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# Prevalence and determinant factors of intestinal parasites among school children in Arba Minch town, Southern Ethiopia

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**Abstract:** Back ground: Intestinal parasitic infections are still quite common in developing countries including Ethiopia, particularly in children. They are mostly associated with unsafe and low quality of drinking water, poor personal and environmental sanitation. Thus, the objective of this study was to assess the prevalence and determinant factors of intestinal parasites among school children. Methods: A cross sectional study was conducted in March, 2014, among 498 students selected from three governmental elementary schools in Arbaminch- town, Southern Ethiopia using stratified multistage sampling method. Structured questionnaire was used to identify environmental, socio demographic and behavioral factors. Stool specimens were collected from all study subjects and were examined for intestinal parasites using direct smear (mount examination) and Formal-ether concentration techniques. Finally, data entry and analysis was done using Epi-info and SPSS statistical soft ware respectively. A bivariate and multivariate logistic regression analysis was done. P value less than 0.05 was considered as statistically significant. Results: A total of nine parasites were detected .The overall prevalence of intestinal parasites was 27.7% (95% confidence interval (CI): (23.8-31.6%)). The predominant parasite was *E.histolytica/dispar* 64(12.9%) followed by *A.lumboricoids* 53(10.6%), *H.nana* 21 (4.2%) and *G.lamblia* 21 (4.2%). Hand washing practice before meal [AOR = 5.7; 95% CI (3.4, 9.7)], nail hygiene [AOR= 2.6; 95% CI (1.5, 4.4)], and children's mother educational level [ A OR =3.5; 95% CI (1.01, 11.4)] showed statistically significant association with high rates of intestinal parasitic infections. Conclusion and recommendations: The prevalence of intestinal parasites is high in the study area among school children .Thus, it indicates the need of interventions like health education regarding to personal hygiene and mass treatment.

**Keywords:** Intestinal Parasites, School Children, Prevalence, Determinant Factors, Ethiopia

## 1. Introduction

Intestinal parasitic infections (IPIs) are distributed virtually throughout the world. According to the World Health Organization (WHO) estimates, globally about 3.5 billion people are affected by intestinal parasitic infections and cause clinical morbidity in approximately 450 million, majorities of the cases occur among children (1).

Intestinal parasitic infections such as *Ascariasis*, *hookworm* infection and *Trichiuriasis* are among the ten most common infections in the world and each constituting of 1000 million, 900 million, and 500 million respectively, being responsible for considerable morbidity and mortality. Beside of causing morbidity and mortality, infections with intestinal parasites have been associated with stunting, physical weakness and low educational performance of schoolchildren. These infections are more prevalent among the poor segments of the population and intimately linked with low economic level, poor personal and environmental sanitation, and overcrowding, limited access to clean water, tropical climate and low altitude (1-3).

The degree of harm caused by intestinal parasitic infections to the health of individuals and communities depends on: the parasite species, the intensity and course of infection, the nature of interactions between the parasite species and concurrent infection, the nutritional and

immunological status, and numerous socioeconomic factors of the populations. Thus, it is generally extremely difficult to measure the suffering caused by intestinal parasitic infections because so many cases of the diseases are asymptomatic and therefore remain undetected(1).

Another study which was done in children of aged 17 years and below from East African countries showed 50% prevalence rate and all infected children were asymptomatic at diagnosis (4).

Intestinal helminths are more prevalent through out the tropics ,especially among poor communities that is often neglected. In these parts of the world the high prevalence rate of intestinal parasites is attributed largely to socio-economic status, poor sanitation, inadequate medical care and absence of safe drinking water supplies. Records show increasing trends in helminthiasis infections, particularly in developing nations(3).

Regarding to intestinal protozoan infections, *Giardiasis* caused by *Giardia duodenalis*, is the most predominant protozoa infection with an estimated prevalence rates ranging from 2.0 to 7.0% in developed countries and 20.0 to 30.0% in most developing countries, affecting approximately 200 million people worldwide (5). *Amoebiasis* due to infections with the intestinal protozoon *Entamoeba histolytica* results in 40,000–100,000 deaths each year (6). The opportunistic protozoa, *Cryptosporidium sp*. has also emerged as an important cause of diarrheal illnesses worldwide particularly in young children and immuno-compromised patients with a prevalence of 4% in developed countries and three to four times more frequent in developing countries(7).

