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Intestinal Parasitosis and Associated Factors Among Food Handlers Working in the University of Southern Ethiopia

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ABSTRACT

BACKGROUND: Intestinal parasite infections are major global public health problems. The majority of persons infected reside in Sub-Saharan Africa with a high burden of the disease. Very few studies have been done in Ethiopia and none exist at Wachemo University, Southern Ethiopia. The present study aimed to investigate intestinal parasitic infections and associated factors among Wachemo University students' cafeteria food handlers.

METHODS: Institution-based cross-sectional study was conducted on 212 randomly selected food handlers from 15, February to 05, March/2019. A structured questionnaire was used to collect data and standard laboratory procedures were employed to collect stool and finger specimens and analyzed them for intestinal parasites. Data were edited, cleaned, entered, using EPI data 3.3.1, and analyzed by statistical package for social science version 20. A stepwise logistic regression model was used to calculate the odds ratios and 95% confidence interval for the different factors.

RESULTS: Of 212, the majority 63.7% were females and 48.1% attended grades 9 to 10. Of the stool and fingernail specimens examined, 29.7 % and 5.6% were positive for different parasites, respectively. The most prevalent parasite is *Ascaris lumbricoides* (12.7%) followed by *Hookworm* (6.6%), *Giardia lamblia* (4.7%), *Taenia saginata* (2.4%), and mixed infection (3.3%). Although several factors showed significant association with intestinal parasitosis, attending secondary level education 94.5% (AOR: 0.055; 95% CI [0.007-0.413]), fingernail status (AOR: 0.330; 95% CI [0.113-0.965]), and hand washing with soap and water after toilet use (AOR: 0.332; 95% CI [0.125-0.884]) were the significant variables in multivariable analysis ($P < .05$).

CONCLUSIONS: The results demonstrated intestinal parasite infections as a public health issue in Ethiopia that requires attention. Appropriate intervention programs like encouraging food handlers to practice good hygiene, routine hand washing at key times, and nail trimming should be implemented.

KEYWORDS: Intestinal parasites, food handlers, students' cafeteria, Wachemo University, Southern Ethiopia

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Introduction

Intestinal parasites of humans are a very diverse group of organisms, ranging from single-celled protozoans to multicellular worms that inhabit the gastrointestinal tract.[1] They can be transmitted directly or indirectly through feces-contaminated objects like food, water, soil, and finger.[2] Because of their easy way of transmission and high impact on the population intestinal parasite is one of the concerning areas for research and public health problems interventions.

Intestinal parasites are one of the worldwide and country-wide public health problems. Universally, 33% of the total population is estimated to be infected with intestinal parasites, with the majority of people living in tropical and sub-tropical parts of the world.[3] About 819 million people are infected with *Ascaris lumbricoides* (*A. lumbricoides*), 464.6 million people with *Trichuris trichiura* (*T. trichuira*), 438.9 million people with *Hookworm* infection,[4] 500 million people with *Entamoeba histolytica* (*E. histolytica*), and 2.8 million people are infected with *Giardia lamblia* (*G. lamblia*).[5] As in other developing countries, the cases of intestinal parasitosis are also highly abundant in Ethiopia. Of the population of Ethiopia one-third, one-fourth, and 1 in 8 were infected by *A. lumbricoides*, *T. trichiura*, and *Hookworm* respectively.[6]

Different factors can determine and lead to a high prevalence of intestinal parasites. Some of these factors are poor socio-economic condition, lack of safe and adequate water supply, poor environmental sanitation, improper irrigation, overcrowding, resettlement, low altitude, lack of proper disposal of

waste, noncompliance with health standards, lack of adequate washing of vegetables, and consumption of uncooked meat, the practice of personal hygiene, knowledge of disease transmission, different environmental factors and education status of the food handlers are identified by different scholars.[2,7]

The case of intestinal parasites and food-borne diseases are more interrelated. Some reported food-borne disease prevalence in food service establishments can be attributed because of improper food handling practices among food handlers.[8] Food handlers working in foodservice establishments with poor personal hygiene can be infected by different pathogens where that can cause contamination of foods by their hands during food preparation and which might be transmitted to the public. Due to the high rate of survival of microorganisms and the difficulty of keeping a fingernail and hand hygiene food-borne illnesses were transmitted from food handlers during food production.[9,10]

Ethiopia's Ministry of Health has prioritized the most common causes of intestinal parasitic infection (*Ascaris lumbricoides*, *Trichuris trichiura*, *Entamoeba histolytica*, and *Giardia lambia*) as one of the neglected tropical diseases (NTDs), and implementing intervention plan for addressing the public health problems.[11] But the epidemiology of intestinal parasites remained complex because of the diversity of associated factors involved and the complexities of addressing this expanding challenge.[12] In Ethiopia, intestinal parasites are a steadily increasing public health concern.[13] On the other hand, the study area is not researched and there is a scarcity of scientific information in the district at large. Therefore, this cross-sectional study was conducted to assess the prevalence and associated factors of intestinal parasites among food handlers in Wachamo University students' cafeteria, Hossana, Ethiopia.

