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Intestinal parasitic infections and nutritional status of pre-school children in Hawassa Zuria District, South Ethiopia

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Though early childhood nutritional status is an important aspect of children's health, different factors affect it. Intestinal parasitosis is common among children of developing countries. Even if studies well discuss the public health significance of intestinal parasites and nutritional deficits as a separate issue, evidences discussing their relationship are limited from Ethiopia. Therefore, this study investigated the relationship between intestinal parasites and anthropometric status of pre-school children in Hawassa Zuria district, South Ethiopia. A community based cross-sectional study design was applied. Five hundred ninety seven (597) child-mother pairs were selected using simple random sampling. Basic data was collected by interviewing mothers with a semi-structured questionnaire. Z-scores of children's anthropometric statuses were generated using the WHO-Anthro software. Pearson's chi-square analysis was done to test the association between intestinal parasites and nutritional status. Prevalence of stunting, underweight and wasting were 245 (41%), 134 (22.4%) and 79 (13.2%), respectively. Half (51.3%) of children were infected at least with one type of intestinal parasite. *Ascaris lumbricoides* was the most prevalent (42.2%) parasite. *A. lumbricoides* was associated with weight for age (X^2 = 16.44 and p-value <0.001), weight for height (X^2 = 11.86 and p-value = 0.001) and height for age (X^2 = 27.77 and p-value < 0.001). Hookworm (X^2 = 4.08 and p-value = 0.04) and *Trichuris trichiura* (X^2 = 5.32 and p-value = 0.02) were associated with weight for height status. *Giardia lamblia* was associated with height for age (X^2 = 8.81 and p-value = 0.003) and weight for age (X^2 = 6.41 and p-value = 0.01). *Entamoeba histolytica* was associated with height for age (X^2 = 4.59 and p-value = 0.03). Both undernutrition and intestinal parasites are prevalent in the study area. *A. lumbricoides*, Hookworm, *G. lamblia*, *E. histolytica* and *T. trichiura* are associated with pre-school children's nutritional status. Better attention shall be given to preventive and curative measures of both undernutrition and intestinal parasites.

Key words: Intestinal parasites, pre-school children, nutritional status.

INTRODUCTION

Nutritional status is important as it determines children's health, physical growth and mental development, academic performance and progress in life (Ruwali, 2011; Saqib et al., 2010). Childhood malnutrition increases the risk of

morbidity and mortality both during early age and in later years of life (WHO, 2012). Pre-school children are at risk of malnutrition (WHO, 2006). Globally, undernutrition affects more than 161 million of under five children (IFPRI, 2014). In developing countries, about 54% of deaths among under five children are believed to be associated with malnutrition. In Sub-Saharan Africa, 41% of under five children are malnourished (FAO, 2008). In Ethiopia, malnutrition is one of the most serious public health problems (Solomon and Zemene, 2008; WHO, 2005) and the country has the second highest rate of malnutrition in Sub-Saharan Africa (FMoH, 2008).

Generally, limited access to sanitary facilities and household and community level less acceptable (unhealthy) sanitary practice are common challenges in the developing world (WHO, 2006; Admassu et al., 2003). Poor sanitation facilities and practices increase risk of intestinal parasitic infections (UN-WATER/WWAP, 2004; WHO, 2004). Intestinal parasites inhabit gastrointestinal tract, where nutrients are digested and absorbed, and affect nutrition in multiple ways. As majority of Ethiopian population share sanitary problems of the developing world, intestinal parasitic infection is common in the country (Legesse and Erko, 2004; Ali et al., 1999; Tadesse, 2005). Since intestinal parasitic infections are associated with unsanitary conditions, people living in area with poor infrastructure are at increased risk of being infected with intestinal parasites and must to suffer from its undesired diverse health effects (UN Water Initiative, 2010). An estimated 50% of malnutrition was caused by repeated intestinal nematode infections which happen because of unsafe water, inadequate sanitation or insufficient personal hygiene and environmental sanitation (Prussa et al., 2002; UNICEF and WHO, 2009). Number of studies conducted in Ethiopia separately target intestinal parasitic infection (Adamu et al., 2005; Birrie et al., 1998; Liza et al., 2010) and nutritional status (Yirgu et al., 2015; Gugsa, 2000; Mandefro et al., 2015; Hiwot et al., 2015; Abdibari et al., 2016; Beka et al., 2009). They did not aim to assess them together among pre-school children. Therefore, this study was conducted to investigate the relationship between intestinal parasitic infection and nutritional statuses among pre-school children in Hawassa Zuria district, South Ethiopia.

