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Intestinal Parasitic Infection and Nutritional Status of Elementary Schoolchildren Aged 7 - 14 in Enemorena-Ener District, Gurage Zone, Ethiopia

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Abstract

Background: Intestinal parasitic infections (IPI) are distributed worldwide, with a higher prevalence in developing countries especially in areas with inadequate sanitation and poor living conditions. They are very common among school age children. This study was conducted to estimate the prevalence of IPI and its possible association with the nutritional status of the schoolchildren in Gurage Zone, South Central Ethiopia.

Methods: This is a cross sectional study of 641children aged 7 to 14 years from Enemorena-Ener District, Ethiopia. Data were collected using questionnaire and anthropometric measurements. Stool examinations for parasitic protozoa and helminths were carried out. Univariate/Multivariate Logistic regression procedures were done to evaluate the association between stunting, thinness and wasting with parasitic infections.

Results: Underweight and stunting were found to be 40.9 % and 39% respectively where the overall IPI rate was 40.2%. The prevalence of IPI was *E. histolytica* (12%), *G. lamblia* (7.66%), *Taenia* spp (7,6%), *A. lumbricoides* (5.28%), hookworm (4.55%) and *T. trichiura* (3.1%). IPI showed a significant association with stunting, (OR 0.41, 95% CI 0.29 - 0.57, P < 0.001) and Thinness, (OR 0.53, 95% CI 0.38 - 0.73, P < 0.001).

Conclusions: The study found high prevalence of intestinal parasitic infections and malnutrition (stunting, thinness and underweight). The prevalence of IPI increase, under nutrition (stunting and thinness) and lower nutritional status. This survey should sensitize concerned bodies for improving primary schoolchildren health and nutrition.

Keywords: *Intestinal Parasitic Infection; Protozoa; Helminth; Schoolchildren; Nutrition; Anthropometric Measurements*

Introduction

Like many other developing countries, intestinal parasites are widely distributed in Ethiopia, largely due to the low level of environmental and personal hygiene that contaminate food and drinking water from improper disposal of human and animal excreta [1-3]. Previous studies have shown that access to basic sanitation facilities in Ethiopia, particularly in rural areas, is quite poor [4]. These factors, as well as poor knowledge, attitudes and practices on personal hygiene have added to the increasing public health problem.

The public health importance of intestinal parasitic infections remains important because of their effects on both nutritional and the immune status of populations [5].

The best global indicator of a child's wellbeing is growth and irregular growth patterns in children are known to be indicative of underlying risk factors including low household income and resources, inadequate food consumption, increased burden of diseases, particularly communicable diseases that result from inadequate sanitation and poor hygienic conditions [6].

In Ethiopia, intestinal parasitic infections are of serious public health concern [2] as they cause malnutrition, anemia, growth retardation and predispose to other infections [7]. Among these, soil transmitted helminthic (STH) infections are frequently reported and highly prevalent particularly in children [3,8-10].

The most wide spread intestinal helminth is *A. lumbricoides* usually occurring together with *Trichuris trichuria* infection [11]. Hookworm infection, strongyloidiasis and enterobiasis are widely prevalent, although their magnitude is lesser compared to ascariasis [2]. The prevalence of hookworm, *A. lumbricoides* and *T. trichiura* estimated as 16%, 37% and 20% respectively and the prevalence of taeniasis alone ranges from 1 - 48% and the infection rate with *Hymenolepis nana* is 3 - 61% [2]. Amoebiasis and giardiasis are common causes of intestinal protozoan infections throughout the nation. The prevalence of amoebiasis by microscopy ranges from 0 - 4% and that of giardiasis is 3 - 23% [2]. Although a wide range exists, still illustrates of high prevalence of these infections in Ethiopia.

Under nutrition and anemia are common in children in the developing regions of the world. According to WHO [12]. under nutrition is responsible for the death of one third of children in globally each year. Ethiopia is one of the least developed countries in the world and is the second most severely affected by malnutrition where, children and women are the most affected [13].

