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Prevalence of intestinal parasites and associated factors among food handlers in food establishments in Lideta sub city of Addis Ababa

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3 **1 Prevalence of intestinal parasites and associated factors among food handlers in food**
4 **2 establishments in Lideta sub city of Addis Ababa**

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38
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41
42 19 **Abstract**

43
44
45 20 **Objectives:** This study was conducted to assess the prevalence of intestinal parasites and
46 21 associated factors among food handlers.

47
48
49 22 **Setting:** This study was conducted in different food establishments in Lideta sub city of the
50 23 Addis Ababa, Ethiopia.

51
52
53 24 **Participants:** Four hundred and eleven food handlers were participated in this study.

25 **Design:** An institution-based cross-sectional study design was used. Stool samples were
26 collected from food handlers and examined using direct wet mount technique. Personal and
27 establishment related information was collected using pretested questionnaire with structured
28 observation. Multivariable binary logistic regression was used to identify factors associated with
29 prevalence of intestinal parasites on the basis of adjusted odds ratio and 95% confidence interval
30 with $p < 0.05$.

31 **Outcome measures:** The primary outcome is prevalence of intestinal parasites, which was
32 defined as presence of one or more intestinal parasitic species in stool samples.

33 **Results:** One or more intestinal parasites were detected in 171 (41.6%) of the stool samples. The
34 most common intestinal parasites were *E. histolytica* (12.2%), *G. lamblia* (10.5%), and *A.*
35 *lumbricoides* (6.1%). This high prevalence of intestinal parasites among food handlers was
36 associated with low monthly income (AOR: 2.83, 95% CI: 1.50, 8.84), untrimmed fingernails
37 (AOR: 4.36, 95% CI: 1.98, 11.90), no food safety training (AOR: 2.51, 95% CI: 1.20, 5.58),
38 low level of education (AOR: 3.13, 95% CI: 1.34, 7.44), poor handwashing practice (AOR:
39 2.16, 95% CI: 1.03, 4.22), and lack of medical checkup (AOR: 2.31, 95% CI: 1.18, 6.95).

40 **Conclusion:** The prevalence of intestinal parasites among food handlers in the studied region
41 was high. This high prevalence was linked to socio-economic conditions, poor hand hygiene
42 condition, and absence of food safety trainings. It is, therefore, important to promote hand
43 washing practice and providing food hygiene and safety training is critical.

44 **Key words:** Intestinal parasites, food handlers, food establishments, hand hygiene, Ethiopia

45 **Strengths and limitations of this study**

- 46 - The study has focused on one of the most potential groups, i.e., food handlers that had potential to
47 spread food borne infections to the consumers.
- 48 - The use of sensitive diagnostic techniques and combination of methods with triplicate
49 examination applied in this study would help to recover greater rate of intestinal parasites
50 that would indicate the true prevalence.
- 51 - As a limitation, we measured the burden of intestinal parasites in the dry season, so that the

52 associations reported in the current study are not adjusted for seasonal variations.

53 **Introduction**

54 Foodborne diseases are increasingly becoming a serious global public health problem. The
55 World Health Organization (WHO) estimate indicates that each year worldwide, unsafe food
56 causes 600 million cases of foodborne diseases and 420 000 deaths. WHO estimated that 33
57 million years of healthy lives are lost due to eating unsafe food globally each year, and this
58 number is likely an underestimation [1]. One of the causes of foodborne diseases is
59 contamination during food preparation; food handlers carrying pathogens might be involved in
60 the origin of this condition. Foods can be contaminated with fecal material at the point of
61 production or during food preparation, in both the home and in commercial premises [2]. Food
62 handlers with poor personal hygiene and inadequate knowledge on food safety could be potential
63 sources of infections. Food handlers who harbor and excrete enteropathogens may contaminate
64 foods from their feces via contaminated hands, then to food or food contact surfaces, and finally
65 to healthy individuals [3-7].

66 The contribution of the infected food worker (whether symptomatic or not) to food borne disease
67 outbreaks has been difficult to establish. However, reports showed that food workers in many
68 settings have been responsible for foodborne disease outbreaks for decades. For instance,
69 members of the Committee on Control of Foodborne Illnesses of the International Association
70 for Food Protection analyzed 816 foodborne disease outbreaks with 80,682 cases in different
71 countries where food workers were implicated as the source of the contamination. The report
72 also estimated that infected food worker was documented as responsible for 18% of 766
73 outbreaks occurring in the United States [8, 9]. Moreover, according to the Centers for Disease
74 Control (CDC), as cited in Mathew RR (2019), 20 to 40% of food borne illness associated with
75 the consumption of contaminated food originated in catering establishments [10].

76 Since the food handling personnel play a role in the transmission of food borne diseases and the
77 health of the food handlers is of great importance for maintaining quality of food prepared and
78 served by them, pre-employment and periodic medical checkups are very important to safeguard
79 the consumers from getting diseases from cross contaminated foods along with other food safety
80 measures [11, 12]. However, pre-employment and periodic medical checkups are not commonly

practiced in Ethiopia. As a result of this, money of food handlers working in different food establishments all over the country harbor one or more enteropathogens. For instance, a systematic review and meta-analysis reported that the overall pooled prevalence estimate of intestinal parasites among food handlers of food service establishments in Ethiopia was 33.6% (95% CI: 27.6, 39.6%) [13] and the common factors associated to high prevalence of intestinal pathogens among food handlers are poor hand hygiene, inadequate access to water and sanitation facilities, and poor socio-economic conditions [13-18]. However, the prevalence and risk factors may be different across various settings. Accordingly, this study was conducted to assess the prevalence of intestinal parasites and associated factors among food handlers working in food establishment in Lideta sub city of the Addis Ababa, Ethiopia.