MATERIALS AND METHODS

Study setting, design and period

Hawassa Zuria district is one of the 21 districts in Sidama Zone, Southern Ethiopia. It is located 297 km south of Addis Ababa, the capital city of Ethiopia, and 22 km from Hawassa, the capital city of SNNPR. The total population of the district projected in 2013/2014 was 151,016. According to the annual report of Hawassa Zuria Health Office, the estimated number of pre-school children (aged 24-59 months) in the district was 16,016 in the year 2014. A community based cross sectional study design was conducted from April 21 to May 21, 2014.

Sample size and sampling procedure

Sample size was calculated using single population proportion formula in consideration of national proportion of undernutrition among under five children. Prevalence of underweight, stunting and wasting were 28.3, 44.1 and 7.6%, respectively, reported by the Ethiopian demographic and health survey (CSA, 2011). The confidence level 95% ($\alpha = 0.05$) and margin of error ($d = 0.05$) were considered. A sample size of 597, calculated based on the national prevalence of stunting, was found to be the largest and was taken as a sample size for the study.

Out of 23 kebeles (lowest administrative units), found in Hawassa Zuria district, four kebeles were selected applying simple random sampling technique. Households with pre-school children were identified with house-to-house census. Then sample size was allocated proportionally to each of already selected four kebeles. Finally, sample units were selected using simple random sampling.

Biological sample collection and processing

Grouped child - mother pairs were centrally gathered and clean pieces of plastic sheets were distributed to the mothers to collect fresh stool sample. Stool specimens were collected in plastic screw capped cups. Stool cups were labeled, stored in an icebox and transported at ambient temperature to the examination center (Hawassa Health Science College Medical Laboratory). Experienced laboratory technicians processed the samples. After preparing, sample examination was done by light microscope for identification of ova of nematode. A differential diagnosis of protozoan cyst was done using Lugol's solution. Further search was conducted by formol-ether concentration method for samples that did not reveal any intestinal parasite on direct saline smear.

Anthropometric measurement

Anthropometric measurements (weight and height) were taken for all children by the principal investigator with an assistant. Standard anthropometric measurement procedures were used as Food and Nutrition Technical Assistant Project recommended it (Bruce, 2003).

Data analysis

Pre-tested interviewer administered semi-structured questionnaire was used to collect data. Entire data were checked for completeness, coded, entered into SPSS version 20 for window and cleaned. Anthropometric data were exported from SPSS to WHO Anthro version 3.0.1 for window and standard Z-scores were generated for nutritional status: Weight-for-length (WLZ), length-for-age (LAZ) and weight-for-age (WAZ). Children below-2 standard

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deviations (−2SD) of the WHO median for WLZ, LAZ, and WAZ were considered wasted, stunted or underweight, respectively.

Descriptive statistics like frequencies, proportions, mean, median and standard deviation were calculated. Pearson's Chi-square analysis was done to determine the association between specific intestinal parasite and nutritional status (stunting, underweight and wasting) of pre-school children. P-values less than 0.05 were considered as statistical significance level.

Ethical issue

Ethical clearance and letter of permission were obtained from Hawassa University Institutional Review Board. Letter of cooperation was also collected from Zonal Health Desk. All the study participants were informed about the purpose of the study, their right to refuse participation and anonymity of information. The informed consents were obtained from all participants prior to their participation. Severely malnourished children were linked to health posts for clinical management. Mothers and caretakers were provided with bars of soap as a compensation for the time they spent.

RESULTS

Socio-demographic and economic characteristics

A total of 597 mothers (aged 18-46 years, mean (± SD) age 29.02(± 5.47) were involved in the study and the response rate was 100%. The majority of the mothers were housewives [546(91.5%)], protestant religion followers [549(92%)], cannot read and write [359(60.1%)] and from Sidama ethnic group 568(95.1%)].

