infected pupils, 124(37.2%) had their heights below the normal heights, 107(32.1%) had their heights above the normal height while 102(30.6%) had normal heights. For the 69 infected pupils between the ages of 5-7 years old, 34(49.3%), 8(11.6%) and 27(39.1%) were over height, under height and normal heights respectively. For the 127 infected pupils between the age group 8-10 years old, 23(18.1%) had heights above the normal height, 45(35.4%) had heights below the normal heights while 59(46.5%) pupils were within normal heights. Among the 131 infected pupils of age 10-13 years old, 50(38.2%) had heights above the normal heights, while 65(49.6%) and 16(12.2%) had heights below the normal heights and within the normal heights respectively. Out of the 68 pupils of 14 years and above, 6(100%) were infected and all of whom had their heights below the normal heights. The difference in the rates of infection between the various categories of height for age Z-score was statistically significant (P = 0.000, P<0.05) (Table 3).

Table 3: Anthropometric Measurements of Infected Pupils' Height-for-Age Z score in relation to Age Group

Age (Years)	No. infected	*Over height (%)	*Normal height (%)	*Under height (%)
5 – 7	69	34 (49.3)	27 (39.1)	8(11.6)
8 – 10	127	23 (18.1)	59 (46.5)	45 (35.4)
11 – 13	131	50 (38.2)	16 (12.2)	65 (49.6)
14+	6	0 (0.0)	0 (0.0)	6 (100)
Total	333	107 (32.1)	102 (30.6)	124 (37.2)

P = 0.000, P<0.05 *Range for nutritional status of height for age Z-score (WHO, 2007) > +2: Over height ≥ -2 to +2: Normal height < -2 to -3: Stunted (under height)

Anthropometric Measurements of Infected Pupils' Weight-for-Age Z-score in Relation to Gender

The weight-for-age Z score anthropometric measurements in relation to gender showed that out of 333 infected pupils, 173(51.9%) were underweight, while 123(36.9%) had normal weight and 37(11.1%) are overweight. More infected females (56.8%) than males (48.1%) were underweight. The difference in the infection rate for all categories of weight for age in relation to gender was statistically significant (P = 0.000, P<0.05) (Table 4).

Table 4: Anthropometric Measurements of Infected Pupils' Weight-for-Age Z-score in Relation to Gender

Gender	No infected	*Underweight (%)	*Normal weight (%)	*Overweight (%)
Males	185	89 (48.1)	69 (37.3)	27 (14.6)
Females	148	84 (56.8)	54 (36.5)	10 (6.8)
Total	333	173 (51.9)	123 (36.9)	37(11.1)

P = 0.000; P<0.05 *Range for nutritional status of weight for age Z-score (WHO, 2007) Z-score > +2: Overweight Z –score ≥ -2 to +2: Normal weight Z -score < -2 to -3: underweight

Anthropometric Measurements of Infected Pupils' Weight-for-Age Z-score in Relation to Age Group

In relation to the various age groups, pupils of age group 5-7 years old had 20(29.0%), 18(26.1%) and 31(44.9%) for overweight, underweight and normal weight respectively. Pupils among 8-10 years old recorded 11(8.7%), 57(44.9%) and 59(46.5%) for overweight, underweight and normal weight respectively. Among the pupils of age group 11-13 years old, 92(70.2%) were underweight, while 6(4.6%) and 33(25.2%) were overweight and of normal weight respectively. All infected pupils aged 14 years were underweight (100%). The difference in the rate of infection between the various categories of weight-for-age z-score in relation to age group was statistically significant (P = 0.000; P<0.05). (Table 5)

Table 5: Anthropometric Measurements of Infected Pupils' Weight-for-Age Z-score in Relation to Age Group

Age (Years)	No infected	Overweight (%)	Normal weight (%)	Underweight (%)
5 – 7	69	20 (29.0)	31 (44.9)	18 (26.1)
8 – 10	127	11 (8.7)	59 (46.5)	57 (44.9)
11 – 13	131	6 (4.6)	33 (25.2)	92 (70.2)
14+	6	0 (0.0)	0 (0.0)	6 (100)
Total	333	37 (11.1)	123 (36.9)	173 (51.9)

