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Prevalence of Intestinal Parasites and Associated Risk Factors in Schoolchildren of Aksum Town, Northern Ethiopia

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Abstract: A cross- sectional study was conducted from February to March 2013 to document prevalence and associated risk factors of intestinal parasites in children of the Abreha-Weatsibeha primary school, Aksum town Northern Ethiopia. Four hundered four randomly selected children were examined for intestinal protozoa and helminths by direct stool wet mount (For trophozoites of protozoa) and formalin-ether concentration technique (For cysts of protozoa or eggs of helminths). Semi-structured interview questionnaire was used to gather information about potential risk factors of infection with intestinal parasites in the study area. Nine species of intestinal parasites were identified in a total of 404 faecal samples examined. One hundred eighty (44.6%) of the children examined were found positive for at least one intestinal parasite species. The most common intestinal parasites identified were *Entamoeba spp* (17.%) followed by *Giardia lambilia* (14%) and *Ascaris lumbricoides* (9%). The prevalence rates of single and co-infections (Double or triple) were 37 and 7%, respectively. The prevalence of intestinal parasite was associated with low household income, absence of hand washing habit with soap after defecation and habit of eating raw unwashed vegetables ($P<0.05$). The high prevalence of intestinal parasitic infections among children of Aksum primary school calls for integrated control and prevention measures.

Key words: School children · Intestinal Parasites · Risk Factors Axum Town

INTRODUCTION

Intestinal parasitic infections are among the most common infections worldwide. It is estimated that some 3.5 billion people are affected and 450 million are ill as a result of these infections, the majority being school aged children [1]. About 150,000 children die annually due to intestinal obstruction and related abdominal complications caused by large adult worms [2]. Moreover, intestinal helminths contribute for about 39 million disability adjusted life years and thus result in substantial economic loss [3].

Infections with intestinal helminths and protozoa parasites cause health problems including deficiency of micronutrients, growth retardation, poor cognitive development and predisposition to other infections in children [4,5]. High prevalence of infections with intestinal parasites in developing countries the tropics and sub tropics is associated with poverty and climatic factors [2]. Like other tropical and sub tropical developing countries, intestinal parasites are widely distributed in Ethiopia due to the aforementioned factors [6, 7]. Distributions of intestinal parasites have been documented from almost all corners of Ethiopia [8-12]. Although several studies have been conducted and intervention efforts have been made to control and prevent intestinal parasites in Ethiopia, the changing environment and movement of people is causing distribution of the infections to previously non affected areas in the country [13].

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Therefore, objective of this study was to establish current prevalence and associated risk factors of intestinal parasite infections in schoolchildren in Axum town of the Tigray Regional State, Northern Ethiopia.

MATERIALS AND METHODS

Study Area and Population: Aksum town is one of the tourist attraction sites of the Tigray Regional state of Ethiopia located 1024 km north of Addis Ababa, the capital of Ethiopia.The town is situated with latitude and longitude of N 14° 7' 47.00" E 38° 42' 57.00" and an elevation of 2,132 m.a.s.l. The average annual rainfall and temperature of the area is 729.7mm and 18.40 0c, respectively. The total population of the study area is approximately 51, 727 [14]. The study population consisted of all children attending their class in Abreha Weatsibeha primary school. In 2013 academic year, the total student population of the school was 1722 out of this 853 were males and 869 were females.

Ethical Considerations: The study was ethically approved by Ethical Clearance Committee for Health of the Mekelle University, Ethiopia. Official letter communication was made to the school for permission of the study. Stool samples were taken only from volunteer children in the sample.All children who were found positive for intestinal parasite infection were treated with appropriate drug.

Study Design: A cross-sectional parasitological study was conducted in children of the Abraha Weatsibaha Primary School of Aksum town from February to March 2013. Four hundred and four children were selected by systematic random sampling and enrolled.To determine the sample population; children were first stratified according to their educational level (Grade 1 to 8). The sample size was then proportionally allocated and the required numbers of children from each class were then drawn using systematic random sampling technique.

Sample Size Estimation: The sample size (n) was determined using the single proportion formula [15]. Since the overall prevalence rate (p) of intestinal parasite is not known for the study area p was taken as 50%. For the calculation, a 95% confidence interval (z) corresponds to 1.96 and a 5% marginal error (d) was used. To minimize errors arising from the likelihood of non-compliance, five percent of the sample size was added giving a final sample size of 404.

Stool Collection, Processing and Examination: Children with no any other chronic infections and those who were able to give stool samples were included in the study. Prior to stool sample collection, children were guided on how to bring their stool samples not to mix with soil and urine.Each study subject was given a plastic sheet with an applicator stick to bring approximately 4gm stool sample of his/her own. A portion of the stool sample was used to prepare a direct wet mount in the field for trophozoites of intestinal protozoa. The remaining portion of the stool was transferred to screw cap bottles, preserved in 10% formalin and transported to Parasitology laboratory,Department of Biology, Mekelle University for formalin-ether concentration technique for cyts of protozoa and eggs of intestinal helminths.