Nearly two third (63.5%) of the households had five or more family members with mean (± SD) family size of 5.3(±1.8). All 591(99%) of the preschool children live in male headed households. Almost all, 582(98.2%) of the households own agricultural/farmland of different sizes. Five hundred fifty (92.1%) of the households in the study area had a monthly income of less than 500 Ethiopian Birr.

Most of the households [585(98%)] use water from improved sources: Pipe water for drinking. Five hundred and ten (85.4%) of the households had no access to improved sanitation facilities, with more than a half 321(52.3%) practicing open field defecation, and 285 (47.7%) using latrines. During the survey, only 202 (70.9%) of available latrines were functional.

Five hundred and ninety seven pre-school children were included (aged 24-59 month) in the study. The children had mean (±SD) age of 40.99 (±11.16) months. Of the 597 children sampled 263(44.1%) were boys and 334 (55.9%) were girls (Table 1).

Magnitude of intestinal parasite

Out of the total (597) pre-school children, stool samples were collected for 587 children. During biological sample collection period, mothers of 10 children from four could not collect the stool specimen on two consecutive visits.

Out of the 587 pre-school children, 301(51.3%) were found to be infected at least with one intestinal parasite (Table 2).

The prevalence of *Ascaris lumbricoides*, *Giardia lamblia*, Hookworm, *Entamoeba histolytica* and *Trichuris trichiura* among pre-school children were 42.2, 4.4, 2.8, 1.8 and 1.8%, respectively. *A. lumbricoides* was with the high frequency 252 (42.2%) followed by *G. lamblia* accounting for 26 (4.4%) (Table 2).

Anthropometric status of preschool children

Out of the 597 children, 318 (53.3%) were undernourished and 279 (46.7%) were with normal anthropometric status. Overall, the prevalence of stunting, underweight and wasting were 245 (41%), 134 (22.4%) and 79 (13.2%), respectively (Figure 1).

Association between intestinal parasite infection and nutritional status

One hundred twenty nine (22.4%) children were under-weight, out of which 91(70.5%) were with intestinal parasitic infection. Similarly, 77 (13.2%) children were wasted of which 57(74%) were infected with intestinal parasites (Table 3).

A. lumbricoides (X^2 = 27.77 and p-value < 0.001), *G. lamblia* (X^2 = 8.81 and p-value = 0.003) and *E. histolytica* (X^2 = 4.59 and p-value = 0.03) are associated with stunting (height for age) status of pre-school children (Table 4).

A. lumbricoides (X^2 = 16.44 and p-value < 0.001) and *G. lamblia* (X^2=6.41 and p-value = 0.01) were associated with underweight (weight for age) status of pre-school children (Table 5).

A. lumbricoides (X^2 = 11.86 and p-value = 0.001), Hookworm (X^2 = 4.08 and p-value = 0.04) and *T. trichiura* (X^2=5.32 and p-value = 0.02) were found associated with wasting (weight for height) status of pre-school children (Table 6).

DISCUSSION

This study assessed the relationship between anthro-pometric statuses of pre-school children with intestinal parasitic infections in Hawassa Zuia district of Ethiopia. It is the first study to examine such relationship between anthropometric status and intestinal parasitic infections among pre-school children in the study area. The nutritional assessment using anthropometric indices revealed that 41% were stunted, 22.4% were under-weight and 13.2% wasted. The prevalence of stunting,

Table 1. Socio-demographic and economic characteristics of study participants in Hawassa Zuria District, South Ethiopia.