P = 0.000; P<0.05 *Range for nutritional status of weight for age Z-score (WHO, 2007); Z-score > +2: (Overweight) Z –score ≥ -2 to +2: (Normal weight) Z -score < -2 to -3: (underweight)

Anthropometric Measurements of Infected Pupils' Weight-for-Height Z-score in Relation to Gender

The results of anthropometric measurement of infected pupils based on weight for height Z-score in relation to gender indicated that out 333 of pupils infected with intestinal helminths, 150(45.0%) were malnourished, 47(14.1%) were severely malnourished while 136(40.8%) were well-nourished (*P* = 0.129). Among the 185 of male pupils infected, 31(16.8%) were within the severely malnourished category, 87(47.9%) were malnourished while 67(36.2%) were well-nourished (*P* = 0.172). Among the 148 of female pupils infected with intestinal helminth parasites, 16(10.8%) were severely malnourished, 63(42.6%) were malnourished while 69(46.6%) were well-nourished (*P* = 0.122). The difference in the rate of nourishment infection in relation to gender was not statistically significant (P = 0.129, P<0.05) (Table 6).

Table 6: Anthropometric Measurements of Infected Pupils' Weight-for-Height Z-score in Relation to Gender

Gender	No infected (%)	Malourished (%)	Well Nourished (%)	Severely Malnourished (%)
Males	185	87(47.9)	67(36.2)	31(16.8)
Females	148	63 (42.6)	69 (46.6)	16 (10.8)
Total	333	150 (45.0)	136 (40.8)	47(14.1)

P = 0.129; P >0.05. Reference range for nutritional status based on weight for height z-score for both gender (CDC, 2018) WHZ < -3SD (severely malnourished/wasting); WHZ < -2SD (under nourished/malnutrition); WHZ -2 T0 +2SD (well-nourished/healthy)

Anthropometric Measurements of Infected Pupils' Weight-for-Height Z-score in Relation to Age Group.

Results of intestinal helminths infection for weight for height Z-score in relation to age group of pupils showed that out of 333 pupils infected with intestinal helminth parasites, 47(14.1%) were severely malnourished while 136(40.1%) were well-nourished. Among the 69 infected 5-7years old, 9(13.0%) were severely malnourished while 45(65.2%) were well-nourished. Among the 8-10 years old, 12(9.4%) were severely malnourished while 66(60.0%) well malnourished. For the 11-13 years old, 86(65.6%) were malnourished while 21(16.0%). The difference in the rate of infection was statistically significant (P = 0.000, P<0.05). (Table 7).

Table 7: Prevalence of intestinal helminth infection based on Anthropometric measurements of weight for height Z-score in relation to age group.

Age (Years)	No infected	Severely malnourished (%)	Well nourished (%)	Malnourished (%)
5 – 7	69	9 (13.0)	45 (65.2)	15 (21.7)
8 – 10	127	12 (9.4)	66 (60.0)	49(38.6)
11 – 13	131	24 (18.3)	21 (16.0)	86 (65.6)
14+	6	2 (33.3)	4 (66.7)	0 (0.0)
Total	333	47 (14.1)	136 (40.1)	150 (45.0)

P = 0.000; P <0.05. Reference range for nutritional status based on weight for height z-score for 5 – 17years (CDC, 2018) WHZ < -3SD (severely malnourished/wasting); WHZ < -2SD (under nourished/malnutrition); WHZ -2 to +2SD (well-nourished/healthy)

Helminths species effects on Nutritional Status in relation to Body Mass Index (BMI)

In relation to the standard values for body mass index, out of 333 infected pupils, 234 (70.3%) were severely stunted, while 61 (18.3%) had normal BMI. None of the infected pupils were overweight or obese. There was no significant statistical difference in the rate of infection in relation to body mass index (P=0.466, P>0.05) (Table 7, Fig. 1).

