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ABSTRACT

BACKGROUND: Soil-transmitted helminths and protozoan parasitic infections are endemic throughout the world. The problem of intestinal parasitic infection is higher among developing countries where children are the most vulnerable groups. Although health information related to parasitic infections is available globally, it is often limited in rural setups in least developed countries. This study was, therefore, conducted to assess socioeconomic predictors of intestinal parasitic infections among under-five children in rural Dembiya, Northwest Ethiopia.

METHODS: This cross-sectional study was conducted among 224 randomly selected households with under-five children. We used questionnaire to collect data and direct stool examination to identify intestinal parasitic infections. Adjusted odds ratio (AOR) with 95% confidence interval (CI) and $P < .05$ was used to identify socioeconomic predictors of parasitic infections.

RESULTS: We found that 25.4% (95% CI = [20.2, 31.1]) under-five children had intestinal parasitic infection. *Ascaris lumbricoides* was the leading infection, which accounted 44 of 224 (19.6%). The prevalence of childhood intestinal parasitic infections was higher among households with no members whose education level is secondary and above (AOR = 3.36, 95% CI = [1.23, 9.17]). Similarly, intestinal parasitic infections were statistically associated with presence of 2 under-five children in a household (AOR = 3.56, 95% CI = [1.29, 9.82]), absence of frequent health supervision (AOR = 3.49, 95% CI = [1.72, 7.09]), larger family size (AOR = 2.30, 95% CI = [1.09, 4.85]), and poor household economic status (AOR = 2.58, 95% CI = [1.23, 5.41]).

CONCLUSIONS: Significant proportion of children was infected with intestinal parasitic infection in rural Dembiya. Educational status of family members, number of under-five children in a household, health supervision, family size, and wealth index were statistically associated with parasitic infections. Provision of anthelmintic drugs, health supervision, and health education targeted with transmission and prevention of infections are recommended.

KEYWORDS: Intestinal parasitic infections, socioeconomic predictors, under-five children, rural Dembiya

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Background

Helminth and protozoan parasites cause health problems in human. Twenty-five percent of the known human infections are caused by the helminth/protozoan group.[1] The burden of disease caused by infection with soil-transmitted helminths (STH) remains enormous. Helminth/protozoan infections represented greater than 40% of the burden caused by all tropical diseases.[2] Intestinal parasitic infections are associated with a disability-adjusted life year (DALY) loss of 5 266 000 globally.[3]

Intestinal parasitic infections are common in the world. However, the problem is higher in developing countries. In 2010, at least 1.3 billion people were estimated to be infected with STH.[4] A global-level estimate indicated that greater than 0.8 billion people had *ascariasis* in 2010,[5] around 0.45 billion people had hookworm,[5] and at least 0.23 billion people are estimated to have *schistosomiasis*,[6-8] in which the most of the cases are children. In 2010, an estimated 9 million life years lost due to the major worm infections of children.[9,10]

The burden of intestinal parasitic infections is higher in Sub-Saharan Africa (SSA).[1,5,7,8] More than 90% of *schistosomiasis* cases occurred in SSA, with the largest number in Nigeria, Ethiopia, and Democratic Republic of Congo.[11,12] In Ethiopia, a 2005 estimate showed that 4882 children were infected with Hookworm, 1956 with *ascariasis*, 1983 with *trichiurasis*, and 7357 with other STHs.[12]

The parasitic relation of worms with human has been influenced by global changes in the human sociocultural spectrum.[13,14] Socioeconomic factors, like income or poverty,[8,15-18] occupation especially farming and fishing,[8,18-20] number of siblings,[16,20] age of children,[19,21,22] family size,[19,20] households educational status,[19,23] and health supervision or provision of health education[24,25] are contributing for persistent transmission of the parasitic disease.

Although health information related to parasitic infections is available globally, health information often limited in rural setups in least developed countries including Ethiopia. This study was, therefore, done to investigate socioeconomic predictors of intestinal parasitic infections in under-five children in rural Dembiya, Northwest Ethiopia.