Methods and Materials

Study area

Wachemo University was one of the public higher education institutions found in the Southern Nations, Nationalities, and Peoples' Region (SNNPR), Ethiopia, and was established in 2009. It was located 230 km southwest of Addis Ababa. The university started its functions in 2012 admitting 538 students and currently, the university had admitted over 18 000 students in regular and continuing education programs. Based on the information collected from the human resource management during the study period a total of 520 individuals were serving as food handlers throughout Wachemo University cafeterias.

Study design and Population

A cross-sectional study design was conducted from 15, February to 05, March/2019 in randomly selected food handlers who had direct contact with food preparation and handling within the students' cafeteria of Wachemo University. Study subjects were selected by a simple random sampling technique from the study population who met inclusion criteria within in Wachemo University students' cafeteria.

All food handlers who had direct contact with foods and drinks were included in the study and food handlers who had taken annual leave during data collection time or those who had received medical treatment for any intestinal diseases within the past 2 to 3 weeks before data collection were excluded from the study.

Sample size determination and sampling technique

The sample size was determined using the single population proportion formula and we took the prevalence of parasites ($p = 36\%$) with a 95% confidence interval ($z = 1.96$) and 5% marginal error ($d = 0.05$) from a previous study at Araba Minch University.[2] The sample size calculated was 354, and we used the correction formula because the source population was less than 10 000. Finally, we got an initial sample size of 212, and by considering a 5 % (≈11 subjects) non-response rate we used the final sample size of 223. To select representative groups from 520 total food handlers a proportional sample size was determined for each stratum (cafeteria), and food handlers were selected randomly by lottery method from the roster lists of food handlers which were obtained from the cafeteria office of the university (See Figure 1).

Data collection and laboratory setting

The benefits of the study were explained to food handlers before interviewing and collecting stool and ova specimens by laboratory technologists and data collectors. Structured questionnaires were used to collect data related to socio-demographic/economic characteristics, knowledge on parasite transmission, environmental and personal hygiene practices of food handlers, and related risk factors were collected by face-to-face interviews using pre-tested questionnaires and observational checklists by trained Nurses and Environmental Health professionals. The questionnaire was adapted from the World Health Organization (WHO) food safety checklist and different literature.[2,14,15] Besides, data on fingernail trimming, wearing a hair cap, or gown, and the status of participants whether they were barefoot or not were recorded by simple observation.

Collection of stool and ova specimen. Selected food handlers were provided with a labeled clean stool cup, applicator stick, and plain paper. The stool cup had a code number; the code number of the container was recorded in a laboratory report format. This was to avoid the accidental exchange of specimens among food handlers. The food handlers were instructed to utilize the provided toilet paper for defecation and to use an applicator stick to prevent contamination from the restroom environment. Finally, they pick up a piece of the stool, place it in the clean plastic container provided, and deliver it. According to a

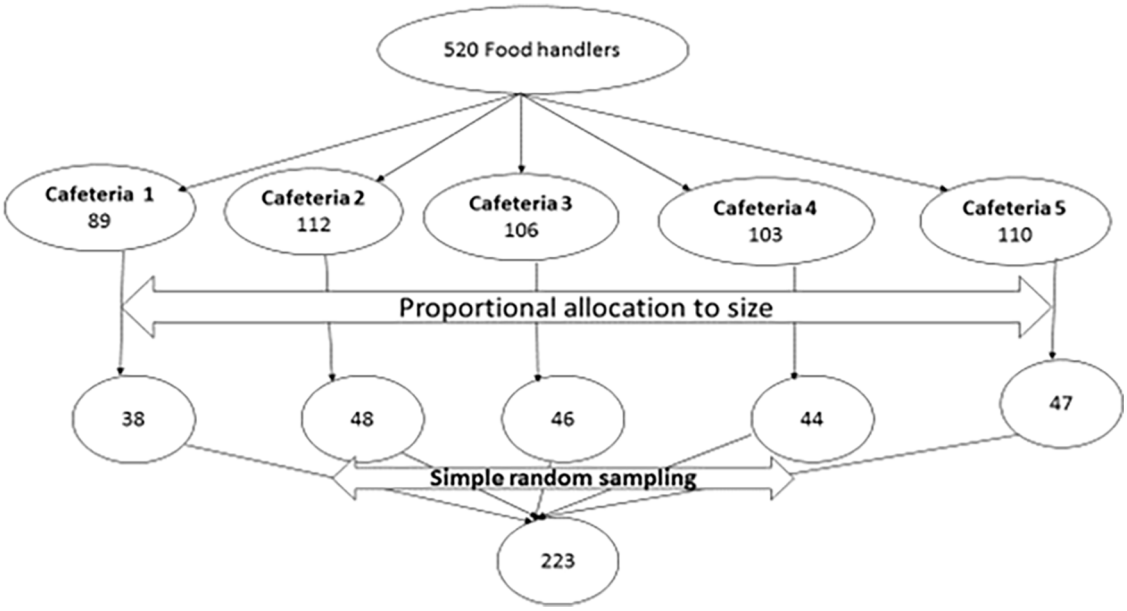

Figure 1. Flow chart for sampling technique for food handlers in Wachemo University, Southern Ethiopia (2019).

list of names with their corresponding code numbers, stool specimens will be collected. The number on the container was compared with the number recorded when they provided the container to check if it was the right container for her/him.