School children carry the heaviest burden of the associated morbidity (8), due to their dirty habits of playing or handling of infested soils, eating with soiled hands, unhygienic toilet practices, drinking and eating of contaminated water and food(9, 10).

In Ethiopia, like in other developing countries, intestinal parasitic infections are widely spread. Several studies indicated that the prevalence of helminthic infections were high in the lower altitudes (11) and *A. lumbricoides* the most prevalent intestinal parasites in different communities usually occurring together with *Trichuris* and *hook worm* (12, 13). Ethiopia has one of the lowest quality of drinking water supply and latrine coverage in the world (11, 14). The distribution and prevalence of various species of intestinal parasites differs from region to region because of several environmental, social and geographical and other factors mentioned above. Hence, study on the prevalence of various intestinal parasitic infections is a prerequisite not only for formulation of appropriate control strategies but also to predict risk for communities under consideration. Thus, the objective of this study was to assess the current epidemiological prevalence of intestinal parasites and the associated risk factors favouring the spread of parasites.

## 2. Methods and Materials

### *2.1. Study Area, Design and Period*

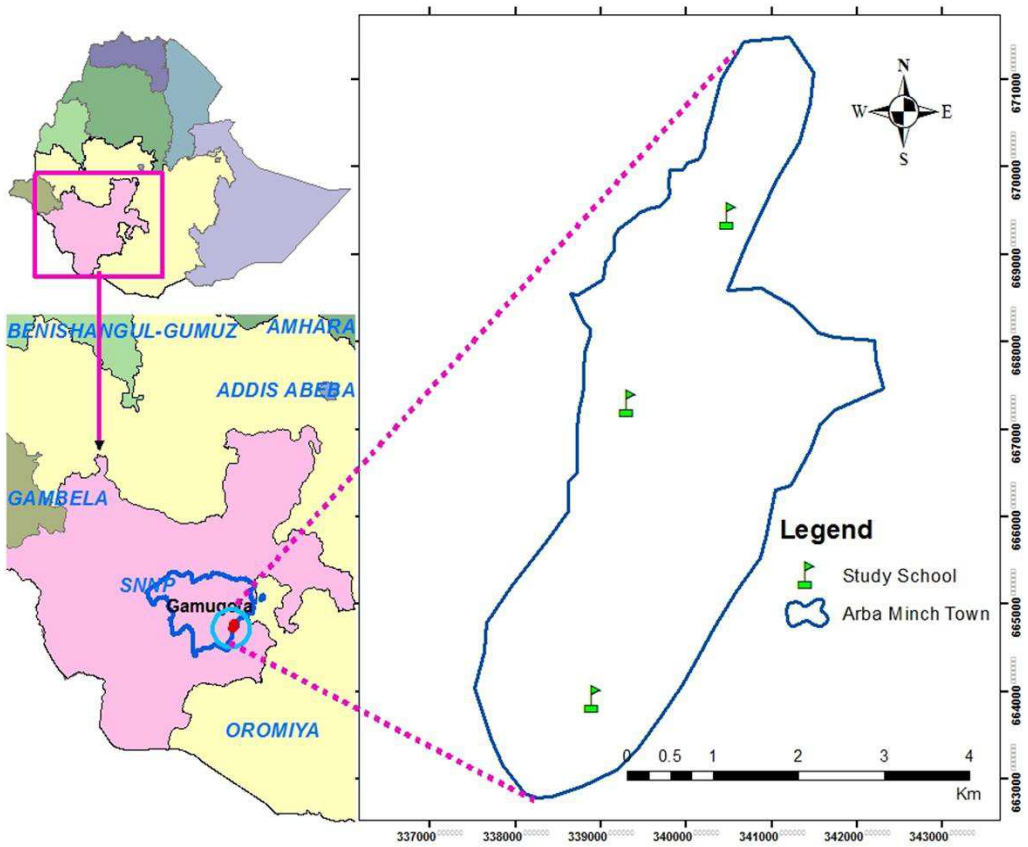


***Figure 1.*** *Map of study area*

A cross sectional study design was conducted in March 2014, in Arbaminch town which is capital city of Gamo Gofa zone, (Southern Nation, Nationality and Peoples Region, (SNNPR)) and Arbaminch Zuria wereda. Arbaminch is located at about 505 kms South of Addis Ababa, at an elevation of 1285 meters above sea level and has a total area of 12, 581.4 square kms. Besides the forty springs crossing the town is a river "Kulfo ", which is used by the local people for washing cloths and farming which predisposes the children to water-borne diseases during swimming, washing, playing, and crossing the water. Based on the 2007 Census conducted by the CSA, this town has a total population of 74,879. There are six elementary schools in the town with a total number of 12,461 students attending during the study period. Of whom, 6389 are female and 6072 are males.

### *2.2. Study Population, Sample Size Determination and Sampling Technique*

The sample size (n) was estimated using the single population proportion formula Z2 p (1-p) / d2. Where P = proportion of intestinal parasites from previous study, d = margin of error and Z = standard score corresponds to1.96. design effect of 1.5 was used. The proportion (p) of intestinal parasites from previous study was 71% (15). For the calculation, a 95% confidence interval and a 5% margin of error were 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 498.

Three government elementary schools were selected from six schools found in the town by simple random sampling methods. To select the study subjects, the students were first stratified according to their educational level (Grade 1 to Grade 8) for each school and allocation of student was done proportional to the number of students in each school and grade level. Finally, the study subjects were selected using systematic random sampling by using class roster as the sampling frame.