91 **Methods**

92 **Study design and setting**

93 This an institution-based cross-sectional study with laboratory investigations was conducted in
94 Lideta sub city of Addis Ababa from March 20 to April 20, 2021. Lideta sub city is one of the 10
95 sub cities of Addis Ababa, the capital of Ethiopia. The sub city is divided into 10 districts
96 (woredas). In Lideta sub city, there are a total of 281 food establishments and 1124 food handlers
97 working in the food establishments.

98 **Sample size calculation and sampling techniques**

99 The sample size was calculated using simple population proportion formula with the following
100 assumptions: prevalence of intestinal parasites among food handlers in Addis Ababa University
101 students cafeteria, Addis Ababa, Ethiopia (p) = 45.3% [19], level of significance (α) = 5%, 95%
102 confidence interval (standard normal probability), z : the standard normal tabulated value, and
103 margin of error (d) = 5%.

$$104 \quad n = \frac{(Z_{\alpha/2})^2 P(1 - P)}{d^2} = \frac{(1.96)^2 0.453(1 - 0.453)}{0.05^2} = 381$$

105 The final sample size was 419 after considering 10% non-response rate. Using lists of food
106 handlers working in different food establishments in the sub city obtained from Addis Ababa
107 food, medicines, and healthcare administration authority (AAFMHACA) as a sampling frame,

1
2
3 108 we used computer generated simple random sampling technique to select food handlers. Food
4
5 109 handlers who treated with anti-helminthes and anti-protozoan drugs in the last four weeks were
6
7 110 excluded from the study.

8 9 111 **Stool sample collection**

10
11 112 Stool sample collectors first explained the purpose of collecting stool to the randomly selected
12
13 113 food handlers, and then asked them to urinate first without pooping to avoid urine contamination
14
15 114 of the stool. Stool sample collectors then handed out paper to food handlers and instructing them
16
17 115 to defecate on it to avoid stool contamination stored feces and dirt. Food handlers were asked to
18
19 116 bring approximately 50 g of the last part of the stool, the softest part, into the collection container
20
21 117 after defecating on the paper. The stool collectors then immediately stored the stool sample in to
22
23 118 a cold box after labeled a code on the outer surface of the plastic cup.

24 25 119 **Personal and food establishment data collection**

26
27 120 Pretested questionnaire with structured observational checklist was used to collect personal and
28
29 121 food establishment related information. The questionnaire was developed by reviewing related
30
31 122 published articles [15, 20-24]. The tool was first prepared in English language and translated to
32
33 123 the local Amharic language by two native Amharic speakers fluent in English, and back-
34
35 124 translated into English by two independent English language experts fluent in Amharic to check
36
37 125 consistency. The questionnaire consisted of three parts: i) socio-demographic characteristics of
38
39 126 food handlers, ii) food handlers' personal hygiene conditions, and iii) food establishment related
40
41 127 factors. Data collectors were trained in the data collection tool as well as ethical issues during
42
43 128 interviewing and observing. Supervisors supervised the data collection process and checked the
44
45 129 completeness of the data on a daily basis. We gathered handwashing data by assessing food
46
47 130 handlers' usual handwashing behavior using self-reports. We also looked at the hands of food
48
49 131 handlers to see the general cleanliness and conditions of fingernails. In addition, we asked food
50
51 132 handlers to demonstrate how they wash their hands on a regular basis, which we evaluated using
52
53 133 checklists for effective handwashing.

134 **Detection of ova of parasites in stool samples**

135 We used direct stool examination (wet mount) and formol-ether concentration techniques to
136 detect ova of intestinal parasites in stool samples. One drop of physiological saline was placed on
137 a clean slide. Using an applicator stick, a small amount of stool specimen was emulsified in
138 saline solution. The preparation was covered with a cover slip and examined under the
139 microscope for the absence or presence of an intestinal parasites. The entire saline preparation
140 was systematically examined for helminthes eggs, larvae, ciliates, cysts and oocysts using 10×
141 objective with condenser iris closed sufficiently to give good contrast, while 40 × objectives was
142 used to assist in the detection of eggs, cysts, and oocytes [25].

143 For the formol-ether concentration technique, an estimated 1 g of formed stool sample or 2 ml of
144 watery stool was emulsified in about 4 ml of 10% formol water contained in a screw-cap bottle.
145 A further 3 ml of 10% formol water was added and mixed well by shaking. The emulsified stool
146 samples were sieved and the sieved suspension transferred to a conical (centrifuge). 3 ml of
147 diethyl ether was added and the tube was stoppered mixed for 1 minute with a tissue wrapped
148 around the top of the tube, the stopper was loosen. It was then centrifuge at 3000 rpm for 1
149 minute. Using a stick, the layer of feces debris from the side of the tube was loosen and the tube
150 inverted to discard the ether, fecal debris, and formol water leaving behind the sediment. The
151 tube was returned to its upright position and the fluid from the sides of the tube allowed draining
152 to the bottom. The bottom of the tube was taped to re-suspend and mix the sediment. The
153 sediment was transferred to a slide and covered with a cover glass and was examined
154 microscopically using the 10x objective for focusing and 40× objective for proper identification.