A study conducted by the central statistical agency (CSA) of Ethiopia in 2005 found that underweight, wasting, and stunting in children aged under five years in Ethiopia was 36% and 51% respectively [14]. This was related to lack of proper hygiene, high prevalence of parasitic infections, low accessibility of food and low parental income [15].

Since intestinal parasitic infections are associated with poor socio demographic and economic factors, people living in rural Ethiopia are at increased risk for developing intestinal parasitic infections and suffer from its various consequences. In study area, there is no previous study and data on IPI and nutrition, and people lives on subsistence agriculture based on enset monoculture. Due to this reason, we assessed the prevalence of intestinal parasitic infections and its effect on nutritional status among schoolchildren in a rural village in Ethiopia.

Materials and Methods

Study area and study population: A school based cross sectional study was conducted on 2014 to assess the effect of IPI on nutritional status among elementary schoolchildren in Enemorena-Ener district, Gurage zone. Gurage zone is found at 7044'5''-8028'5''N latitude and 37025'5''-38042'5'' E longitude. Gurage zone is located 155 km from Addis Ababa on the road to Jimma, South central Ethiopia. Enemorena-Ener district is one of thirteen districts of Gurage zone and located 197 km South West of Addis Ababa, 42 km from the town of Welkite (Zonal town) on the road to Hosanna. The study participants were children aged 7 - 14 years in randomly selected kebeles of Enemorena-Ener district. The total study population originally consisted of a sample 652 students, aged 7 - 14 years, from Enemorena-Ener District primary school. But only 641 participated in the collection of the required samples. Students were grade 1 - 4 and all who were in attendance during the study period, Nov 12/2014 - Dec 30/2014, were included. Each study participant was given unique code to identify during the socio-demographic, economic, stool examination and anthropometric measures.

Sample size and sampling method

Then sample size was estimated using Daniel's formula $n = Z^2 P (1-P)/d2$ [16]. Where P = 0.5 prevalence of intestinal parasites from previous studies, d = margin of error and Z = standard score corresponds to 1.96. This would give a sample size of 326. The prevalence rate (p) of intestinal parasites from previous similar study in kocho users as staple food was 69.4% in primary school children [17], a 95% confidence interval and a 5% margin of error was added. Due to the use of multistage sampling of which cluster sampling was used, a design effect of 2 was added. Therefore, a total population of 652 children were included in the study.

Sampling method

A multistage sampling was used to select the sample. It was a two-stage sampling. The first stage was stratified cluster sampling with proportional allocation to size, and the second stage was simple random sampling.

Ethical Considerations

The study was reviewed and approved, and ethical clearance was obtained from the Ethical Committee of College of Natural Sciences, through the Department of Microbial Cellular and Molecular Biology, Addis Ababa University. Informed verbal consent or permission was also obtained from Southern Nation and Nationalities of People Regional State Health Bureau. The ethical considerations were addressed by treating positive children using standard drugs under the supervision of a local nurse. The objective of the study was explained to school communities, kebele leaders and parents; and written consent was obtained from every participant's parent or guardians of the selected children before conducting the survey and the children also gave their assent before collecting the samples.

Anthropometric measurement

A digital portable weight scale was used for weight and height measurements simultaneously by appropriately trained nurses. The weight of each student was taken with minimal clothing and to the nearest 0.1 kg. Boys were weighed wearing their trousers, while girls were weighed wearing their minimal dresses. Measurement of height was done without shoes, to the nearest 0.1 cm. Raw anthropometric data (height, weight and age) of schoolchildren was converted to nutritional indicators (WAZ, BAZ and HAZ) using WHO Anthroplus Software. These anthropometric measurements were determined according to the World Health Organization (WHO) guidelines [18].