### *2.3. Data Collection and Parasitological Investigation*

A pre-tested structured questionnaire was developed and modified based on possible determinant factors that was applied in different similar studies related to this study in English and then was translated into the local language(Amharic ) and back translated to English .One supervisor and three data collectors were selected and trained for this purpose At the end of the day all the questionnaires were checked for consistency and completeness.

After proper instruction, each student was provided with labeled/ with unique identification numbers (IDs), clean, dry, and leak proof stool cup and pieces of applicator sticks to bring proper fresh stool. Every child was instructed to bring his own sufficient amount of stool so that no mixing up occurs. On delivery of the stool specimen, each child was interviewed using a structured questionnaire for demographic and determinant factors for intestinal parasites. Stool samples were examined for intestinal parasites using direct smear (mount examination) and Formal-ether concentration techniques. A portion of each stool samples was processed with a direct microscopic technique to detect cysts, trophozoites, eggs and larva of intestinal parasites immediately at the school. The remaining part of the samples was preserved in 10% formalin solution and transported to Arba Minch University College of Medicine and Health science and processed using formal- ether concentration technique. It was processed by two senior laboratory technologists who were trained for this purpose.

## 3. Data Management and Analysis

Data was entered and cleaned using Epi info version 3.5.3 and analyzed by SPSS (Statistical Package for Social Sciences) version 21.0 soft ware. Descriptive statistics were done to assess the prevalence and distribution of intestinal parasites.

Logistic regression analysis was performed to determine the independent effect of the independent variables with dependent variable by calculating the strength of the association between intestinal parasites infection and determinant factors using odds ratio (OR) and 95% confidence interval (CI). Crude OR and adjusted OR were estimated by bivariate and multivariate logistic regression analysis with respective 95% CIs respectively. P value less than 0.05 was considered as statistically significant.

### *3.1. Data Quality Assurance*

To ensure reliable information:-Before the data collection period, the questionnaire and laboratory materials was pretested in the randomly selected students on 5% of the total sample size. Training for data collectors was done. Standard operating procedures were used for specimen collection and processing for maintaining a good quality study. The use of two different techniques, direct smear and Formal-Ether concentration for diagnosis of the parasite were also used as a quality control. Ten percent of the slides was randomly selected and re-examined at the end by experienced laboratory technologist who was blind for the first examination result to ensure quality control. The result of laboratory examination was recorded on well prepared format carefully and finally it was attached with the questionnaire.