Collection of Data about Risk Factors: Semi-structured interview questionnaire was first prepared in English and then translated to the local language "Tigrigna" to gather demographic and risk factor information for infection with intestinal parasites among the study children.Variables including age, sex, religion, hand washing habit, monthly income of child's family and mothers' educational status were assessed as potential risk factors for infection with intestinal parasites.

Data Analysis: Statistical analysis was performed using SPSS software version 16.0. Chi-square test was used to see if age has any effect on infection prevalence of intestinal parasites. Logistic regression was used to determine strength of association between infection prevalence and potential risk factors using odds ratio (OR) and 95% confidence interval (CI). Crude OR was estimated by univariate analysis and adjusted OR was then estimated by multivariate logistic regression analysis. Values were considered statistically significant when the p-value obtained was less than 0.05.

RESULT

Information about Study Subjects: Out of a total of 404 school children examined, 203(50.2%) and 201(49.8%) were males and females, respectively. The minimum and maximum age of the study subjects was 5 and 17 years, respectively. All children involved in the study are residents of urban area. Most 153(37.9%). of mothers' of the children were secondary school completes (Table 1).

Out of the 404 school children examined, 44.6% were found to be infected with at least one intestinal parasite. Nine species of intestinal parasites were identified with

Table 1: General information of students versus intestinal parasite infection

Variable	Frequency number (%)	Positive for parasite (%)
Age group		
5-9	200(49.5)	81(20)
10-14	201(49.8)	97(24)
15-19	3(0.7)	1(0.2)
Sex		
Female	201(49.8)	93(23)
Male	203(50.2)	87(21.5)
Mother educational status		
Illitrate	109(27)	51(12.6)
1-6 grade	119(29.5)	54(13.4)
7-12 grade	153(37.9)	66(16.3)
>12 grade	23(5.7)	9(2.2)
Religion		
Christain	388(96)	172(42.6)
Muslim	16(4)	8(2)

Table 2: Prevalence of single and mixed intestinal parasite infections

		Most prevalent intestinal parasitic infection	
Type of infection	Frequency No(%)	Species	Frequency No (%)
Single infection	151 (37.4)	E. spp	56 (13.9)
Double infection	28 (6.9)	E. spp +G.l	8 (2)
Triple infection	1 (0.2)	G.l+A.l+H.w	1 (0.2)

E.spp*=Entamoebe species,G.l*=G. lamblia; A.l*=A. lumbricoids; H.w*=Hookworm

Table 3: Age-related prevalence of intestinal parasite infections

	Age group				
Parasites Detected	5-9 (n = 81) No (%)	9-14 (n = 97)No (%)	15-19 (n = 2)No (%)	χ^2	P-value
E. species	28(6.9)	42(10.4)	0 (0)	3.96	0.138
G. lamblia	26(6.4)	31(7.7)	0 (0)	0.98	0.612
A. lumbricoides	17(4.2)	20(5.0)	1(0.2)	2.28	0.327
H. nana	12(3.0)	13(3.2)	0 (0)	3.84	0.147
Taenia spp	4(1)	5(1.2)	0 (0)	0.18	0.915
Hookworm	4(1)	7(1.7)	0 (0)	0.91	0.632
S. mansoni	1(0.2)	3(0.7)	0 (0)	1.04	0.595
E. vermicularis	1(0.2)	0 (0)	0 (0)	1.02	0.600
S. stercoralis	1(0.2)	0 (0)	0 (0)	1.02	0.600
Total infection	81(20)	98(24.3)	1(0.2)	2.92	0.232

χ^2*=Chi-square, NO*= number

*Both single and mixed infections were considered to calculate the prevalence.

variable prevalence. The identified prevalent intestinal parasites were Entamoeba histolytica/dispar, 70(17.3%), Giardia lambilia 57(14.1%), Ascaris lumbricoides 38(9.4%), Hymenolepis nana 25(6.2%), Hookworm 11(2.7%), Taenia species 9(2.2%), Schistosoma mansoni 4(1%), Enterobius vermicularis and Strongyloides stercolaris each 1(0.2%). E. histolytica/dispar was the most prevalent parasite followed by G. lambilia and A. lumbricoides compared with the other intestinal parasite species.

Of the entire 180 (44.6%) school children which were positive for intestinal parasites, 151(37.4%) and 29 (7.1%) were shown to have single infection and co-infections, respectively. Among the infected school children, 93 were males and 87 were females; with male to female ratio of 1: 0.9 (Table 2).