155 Standard operating procedures were used for every laboratory procedure during lab examination,
156 stool specimen collection, transportation, and storing. The expiry date of normal saline, ether,
157 and formol was evaluated before stool sample preparation and examination.

158 **Outcome variable of the study**

159 Prevalence of intestinal parasites, the primary outcome variable of the study is defined as the
160 presence of one or more intestinal parasite species in stool samples.

161 **Data processing and analysis**

Data were entered using EPI-INFO version 3.5.3 statistical package and export into Statistical Package for Social Sciences (SPSS) version 20 for further analysis. For most variables, data were presented by frequencies and percentages. Univariable logistic regression analysis was used to choose variables for the multivariable logistic regression analysis, and variables which had p - value less than 0.25 by the univariable analysis were then analyzed by multivariable analysis for controlling the possible effect of confounders. Finally, variables which had significant association were identified on the basis of adjusted odds ratio (AOR) with 95% confidence interval (CI) and p-values < 0.05. Model fitness was check using Hosmer and Lemeshow goodness-of-fit test.

171 **Patient and public involvement**

172 No patient involved.

173 **Results**

174 **Socio-demographic characteristics of study participants**

175 We collected personal information and stool samples from a total 411 food handlers with a response rate of 97.62%. The majority, 293 (71.3%) of the study participants were female. About half, 198 (48.18%) of the respondents aged 25 years and below. Half, 207 (50.3 %) of the respondents reported that they completed primary school education. Two hundred and seventy-eight (67.6%) of the food handlers reported that they had 3 years or less work experience. One hundred and eleven (27.0%) of the food handlers earned <1500 Ethiopian birr (Table 1).

181 Table 1: Socio-demographic characteristics of food handlers (n = 411) working in different food establishments in Lideta sub city of Addis Ababa, Ethiopia, March 20 to April 20, 2021

Socio-demographic characteristics	Frequency	Percent
Sex of the respondents		
Female	293	71.3
Male	118	28.7
Age of the respondents in years		
≤25	198	48.2

26-35	113	27.5
36-50	100	24.3
Education status of the respondents		
Tertiary education	23	5.6
Secondary school	163	39.7
Primary school	207	50.3
Illiterate	18	4.4
Service year		
≤3 years	278	67.6
>3 years	133	33.4
Average monthly income in Ethiopian birr		
<1500	111	27.0
1501-2500	152	37.0
2501-3500	94	22.9
>3500	54	13.1

183 **Personal hygiene characteristics of food handlers**

184 Two hundred and forty-two (58.9%) of the food handlers did not keep their fingernails short.
 185 One hundred and ninety-four (47.2%) and 206 (50.1%) of the food handlers did not regularly
 186 wash hands with soap after visiting toilet and before eating, respectively. Two hundred and eight
 187 (50.6%) of the food handlers reported that they regularly worn clean protective clothes. About a
 188 quarter, 76 (24%) of the food handlers reported that they received food safety training and 121
 189 (29.4%) of the food handlers had medical checkup in the previous 6 months prior to the survey
 190 (Table 2).

191 Table 2: Personal hygiene characteristics of food handlers (n = 411) working in different food
 192 establishments in Lideta sub city of Addis Ababa, Ethiopia, March 20 to April 20, 2021

Variables	Frequency	Percent
Condition of fingernails		
Trimmed	169	41.1

Untrimmed	242	58.9
Regular hand washing with soap after toilet		
Yes	217	52.8
No	194	47.2
Regular hand washing with soap before eating		
Yes	205	49.9
No	206	50.1
Wearing clean protective clothes regularly		
Yes	208	50.6
No	203	49.4
Food safety training		
Yes	76	24
No	335	76
Medical checkup (in last 6 month)		
Yes	121	29.4
No	290	70.6

193

194 Intestinal parasites in food handlers

195 A total of 411 food handlers were examined, with 171 (41.6%) of them had ova of one or more
 196 intestinal parasites, of which 14 (3.4%) had mixed parasites (Figure 1). The most common
 197 intestinal parasites were *E. histolytica* [50 (12.2%)], *G. lamblia* [43 (10.5%)], *A. lumbricoides*
 198 [25 (6.1%)], Hookworms [15 (3.7%)], *T. trichuria* [14 (3.4%)], and Taenia species [10 (2.4%)]
 199 (Table 3).