The specimen from hands swabs was collected from the hands using moisten sterile cotton swab, with (0.9% w/v) physiological saline. The swab was kept quickly in its container and sealed with a unique code number. The collected samples were preserved in ice bag at temperature interval of +2°C to +8°C and transported immediately within 1 hour for examination to Nigest Elieni Mahammed Memorial Referral Hospital of Wachemo University and Gimbichu Primary Hospital.

Examination of stool and ova specimen. About 2 mg of stool was picked with an applicator stick and emulsified in a drop of normal saline (0.85% NaCl) at the one end of a clean, non-scratched glass slide, and the same size of stool in Lugol's iodine at the opposite end of the same glass slide. Then cover slip was placed on both preparations and scanned under 10× and 40× objective lenses of a light microscope for detection of intestinal protozoan trophozoite, cysts, and ova of nematodes. One gram of stool was performed by formalin ethyl acetate, briefly, 1 g of stool emulsified in 8 ml of formula water, and the resulting suspension was filtered through 3 layers of wet cotton gauze in a funnel into a centrifuge tube and then 4 ml of diethyl acetate was added.The centrifuge tube was shaken vigorously and centrifuged at 750 to 1000*g* for 1 minute. Then after the supernatant was poured off the sediment and slightly shaken.

And 1 drop was added at the center of the clean slide, non-scratched with a free glass slide. The coverslip was applied to the preparation and examined in the same way as explained earlier. A small drop of Lugol's iodine was allowed to run under the lip of the cover to observe the characteristic features of the cyst. Dysenteric (watery) stools were examined before solid stools. This was necessary because protozoan trophozoites were more likely to be present in watery stool, and trophozoites had a shorter survival time in feces than cysts. The different intestinal parasites identified were recorded on the laboratory investigation result recording form.

Operational definitions. **Outcome variable:** In the current study, the outcome variable was the presence of intestinal parasites. The presence of at least 1 intestinal parasite infection in a food handler indicated a positive result, and negative if it is not.

Knowledge: To assess the level of knowledge, respondents were asked 13 questions questionnaire and those who scored less than or equal to the mean value were considered as having poor knowledge, and those who scored greater than the mean value were considered as having good knowledge.

Hand hygiene

- **Always:** Wash hands with soap and water frequently after toilet use, body and raw material touching, and before food preparations 3 times a day.
- **Sometimes:** Not washing hands with soap and water frequently after toilet use, body and raw material touching, and before food preparations 3 times a day.

Fingernail status: Assessing food handlers' both hands of fingernails whether trimmed or untrimmed by observing.

Data quality control. To ensure the quality of data standardization of the study tools and procedures was done. The English version of the questionnaire was translated into Amharic

and Hadiyisa language and back-translated to English by translators who are blind to the original questionnaire. Training for all research team members consists of 2 days of classroom instruction and practice and 1 day of pretesting in Hossana Health Science College among food handlers of the cafeteria in all research procedures including interviews and stool and ova specimen collection in 5% of the sample size 1 week before actual data collection period. Some of the variables were corrected after pretesting tools like medications which is similar to medical checkup, job responsibilities, and frequency of hand washing. Stool and ova sample collection and investigations were conducted according to standard procedures. Microscopic reading was made by the first author and a result was confirmed by him.

During data collection, the research team supervisor supervised all steps of data collection including the interview, and stool and ova specimen collection. Upon completion of data collection, the PI was review the entire data collection form to ensure completeness and accuracy.

Data analysis. Data were edited, cleaned, entered, using EPI data 3.3.1, and analyzed by statistical package for social science (SPSS) version 20. Descriptive analyses like frequencies and mean were used and the odds ratio was analyzed to measure the strength of the association. Bivariate analysis was used, and a crude and adjusted odds ratio with 95% CI was calculated for statistical significance tests. The goodness of fit model was checked by Hosmer Lemeshow statistic and a *P*-value greater than .05 was considered a fit model. Variables with $P < .25$ in bivariate analysis were considered for multivariable analysis through a multivariable logistic regression model to look at their relative effect on the outcome variable by controlling other possible confounding factors and significantly associated factors were selected entry method. A *P*-value of $<.05$ was considered for indicating statistical association. Lastly, the result was presented by using tables and graphs and described by narration.

Ethical considerations. Ethical clearance was obtained from Jimma University Ethical Committee. An official letter of cooperation from the above organization was written to Wachemo University. Before the date of data collection, translated consent forms were forwarded to the food handlers requesting the food handlers' participation in the research as well as highlighting the need for collecting stool and ova samples from the food handlers. Food handlers were requested to return completed consent forms. Written informed consent was signed by participants. When food handlers were illiterate, they consented by their thumbprint after verbal consent from the interviewer during data collection. The procedure was not harmful to the subjects. Those who tested positive for the parasites were recommended for treatment. Additionally, the confidentiality of all the information was assured.

Table 1. Socio-demographic and economic characteristics of food handlers in Wachemo University students' cafeteria, Southern Ethiopia (2019) (n = 212).