The distribution of infection among school children in the different age groups is shown in Table 3. The overall infection rate was highest among the 9-14 years age group (24.3%) followed by 5- 9 years age group (20%). Only 0.2% of children from 15 to19 year age group were infected. There was no significant difference in infection prevalence of intestinal parasites among the different age groups of school children ($P > 0.05$) (Table 3).

Table 4: Univariate logistic regression analysis for factors potentially associated with intestinal parasite infection

	Intestinal parasites			
Risk factors	Total positive n (%)	Total negative n (%)	COR (95% CI)	P-value
Sex				
Male	87 (21.5)	116 (28.7)	1.05 (0.63,1.74)	0.86
Female	93 (23)	108 (26.7)	1	
Age group in years				
5 to 9	81 (20.0)	119 (29.5)	1.36 (0.121, 15.27)	0.49
10 to 14	98 (24.3)	103 (25.5)	1.9 (0.17, 21.322)	0.45
15 to 19	1 (0.2)	2 (0.5)	1	
Grade level				
1 to 4	97 (24)	138 (34.2)	0.97 (0.43, 2.18)	0.71
5 to 8	83 (20.5)	86 (21.3)	1	
Mother educational status				
Illiterate	51 (12.6)	58 (14.4)	0.59 (0.19, 1.88)	0.412
Primary school	54 (13.4)	87 (21.5)	0.60 (0.19,1.88)	0.392
Secondary school and above	75 (18.6)	101 (25)	1	
Income/month				
< 700 Birr/month	109 (53.4)	64 (15.8)	3.49 (2.04, 6.0)	0.00
>700 Birr/month	71 (17.6)	160 (39.6)	1	
Water source for drinking				
Private tap water	128 (31.68)	165 (40.84)	1.18 (0.19, 7.26)	0.833
Public tap water	49 (12.13)	56 (13.86)	1.05 (0.16, 6.79)	0.877
Well	3 (0.74)	3 (0.74)	1	
Latrine				
Yes	170 (42.1)	214 (53)	1.13 (0.35, 3.63)	0.77
Open field defecation	10 (2.5)	10 (2.5)	1	
Hand washing with soap after defecation				
Yes	57 (14.1)	119(47.3)	1	0.00
No	123 (30.4)	33 (8.2)	12.49(7.69, 20.28)	
Eating raw/ unwashed vegetables				
Yes	171 (42.3)	192 (47.5)	7.28 (1.91, 27.73)	0.01
No	9 (2.2)	32 (7.9)	1	

COR*= Crude odds ratio, CI*= Confidence interval

Logistic regression analysis was used to determine the association of different factors with prevalence of intestinal parasites. These results are presented as crude odds ratios with 95% confidence intervals.

From the results of logistic regression analyses, among the associated risk factors, potential risks were house hold income, hand washing practice with soap after defecation, habit of eating raw/ unwashed vegetables, showed significant association to intestinal infections identified in the study ($p< 0.05$). Whereas the other variables such as sex, age, grade level, water source for cooking and drinking and using latrine and open field defecation did not show significant association with prevalence of intestinal parasite ($p>0.05$) (Table 4).

From the adjusted logistic regression, those children whose family income was less than 700 birr monthly (AOR 4.38; 95% CI 1.87 to 5.09) were four times more likely to acquire intestinal parasite infection than those children whose family income is more than 700 birr monthly. In addition, those school children who did not wash their hands with soap after defecation (Odds Ratio 11.24; 95% CI 6.73 to 18.78) were eleven times more likely to acquire intestinal parasite infection than children who wash their hands with soap after defecation. Similarly, children who had habit of eating raw/unwashed vegetables (Odds Ratio 8.12; 95% CI 2.16 to 30.46) were eight times more likely to acquire intestinal parasite infection than students who had no habit of eating raw/unwashed vegetables (Table 5).

Table 5: Analyses of risk factors associated with intestinal infections using univariate and multivariate logistic regression

	Intestinal parasites			
Risk factors	Total positive n (%)	Total negative n (%)	Adjusted OR(95% CI)	P-Value
Income				
<700 birr	109(53.4)	64(15.8)	3.09 (1.87, 5.09)	0.00
>700 birr	71(17.6)	160(39.6)		
Hand washing				
No	123(30.4)	33(8.2)	11.24 (6.73, 18.78)	0.00
Yes	57(14.1)	191(47.3)		
Eating raw/poorly washed vegetable				
Yes	171(42.3)	192(47.5)	8.12 (2.16, 30.46)	0.02
No	9(2.2)	32(7.9)		

OR*Odds ratio, CI* Confidence interval, n*=number

DISCUSSION

Epidemiological study on the prevalence of intestinal parasites and associated risk factors is of paramount importance to identify high-risk communities and formulate appropriate intervention measures. In line with this, the present study attempted to determine the prevalence and associated risk factors for infection with intestinal parasite among Abereha-Weatsibeha school children of Aksum town.