Materials and Methods

Study design and description of study settings

A cross-sectional survey, which is community-based, was conducted in rural Dembiya during May 2017. The study setting is described elsewhere.[26]

Sample size determination and sampling procedures

This study is part of the baseline survey for Dembiya Water, sanitation and hygiene—neglected tropical diseases (Dembiya WASH-NTDs) project. The project was implemented to prevent intestinal parasitic infections through improved WASH. In this project, single population proportion formula was used to calculate sample size. The assumptions we used to calculate sample size were presented elsewhere.[26] A total of 225 children aged 6 to 59 months were selected from 5 rural kebeles (the lowest administrative units in Ethiopia). The study subjects were selected by systematic random sampling technique.

Data collection tools

We used pretested and structured questionnaire to collect sociodemographic information. Direct stool examination technique was used to identify parasitic infections in children. We used standardized procedures as presented in World Health Organization's training manual on diagnosis on intestinal parasitic infections.[27]

Wealth index of households, one of the socioeconomic predictors of intestinal parasitic infections, was determined by principal component analysis (PCA). Asset information was gathered based on the list of assets in health and demographic surveys and other related studies to determine wealth index.[28-30] Variables were selected based on eigenvalues greater than 1, and variables whose components greater than 0.4 in the component matrix were considered to compute wealth index. Finally, wealth index of households was classified into poor and rich.

Data analysis

Frequencies, percentages, mean or/and median, standard deviation (SD) or/and interquartile range (IQR) were used to present data. Socioeconomic predictors were selected by univariable binary logistic regression analysis on the basis of $P<.2$ and then analyzed by multivariable binary logistic regression for controlling the possible effect of confounders, and finally, the variables which had significant association were identified on the basis of adjusted odds ratio (AOR) with 95% confidence interval (CI) and $P<.05$. Hosmer and Lemeshow test was used to test the model goodness of fitness.

Results

Socioeconomic information

Two hundred twenty-five children were participated in this study. However, the data set for 1 child is incomplete for some variables and so that we considered 224 children in the analysis. Out of 224 children, 118 (52.7%) of them were women, and 166 (74.1%) of the study subjects were 24 to 59 months old. The median age was 42 months, and the IQR was 24 to 48 months. More than half 134 (59.8%) of the mothers were ≤30 years old. The minimum age of mothers participated in this study was 18 years and the maximum was 47 years. The median age was 30 years and the IQR was 25 to 35 years. One hundred seventy-nine (79.9%) of mothers did not attend formal education and 50 (22.3%) of the households had at least 1 member whose education level is secondary and above. Two hundred thirteen (95.1%) of the mothers were married at the time of the survey and 221 (98.7%) of the mothers were farmer by their occupation. One hundred twenty-six (56.3%) of the households had more than 5 family members, and 139 (57.6%) households were economically poor (Table 1).

Health information of rural households

One hundred forty-one (62.9%) of the households reported that they were frequently supervised by health professionals. One hundred sixteen (51.8%) households reported as they received health messages 1 week before the time of the survey and the commonest source of information was government health workers, which accounted 112 (96.6%). One hundred thirty-eight (61.6%) households reported as they exchanged health information within the family weekly at regular basis (Table 2).

Prevalence of intestinal parasitic infections

This study reported that 57 of 224 (25.4%; 95% CI = [20.2, 31.1]) of under-five children had intestinal parasitic infection. *Ascaris lumbricoides* (44 of 224), hookworm (6 of 224), *Hymenolepis nana* (3 of 224), *Enterobius vermicularis* (2 of 224), *Schistosoma mansoni* (1 of 224), and *Giardia lamblia* (1 of 224) were identified.

Socioeconomic factors associated with parasitic infections

Childhood intestinal parasitic infections were statistically associated with educational status of family members, number of

Table 1. Sociodemographic information of households with children aged 6 to 59 months (225) in rural Dembiya, Northwest Ethiopia, May 2017.