### *3.2. Ethical Consideration*

Prior to the commencement of the study approval letter was obtained from Ethiopian Institute of Water Resource, Addis Ababa University. Permission was also obtained from Arbaminch education, and health offices, authority of the schools to conduct the study. Informed verbal consent was obtained from students and school directors. The

students' privacy during the interview and stool collection was maintained and the data obtained from them were strictly kept confidential. Finally, the study participants who were found positive for intestinal parasites were treated with the standard regimen for free by local health professionals

# 4. Results

### *4.1. Socio Demographic Characteristics*

All of the study participants, 498 school children were participated and included in the analysis, providing 100% response rate. There were 243(48.8%) males and 255(51.2%) females. The mean (±SD) age of the children was 10.72(±2.55) years. Of the total 498 students, 311(62.4%) were in the age group of 10-14 years (Table1).

***Table 1.*** *Frequency of distribution among school children by socio-demographic characteristics, Arbaminch town, Southern Ethiopia, March, 2014.*

| Socio demographic characteristics | Frequency | Percent |
|---|---|---|
| Sex | | |
| Male | 243 | 48.8 |
| Female | 255 | 51.2 |
| Residence | | |
| Urban | 462 | 98.8 |
| Rural | 36 | 7.2 |
| Grade level | | |
| Grade1 | 75 | 15.1 |
| Grade 2 | 60 | 12 |
| Grade 3 | 51 | 10.2 |
| Grade 4 | 61 | 12.2 |
| Grade 5 | 47 | 9.4 |
| Grade 6 | 41 | 8.2 |
| Grade 7 | 65 | 13.1 |
| Grade 8 | 98 | 19.7 |
| Religion | | |
| Orthodox | 275 | 55.2 |
| Protestant | 217 | 43.6 |
| Muslim | 6 | 1.2 |
| Ethnicity | | |
| Gamo | 442 | 88.8 |
| Wolayta | 22 | 4.4 |
| Amhara | 14 | 2.8 |
| Oromo | 7 | 1.4 |
| Others | 13 | 2.6 |
| Age category of respondents in years | | |
| ≤ 9 | 152 | 30.5 |
| 10-14 | 311 | 62.4 |
| 15+ | 35 | 7 |
| Fathers educational status | | |
| Unable to write and read | 91 | 18.3 |
| Able to write and read | 37 | 7.4 |
| Grade 1-4 | 50 | 10 |
| Grade 5-8 | 117 | 23.5 |
| Grade 9-12 | 133 | 26.7 |
| Above diploma | 70 | 14.1 |
| Mothers educational status | | |
| Unable to write and read | 112 | 22.5 |
| Able to write and read only | 39 | 7.8 |
| Grade 1-4 | 64 | 12.9 |
| Grade 5-8 | 151 | 30.3 |
| Grade 9-12 | 94 | 18.9 |
| Diploma and above | 38 | 7.6 |

### *4.2. Prevalence of Intestinal Parasites*

Nine species of intestinal parasites were identified with an overall prevalence (95%CI) of 27.7 % (23.8%, 31.6%). The predominant parasite was *E.histolytica/dispar* which was observed in 64(12.9%) students followed by *A.lumboricoids* 53(10.6%) students, *H.nana* and *G.lamblia* 21 (4.2%) each (Table2).

Among the 138 positive individuals, the majority, 108 (21.7%) had single infection and 35(7%) individuals had multiple infection or poly parasitism. Of these multiple infections, twenty five (5%), and 5(1.00%) harboured dual, triple and above infections concurrently respectively.

***Table 2.*** *Number of males and females positive for at least one of intestinal parasites (s) among Arbaminch town school children, Southern Ethiopia, March 2014*

| Intestinal parasites | Male | | Female | | Total | |
|---|---|---|---|---|---|---|
| | N0 | % | No | % | No | % |
| *Protozoans* | | | | | | |
| *E.histolytica/dispar* | 34 | 14 | 30 | 11.8 | 64 | 12.9 |
| *G.lamblia* | 12 | 4.9 | 9 | 3.5 | 21 | 4.2 |
| *Helminthes* | | | | | | |
| *A.lumboricoids* | 27 | 11.1 | 26 | 10.2 | 53 | 10.6 |
| *T.trichuria* | 3 | 1.2 | 4 | 1.6 | 7 | 1.4 |
| *S.stercolaris* | 3 | 1.2 | 0 | 0 | 3 | 0.6 |
| *H.worm* | 3 | 1.2 | 8 | 3.1 | 11 | 2.2 |
| *H.nana* | 11 | 4.5 | 10 | 3.9 | 21 | 4.2 |
| *Taenia spp.* | 1 | 0.4 | 5 | 2 | 6 | 1.2 |
| *E.vermicularis* | 1 | 0.4 | 3 | 1.2 | 4 | 0.8 |
| Over all | 67 | 27.6 | 71 | 27.8 | 138 | 27.7 |

NB: The sum of the columns is greater than the total because of the co infections of some of the students.