Socio-demographic and economic surveys

A standardized closed-ended and open-ended questionnaires were prepared first in Amharic,which is easily understandable by the study population. Then the questionnaire was translated into English,and it was translated back into Amharic to check and correct any inconsistencies or distortions of words or concepts. The questionnaire was administered by trained interviewers who performed in person interviews of all participating students.

Parasitological examinations

A total 641 fresh stool samples were collected in plastic cups and were labeled with the students unique study code. Labeled cups were given to the students by trained laboratory technicians with directions on stool sample collection. Following stool collection, the samples were preserved in a tube containing 10% formalin in 0.85% saline. The samples were taken to Aklilu Lemma Institute of Patho biology, Addis Ababa University from the site, for processing. Formol ether sedimentation technique for fecal examination to diagnose infections with intestinal worms and protozoa, following a WHO standard operating procedures for the parasitological examination of feces [19]. To evaluate accuracy, 10% of the fecal samples were randomly reprocessed by a separate laboratory technician from Aklilu lemma Institute of Pathobiology and the results were compared with the results made by the original lab technician were validated.

Data Entry

The variables were pre-coded before the survey. The coded data were entered into a computer and validation was performed in Microsoft excel 2010 spread sheets. Thus, raw nutritional data (height, weight, age and sex) from schoolchildren were converted into nutritional indicators (WAZ, BAZ and HAZ) using WHO Anthroplus Software. These indices were expressed using Z-score [20] in relation to the reference median of the National Center for Health Statistics (NCHS). Wasting, underweight and stunting were expressed by weight for age Z-score (WAZ), BMI for age Z- score (BAZ) and height for age Z-score (HAZ) respectively, using < -2 standard deviations (<-2 SD) of Z-score as a cutoff point. The analysis was computed using SPSS Version 16 Program.

Data Analysis

The data was initially checked for completeness and consistency, coded and entered into computer and validation was performed in Microsoft excel 2010 spread sheet. The nutritional data was imported to WHO Anthroplus Software. Thus, the software converted raw nutritional data into Z- scores of the indices- WAZ, BAZ and HAZ taking age and sex into consideration, using NCHS reference population standard of WHO reference 2007 (5 - 19 years). The data was then exported to SPSS Version 16 program for analysis. P value less than 0.05

was considered as statistically significant. Univariate and multivariate logistic regression analyses, based on UNICEF's analytical framework, was conducted to identify determinants of nutritional status and to account for possible confounding factors using SPSS standard enter method.

Results

A total of 641 students from grade 1 to 4 were enrolled in the study. Male 342 (53.4%) and female 299 (46.6%) students constituted the study participants. Out of the total 641 fathers, 255 (39.8%) were unable to read/write, and 386 (60.2%) were able to read/write. In educational status of mothers, 306 (47.7 %) unable to read/write, and 335 (52.3%) were able to read / write. About 81.1% of the study subjects were using protected drinking water which was from tap/ protected spring or well. The rest were getting their drinking water from unsafe sources, including rivers, or unprotected or un cleaned springs or wells. Availability of latrine was 317 (49.5%). The overall IPI rate (the presence of at least one IPI) was 40.2%. Of the individual parasites, the most prevalent was *E. histolytica/dispar* (12%) followed by *G. lamblia* (7.66%) (Table 1).

Characteristics	Total (N = 641) (%)*	IPI n (%)**
Gender		
Male	342 (53.4)	126 (36.8)
Female	299 (46.6)	132 (44.2)
Father education		
Unable to read/ write	255 (39.8)	107 (41.9)
Able to read /write	386 (60.2)	151 (39.1)
Mother education		
Unable to read/write	306 (47.7)	133 (43.5)
Able to read /write	335 (52.3)	125 (37.3)
Water used		
Protected	520 (81.1)	186 (35.8)
Un protected	121 (18.9)	72 (59.5)
Latrine		
Not available	324 (50.5)	223 (68.8)
Available	317 (49.5)	35 (11.04)