200 Table 3: Common intestinal parasites detected among food handlers (n = 411) working in
 201 different food establishments in Lideta sub city of Addis Ababa, Ethiopia, March 20 to April 20,
 202 2021

Parasitic species	Frequency	Percent
<i>E. histolytica</i>	50	12.2
<i>G. lamblia</i>	43	10.5
<i>A. lumbricoides</i>	25	6.1

Hookworms	15	3.7
<i>T. trichuria</i> ,	14	3.4
Taenia species	10	2.4

203 Factors associated with intestinal parasites among food handlers

204 Table 4 shows factors associated with prevalence of intestinal parasites in food handlers. This
 205 study depicted that educational status of food handlers was significantly associated with
 206 intestinal parasites. Illiterate food handlers had higher odds to have intestinal parasite compared
 207 with food handlers who attended tertiary education (AOR: 3.13, 95% CI (1.34, 7.44)). Similarly,
 208 the odds of having intestinal parasites was higher among food handlers who attended primary
 209 education (AOR: 2.22, 95% (1.10, 6.65)) and secondary education (AOR: 2.16, 95% CI (1.10,
 210 5.20)) compared with food handlers who attended tertiary education. The prevalence of intestinal
 211 parasites was statistically associated with monthly income of food handlers. The odds of having
 212 intestinal parasites was 2.84 times higher among food handlers who earned below 1500
 213 Ethiopian birr per month (AOR: 2.84, 95% CI (1.50, 8.84)). This study revealed that intestinal
 214 parasites was significantly associated with hand hygiene of food handlers. Food handlers who
 215 did not keep their fingernails short had 4.36 more odds to have intestinal parasites compared with
 216 food handlers who trimmed fingernails (AOR: 4.36, 95% CI (1.98, 11.90)). The odds of having
 217 intestinal parasites was also 2.16 times higher among food handlers who did not wash hands with
 218 soap before eating (AOR: 2.16, 95% CI (1.03, 4.22)). Furthermore, intestinal parasites among
 219 food handlers was significantly associated with food safety training and medical checkup. The
 220 odds of having intestinal parasites was high among food handlers who did not take food safety
 221 training (AOR: 2.51, 95% CI (1.20, 5.58)) compared with food handlers who took food safety
 222 training and the odds of having intestinal parasites was 2.32 times higher among food handlers
 223 who did not take medical checkups in the previous six months prior to the survey (AOR: 2.32,
 224 95% CI (1.18, 6.95)).

225 Table 4: Factors associated with intestinal parasites among food handlers (n = 411) working in
 226 different food establishments in Lideta sub city of Addis Ababa, Ethiopia, March 20 to April 20,
 227 2021

Variables	Intestinal parasites	Crude odds ratio	Adjusted odds ratio
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	Yes	No	with 95% CI	with 95%
Educational status				
Illiterate	9	9	3.60 (1.81, 10.80)	3.13 (1.34, 7.44)*
Primary school	92	115	2.88 (1.65, 6.17)	2.22 (1.10, 6.65)*
Secondary school	68	95	2.58 (1.20, 5.56)	2.16 (1.10, 5.20)*
Tertiary education	5	18	1.0	1.0
Average monthly income in Ethiopian birr				
<1500	56	55	2.91 (1.43, 7.86)	2.84 (1.50, 8.84)*
1501-2500	68	84	2.31 (1.14, 6.96)	2.28 (0.63, 8.10)
2501-3500	33	61	1.55 (1.05, 4.85)	1.41 (0.60, 5.96)
>3500	14	40	1.0	1.0
Condition of fingernails				
Untrimmed	134	108	4.43 (2.12, 12.62)	4.36 (1.98, 11.90)**
Trimmed	37	132	1.0	1.0
Hand washing with soap after toilet				
No	101	93	2.28 (1.10, 7.51)	2.19 (0.92, 5.62)
Yes	70	147	1.0	1.0
Hand washing with soap before eating				
No	112	94	2.95 (1.23, 6.72)	2.16 (1.03, 4.22)*
Yes	59	146	1.0	1.0
Food safety training				
No	153	182	2.71 (1.34, 8.53)	2.51 (1.20, 5.58)*
Yes	18	58	1.0	1.0
Medical checkup in the last 6 month				
No	140	150	2.71 (1.27, 7.56)	2.32 (1.18, 6.95)*
Yes	31	90	1.0	1.0

Note: * statistically significant at $p < 0.05$, ** statistically significant at $p < 0.01$, Hosmer and Lemeshow goodness-of-fit test = 0.483

228 Discussion

229 This is an institution-based cross-sectional study assessed intestinal parasites among food
230 handlers working in food establishments in Lideta sub city of Addis Ababa, Ethiopia and found
231 that 41.6% of the food handlers had one or more intestinal parasites in the studied region. The
232 prevalence of intestinal parasites reported in this study was lower than findings of studies
233 conducted among food handlers in Bule Hora (46.3%) [16], Addis Ababa University (45.3%) [19],
234 Nekemte town (52.1%) [26], and Mekele University (49.4%) [15]. Furthermore, the prevalence of
235 intestinal parasites reported in the current study was higher than findings of studies conducted
236 among food handlers in Wolaita Sodo (23.6%) [14], Jimma (33%) [27], Madda Walabu University
237 (25.3%) [28], Motta town (27.6%) [29], Nairobi(15.7%)[30], Iran (9%) [31], Saudi Arabia (23%)
238 [32], and Thailand (10%) [33].The high prevalence of intestinal parasites among food handlers in
239 the studied region might be explained by poor socio-economic conditions, poor hand hygiene,
240 and inadequate access to basic sanitation services.