Variable		Frequency	Percentage
Maternal education	Cannot read and write	359	60.1
	Reading and writing	8	1.3
	1-4 Grade	102	17.1
	5-8 Grade	107	17.9
	9-12 Grade	20	3.4
	College	1	0.2
Marital status	Married	588	98.5
	Widowed	9	1.5
Head of the household	Father	591	99.0
	Mother	6	1.0
Ethnicity of the respondent	Sidama	568	95.1
	Kembata	24	4.0
	Wolyita	5	0.8
Religion of the respondent	Protestant	549	92.0
	Muslim	32	5.4
	Catholic	16	2.7
Age of the caretaker in Years	15-19	5	0.8
	20-24	103	17.3
	25-29	217	36.3
	30-34	144	24.1
	35-39	100	16.8
	40-44	20	3.4
	45-49	8	1.3
Monthly income of the household in Ethiopian Birr (ETB)	≤500-ETB	550	92.1
	501-1000 ETB	41	6.9
	≥1001ETB	6	1.0
Farmland ownership	Yes	582	97.5
	No	15	2.5
Decision on household earning is made by	Both	239	40.0
	Father	343	57.5
	Mother	15	2.5

underweight and wasting found to be lower than statistical reports of studies from Afghanistan (CSA, 2010/2011), Sudan (Ali and Moawia, 2008), Tigray region-Ethiopia (Afework et al., 2009), Hawassa - Ethiopia (Wolde et al., 2014) and Hidabu Abote district-Ethiopia (Mengistu et al., 2013). The observed difference might be because of variation in the study period, setting and season.

Stunting is a direct child physical growth failure indicator that happens because of long time nutrition and related deficits. Commonly, it is associated with community's socioeconomic status (AUC, 2014). As compared to studies conducted in Gumbrit-Ethiopia (34% stunting) (Melkie, 2007), Nigeria (39.2% stunting) (Olatidoye et al., 2011) and Gambia (31.2% stunting) (CSA, 2010), prevalence of stunting in the study area was high Ethiopian mini-Demographic and Health Survey report. However, the proportion of stunted (41%) and wasted (13.2%) pre-school children were higher than that of the countrywide figure (40% of stunting and 9% of wasting) (EmDHS, 2014).

The result of this study reveals that pre-school children were infected with various intestinal parasites. The high prevalence of parasitic infections among children might be due to the habits, poor water supply and lack of environmental sanitation, especially where children eat, drink, exercise development activities and

Table 2. Frequency and percentage distribution of different intestinal parasites infection among pre-school children in Hawassa Zuria District, South Ethiopia.

Parasite species	Frequency	Percentage
Ascaris lumbricoides	252	42.2
Giardia lamblia	26	4.4
Hookworm	17	2.8
Entamoeba histolytica	11	1.8
Trichuris trichiura	11	1.8
Enterobius vermicularis	6	1.0
Hymenolepis nana	6	1.0
Strongyloides stercoralis	1	0.2
A. lumbricoides and Hook worm	6	1.0
A. lumbricoides and *E. vermicularis*	5	0.8
A. lumbricoides and *T. trichiura*	3	0.5
Any one intestinal parasitic infection	301	51.3

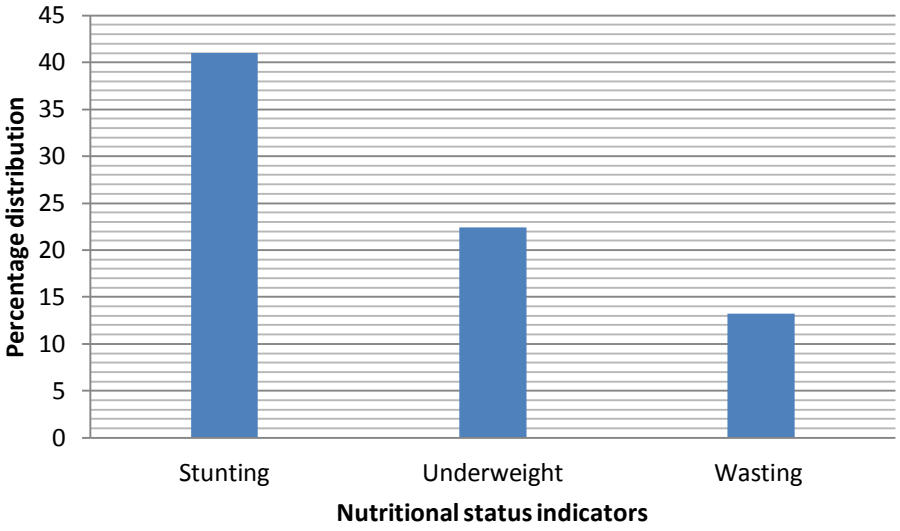

Figure 1. Percentage distribution of stunting, underweight and wasting among pre-school children in Hawassa Zuria District, South Ethiopia.