VARIABLE	CATEGORY	FREQUENCY NO. (%)
Sex	Male	77 (36.3)
	Female	135 (63.7)
Age	<20	13 (6.1)
	21-30	94 (44.3)
	31-40	87 (41)
	>40	18 (8.5)
Educational status	Primary	70 (33)
	Secondary	130 (61.3)
	College and above	12 (5.7)
Job responsibility	Waiter	89 (42)
	Cooker	80 (37.7)
	Equipment collector	19 (9)
	Dishwasher	24 (11.3)
Marital status	Single	109 (51.4)
	Married	101 (47.6)
	Divorced	1 (0.5)
	Widowed	1 (0.5)
Income per month	<1500 ETB	151 (71.2)
	1501-1800 ETB	50 (23.6)
	>1801 ETB	11 (5.2)
Training	Yes	37 (17.5)
	No	175 (82.5)
Training certificate	Yes	12 (5.7)
	No	200 (94.3)
Working condition	Permanent	17 (8)
	Contract	195 (92)

Results

Socio-demographic and economic data

Of a total of 212 food handlers working at Wachemo University and recruited to participate in the current study, 135 (63.7%) were females and 77 (36.3%) were males with a response rate of 95%. The mean age of the respondents was 31.51 years. Regarding their educational status, most of the study participants 102 (48.1%) attended grades 9 to 10. Regarding training, 37 (17.5%) were trained and only 12 (5.7%) were certified, 175 (82.5%) were not trained and 200 (94.3%) were not certified (See Table 1).

Table 2. Personal hygiene practices of food handlers in Wachemo University students' cafeteria, Southern Ethiopia (2019) (n=212).

VARIABLE	CATEGORY	FREQUENCY NO. (%)
Fingernail status	Trimmed	99 (46.7)
	Untrimmed	113 (53.3)
Sharing knife	Yes	8 (3.8)
	No	204 (96.2)
Wearing clean apron	Yes	209 (98.6)
	No	3 (1.4)
Wearing hair cap	Yes	211 (99.5)
	No	1 (0.5)
Shoe wearing habit	Yes	210 (99.1)
	No	2 (0.9)
Reporting when sick	Yes	75 (35.4)
	No	137 (64.6)
Hand washing after using a toilet	Always	97 (45.8)
	Sometimes	115 (54.2)
Wash hands before touching food	Yes	163 (76.9)
	No	49 (23.1)
Washing hands with soap and water	Yes	66 (31.1)
	No	146 (68.9)
Washing hands with water only	Yes	157 (74)
	No	55 (26)
Washing fruits and vegetables before eating	Yes	209 (98.6)
	No	3 (1.4)
Follow medical check-up	Yes	75 (35.4)
	No	137 (64.6)

Personal hygiene-related factors of food handlers

Of the total 212 respondents, 99 (46.7%) reported that they trimmed their fingers and 113 (53.3%) were not. For cutting raw and cooked foods 204 (96.2%) were not using a common knife, 209 (98.6%) were wearing a clean apron, 210 (99.1%) had a habit of wearing shoes, and 75 (35.4%) had a habit of reporting to the managers when sick. After using the toilet facility 97 (45.8%) and 115 (54.2%) wash their hands always and sometimes respectively. Similarly, 163 (76.9%) wash their hands before touching foods, 66 (31.1%) wash their hands with water and soap while 146 (68.9%) were not washing their hands with soap and water, while 157 (74%) wash their hands only with water, moreover 209 (98.6%) were washing fruits and vegetables before eating (Table 2).

Table 3. Environmental related risk factors of food handlers in Wachemo University students' cafeterias, Southern Ethiopia (2019) (n=212).

VARIABLE	CATEGORY	FREQUENCY NO. (%)
Source of water	Tap water	212 (100)
Farming activity	Yes	21 (9.9)
	No	191 (90.1)
Toilet facility types	Pit latrine	187 (88.2)
	Water flush type	25 (11.8)
Hand washing facility	Yes	87 (41)
	No	125 (59)
Shower facility	Yes	35 (16.5)
	No	177 (83.5)
Vegetables and fruits	Farm	21 (9.9)
	Market	140 (66)
	Farm and market	51 (24.1)

Table 4. Knowledge level of food handlers in Wachemo University students' cafeteria, southern Ethiopia (2019) (n=212).

KNOWLEDGE CATEGORY	POSITIVE		NEGATIVE	
	NUMBER	%	NUMBER	%
Good	41	29	101	71
Poor	22	31	48	69

Environmental-related factors of food handlers

Of the total respondents, 21 (9.9%), 140 (66%), and 51 (24.1%) obtained vegetables and fruits from the farm, markets, and both markets and farms respectively. According to this study 21 (9.9) participated in farming activities like digging and weeding but 191 (90.1%) did not participate. All 212 (100%) respondents were users of private tap water, and 35 (16.5%) had a shower facility (Table 3).

All of the respondents had a toilet facility in their establishment of which, 187 (88.2%) had a pit latrine and 25 (11.8%) had a water flush type of toilet. Among those toilets, 87 (41%) had separate hand washing facilities while 125 (59%) hadn't separate hand washing facility (Table 4)

Knowledge of food handlers and parasitic infection status

The majority of food handlers, 142 (67%) have good knowledge scores on food handling, and the remaining 70 (33%) food handlers had poor. Of the study participants, those who had got good knowledge 29% were infected with parasitic