241 The high prevalence of intestinal parasites among the food handlers in studied region
242 suggests that poor hygiene practices of food handlers and inadequate access to sanitation
243 services. The results may also suggests that there might be transmission of intestinal parasitic
244 infections from food handlers to food users, unless large scale screening and mass drug
245 administration are done. As it is documented in literature, infected food handlers play a
246 significant role in infection transmissions to customers of the food establishments where the
247 infected food handlers are working [4].

248 This study showed that educational status of food handlers was associated with a high prevalence
249 of intestinal parasites. Prevalence of intestinal parasites was higher among food handlers who
250 were illiterate or attended primary and secondary education compared with food handlers who
251 attended tertiary education. This may be due to the fact that educated food handlers may have
252 awareness about the transmission and prevention methods of infectious diseases. Education
253 encourages changes in healthy behaviors. Other similar studies also reported the relation of
254 education with occurrence of parasitic infections [34-38].

255 The current study revealed that monthly income of food handlers was associated with intestinal
256 parasites in the studied region. Food handlers with low monthly income had higher odds of

1
2
3 257 intestinal parasites. This may be due to the fact that food handlers with low economic status
4
5 258 could not afford for services like soap, household water treatment, toilets and other facilities, and
6
7 259 so that will have limited opportunities to practice healthy measures. The effect of low income on
8
9 260 risk of parasites is complex and could be attributed to limited access to sanitary materials,
10
11 261 sources of drinking water and food, environment sanitation, and education [37-40].

12
13 262 The high prevalence of intestinal parasites among food handlers was associated with hand
14
15 263 hygiene. Food handlers who did not keep their fingernails short had higher odds to have
16
17 264 intestinal parasites and the odds of having intestinal parasites was also higher among food
18
19 265 handlers who did not wash hands with soap before eating. This might be due to the fact that the
20
21 266 area beneath the fingernails has the highest concentration of microorganisms on the hands and is
22
23 267 the most difficult to clean [41-44]. Moreover, food handlers may ingest diseases causing
24
25 268 pathogens when they eat without washing hands. Hands are one of the most important
26
27 269 mechanisms to transmit pathogenic microorganisms leading to infection [45]. Evidence indicates
28
29 270 that hands together with food contact or other environmental surfaces cause 60% of the spread of
30
31 271 gastrointestinal infection. Contaminated hands could also be associated with up to 50% of
32
33 272 respiratory tract infections [46].

34
35 273 This study depicted that intestinal parasites among food handlers was significantly associated
36
37 274 with food safety training. The odds of having intestinal parasites was high among food handlers
38
39 275 who did not take food safety training compared with their counterparts. This could be due to the
40
41 276 fact those food handlers who did not take food safety training may lack the necessary
42
43 277 knowledge and practice towards transmission and prevention of disease causing pathogens.
44
45 278 Moreover, food safety training or health education promotes health behaviors toward hygiene
46
47 279 and sanitation practices. Health education increases knowledge and acceptability of
48
49 280 interventions. It also sustains integrated control of the infection [47-49].

50
51 281 Furthermore, intestinal parasites was significantly associated with medical checkup. The odds of
52
53 282 having intestinal parasites was high among food handlers who did not take medical checkups in
54
55 283 the previous six months prior to the survey. Other studies are also reported that medical checkup
56
57 284 of food handlers is associated with intestinal parasites [15, 31, 50]. This is because food handlers
58
59 285 who did not know their health condition before employment and while working in different
60
286 establishments has less chance to take treatment and mass drugs as a result there may be existed

287 or new or re-infections.

288 **Conclusion**

289 The prevalence of intestinal parasites among food handlers in the studied region was found to
290 be high. This high prevalence of intestinal parasites was linked to socio-economic conditions
291 of food handlers, poor hand hygiene condition, absence of food safety trainings and regular
292 medical checkup. It is, therefore, important to promote hand washing practice of food
293 handlers, provide food hygiene and safety trainings, and establishing a system to regularly
294 check the health conditions of food handlers.

295 **Data availability statement**

296 Individual participant data after deidentification that underline the results reported in this article
297 will be made available upon requesting the primary author immediately following publication.

298 **Authors' contribution**

299 WA designed the study, facilitated data collection, and conducted data analysis. BG, TS, ZNM,
300 and ZG supervised data collection and analysis and contributed to conceptualizing the study. ZG
301 prepared the manuscript. All authors approved the final version of the manuscript.

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305 **Competing interest**

306 None of the authors have any competing interests in the manuscript.

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311 **Ethical Approval**

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3 312 The ethical and methodological issues of this protocol was approved by the institutional review
4
5 313 board (IRB) of Yanet Health College (reference number: YEC/060/21).
6