### *4.3. Determinant Factors for Intestinal Parasitic Infections*

Among the potential determinant factors analyzed using bi-variate logistic regression most common behavioural and environmental risk factors that have previously been described to have an impact on parasitism were not

associated with parasite infections in this study population except, children mothers' educational level, regular practice of hand washing before feeding of the study participant, and fingers nail status of the children that were significantly associated with any of the identified intestinal parasite(s) as shown in table 3and4.

There was no significant difference of the IPIs between male and female although female (51.4% had slightly higher overall prevalence rate compared to male (48.6%). Similarly, although there was no statistically significant association between age and parasitic infection, the highest parasite prevalence was reported among the age group of 10-14 years (P>0.05).

Adjustment of the confounding variables was done using multivariate logistic regression analysis model. Accordingly, the children of illiterate women were more likely to get infection for at least one intestinal parasite than those who had higher educational level [ AOR=3.5; 95% CI(1.07,11.4)], children who did not wash their hands before eating [AOR 5.7; 95% CI (3.4,9.7)] were more likely to acquire intestinal parasites infection than children who wash their hands before meal regularly. Similarly, children who had dirty materials in their fingers [AOR= 2.6; 95% CI (1.5,4.4)] were two times more likely to acquire intestinal parasitic infections than their counter parts who had no dirty materials in their fingers (Table 3 and 4).

***Table 3.*** *Intestinal parasites by socio demographic characteristics among students of Arbaminch Elementary Schools in Arbaminch, Southern Ethiopia, March, 2014.*