Table 7: Species Prevalence of Intestinal Helminths in Relation to Nutritional Status

Nutritional Status *(BMI)	No infected (%)	*A. lumbricoides* (%)	Hookworm (%)	*T.trichiura* (%)	*S. Stercoralis* (%)	*S. mansoni* (%)
>-3SD (Severely stunted)	234 (70.3)	197(84.2)	21(9.0)	10(4.3)	4(1.7)	2(0.9)
<3SD -> -2SD (Stunted)	38 (11.4)	30(78.9)	4(10.5)	4(10.5)	0(0.0)	0(0.0)
<-2 - 2SD (normal BMI)	61 (18.3)	54(88.5)	2(3.3)	2(3.3)	2(3.3)	1(1.6)
>2SD - <3SD (Over weight)	0 (0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
>3SD (Obese)	0 (0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
Total	333	281(84.4)	27(8.1)	16(4.8)	6(1.8)	3(0.9)

***Reference range for BMI in children (WHO, 1995); >-3SD (Severely stunted); <3SD - -2SD (Stunted); <-2 - 2SD (normal bmi); >2SD - <3SD (overweight); >3SD (obese)**

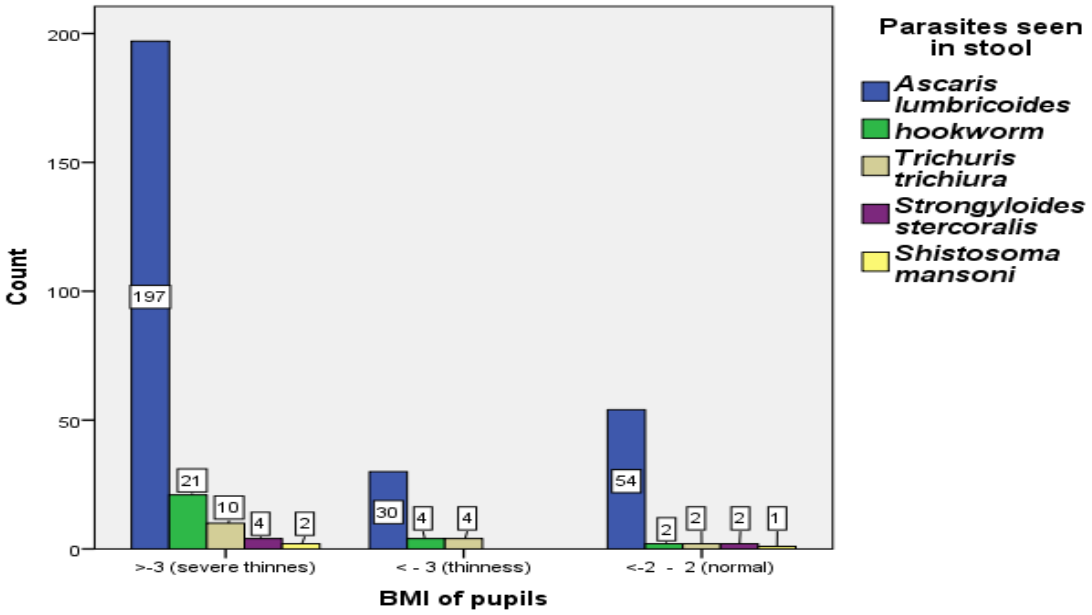


Figure 1: Intestinal helminth species distribution and children's Body Mass Index (BMI)

Discussion

Nutrition plays important role in ensuring good health while the absence of good nutrition makes one particularly children vulnerable to diseases. The results of the effect of intestinal helminths on the nutritional status of pupils revealed that of the 333 intestinal helminth infected children, 37.2% was observed to be stunted (under height). Severe stunt is a sign of chronic malnutrition which weakens the immune system and makes children more susceptible to infection. This agrees with Nnolim *et al*. (2020) at Ibadan Nigeria. They recorded 28.8% of stunting in a related study highlighting it as a predictor to intestinal helminths infection. The higher rate of stunting may also be likely due to poor nutrition and potentially poor living condition. Similarly, results of this study is in line with the study of Mekonnen *et al*. (2020) who surveyed soil-transmitted helminths and nutritional status among children in Jimma Ethiopia and reported stunting among infected children.