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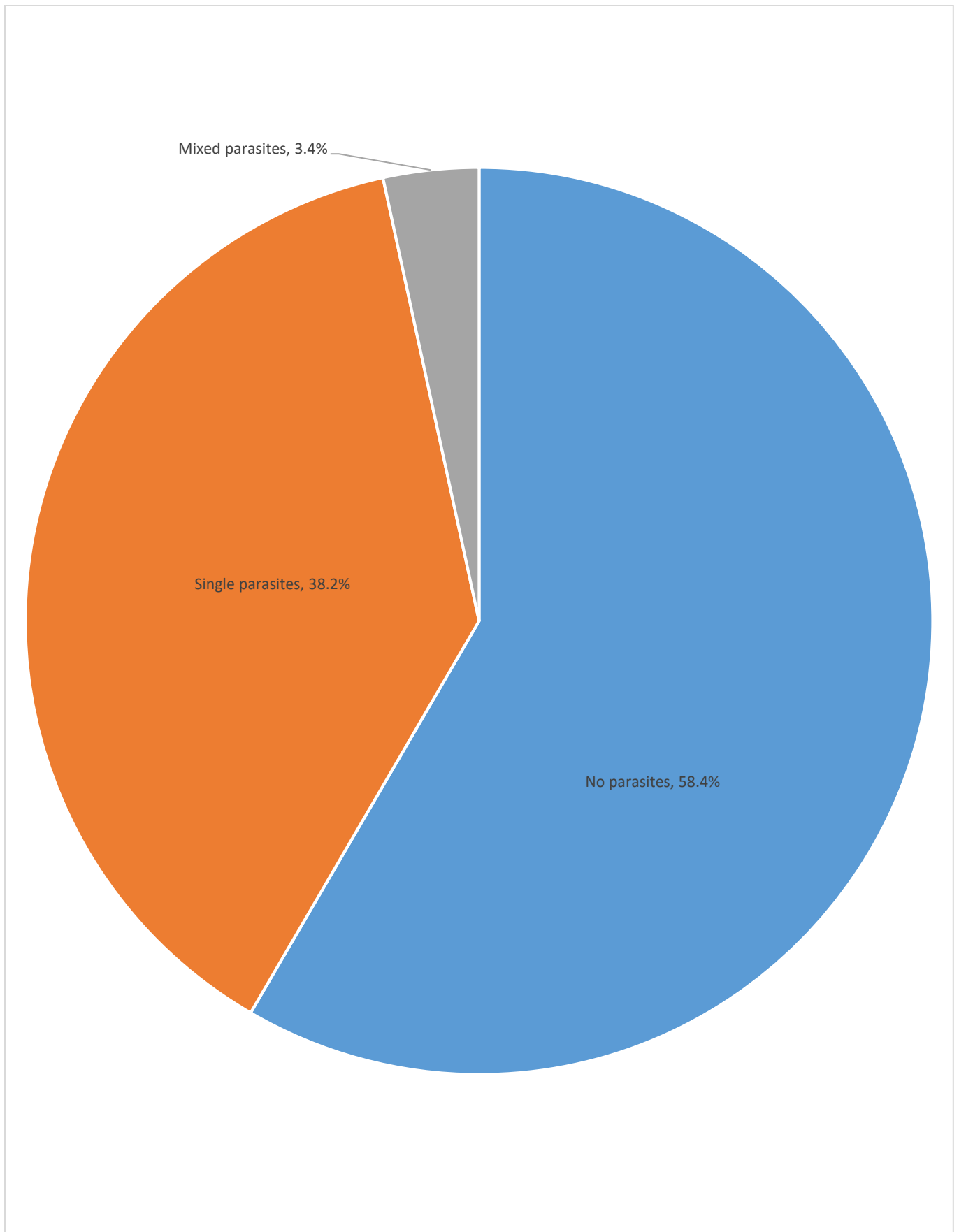
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16 460 **Figure caption**

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19 461 Figure 1: Proportion of food handlers with no, single and mixed parasites (n = 411) working in
20 462 different food establishments in Lideta sub city of Addis Ababa, Ethiopia, March 20 to April 20,
21 463 2021
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Prevalence of intestinal parasites and associated factors among food handlers in food establishments in the Lideta sub-city of Addis Ababa, Ethiopia: an institution-based cross-sectional study

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3 1 **Prevalence of intestinal parasites and associated factors among food handlers in food**
4 **establishments in the Lideta sub-city of Addis Ababa, Ethiopia: an institution-based cross-**
5 **sectional study**
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44 20 **Abstract**
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46 21 **Objectives:** This study was conducted to assess the prevalence of intestinal parasites and
47 associated factors among food handlers.
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51 23 **Design:** An institution-based cross-sectional study design was used. Stool samples were
52 collected from food handlers and examined using direct wet mount and formalin-ether
53 24 concentration (FEC) techniques. Personal and establishment related information was collected
54 25 using pretested questionnaire with structured observation. Multivariable binary logistic
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27 regression was used to identify factors associated with prevalence of intestinal parasites on the
28 basis of adjusted odds ratio and 95% confidence interval with $p < 0.05$.

29 **Setting:** This study was conducted in different food establishments in the Lideta sub-city of
30 Addis Ababa, Ethiopia.

31 **Participants:** Four hundred and eleven food handlers were participated in this study.

32 **Outcome measures:** The primary outcome is prevalence of intestinal parasites, which was
33 defined as presence of one or more intestinal parasitic species in stool samples.