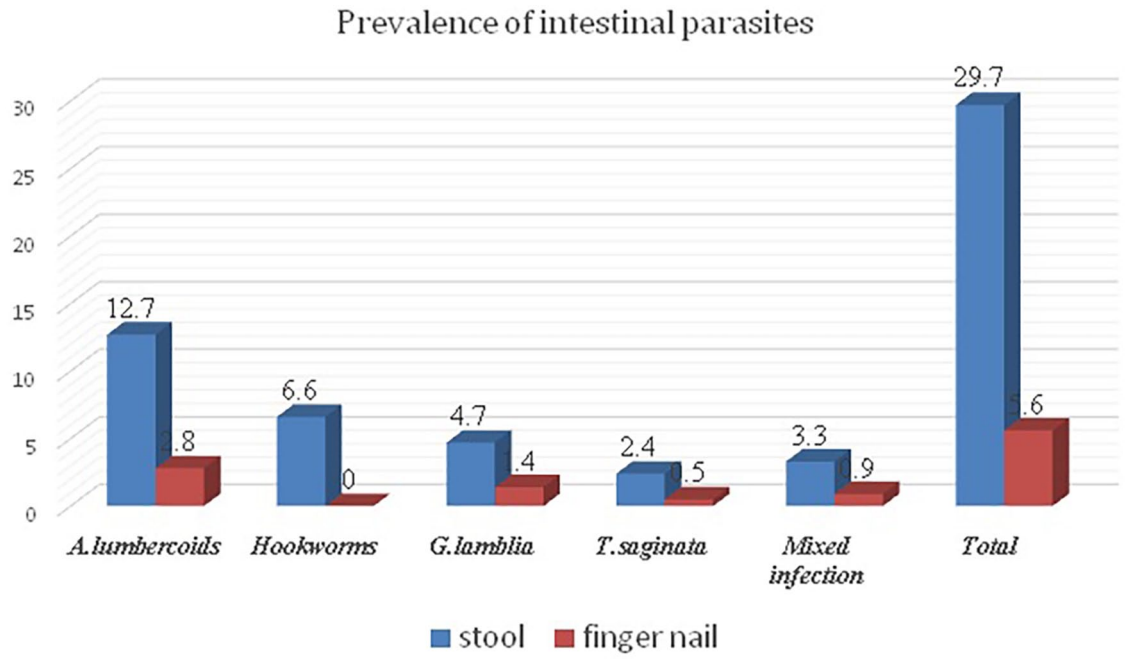

Figure 2. Type and prevalence of intestinal parasites isolated from stool and fingernail swabs of food handlers in Wachemo University students' cafeteria, southern Ethiopia (2019) (n=212).

infection whereas who got poor knowledge 31% were also infected with parasitic infection.

Prevalence of intestinal parasites

From the total 424 samples (212 stool and 212 finger-nail contents) examined, 63 (29.7%) with 95% CI (24.1-35.2) were positive for 1 or more parasites from the stool and 12 (5.6%) with 95% CI (0.9-12.3) were positive for 1 or more parasites from fingernail swab examinations.

A total of 5 genera of intestinal parasites were identified including, *A. lumbricoides*, Hookworm, *G.lamblia*, *T.saginata*, and mixed infections like *A.lumbricoides*, Hookworm, *G.lamblia.* The most prevalent parasite identified in stool specimens were *A. lumbricoides* (12.7%) followed by Hookworm (6.6%), *G. lamblia* (4.7%), *T. saginata* (2.4%), and mixed infections (3.3%).

From the fingernail examined positive cases, 6 of them harbored ova of *A. lumbricoides*, 3 had ova of *G. lamblia*, 1 had ova of *T. saginta*, and 2 had harbored mixed ova of hookworm and *G. lamblia* (Figure 2).

Intestinal parasitic infections and associated factors

As shown in Table 5, different factors were assessed for possible association with intestinal parasitic infection among the study participants. From the binary logistic regression analysis, 9 variables met the criteria (*P*-value <.25) to select variables for multivariate analysis. The logistic regression analysis result showed that the odds of being positive for intestinal parasites among male food handlers had less likely to occur with a protective effect of 93% (AOR: 0.070; 95% CI [0.019-0.258]) compared to female food handlers.

Food handlers who attended secondary education from grade 9 to 12 had a less likely risk of being infected with intestinal parasites with a protective effect of 94.5% (AOR: 0.055; 95% CI [0.007-0.413]) as compared to those food handlers who were primary education level.

The extent of intestinal parasitic infection was less likely to occur with a protective effect of 67%, among food handlers who had trimmed their fingers or nails (AOR: 0.330, 95% CI [0.113-0.965]) compared to those who had not trimmed their fingernail.

The odd of being positive for intestinal parasitic infection was less likely to occur with a protective effect of 66.8%, among food handlers who washed their hands after toilet use with soap and water (AOR: 0.332; 95%CI [0.125-0.884]) than those who did wash with water only after toilet use (Table 5).

Among those 9 variables 4 variables (sex, education, fingernail, and hand washing by using soap and water) were significantly and negatively associated with parasitic infection (*P*-value <.05).

Discussion

Food handlers may be carrying a wide range of intestinal parasites and have been implicated in the transmission of many infections to the public in the community and students at the University. The spread of disease via food handlers was a common and persistent worldwide problem. Therefore, this study was undertaken to determine the prevalence of intestinal parasites by taking both stool and fingernail content samples among food handlers of Wachemo University students' cafeteria, Southern Ethiopia.

Examination of stool specimens showed a greater prevalence of intestinal parasites than their counter fingernail contents. In

Table 5. Multivariable analysis of factors associated with prevalence of intestinal parasites among food handlers in Wachemo University students' cafeteria, Southern Ethiopia (2019) (n=212).