| Socio demographic characteristics | Intestinal parasites | | P-value | COR(95%CI) | AOR(95%CI) |
|---|---|---|---|---|---|
| | Positive | Negative | | | |
| Sex | | | | | |
| Male | 67(27.6)* | 176(72.4) | 0.95 | 0.99(0.67,1.46) | 1.07(.73,2) |
| Female | 71(27.8) | 184(72.2) | | 1.00 | 1.00 |
| Grade level | | | | | |
| Grade1 | 22(29.3) | 53(70.7) | | 0.9(0.46,1.73 | 1.36(.35,5.3) |
| Grade 2 | 15(25) | 45(75) | | 0.72(0.35,1.49) | 0.58(0.18,1.9) |
| Grade 3 | 15(29.4) | 36(70.6) | | 0.9(0.43,1.9) | 0.8(0.3,2.4) |
| Grade 4 | 11(18) | 50(82) | 0.56 | 0.475(0.2,1.04) | 0.27(0.1,0.7) |
| Grade 5 | 10(21.3) | 37(78.7) | | 0.58(00.26,1.3) | 0.57(0.2,1.5) |
| Grade 6 | 13(31.7) | 28(68.3) | | 1.00(0.46,2.2) | 0.96(0.37,2.5) |
| Grade 7 | 21(32.3) | 65(100) | | 1..03(0.53,2.02) | 0.9(0.38,2.2) |
| Grade 8 | 31(31.6) | 67(68.4) | | 1.00 | 1.00 |
| Religion | | | | | |
| Orthodox | 71(25.8) | 204(74.2) | 0.62 | 1.7(0.2,15.15) | 2.5(0.2,27.6) |
| Protestant | 66(30.4) | 151(69.6) | 0.48 | 2.2(0.25,19.07) | 2.3(0.2,25.7) |
| Muslim | 1(16.7) | 5(83.3) | | 1.00 | 1.00 |
| Ethnicity | | | | | |
| Gamo | 123(27.8) | 319(72.2) | | 0.62(0.2,192) | 0.7(0.2,3) |
| Wolayta | 7(31.8) | 15(68.2) | 0.5 | 0.75(0.18,3.13) | 0.7(0.12,4.3) |
| Amhara | 1(7.1) | 13(92.9) | | 0.12(0.01,1.25) | 0.24(0.02,3.14) |
| Oromo | 2(28.6) | 5(71.4) | | 0.64(0.09,4.66) | 0.2(0.02,2.6) |
| Others | 5(38.5) | 8(61.5) | | 1.00 | |
| Age category of respondents in years | | | | | |
| ≤ 9 | 40(26.3) | 112(73.7) | .673 | 1.21(.51,2.87) | 1.08(0.3,4.7) |
| 10-14 | 90(28.9) | 221(71.1) | .451 | 1.37(.6, 3.14) | 2.3(0.78,6.5) |
| 15+ | 8(22.9) | 27(77.1) | | 1.00 | 1.00 |
| Fathers educational status | | | | | |
| Unable to write and read | 22(24.2) | 10(27) | | 1.4(0.65,3.02) | 0.6(0.2,1.7) |
| Able to write and read only | 69(75.8) | 27(73) | | 1.62(0.63,4.17) | 1.2(0.34,4.3) |
| Grade 1-4 | 18(36) | 32(64) | 0.09 | 2.47(1.07,5.68) | 2.13(0.68,6.6) |
| Grade 5-8 | 42(35.9) | 75(64.1) | | 2.46(1.21,5.00) | 2.8(1.07,7.45) |
| Grade 9-12 | 33(24.8) | 100(75.2) | | 1.45(0.71,2.97) | 1.37(0.5,3.5) |
| Above diploma | 13(18.6) | 57(81.4 | | 1.00 | 1.00 |
| Mothers educational status | | | | | |
| Unable to write and read | 61(42.7) | 82(57.3) | | 2.98(1.22,7.26) | 3.5(1.07,11.4) |
| Able to write and read only | 15(35.7) | 27(64.3) | | 2.22(0.78,6.3) | 3.3(0.86,12.3) |
| Grade 1-4 | 11(18.6) | 48(81.4) | <0.001 | 0.92(0.32,2.64) | 0.68(0.2,2.5) |
| Grade 5-8 | 23(17.4) | 109(82.6) | | 0.84(0.33,2.17) | 0.78(0.2,2.6) |
| Grade 9-12 | 21(24.1) | 66(75.9) | | 1.27(0.49,3.33) | 1.8(0.54,5.9) |
| Diploma and above | 7(20) | 28(80) | | 1.00 | 1.00 |

* Figures in parenthesis indicate percentages; COR = Crude Odd Ratio, CI= Confidence Interval, AOR= Adjusted Odd Ratio

***Table 4.*** *Association of environmental and behavioral determinant factors with intestinal parasitic infections among school children in Arbaminch town, Southern Ethiopia, March, 2014.*