34 **Results:** One or more intestinal parasites were detected in 171 (41.6%) (95% CI: 36.6, 46.4%)
35 of the stool samples. The most common intestinal parasites were *E. histolytica/dispar* (12.7 %),
36 *G. duodenalis* (11.2%), and *A. lumbricoides* (8.3%). This high prevalence of intestinal parasites
37 among food handlers was associated with low monthly income (AOR: 2.83, 95% CI:1.50,
38 8.84), untrimmed fingernails (AOR: 4.36, 95% CI: 1.98, 11.90), no food safety training
39 (AOR: 2.51, 95% CI: 1.20, 5.58), low level of education (AOR: 3.13, 95% CI: 1.34, 7.44),
40 poor handwashing practice (AOR: 2.16, 95% CI: 1.03, 4.22), and lack of medical checkup
41 (AOR: 2.31, 95% CI: 1.18, 6.95).

42 **Conclusion:** The prevalence of intestinal parasites among food handlers in food
43 establishments in the Lideta sub-city of Addis Ababa was high. This was linked to socio-
44 economic conditions, poor hand hygiene condition, and absence of food safety trainings. It is,
45 therefore, important to promote hand washing practice and providing food hygiene and safety
46 training is critical.

47 **Key words:** Intestinal parasites, food handlers, food establishments, hand hygiene, Ethiopia

48 **Strengths and limitations of this study**

- 49 - The study has focused on one of the most potential groups, i.e., food handlers that had
50 potential to spread food borne infections to the consumers.

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3 51 - The use of sensitive diagnostic techniques and combination of methods with triplicate
4 52 examinations applied in this study would help to recover greater rate of intestinal parasites
5 53 that would indicate the true prevalence.
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8 54 - As a limitation, the collection of a single stool sample may affect the result of parasitic
9 55 examination since the sensitivities of the direct smear examination technique is reduced when
10 56 a single stool sample is examined and the procedure of FEC technique may also damage the
11 57 eggs of parasites.

16 58 **Introduction**

19 59 Foodborne diseases are increasingly becoming a serious global public health problem. The
20 60 World Health Organization (WHO) estimate indicates that each year worldwide, unsafe food
21 61 causes 600 million cases of foodborne diseases and 420 000 deaths. WHO estimated that 33
22 62 million years of healthy lives are lost due to eating unsafe food globally each year, and this
23 63 number is likely an underestimation [1]. One of the causes of foodborne diseases is
24 64 contamination during food preparation; food handlers carrying pathogens might be involved in
25 65 the origin of this condition. Foods can be contaminated with fecal material at the point of
26 66 production or during food preparation, in both the home and in commercial premises [2]. Food
27 67 handlers with poor personal hygiene and inadequate knowledge on food safety could be potential
28 68 sources of infections. Food handlers who harbor and excrete enteropathogens may contaminate
29 69 foods from their feces via contaminated hands, then to food or food contact surfaces, and finally
30 70 to healthy individuals [3-7].

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40 71 The contribution of the infected food worker (whether symptomatic or not) to food borne disease
41 72 outbreaks has been difficult to establish. However, reports showed that food workers in many
42 73 settings have been responsible for foodborne disease outbreaks for decades. For instance,
43 74 members of the Committee on Control of Foodborne Illnesses of the International Association
44 75 for Food Protection analyzed 816 foodborne disease outbreaks with 80,682 cases in different
45 76 countries where food workers were implicated as the source of the contamination. The report
46 77 also estimated that infected food worker was documented as responsible for 18% of 766
47 78 outbreaks occurring in the United States [8, 9]. Moreover, according to the Centers for Disease
48 79 Control (CDC), as cited in Mathew RR (2019), 20 to 40% of food borne illness associated with
49 80 the consumption of contaminated food originated in catering establishments [10].

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3 81 Food handling personnel play a role in the transmission of food borne diseases. The health of
4 82 food handlers is of great importance for maintaining quality of food products. Accordingly, pre-
5 83 employment and periodic medical checkup is very important to safeguard the consumers from
6 84 getting diseases from contaminated foods along with other food safety measures [11, 12].
7
8 85 However, pre-employment and periodic medical checkups are not commonly practiced in
9 86 Ethiopia. As a result of this, many of the food handlers working in different food establishments
10 87 all over the country may harbor one or more enteropathogens. For instance, a systematic review
11 88 and meta-analysis reported that the overall pooled prevalence estimate of intestinal parasites
12 89 among food handlers of food service establishments in Ethiopia was 33.6% (95% CI: 27.6,
13 90 39.6%) [13] and the common factors associated to high prevalence of intestinal pathogens among
14 91 food handlers are poor hand hygiene, inadequate access to water and sanitation facilities, and
15 92 poor socio-economic conditions [13-18]. However, the prevalence and risk factors may be
16 93 different across various settings. Accordingly, this study was conducted to assess the prevalence
17 94 of intestinal parasites and associated factors among food handlers working in food establishment
18 95 in the Lideta sub-city of Addis Ababa, Ethiopia.

29 30 96 **Methods**

31 32 97 **Study design and setting**

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34 98 This an institution-based cross-sectional study with laboratory investigations was conducted in
35 99 the Lideta sub-city of Addis Ababa from March 20 to April 20, 2021. Lideta sub-city is one of
36 100 the 10 sub cities of Addis Ababa, the capital of Ethiopia. The sub-city is located at the global
37 101 positioning system (GPS) coordinates of 9°0'N and 38°45'E. The sub city is divided into 10
38 102 districts (Figure 1). In the Lideta sub-city, there are a total of 281 food establishments and 1124
39 103 food handlers working in the food establishments.