VARIABLE	POSITIVE		NEGATIVE		COR	95% CI	P-VALUE
	NO.	%	NO.	%			
Sex							
Male	10	13	67	87	0.251	0.109-0.488	.000*
Female	53	39	82	61	1		
Educational status							
Primary	44	63	26	37	8.46	0.049-2.108	.4502
Secondary	17	13	113	87	0.092	0.018-0.465	.005*
Above 12	2	17	10	83	1		
Income level							
<1500 ETB	39	26	112	74	2.393	0.692-8.282	.168
1501-1800 ETB	19	38	31	62	1.360	0.364-5.075	.648
>1801 ETB	5	45	6	55	1		
Job responsibilities							
Waiter	20	22	69	78	1.725	0.645-4.614	.277
Cooker	22	28	58	72	1.318	0.495-3.514	.581
Equipment collector	13	16	6	84	0.231	0.064-0.836	.026
Dish washer	13	45	16	55	1		
Training status							
Yes	15	41	22	69	1.865	0.865-3.764	.116
No	48	27	127	73	1		
Finger nail status							
Trimmed	18	18	81	82	0.336	0.178-0.633	.001*
Untrimmed	45	39	68	61	1		
Medical check ups							
Yes	38	33	76	67	1.46o	0.803-2.656	.215
No	25	25	73	75	1		
Frequency of hand washing							
Always	23	24	74	76	0.583	0.318-1.067	.080*
Sometimes	40	35	75	65	1		
Washing with soap and water							
Yes	15	23	51	77	0.600	0.307-1.175	.027*
No	48	33	98	67	1		

*Significant at *P*-value < .05.

this study, the overall prevalence of intestinal parasites among food-handlers was 29.7% which was similar to the study conducted in Wolaita Sodo town of Ethiopia at 33.68%,[11] Haramaya University at 25.5%,[16] Jimma University at 33%,[17] and Khartoum, Sudan at 29.4%.[18] But the prevalence of the intestinal parasite in this study was higher than in the study at Gonder University (13.8%)[19] and in Axum town, northern Ethiopia (14.5%).[15]

Also, it was lower than 45.5% which was from Addis Ababa University,[8] 36% from Arabaminch University,[2] 41.1% from Bahirdar University,[20] 46.3% in the Gambia,[1] 83.1% in northern Iran,[21] 44.1% in Yebu town Western Ethiopia,[10] and 81% in Chencha town, Southern Ethiopia.[7]

The differences might be due to differences in climatic condition, geographical location, and socio-demographic features including poverty and overall hygienic status of the populations studied, proper housing, safe water supplies, and hygienic waste disposal systems of the establishments.[6,22,23]

Therefore, regular evaluation of food handlers for their health status, including screening for the prevalence of parasites is important and helpful in the prevention of probable morbidity and the protection of consumer health.

The predominant parasite identified in the present study was *A. lumbricoides* with a prevalence of 12.7% followed by Hookworm (6.6%). This finding was relatively similar to the finding of a study conducted at Haramaya University in which *A. lumbricoides* (14.3%) and Hookworm (7.6%) were the predominant parasites reported.[16] The occurrence of parasitic infections is an indicator of fecal contamination of different objects around homes or the working environment due to poor sanitation and improper sewage disposal.[24]

The study revealed that out of the total of fingernail contents examined 5.6% were found to be positive for ova of intestinal parasites, which was consistent with 10.9% in Jimma town[25] and 2% in Sohag, Egypt,[26] lower than 29.1% in Sidewalk food vendors, University of Indonesia,[27] 21% in Lahore, Punjab Pakistan[28] and 57.2% in Ebony State, Nigeria.[29] This difference might be due to the difference in personal hygiene and environmental sanitation status, safe water supply, and health promotion practices among study participants and their living communities.

The predominant parasite identified in fingernail examination of ova parasites in the present study was *A. lumbricoides* prevalence of 2.8% which was lower than 4.95% reported from Jimma town,[25] 9.52% from Lahore, Punjab Pakistan,[28] and 20% from Ebony State, Nigeria[29] and in agreement with 2% of Sohag, Egypt.[26] This could be due to different environmental and personal factors which can affect the survival capacity of infective eggs. The presence of cysts and ova of parasites in the fingernail contents indicate contamination of the fingernail as a potential source of transmission for intestinal parasites. So food handlers' fingernails were contaminated part of the hand due to the surviving of microorganisms. To prevent and halt the parasite infection chain food handlers should be responsible to wash their hands with soup at all necessary critical times and to trim their nails regularly.

The analysis in this study indicated that female food handlers were at high risk of intestinal parasite infection as compared to male food handlers (AOR: 0.070; 95% CI [0.019-0.258]). It disagrees with the study conducted on Intestinal helminthic infections among elementary students of Babile town, eastern Ethiopia in which male students (AOR: 0.61;95% CI [0.39-0.96]) were more infected than female students.[30]

This can be because women are much more involved in kitchen work than men. Most of the males participate in the delivery of the already prepared food, while women are those who go barefooted during the preparation of the food, as well as those who do the washing of vegetables and fruits mainly in the kitchen.[2] This could be due to carelessness and unhygienic habits practiced by female food handlers than male food handlers.[30] Therefore, increasing awareness about hygienic practices among food handlers is very important to enhance their health status.