Table 1: *Socio demographic and economic characteristics and prevalence of Intestinal parasitic infections of primary schoolchildren, Enemorena Ener District, Gurage Zone, Ethiopia, 2014.*

***The percentage is calculated from the total examined for the respective characteristic*

*** IPIs are E. histolytica/dispar, Giardia lamblia, A. lumbricoides, hookworm, T. trichiura and Taenia spp*

Nutritional status of students

Nutritional status determination of the study participants revealed that 262 (40.9%) had thinness (<-2 SD of BAZ) and 250 (39%) stunted (<-2SD of HAZ). For underweight index determination only students below 11 years old were included in the analysis and among these 148 eligible students, 71 (48%) were underweighted (<- 2 SD of WAZ) (Table 2).

Type of malnutrition	Number of undernourished, n (%)	IPI n (%)
Thinness (BAZ<-2SD)	262 (40.9)	129 (49.2)
Stunting (HAZ< - 2SD)	250 (39)	133 (53.2)
Underweight N= 148 (WHZ<- 2S D)	71 (48)	31 (43.7)

Table 2: *Protein energy malnutrition and in primary schoolchildren, Enemorena Ener District, Gurage Zone, Ethiopia, 2014.*

Socio-demographic and economic determinant of PEM

Among the socio-demographic factors explored for the intestinal parasitic infections (IPI) and BMI for age Z-score, only lack of latrine and the presence of large family size were significantly associated with the presence of intestinal parasitic infection, with (Adjusted OR 0.14, 95% CI 0.08, 0.24) and (AOR 4.3,95% CI 2.46 - 7.46) respectively (Table 3).

Variable N = 641	Thinness * (%) (N = 262)	Adjusted OR (95% CI)	IPI, n (%)* N = 128	Adjusted OR (95% CI)
Sex				
Male (N = 342)	156 (45.6)	1.49 (0.78, 2.85)	69 (20.2)	1.13 (0.73,1.74)
Female (N = 299)	106 (35.5)		59 (19.7)	
Age group				
7 - 9 (N = 297)	27 (9.0)	0.77 (0.40, 1.46)	15 (5.0)	1.06 (0.54,2.05)
10 - 14 (N = 373)	235 (63)		113 (30.3)	
Water type				
Unprotected (N = 103)	46 (44.6)	0.72 (0.29, 1.79)	97 (94.2)	1.18 (0.70,1.98)
Protected (538)	216 (40)		31 (5.8)	
Latrine				
Available (N = 514)	147 (28.6)	0.64 (0.34,1.23)	114 (22.2)	0.14 (0.08,0.24)
Unavailable (N = 127)	115 (90.6)		14 (11.0)	
Family size				
2 - 5 (N = 327)	103 (31.5)	0.67 (0.34,1.31)	21 (6.4)	4.28 (2.46,7.46)
> 5 (N = 314)	159 (50.6)		107 (34.0)	
Mother education				
Unable to read/write (N = 505)	138 (27.3)	0.78 (0.40,1.50)	60 (11.9)	1.00 (0.66,1.55)
Formal education (N = 136)	124 (91.2)		68 (0.5)	

Table 3: *Effects of socio-demographic factors and IPI on nutritional status (BMI for age z-score) of Enemorena-Ener District primary schoolchildren, 2014.*

AOR: Adjusted Odds Ratio; COR: CI: Confidence Interval

**The percentage is calculated from the total examined for the respective characteristic*

Thin children in parents with family having more than five had 4.3 times intestinal parasitic infection than children in parents with family less than five.

None of the socio-demographic factors were found to be significantly associated with thinness (Table 3).

Among socio-demographic variables lack of latrine and the presence of large family size had significant association with the presence of intestinal parasitic infection with (Adjusted OR 8.32, 95% CI 2.98 - 23.24) and (AOR 0.21,95% CI 0.06 - 0.63) respectively (Table 4).