VARIABLES	FREQUENCY	PERCENT
Sex of children		
Male	106	47.3
Female	118	52.7
Age of children		
Under 2 years	58	25.9
2 and above years	166	74.1
Mothers age		
⩽30 years	134	59.8
>30 years	90	40.2
Maternal education		
No formal education	179	79.9
Have formal education	45	20.1
The household has at least 1 member whose education is secondary and above		
Yes	50	22.3
No	174	77.7
Mother's marital status		
Married	213	95.1
Not married	11	4.9
Maternal occupation		
Farmer	221	98.7
Merchant	3	1.3
Family size		
⩽5	126	56.3
>5	98	43.8
Wealth index		
Poor	129	57.6
Rich	95	42.4

Table 2. Health information of households with children aged 6 to 59 months (n = 225) in rural Dembiya, Northwest Ethiopia, May 2017.

VARIABLES	FREQUENCY	PERCENT
Health professional frequently visit the household		
Yes	141	62.9
No	83	37.1
The household received health messages last week prior to the survey		
Yes	116	51.8
No	108	48.2
Source of health messages		
Government health workers	112	96.6
School children	26	22.4
Church leaders	5	4.3
Radio	3	2.6
Community discussion	2	1.7
Households exchange health information at regular basis		
Yes	138	61.6
No	86	38.4

under-five children in a household, health supervision, family size, and wealth index. Age of children and age of mothers did not show statistically significant association with parasitic infections (Table 3). Occupational and educational status of mothers did not pass the chi-square assumption.

This study revealed that childhood parasitic infections were associated with educational status of family members. The odds of childhood parasitic infections were 3.36 times more likely to be higher among households who had no members whose education status is secondary and above (AOR = 3.36, 95% CI = [1.23, 9.17]). The presence of 2 under-five children in a household was statistically associated with intestinal parasitic infections. Childhood parasitic infections were more prevalent among households having 2 under-five children compared with their counterparts (AOR = 3.56, 95% CI = [1.29, 9.82]). Intestinal parasitic infections were statistically associated with absence of health supervision. The prevalence of childhood parasitic infections was 3.49 times to be higher among households who had not been frequently supervised by health professionals (AOR = 3.49, 95% CI = [1.72, 7.09]). Children who live in households whose family size is greater than 5 had more odds to have parasitic infections (AOR = 2.30, 95% CI = [1.09, 4.85]). Households' economic status was also identified as a contributing factor for the occurrence of parasitic infections in children. Children from the poor families had 2.58 more chance to have parasitic infections (AOR = 2.58, 95% CI = [1.23, 5.41]).

Discussion

This study reported that 57 of 224 (25.4%; 95% CI = [20.2, 31.1]) children had intestinal parasitic infection, which was lower than the findings of studies in Wondo Genet (85.1%),[31] Hawassa Zuria District (51.3%),[32] Southern Ethiopia (41.9%),[33] and Chuahit (35.2 %).[34] The prevalence reported by this study was similar to the findings in Wonji Shoa Sugar Estate (24.3%)[35] and Butajira town (23.3%)[36]; Sudan (24.9%)[37];

Table 3. Sociodemographic factors affecting parasitic infection among children aged 6 to 59 months (n = 225) in rural Dembiya, Northwest Ethiopia, May 2017.

VARIABLES	PARASITIC INFECTION		COR WITH 95% CI	AOR WITH 95% CI
	YES	NO		
The family has 1 or more members whose education level is secondary and above				
Yes	6	44	1	
No	51	123	3.04 [1.22, 7.58]	3.36 [1.23, 9.17]*
Age of children				
Under 2 years	20	38	1	
2 years and above	37	129	0.55 [0.28, 1.05]	0.62 [0.30, 1.32]
Mothers age				
⩽35 years	27	107	1	
>35 years	30	60	1.98 [1.09, 3.64]	1.55 [0.73, 3.28]
Number of under-five children				
1	47	154	1	
2	10	13	2.52 [1.04, 6.12]	3.56 [1.29, 9.82]*
Health professional frequently visit households				
Yes	24	117	1	
No	33	50	3.23 [1.73, 5.99]	3.49 [1.72, 7.09]**
Family size				
⩽5	22	104	1	
>5	35	63	2.63 [1.42, 4.87]	2.30 [1.09, 4.85]*
Wealth index				
Poor	43	86	2.89 [1.47, 5.68]	2.58 [1.23, 5.41]*
Rich	14	81	1	

Abbreviations: COR, crude odds ratio; CI, confidence interval; AOR, adjusted odds ratio.