Another risk factor that had a statistically significant association with intestinal parasites was fingernail status. A higher intestinal parasites rate was found in those food handlers that had not trimmed fingernails than those that had trimmed fingernails (AOR: 0.330; 95 % CI [0.113-0.965]). This was lower than the study conducted among food handlers at Arabaminch University in which (AOR: 2.193; 95 % CI [1.293-1.990])[2] and Haramaya University in which (AOR: 3.31; 95 % CI [1.99-5.49]).[16] Untrimmed fingernails could serve as a vehicle for the transport of organisms from the source to the food due to the area beneath a fingernail harboring most organisms is difficult to clean.[24,26] Thus, a lack of personal hygiene might increase the probability of exposure to intestinal helminths infection.

Hand washing with soap and water after the toilet (AOR: 0.332; 95% CI [0.125-0.884]) had an association with the presence of intestinal parasites. Food handlers who washed their hands with soap and water were higher than Mekele University (AOR: 0.15; 95% CI [0.06-0.38]),[13] and lower than (AOR: 2.43; 95% CI [1.22-4.86]) Haramaya University.[16]

The level of education, nature of the working environment, limited or no sanitary surveillance made by the responsible body, and availability of facilities used for hand washing practice could explain this discrepancy.[24] Inadequate hand washing among food handlers is a common practice that contributes to food-borne diseases. Improvement of food establishment workers' hand washing practice is, therefore, crucial to reducing the incidence of foodborne illnesses due to parasitic infection.

Hence, in this study multivariable logistic regression model indicated that sex, education, untrimmed fingernail, and infrequent hand washing with soap after toilet were identified as determinant factors for food handlers being infected by intestinal parasites.

These findings were consistent with the results of a study conducted among food handlers in Haramaya University, eastern Ethiopia[16] with hand washing with soap and water and fingernail; sex with Addis Ababa University[8]; education with Aksum town, northern Ethiopia.[15] But no statistically significant difference between sex and education in a study conducted at Arbaminch University,[2] educational status, and sex, fingernail status in a study conducted at Mekele University.[13]

This study has some limitations specific methods such as the adhesive scotch tape for *E. vermicularis*, Harada Mori's filter paper for *S. stercoralis* for hookworm infections were not done.

Conclusion and Recommendation

Conclusion

The present studies revealed that the prevalence of intestinal parasites was (29.7%) in the food handlers working at Wachemo University students' cafeteria, who were positive for different intestinal parasites. The most prevalent parasite was *A.lumbricoides* followed by Hookworm. The results of this study indicated that helminthic infections were more predominant than protozoan infections. Since most intestinal parasites are transmitted by the fecal-oral route, food handlers could be an important source of infection in the general population. But sex, education, untrimmed fingernails, and infrequent hand washing with soap after the toilet were found to be associated with the risk of infection with intestinal parasites and they were preventive. The prevalence of intestinal parasites among food handlers is high, so appropriate intervention programs are needed on identified factors to avoid further infection transmission to students and the general population. Food handlers should be encouraged to follow good hygiene, including frequent hand washing and nail trimming. Food handlers must also frequently trim their fingernails.

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Author contributions

WD conceptualization, did the analysis and interpretation of the result and drafted the original paper, and participated in preparing all versions of the manuscript. WB, TT, KB, and MT assisted in the design and the proposal development, monitored data collection, assisted during analysis, and revised subsequent drafts of the paper. Also, MT, AT, and LT participated in manuscript preparation, and final all authors read and approved the final manuscript before submission.

Availability of data and materials

We are still publishing from the dataset that supported these findings. On the other hand, the data is with the corresponding author and will be made available upon request.