Underweight children from house lacking latrine had 8.3 times intestinal parasitic infection than Underweighted children from house had latrine.

None of the socio-demographic factors were found to be significantly associated with underweight (Table 4).

Variable N = 148	*Underweight, n %) N = 71	OR (95%CI)	*IPI, n (%) N = 31	OR (95% CI)
Sex				
Male (N = 80)	42 (52.5)	1.49 (0.78, 2.85)	14 (17.5)	0.64 (0.29, 1.41)
Female (N = 68)	29 (42.6)		17 (25)	
Age group				
7 - 9 (N = 76)	34 (44.7)	0.77 (0.40, 1.46)	16 (21.1)	1.01 (0.46, 2.24)
10 - 14 (N = 72)	37 (51.4)		15 (20.8)	
Water type				
Unprotected (N = 22)	62 (49.2)	0.72 (0.285, 1.79)	3 (13.6) 28 (22.2)	0.55 (0.15, 2.00)
Protected (N = 126)	9 (40.9)			
Latrine				
Unavailable (N = 71)	41 (53.2)	0.64 (0.34, 1.23)	26 (36.6)	8.32 (2.98,
Available (N = 77)	30 (42.3)		5 (6.5)	23.24)
Family size				
2 - 5 (N = 53)	22 (41.5)	0.67 (0.34, 1.31)	4 (7.5)	0.21 (0.06,
> 5 (N = 95)	49 (51.6)		27 (28.4)	0.625)
Mother education				
Unable to read/write (N = 87)	44 (50.6)	0.78 (0.40, 1.50)	16 (26.2)	1.71 (0.77, 3.79)
Formal education (N = 61)	27 (44.3)		15 (17.2)	

Table 4: *Effects of socio-demographic factors and IPI on nutritional status (wasting) of Enemorena- Ener District primary schoolchildren, 2014.*

**The percentage is calculated from the total examined for the respective characteristic*

Among the socio-demographic factors explored age group, latrine availability and family size had statically significant association to stunting (Table 5). Variables like latrine availability and family size were remained significant positive association with any intestinal parasitic infection (Table 5).

Children from house with no latrine were 1.77 times stunted than those children from house had latrine.

Stunted children in parents with family having more than five had 4.3 times intestinal parasitic infection than stunted children in parents with family less than five.

Intestinal parasitic infections showed a significant association with stunting, (OR 0.41, 95% CI 0.29 - 0.57, P < 0.001) and thinness, (OR 0.53, 95% CI 0.38 - 0.73, P < 0.001) (Table 6).

There was no significant association between wasting and IPI (Table 6).

Weight-for-age reference data are not available beyond age 10 because this indicator does not distinguish between height and body mass in an age period where many children are experiencing the pubertal growth spurt and may appear as having excess weight (by weight-for-age).

Variable N = 641	Stunting* n (%) N = 250	Adjusted OR (95% CI)	IPI, n (%)* N = 133	Adjusted OR (95% CI)
Sex				
Male (N = 342)	141 (41.2)	1.22 (0.89,1.68)	71 (20.8)	1.12 (0.73,1.73)
Female (N = 299)	109 (36.5)		62 (20.7)	
Age group				
7 - 9 (N = 77)	21 (27.3)	0.55 (0.32,0.93)	17 (22.1)	0.94 (0.49,1.79)
10 - 14 (N = 564)	229 (40.6)		116 (20.6)	
Water type				
Unprotected (N = 121)	56 (46.3)	1.45 (0.97,2.16)	40 (33.1)	0.75 (0.45,1.22)
Protected (N = 520)	194 (37.3)		93 (17.9)	
Latrine				
Unavailable (N = 324)	148 (45.7)	1.77 (1.29,2.44)	116 (35.8)	0.14 (0.078,0.24)
Available (N = 317)	102 (32.2)		17 (5.4)	
Family size				
2 - 5 (N = 268)	88 (32.8)	0.64 (0.46,0.88)	18 (6.7)	4.28 (2.46,7.46)
> 5 (N = 373)	162 (43.4)		115 (30.8)	
Mother education				
Illiterate (N = 306)	121 (39.5)	1.04 (0.76,1.44)	66 (21.6)	1.00 (0.66,1.55)
Educated (N = 335)	129 (38.5)		67 (20.0)	