Hosmer and Lemeshow test = 0.376.
*Statistically significant at $P < .05$.
**Statistically significant at $P < .001$.

Bogota (26.4%)[20]; and Diamantina, Brazil (27.5%).[18] The current prevalence is also higher than the finding of a study in Nigeria (13.7%).[38] The prevalence of intestinal parasitic infections in children was higher in rural Dembiya. This may be due to the fact that the population in the area had poor access to sanitation. During June 2017, clean water and latrine coverage was 26.6% and 55%, respectively.[10] Moreover, as depicted by this study, significant proportion of the households lack WASH information. In this study, 37.1% of households reported that they were not frequently supervised by health professionals.

This study showed that educational status of family members was associated with intestinal parasitic infections in children. Childhood parasitic infections were higher among households who had no members whose education status is secondary and above. This may be due to the fact that educated households may have awareness about the transmission and prevention methods of infectious diseases. Education encourages changes in healthy behaviors at the household level. Other similar studies also reported the relation of education with occurrence of parasitic infections.[19,23,39,40]

Childhood intestinal parasitic infections were associated family size and number of under-five children in a household. Childhood intestinal parasitic infections were more prevalent among households having higher family size and 2 under-five children. Other studies also identified the relationship between number of under-five children and parasitic infections.[16,19,20] This can be justified that children in larger families may be exposed to infections because the quality of care and attention from parents decreases as mothers may become unable to care children and less effort is available for each individual child. Moreover, high family size affects mothers or caregivers health seeking and hygienic behaviors.[40-43]

This study depicted that intestinal parasitic infections were associated with health supervision or health education. The prevalence of intestinal parasitic infections was higher among households who had not been frequently supervised by health professionals. Other studies also reported the association of health supervision or health education and intestinal parasitic infections.[24,25,44,45] This fact can be justified that health education promotes health behaviors toward hygiene and sanitation practices. Health education increases knowledge and acceptability of interventions within the community. It also sustains integrated control of the infection.[45-50]

Childhood parasitic infections were significantly associated with households' economic status. Children from the poor families had more chance to have parasitic infections. The finding of this study is in line with findings of other similar studies.[8,15,16,19,39] This may be due to the fact that rich families may have greater opportunity to healthy measures like soap, household water treatment, toilets and other facilities, and lower income families could not afford these facilities.[17,40,51]

As a limitation, in this research, we did not use floatation techniques/McMaster technique to detect hookworm because the McMaster chamber was not available in the country. We used standardized wet mount preparation. We examined each specimen within 1 hour of sampling time to effectively detect hookworm. Moreover, the 95% CI for some predictor variables is wide due to small sample size.

Conclusions

Significant proportion of children was infected with intestinal parasitic infection in rural Dembiya. Educational status of family members, number of under-five children in a household, health supervision, family size, and wealth index were statistically associated with parasitic infections. Provision of anthelmintic drugs, health supervision, and health education targeted with transmission and prevention of infections are recommended.

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Author Contributions

All the authors actively participated during development of a research proposal, data collection, analysis and interpretation, and writing various parts of the research report. ZG prepared the manuscript. All of the authors read and approved the final manuscript.

Availability of Data and Material

Data will be made available on requesting the primary author.

Ethics Approval and Consent to Participate

The Institutional Review Board of the University of Gondar approved the ethical aspects of this study. There were no risks due to participation in this research. Confidentiality and privacy were maintained. Verbal informed consent was obtained from the mothers and participation was on voluntary basis. Appropriate anthelmintic drugs were given for infected children. Moreover, the researchers provided health education for mothers or caregivers.

Consent for Publication

This manuscript does not contain any individual person's data.

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