| Determinant factors | Positive n=138 | Negative n= 360 | P -value | COR(95%CI) | AOR(95%CI) |
|---|---|---|---|---|---|
| Source of water for drinking | | | | | |
| Tap water | 129(26.9)* | 351(73.1) | | 1.00 | 1.00 |
| River | 5(55.6) | 4(44.4) | 0.07 | 3.4(0.9,12.9) | 2.5(0.5,13.7) |
| River and tap | 5(55.6) | 4(44.4) | 0.25 | 0.58,8.23) | 4(0.7,26.9) |
| Latrine availability | | | | | |
| Yes | 136(27.8) | 354(72.2) | | 1.00 | 1.00 |
| No | 2(25) | 6(75) | 0.863 | 0.87(.17,4.35) | 0.6(0.09,4.4) |
| Habit of swimming | | | | | |
| Yes | 82(26.5) | 227(73.5) | 0.46 | 0.86(0.57,1.28) | 1.2(0.6,2.5) |
| No | 56(29.6) | 133(70.4) | | 1.00 | 1.00 |
| Frequency of swimming per week | | | | | |
| 1-2 days | 46(22.5) | 158(77.5) | | 1.00 | 1.00 |
| 3 days and above | 36(34.3) | 69(65.7) | 0.028 | 1.79(1.07,3.01) | 0.7(0.4,1.5) |
| Shoe wearing habit | | | | | |
| Yes | 134(27.5) | 354(72.5) | | 1.00 | |
| No | 4(40) | 6(60) | 0.39 | 1.76(0.49,6.3) | |
| Frequency of shoe wearing | | | | | |
| Some times | 12(22.2) | 42(77.8) | 0.36 | 0.73(0.37,1.43) | 0.5(0.2,1.3) |
| Always | 122(28.2) | 311(71.8) | | 1.00 | 1.00 |
| Bathing | | | | | |
| Home | 87(27.4) | 230(72.6) | | 1.00 | |
| River | 36(29.3) | 87(70.7) | 0.7 | 1.09(0.7,1.73) | 0.8(0.35,1.8) |
| River and home | 15(25.9) | 43(74.1) | 0.8 | 0.92(0.49,1.74) | 0.4(0.2,1.1) |
| Hand washing before feeding | | | | | |
| Yes | 68(18.6) | 297(81.4) | | 1.00 | 1.00 |
| No | 70(52.6) | 63(47.4) | <0.001 | 4.85(3.16,7.46) | 5.7(3.4,9.7) |
| Hand washing after defecation | | | | | |
| No | 13(35.1) | 24(64.9) | 0.39 | 1.37(.67, 2.80) | 1.1(0.4,2.9) |
| Water only | 37(24.5) | 114(75.5) | 0.38 | 0.82(0.52,1.28) | 1.6(0.6,4.4) |
| Water and soap | 88(28.4) | 222(71.6) | | 1.00 | 1.00 |
| Washing cloth | | | | | |
| Home | 84(27.4) | 223(72.6) | | 1.00 | 1.00 |
| River | 44(29.5) | 105(70.5) | 0.63 | 1.12(0.72,1.7) | 1.2(0.6,2.6) |
| River and home | 10(23.8) | 32(76.2) | 0.63 | 0.83(0.4,1.76) | 1.6(0.6,4.5) |
| Presence of dirty materials in their fingers | | | | | |
| Yes | 93(33.1) | 188(66.9) | .002 | 1.89(1.25,2.85) | 2.6(1.5,4.4) |
| No | 45(20.7) | 172(79.3) | | 1.00 | 1.00 |
| Practice of nail trim | | | | | |
| Yes | 96(29.5) | 229(70.5) | | 1.00 | 1.00 |
| No | 42(24.3) | 131(75.7) | 0.21 | 0.77(0.5,1.16) | 0.9(0.4,2.3) |
| Habit of thumb sucking | | | | | |
| Yes | 43(24.9) | 130(75.1) | 0.3 | 0.8(0.53,1.22) | 0.8(0.3,2.1) |
| No | 95(29.2) | 230(70.8) | | 1.00 | 1.00 |
| Habit of eating unwashable vegetables | | | | | |
| Yes | 44(27) | 119(73) | 0.83 | 0.95(0.63,1.44) | 1.3(0.7,2.3) |
| No | 94(28.1) | 241(71.9) | | 1.00 | 1.00 |

# 5. Discussion

Epidemiological study on the prevalence of intestinal parasite infections in different regions/localities is a primary objective to identify communities/individuals at high risk and formulate appropriate intervention. In agreement with this view, the present study attempted to assess the prevalence of different intestinal parasitic infections and local determinant factors among Arbaminch town school children . The results of the study showed the occurrence of several intestinal parasites of public health importance among schoolchildren in three primary schools found in Arbaminch town.

Nearly every third (27.7%) of the students in Arbaminch town were infected by intestinal parasites which was almost similar or comparable to the prevalence documented in Eastern Ethiopia, Babile town (10), Southern and central zone of Tigray (12) , and Northwest Ethiopia (16) which revealed over all prevalence of 27.2% , 28.6%, and 34.2% respectively. Still, this result was higher than results from North west Ethiopia (22.7%) (17) Nepal (13%) (18), and Baglung districts of Western Nepal (19).