The effects of intestinal helminth infection based on 'anthropometric measurements of height for age' in relation to gender revealed that more infected males were observed to be under height than their female counterparts. While this shows that intestinal helminth infection can affect growth in children, it is not with bias to gender as there was no significant relationship between infection, height and gender among infected pupils. This means that the height of male and female children can be affected equally when infected with intestinal helminths.

The effect of infection based on 'anthropometric measurements of height for age Z-score' in relation to age group showed that pupils 5 to 7years age group recorded the least stunting. All intestinal helminth infected pupils aged 14years and above were found to be under height. Current infection and previous infection may be blamed for stunted growth. These results indicated that intestinal helminths infection are factors in the growth of children. This is because they affect the

nutritional and immune status of an individual (WHO, 2015).

Results obtained for the effects of intestinal helminths based on 'anthropometric indices of weight for age' in relation to gender showed that majority of infected children were underweight (51.9%). This confirms the assertion that intestinal helminth infection affects children leading to poor growth (Papier *et al*., 2014; Mohamed *et al*., 2014). In relation to gender, females (56.8%) recorded underweights more their male (48.1%) counterparts. The data obtained suggested that weight-for-age indices could be a significant factor in the outcome of intestinal helminths infection with underweight children being the most affected. The slight gender differences across different weight categories points to the need for targeted intervention that consider both nutritional status and gender specific factors to effectively reduce the burden of helminth infection (WHO, 2015; CDC, 2018; UNICEF, 2019).

The effects of intestinal helminths infections based on 'anthropometric measurements of weight for age' indices in relation to age group suggested a distinct trend in the weight for age categories as children grow older. Weight among the infected children decreases with advance in age. The maybe as result of exposure to several rounds of infection as the children grow. The result obtained are consistent with those of Mationg *et al*. (2021) in a related studies carried out among Filipino children. Mbuh and Nembu (2012) and Hailegebriel *et al.* (2018) in a research carried out on malnutrition and intestinal helminths infection among school age pupils reported that underweight children as well as younger pupils were at risk of intestinal helminth infection and the likelihood of underweight was increased among infected pupils.

The effects of intestinal helminths infection based on 'anthropometric indices of weight for heights' (nutritional status) in relation to gender showed that higher percentage of infected male pupils were observed to be severely malnourished than the females. Malnutrition typically increases vulnerability to infections. In this study, 45.0% of the infected children were malnourished. However, the fact that 40.8% of infected pupils were well-nourished, it indicated that nutrition alone is not a sole determinant of risk of intestinal helminths infection. Other factors such as sanitation, hygienic practices and environmental exposure are likely playing significant roles. This findings agrees with the study of Papier *et al*. (2014) and Tarekegn *et al*. (2022) on their related studies on childhood malnutrition. They recorded varying degrees of prevalence irrespective of nutritional status in relation to gender or age group.

The result of effects of intestinal helminths based 'on weight for height (nutritional status) anthropometric indices' in relation to age groups revealed that of the infected pupils, 33.3% severely malnourished are aged 14years, while 9.4% severely malnourished were aged 8-9years. This is probably due to poor nutritional intake. In addition, fewer number of older children examined belong to this category of nutritional status. The results obtained from the study is consistent with those of Papier *et al*. (2014) in Philippines and Muhammed (2024) in Somalia. Both authors in a related studies reported that poor nutritional intake can increase susceptibility to intestinal helminths infection.

The effects of intestinal parasites on the body mass index (BMI) revealed that out of the 333 infected pupils, 72.9% had severe thinness, whereas none of the infected were overweight or obese. The BMI is the global standard measurement for health indices. Results from this study indicated that

majority of infected pupils were severely malnourished. This could be as a result of inadequate dietary intake in conjunction with intestinal helminth infection, as majority of the sampled children are of low socio-economic background. The presence of intestinal helminth can also result to poor absorption of nutrients consequently affecting the health status of the individual.

Conclusion

The findings of this study have revealed various effects of intestinal helminths infection on the nutritional status of school children. Intestinal helminths infection continues to be of public health importance especially to children in places with poor sanitation and hygiene. Provision of basic amenities like portable drinking water, toilet/sanitary facilities can help curb infection in the study area and similar communities. Mass drug administration which will include out of school and preschool children will help lessen the burden of intestinal helminths among children.

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