Table 3. Cross tabulation of frequency of intestinal parasitic infection and nutritional status indicators of pre-school children in Hawassa Zuria District, South Ethiopia.

Variable		Anthropometric status					
		Stunted	Non stunted	Underweight	Normal	Wasted	Not wasted
Presence of parasitic infection	Yes	167 (69%)	134 (38.8%)	91 (70.5%)	210 (45.9%)	57 (74%)	244 (47.8 %)
	No	75 (31%)	211 (61.2%)	38 (29.5%)	248 (54.1%)	20 (26%)	266 (52.2%)
	Total	242 (100%)	345 (100%)	129 (100%)	458 (100%)	77 (100%)	510 (100%)

play (Francis et al., 2014). In addition, low body immune system response malnourished children might be responsible for high infection rate as it is discussed by Alli et al. (2011a) and Harhay et al. (2010).

In this study's finding, 301 (51.3%) children were at least with one intestinal parasite. The figure is too higher than findings reported by similar studies done in Thailand (22.2%) (Airoong et al., 2007), Gaza, Palestine (16.6%) (Adnan et al., 2008) and South Ethiopia (41.9%) (Abayneh, 2013).

Table 4. Association between intestinal parasite infection and height for age (stunting) status of pre-school children in Hawassa Zuria District, South Ethiopia.

Intestinal parasitic species		Anthropometric status		X^2	*P* value
		Stunted	Non stunted		
A. lumbricoides	Yes	135	117	27.77	<0.001**
	No	107	228		
G. lamblia	Yes	18	8	8.81	0.003*
	No	224	337		
E. histolytica	Yes	8	3	4.59	0.03*
	No	234	342		
T. trichiura	Yes	3	8	0.90	0.34
	No	239	337		
E.vermicularis	Yes	2	4	0.16	0.69
	No	240	341		
Hook worm	Yes	7	10	0.000	0.10
	No	301	269		
H. nana	Yes	4	2	1.62	0.20
	No	238	343		
S. stercoralis	Yes	1	0	1.43	0.23
	No	241	345		
A. lumbricoides and *E. vermicularis*	Yes	1	4	0.94	0.33
	No	241	341		
A. lumbricoides and Hook worm	Yes	2	4	0.16	0.69
	No	240	341		
A. lumbricoides and *T. trichiura*	Yes	0	3	2.12	0.15
	No	242	342		

**p* value <0.001 and * *p* value < 0.05, statistically significant association.

Table 5. Association between intestinal parasite infection and weight for age (Underweight) status of pre-school children in Hawassa Zuria District, South Ethiopia.

Intestinal parasitic species		Anthropometric status		X^2	*P* value
		Underweight	Normal		
A. lumbricoides	Yes	76	176	16.44	<0.001**
	No	54	281		
G. lamblia	Yes	11	15	6.41	0.01*
	No	119	442		
E. histolytica	Yes	5	6	3.53	0.06
	No	125	451		
T. trichiura	Yes	2	9	0.10	0.75
	No	128	448		
E. vermicularis	Yes	1	5	0.11	0.75
	No	129	452		
Hook worm	Yes	7	10	0.00	0.10
	No	301	269		

Table 5. Contd.

Hymnolopis nana	Yes No	2 128	4 453	0.44	0.51
S. stercoralis	Yes No	0 130	1 456	0.24	0.59
A. lumbricoides and *E. vermicularis*	Yes No	0 130	5 452	1.44	0.23
A. lumbricoides and Hook worm	Yes No	0 130	6 451	1.72	0.19
A. lumbricoides and *T. trichiura*	Yes No	1 129	2 455	0.22	0.64

***p* value <0.001, statistically significant association.

Table 6. Association between intestinal parasite infection and weight for height (Wasting) status of pre-school children in Hawassa Zuria District, South Ethiopia.