Table 5: *Effects of socio-demographic factors on nutritional status (stunting) and IPI of Enemorena-Ener District primary schoolchildren, 2014.*

AOR: Adjusted Odds Ratio; Confidence Interval

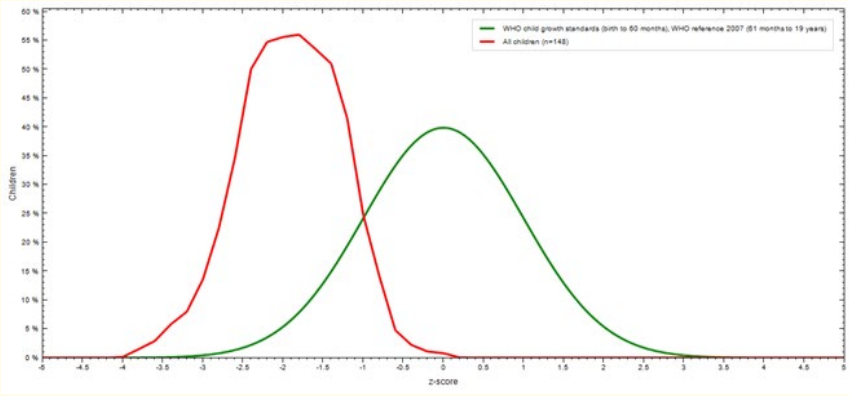
**The percentage is calculated from the total examined for the respective characteristic*

Nutritional status of Students (N = 641)	IPI status	P-value	OR(95%CI)
	Infected (%)*		
Stunting			
Yes	133 (53.2)	< 0.001	0.41(0.29,0.57)
No	125 (32)		
Thinness			
Yes	129 (49.2)	< 0.001	0.53(0.38,0.73)
No	129 (34)		
Underweight (N=71)			
Yes	31 (43.7)	0.48	
No	38 (49.4)		1.26(0.65,2.40)

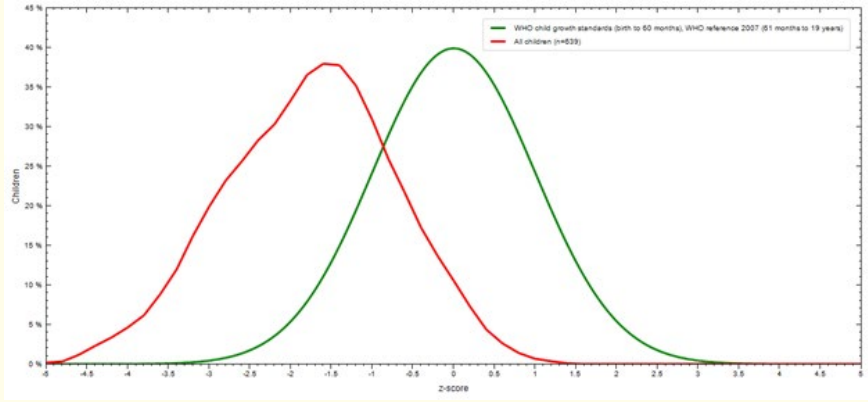
Table 6: *Results from univariate analysis of IPI distribution by nutritional status of Enemorena-Ener District primary schoolchildren, 2014.*

**The percentage is calculated from the total examined for the respective characteristic*

The growth patterns of the total study population of the WHO 2007 reference data for height for age and BMI-for-age. The mean z-score of weight for age, height for age and BMI for age of the total study population were found to be -1.9, -1.86 and -1.76 that was found to be below the WHO 2007 reference values for each respective anthropometric measure respectively (Figure 1).