The study revealed occurrence of nine species of intestinal parasites of public health importance in school children in the study area. The total prevalence of intestinal parasites was 44.6% which is relatively higher than earlier reports from different parts of the country [8-11].The differences in prevalence of intestinal parasites in different localities mitght be attributed to factors such as low household income, low behavioral habits towards sanitation, the amount of sample size taken and the method used for identifying the parasites.

In the present study, Entamoeba spp (17.3%) was the dominant intestinal parasitic infection. The result was higher a reported from Lake Langano (12.7%) [11], Gondar (5.6%) [8] and Wondo Genet (0.35%) [12]. High prevalence of Entamoeba spp in the present study may be attributed to environmental and personal hygiene of the school children. On the other hand, the prevalence of Entamoeba spp observed in this study was lower than the one reported from North Gondar [10], this may be due to the difference in water source, geographic location and sanitary back ground of the study areas.

Even though high proportions, 97.5% of the school children in this study use latrine always, more than 40% of them harbored one or more intestinal parasite. This might be explained by the improper usage and poor quality, of the latrines. Similar findings were reported by Tadesse and Beyene [16] who stated the presence of toil *et al* one by itself is not enough unless used properly

G. lamblia (14.1%) and A. lumbricoides (9.4%) were the second and third prevalent intestinal parasites in this study. The current study indicated relatively very high prevalence rate of both these parasites compared the reports of Mengistu and Berhanu [11], This study has reported lower prevalence of Ascaris lumbricoides than other reports [10, 17, 18]. The prevalence of H. nana (6.2%) in the current study was found to be similar to the study conducted among Delgi schoolchildren (6.8%) [10].

Hookworms were among the low prevalent intestinal parasites in this study with prevalent rate of 2.7%. This may be related to the residence of the study subjects that is all subjects reside in urban and wear shoes. This is by far low in contrast with the findings of Mengistu and Berhanu [11]. This variation in prevalence rate between the study areas might be due to altitude, culture and living standard of the society.

In this study, multiple infections, single, double and triple were common. The most frequent mixed infections in this study were Entamoeba spp and G. lamblia. Both species have fecal oral contamination route, which might contaminate the food and water of the schoolchildren. WHO [6] stated that, E. histolytica and G. lamblia are potentially pathogenic and in many parts of the world either or both organisms constitute a public health problem.

The current study also evaluates the potential association of parasitic intestinal infection with the possible risk factors among schoolchildren. Even though there are many factors associated with intestinal parasites, the logistic regression analysis in the present study indicated that very few were significantly associated in this study making it comparable to earlier studies in Ethiopia. Risk factors strongly associated with intestinal parasite infection in this study were low house hold income, habit of washing hands after defecation and before, practice eating of unwashed /uncooked vegetables. Our findings agree to the recent studies by

Berhanu *et al*. [19] and Wördemann *et al*. [20] who have reported a range of environmental, social and behavioral risk factors to be associated with the intestinal parasite infections.

Schoolchildren from families whose income is less than 700 Ethiopian birr had more than threefold risk of getting infection compared to those with higher family income. The effect of low socio economic risk of infectious diseases in general and parasitic infections in particular is complex in nature and could be attributed to several other factors such as lack of access to clean water, poor hygienic environment, lack of access to education due to financial constraints and overcrowded conditions [21].

Schoolchildren who did not wash their hands with soap after defecation had higher risk of infection than those who wash after defecation. This was in agreement with earlier report of Asrat *et al*. [10]. Similarly a study from rural Ethiopia showed that the practice of hand washing had a strong correlation with the increase transmission and prevalence of parasitic infection [22].

The other factor that exposed children for intestinal parasite infection in this study was eating of unwashed /uncooked vegetables. The reason might be due to Leafy vegetables, eaten raw, be able to transmit contamination from farm fields to consumers. This also agrees with the fact that irrigating of vegetables using untreated wastewater is considered to be the main sources of human infection with protozoan and helminthic parasites [23].

CONCLUSION

Based on the present study, the high prevalence of intestinal parasitic infections indicated that parasitic infections are considerable public health problems and responsible for mild but chronic morbidity. The present study has also revealed that Entamoeba spp and G. lamblia as common protozoan while A. lumberciod as common helminths that cause parasitic infection with varying magnitude in the study area. Factors like low socio-economic status and low hygienic habits such as lack of hand washing after defecation and eating improperly washed vegetables were significantly associated with intestinal infection in the school children in particular and the community in general.

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