Intestinal parasitic species		**Anthropometric status**		**X^2**	***P* value**
		Wasted	**Not wasted**		
A. lumbricoides	Yes No	47 30	205 305	11.86	0.001*
G. lamblia	Yes No	3 74	23 487	0.06	0.81
E. histolytica	Yes No	1 76	10 520	0.16	0.69
T. trichiura	Yes No	4 73	7 503	5.32	0.02*
E. vermicularis	Yes No	1 76	5 505	0.07	0.80
Hook worm	Yes No	5 72	12 498	4.08	0.04*
H. nana	Yes No	1 128	5 453	0.07	0.80
S. stercoralis	Yes No	0 77	1 509	0.15	0.70
A. lumbricoides and *E. vermicularis*	Yes No	1 76	4 520	0.21	0.65
A. lumbricoides and Hook worm	Yes No	1 76	5 505	0.07	0.80
A. lumbricoides and *T. trichiura*	Yes No	1 76	2 508	1.08	0.30

**p* value < 0.05, statistically significant association.

Infection of different types of intestinal parasites is identified by the study. Among intestinal parasitic infections, Ascariasis was the most (42.4%) prevalent. *G. lambelia* was the leading protozoan infection. This finding

is supported by studies done in Southern Ethiopia (Abayneh, 2013), India (Alli et al., 2011b), Nigeria (Odu et al., 2013) and by Harhary et al. (2010). Similar to what was discussed, in Latin America; *A. lumbricoides* was the most prevalent intestinal parasite. This might be attributed to the fact that infection by *Ascaris lumbricoides* is spread through eggs, which are swallowed because of ingestion of contaminated soil or contact between the mouth and objects carrying the adherent eggs. Contamination of food and drink by dust or handling is another source of infection. Soil pollution is thus a major factor in the epidemiology of human Ascariasis (Mordi and Ngwodo, 2007).

The proportion of stunted pre-school children with intestinal parasitic infections (69%) was higher than the proportion of pre-school children without parasitic infection (61.2%). Pre-school children who were infected with intestinal parasites and classified as underweight were also proportionally higher (70.5%) as compared to those without intestinal parasitic infections (54.1%). Proportion of intestinal parasitic infection was also higher among wasted (74%) pre-school children than the non-wasted (52.2%).

By the study, a statistically significant association was observed between anthropometric statuses and infection of intestinal parasites among pre-school children. *A. lumbricoides* was associated with weight for age (X^2 = 16.44 and p-value < 0.001), weight for height (X^2 = 11.86 and p-value = 0.001) and height for age (X^2 = 27.77 and p-value < 0.001). Hookworm was associated with weight for height status (X^2 = 4.08 and p-value = 0.04). *G. lamblia* was associated with height for age (X^2 = 8.81 and p-value = 0.003) and weight for age (X^2 = 6.41 and p-value = 0.01). *E. histolytica* was associated with height for age (X^2 = 4.59 and p-value = 0.03). *T. trichiura* (X^2 = 5.32 and p-value = 0.02) was found associated with weight for height. The results are in agreement with findings of Gutierrez-Jimenez et al. (2009) and Saldiva et al. (1999).

Conclusion

The study focused on pre-school children's anthropometric status, intestinal parasite infection and their relationships. Different forms of intestinal parasites are common among the studied pre-school children. *A. lumbricoides*, *G. lamblia* and Hookworm are the prevalent intestinal parasites. Undernutrition among pre-school children is also prevalent public health concern in the study area. Significant proportions of pre-school children were found being stunted, wasted and underweight.

A. lumbricoides was associated with the three (underweight, wasting and stunting) forms of nutritional statuses assessed. Hookworm was associated with wasting (weight for height status). *G. lamblia* was associated with stunting (height for age status) and underweight (weight for age). *E. histolytica* was associated with height for age and *T. trichiura* was found associated with weight for height. Intestinal parasitic infections were more common among children with low height for age Z-score compared to those with low weight for age Z-score and low weight for height Z-score.

Per the finding, stakeholders and mothers/caregivers better focus on preventive and curative therapies of both undernutrition and intestinal parasitosis. Investigation shall continue to focus on analyzing the cause effect relationship of the condition and examining the effect of intestinal parasites preventive measures and curative therapies on nutritional status of children.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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