Weight for Age Z-score



BMI for Age Z-score

Figure 1: *The mean weight for age, and the mean BMI for age of Enemorena Ener district Primary Schoolchildren with WHO (2007) Reference Data, Gurage Zone, Ethiopia, 2014.*

Discussion

Study on the prevalence of intestinal parasites in school age children is detrimental, since they are the high-risk groups for intestinal parasitic infections [21]. Even though, the continuous efforts made to control intestinal parasitic infections during the past decade, infections remained high in Ethiopia [22]. This could be due to low socioeconomic status, poor hygienic conditions, impure drinking water, low literacy rate of parents, large size of the family and poor health status of the child.

Our study found that the overall intestinal parasitic infection rate (IPI) was 40.2%, the most frequent infections being *E. histolytica/dispar* (12%), *Giardia lamblia* (7.66 %), *A. lumbricoides* (5.28%), hookworm (4.55%), *T. trichiura* (3.1%) and *Taenia* spp (7.6%). The higher *E. histolytica/dispar* and *Giardia lamblia* prevalence rate could be attributed to problems with low personal hygiene measures and environmental sanitation. These values are low as compared to a previous study carried out on schoolchildren in which the most prevalent intestinal parasites identified were *Ascaris lumbricoides* 338 (48%), *Giardia lamblia* 295 (41.9%), *Entamoeba histolytica/dispar* 192 (27.3%), *Schistosoma mansoni* 112(15.9%), Hookworm 1(11.5%) among North Gondar Delgi school children, that showed the prevalence of intestinal parasites as high as 79.8% [23]. The findings of current study are also lower prevalence with the previous study done in Assendabo where *Ascaris lumbricoides* was the leading (56.4%) followed by hookworm (25.5%) and *Trichuris trichiura* (21.6%) [24]. The current findings also indicated that the prevalence of intestinal parasite infections was low compared to a previous study carried

out on schoolchildren in which the prevalence of intestinal parasites was 83.8% [22]. Furthermore, IPI in the present study was low as compared to the previous study done in Jimma zone, that showed prevalence of intestinal parasites to be as high as 83% and 86.2 in urban and rural setting respectively [2,24]. This difference might be due to the increased awareness of the population, and differences in locality that makes vary to factors exposing intestinal parasitic infections, environmental sanitation, life style, and culture of the community among regions. As a result, risk factors for IPI infection in one region may not be determinant in other regions hence contributing to the lower prevalence of parasitic infections.

In the less developed countries like Ethiopia, 52% and 34 - 62% of the school-age children are stunted and underweight, respectively [26]. If interventions are not carried out, it is estimated that close to one billion children will be physically and mentally impaired by 2020 [27]. As school age is a period of physical and mental development, prolonged undernutrition in this age group impairs their growth [26]. Despite continued prevention efforts, child undernutrition remains a major public health problem in Sub Saharan Africa, including Ethiopia [32].

In the present study, a total of 641 children enrolled in Enemorena Ener District of Gurage Zone Elementary Schools were examined and 39%, 40.9%, 48% of children were found stunted (HAZ < -2SD), low BMI for age (BAZ < -2SD) and wasted (WAZ <-2SD), respectively. Among the socio- demographic factors explored for the intestinal parasitic infections (IPI), only lack of latrine and the presence of large family size were significantly associated with the presence of intestinal parasitic infection. In wasted children, lack of latrine and the presence of large family size had significant association with the presence of intestinal parasitic infection. Of the socio-demographic factors, explored age group, latrine availability and family size had statically significant association to stunting identified in the study.