REFERENCES

1. Jallow HS, Kebbeh A, Sagnia O, Fofona B, Sambou SM, Camara Y. High prevalence of intestinal parasite carriage among food handlers in the Gambia. *Int J Food Sci Biotechnol*. 2017;2:1.
2. Mama M, Alemu G. Prevalence and factors associated with intestinal parasitic infections among food handlers of Southern Ethiopia: cross sectional study. *BMC Public Health*. 2015;16:1-7.
3. Dill KA, Chan HS. From levinthal to pathways to funnels. *Nat Struct Biol*. 1997;4:10-19.
4. Pullan RL, Smith JL, Jasrasaria R, Brooker SJ. Global numbers of infection and disease burden of soil transmitted helminth infections in 2010. *Parasit Vectors*. 2014;7:1-19.
5. Duc PP, Nguyen-Viet H, Hattendorf J, Zinsstag J, Cam PD, Odermatt P. Risk factors for Entamoeba histolytica infection in an agricultural community in Hanam province, Vietnam. *Parasit Vectors*. 2011;4:1-9.
6. Lalit I, Brkti G, Dejen Y. Magnitude of hygienic practices and its associated factors of food handlers working in selected food and drinking establishments in Mekelle town, northern Ethiopia. *Int Food Res J*. 2015;22:2650-2656.
7. Abossie A, Seid M. Assessment of the prevalence of intestinal parasitosis and associated risk factors among primary school children in Chencha Town, Southern Ethiopia. *BMC Public Health*. 2014;14:1-8.
8. Aklilu A, Kahase D, Dessalegn M, et al. Prevalence of intestinal parasites, salmonella and shigella among apparently health food handlers of Addis Ababa University student's cafeteria, Addis Ababa, Ethiopia. *BMC Res Notes*. 2015;8:1-6.
9. Abate A, Kibret B, Bekalu E, et al. Cross-sectional study on the prevalence of intestinal parasites and associated risk factors in Teda Health Centre, Northwest Ethiopia. *ISRN Parasitol*. 2013;2013:757451.
10. Tefera T, Mebrie G. Prevalence and predictors of intestinal parasites among food handlers in Yebu town, southwest Ethiopia. *PLoS One*. 2014;9:e110621.
11. Arota FWFSA, Abraham Y. Intestinal parasitic infection and associated factors among food handlers in South Ethiopia: a case of Wolaita Sodo town. *J Pharm Altern Med*. 2016;12:22-28.
12. Arani AS, Alaghehbandan R, Akhlaghi L, Shahi M, Lari AR. Prevalence of intestinal parasites in a population in south of Tehran, Iran. *Rev Inst Med Trop Sao Paulo*. 2008;50:145-149.
13. Nigusse D, Kumie A. Food hygiene practices and prevalence of intestinal parasites among food handlers working in Mekelle university student's cafeteria, Mekelle. *Glob Adv Res J Soc Sci*. 2012;1:65-71.
14. Abera A, Nibret E. Prevalence of gastrointestinal helminthic infections and associated risk factors among schoolchildren in Tilili town, northwest Ethiopia. *Asian Pac J Trop Med*. 2014;7:525-530.
15. Gezehegn D, Abay M, Tetemke D, et al. Prevalence and factors associated with intestinal parasites among food handlers of food and drinking establishments in Aksum Town, Northern Ethiopia. *BMC Public Health*. 2017;17:1-9.
16. Marami D, Hailu K, Tolera M. Prevalence and associated factors of intestinal parasitic infections among asymptomatic food handlers working at Haramaya University cafeterias, eastern Ethiopia. *Ann Occup Environ Med*. 2018;30:1-7.
17. Girma H, Beyene G, Mekonnen Z. Prevalence of intestinal parasites among food handlers at cafeteria of Jimma University Specialized Hospital, Southwest Ethiopia. *Asian Pac J Trop Dis*. 2017;7:467-471.
18. Babiker MA, Ali MSM, Ahmed ES. Frequency of intestinal parasites among food-handlers in Khartoum, Sudan. *East Mediterr Health J*. 2009;15:1098-1104.
19. Gelaw A, Anagaw B, Nigussie B, et al. Prevalence of intestinal parasitic infections and risk factors among schoolchildren at the University of Gondar Community School, Northwest Ethiopia: a cross-sectional study. *BMC Public Health*. 2013;13:1-7.
20. Abera B, Biadegelgen F, Bezabih B. Prevalence of Salmonella typhi and intestinal parasites among food handlers in Bahir Dar Town, Northwest Ethiopia. *Ethiop J Health Dev*. 2010;24:11-16.
21. Sharif M, Daryani A, Kia E, Rezaei F, Nasiri M, Nasrolahei M. Prevalence of intestinal parasites among food handlers of Sari, Northern Iran. *Rev Inst Med Trop Sao Paulo*. 2015;57:139-144.
22. Khan W, Nisa N-u, Khan A. Prevalence and risk factors associated with intestinal parasitic infections among food handlers of Swat, Khyber Pakhtunkhwa, Pakistan. *J Food Nutr Res*. 2017;5:331-336.
23. Nematian J, Nematian E, Gholamrezanezhad A, Asgari AA. Prevalence of intestinal parasitic infections and their relation with socio-economic factors and hygienic habits in Tehran primary school students. *Acta Trop*. 2004;92:179-186.
24. Belachew EB, Tarko DB, Wallie YM. Prevalence of intestinal helminthic parasitic infections and associated risk factors among students in Tepi Town, South West Ethiopia. *Sci J Public Health*. 2017;5:192-197.
25. Sahlemariam Z, Mekete G. Examination of fingernail contents and stool for ova, cyst and larva of intestinal parasites from food handlers working in student cafeterias in three Higher Institutions in Jimma. *Ethiop J Health Sci*. 2001;11:132-139.
26. El-Nadi N, Omran E, Ahmed N, Fadel E. Current status of intestinal parasites among elementary school children in Sohag, Egypt. *J Adv Parasitol*. 2017;4:33-40.
27. Suriptiastuti S, Manan WS. Intestinal parasites from fingernails of sidewalk food vendors. *Universa Medicina*. 2011;30:120-125.
28. Ghani JJ, Ahmed N, Ashraf K, Ijaz M, Maqbool A. Prevalence of intestinal parasites from fingernails of primary school going children of district Lahore. *J Parasitol Vector Biol*. 2016;8:122-125.
29. Alo M, Ugah U, Elom M. Prevalence of intestinal parasites from the fingers of school children in Ohaozara, Ebonyi State, Nigeria. *Am J Biol Chem Pharm Sci*. 2013;1:22-27.
30. Tefera E, Mohammed J, Mitiku H. Intestinal helminthic infections among elementary students of Babile town, eastern Ethiopia. *Pan Afr Med J*. 2015;20:26-34.