However, it was much lower than previously reported among different regions in Ethiopia; Southern Ethiopia around lake Awassa, North west Ethiopia, Azezo (20), North Gondar of Delgi school (13), South east of Lake

Langano area (21) that showed prevalence of 92.7%, 72.9%, 79.8%, and 83.3% respectively. Higher prevalence of intestinal parasitic infections than the present study were also reported from other countries Saint Lucia (61.6%) (22), Nepal (40%) and Nigeria (67.4%) (9).The category of the study population, the methods employed for stool examination, and the time of study may have contributed to the differences.

In this study, E.histolytica is the predominant infection in line with a study documented elsewhere (19) on the other hand , which is higher than studies carried out by Gelaw et al. (16).

Considering the prevalence rate of A. lumbricoides (10.6%) , it was lower than the value for Zarima town (23) and Azezo town (20). But, other studies done in different parts of the country showed lower rates for A.lumbricoides (10, 16, 17).

Among the 138 positive individuals , the majority, one fifth , 108 (21.7%) of the children had single infection in agreement with findings reported in other study, 108 individuals had single infection (9). The double infection rate was 5 % in line with that of study done in Eastern Ethiopia, Babile (10). But quite lower than studies conducted by Gelaw et al. (16). The prevalence of multiple infections was higher compared to the previous studies (16). Sample size determination, study population and the methods used could attribute to this observed difference in detections of various parasites. On the other hand, multiple infections in this study was lower than that of the school children done other studies (13, 21). This difference might be due to climatic, geographic as well as study time differences in the study areas.

Differences due to gender were not observed in this current study although female (51.4%) had slightly higher overall prevalence rate compared to male (48.6%) which is in line with a study reported in Malaysia (24), and Nepal (18).

The finding that intestinal parasites infections are more prevalent in the age groups 10-14 years than the younger counterparts in the study area is an indication that younger children are more exposed since they usually play in the open fields (12) and they frequently involve themselves fully in activities that bring them in contact with the source of infection and this might be due to higher in number with this age category in this study. This is consistent with the findings reported from Eastern Ethiopia (10), Northwest Ethiopia (16). But the difference was not statistically significant. Findings from Saint Lucia also showed the highest infection rate among the age groups 5-14 (22) and in Western Nepal higher in the age group of 10-14 years (19).

According to this study, One of the factors strongly associated with intestinal parasites infections was low educational level of children mothers'. Children of illiterate women were more likely to get infection for at least one intestinal parasite than those who had higher educational level [ A OR=3.5; 95% CI (1.01 , 11.4)]. This finding is in line with results of other similar studies (13, 25). Similarly, children who did not wash their hands before eating [AOR 5.7; 95% CI (3.4,9.7)] were more likely to acquire intestinal parasites infection than children who wash their hands before meal regularly. This finding is similar with a study done by Tadesse G. in Eastern Ethiopia (10), North west Ethiopia (20), North Gondar (26), North west Ethiopia (27) and Nepal (18). The other factor that identified in this study was children who had dirty materials in their fingers [AOR= 2.6 ; 95% CI (1.5,4.4)] were more likely to acquire intestinal parasites infection. This finding also supported by other studies (10), (28). Similar findings also found that poor hand washing and hygiene of nails are conducive environment for feco - oral transmission of intestinal parasites. This might be due to low knowledge of children about the feco-oral transmission of intestinal parasites through their unwashed hands.

The study has some limitations:- Firstly, only single stool sample was collected from each participant. Secondly, due to lack of antigen tests, Entamoeba histolytica and Entamoeba dispar were not separated. Lastly, as the collection period was short, no attempt was made to investigate seasonality as potential seasonal fluctuations might have affected the actual prevalence.

# 6. Conclusion

In conclusion, the result of this study indicated that intestinal parasitic infections were a common health problem with varying magnitude among the school children. This study has also shown that children mothers' educational level, nail hygienic status, and hand washing practice before meal of the children were closely associated with the prevalence of intestinal parasitic infections. Thus, there is a need for intensive and habitual health education for behavioural changes related to personal hygiene and mass treatment for the effective control of intestinal parasitic infections in the concerned area.

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# Authors' Contributions

DH: initiation of the study, design, implementation, analysis and writing. ND: design, implementation, analysis and writing. EA: design, implementation, analysis and

writing. All authors read and approved the final manuscript.

## Competing Interests

The authors declare that they have no competing interests.

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