The prevalence of under nutrition (underweight and/or stunting) in the current study was similar to previous study among school-age children (underweight and/or stunting) (42 to 46.7 %) [8,28,33], in different places of Ethiopia. And also, stunting in school age children, was reported 11% to 42.7% and underweight 7.2% to 59.7% in different parts of Ethiopia [34-36]. However, some studies documented a lower prevalence of under nutrition 32.3%, (27.1% were underweight and 11.2% were stunted) [10]. In Durbete town north west Ethiopia and (30.9 %) undernourished (19.6% were stunted and 15.9% were underweight) [28], in Addis Ababa. Stunting represents the chronic state of under nutrition [37], that often begins in the uterus due to maternal under nutrition [38]. The majority of the studies related to under nutrition report data focused in children under 5 years of age. However, nutritional deficiencies in schoolchildren are also important as they compromise physical and cognitive development, and impact negatively on their learning ability [39]. It was found that 41.5% of the studied schoolchildren were stunted [40]. Another research conducted in northern Angola revealed that 32.2% of the population aged between 6 months and 20 years were moderate or severely stunted [41]. The prevalence of underweight and stunting among school age children in the current study is higher. These differences could be due to differences in the factors affecting underweight and stunting in the different regions of Ethiopia. In current study, there was a significant association between under nutrition (stunting and underweight) and IPI. This might be due to chronic IPI infection supplemented with appetite reduction, absorption problems, with chronic food insecurity.

In current study, mean Z-score weight for age, height-for-age and BMI-for-age of the study population compared with the mean Z-score of WHO 2007 reference population, in each respective anthropometric measure, it was skewed to the left, indicating that poor nutritional status of children in the study area was highly available or they were malnourished and under nutrition was associated with intestinal parasitic infection. This might be due to low accessibility of food in both quality and quantity coupled with poor knowledge in feeding practice and the presence of chronic intestinal parasitic infection.

The nutritional status of students in the present study showed that under nutrition was highly prevalent, compared to the 2007 WHO international reference standards. The consequences of this may result in undesirable costs on an individual's mortality, morbidity, growth, education, and cognitive function, as suggested by [42]. These factors, if not dealt with at a young age, may eventually contribute to reduced school attendance and higher susceptibility to disease, thereby compromising physical capacity and work opportunities in adulthood.

In Ethiopia, despite governmental efforts to address infection and malnutrition, our study documented a high prevalence of intestinal parasitic infections, as well as evidence of under nutrition, as shown by anthropometric indicators. With chronic food insecurity being a major issue in Ethiopia due to structural causes, poverty, and aggravated by recurring droughts [29], children are often the first to be denied adequate nutrition [31]. This is illustrated by the high prevalence of under nutrition, as indicated by reports from the EDHS national survey, which found stunting and wasting in children under-five years to be 46.5% and 38.4%, respectively [14]. Thus, initiatives aimed at improving the nutritional status of school children, particularly younger children, are pivotal to under nutrition. Furthermore, efforts should be made to strengthen and expand school and community-based programs that promote inexpensive, yet effective, practices aimed at preventing the spread of parasitic diseases by promoting the use and distribution of prophylaxis and other de-worming medications while making substantial improvements in school and community-based sanitation facilities. Coordination of these efforts are likely to yield appreciable and sustainable gains in improving the health and welfare of Ethiopia's children, and securing a prosperous future for its people.

Conclusions

IPI is common and has impact on nutritional status of schoolchildren in this locality. Health education, personal hygiene, presence of latrine and provision of safe water could be important to reduce IPI among schoolchildren. Deworming intestinal helminths and treatment of protozoa infection will have additional impact on reducing IPI among schoolchildren in Enemorena-Ener district.

Competing of Interests

The authors declare that they have no competing interests.

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Authors' Contributions

MB conceived the project idea, designed the study protocol, collected the data, analyzed the data, interpreted and drafted the manuscript; BP designed the study protocol, collected the data and manuscript reviewing; KU collected the data and manuscript reviewing. All authors read and approved the final paper.

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