40 104 **Sample size calculation and sampling techniques**

41 105 The sample size was calculated using single population proportion formula with the following
42 106 assumptions: prevalence of intestinal parasites among food handlers in Addis Ababa University
43 107 students cafeteria, Addis Ababa, Ethiopia (p) = 45.3% [19], level of significance (α) = 5%, 95%
44 108 confidence interval (standard normal probability), z : the standard normal tabulated value, and
45 109 margin of error (d) = 5%.

$$n = \frac{(Z_{\alpha/2})^2 P(1 - P)}{d^2} = \frac{(1.96)^2 0.453(1 - 0.453)}{0.05^2} = 381$$

The final sample size was 419 after considering 10% non-response rate. The Lideta sub-city was selected at random from a total of 10 sub-cities of Addis Ababa, Ethiopia. Using lists of food handlers working in different food establishments in the sub-city obtained from Addis Ababa food, medicines, and healthcare administration authority (AAFMHACA) as a sampling frame, we used computer generated random number to select food handlers. Food handlers who treated with anti-helminthes and anti-protozoan drugs in the last four weeks were excluded from the study.

118 **Stool sample collection**

Stool sample collectors first explained the purpose of collecting stool to the randomly selected food handlers, and then asked them to urinate first without pooping to avoid urine contamination of the stool. Stool sample collectors then handed out paper to food handlers and instructing them to defecate on it to avoid stool contamination with stored feces and dirt. Food handlers were asked to bring approximately 50 g of the last part of the stool, the softest part, into the collection container after defecating on the paper. Stool sample collectors didn't violate privacy of food handlers during stool sample collection. Stool sample collectors then immediately stored the stool sample in to a cold box after labeled a code on the outer surface of the plastic cup.

127 **Personal and food establishment data collection**

We used structured questionnaire and observational checklist to collect food handlers' personal data and food establishments' related information. The questionnaire was developed by reviewing related published articles [15, 20-24]. The tool was first prepared in English language and translated to the local Amharic language by two native Amharic speakers fluent in English, and back-translated into English by two independent English language experts fluent in Amharic to check consistency. The questionnaire consisted of three parts: i) socio-demographic characteristics of food handlers, ii) food handlers' personal hygiene conditions, and iii) food establishment related factors. The questionnaire was pretested to evaluate the instructions, response format, and questions work as intended and are understood by those individuals who are likely to respond to them. Data collectors were trained in the data collection tool as well as

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2
3 138 ethical issues during interviewing and observing. Supervisors supervised the data collection
4
5 139 process and checked the completeness of the data on a daily basis. We gathered handwashing
6
7 140 data by assessing food handlers' usual handwashing behavior using self-reports. We also looked
8
9 141 at the hands of food handlers to see the general cleanliness and conditions of fingernails. In
10
11 142 addition, we asked food handlers to demonstrate how they wash their hands on a regular basis,
12
13 143 which we evaluated using checklists for effective handwashing.

14 144 **Detection of ova of parasites in stool samples**

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16
17 145 We used direct stool examination (wet mount) and FEC techniques to detect ova of intestinal
18
19 146 parasites in stool samples. One drop of physiological saline was placed on a clean slide. Using an
20
21 147 applicator stick, a small amount of stool specimen was emulsified in saline solution. The
22
23 148 preparation was covered with a cover slip and examined under the microscope for the absence or
24
25 149 presence of an intestinal parasites. The entire saline preparation was systematically examined for
26
27 150 helminthes eggs, larvae, ciliates, cysts and oocysts using 10× objective with condenser iris closed
28
29 151 sufficiently to give good contrast, while 40 × objectives was used to assist in the detection of
30
31 152 eggs, cysts, and oocytes [25].

32 153 For the FEC technique, an estimated 1 g of formed stool sample or 2 ml of watery stool was
33
34 154 emulsified in about 4 ml of 10% formol water contained in a screw-cap bottle. A further 3 ml of
35
36 155 10% formol water was added and mixed well by shaking. The emulsified stool samples were
37
38 156 sieved and the sieved suspension transferred to a conical (centrifuge). 3 ml of diethyl ether was
39
40 157 added and the tube was stoppered mixed for 1 minute with a tissue wrapped around the top of the
41
42 158 tube, the stopper was loosen. It was then centrifuge at 3000 rpm for 1 minute. Using a stick, the
43
44 159 layer of feces debris from the side of the tube was loosen and the tube inverted to discard the
45
46 160 ether, fecal debris, and formol water leaving behind the sediment. The tube was returned to its
47
48 161 upright position and the fluid from the sides of the tube allowed draining to the bottom. The
49
50 162 bottom of the tube was taped to re-suspend and mix the sediment. The sediment was transferred
51
52 163 to a slide and covered with a cover glass and was examined microscopically using the 10x
53
54 164 objective for focusing and 40× objective for proper identification.

55 165 Standard operating procedures were used for every laboratory procedure during lab examination,
56
57 166 stool specimen collection, transportation, and storing. We used stool sample collection and

1
2
3 167 transportation containers which are leak-proof, dry clean and free from any traces of
4
5 168 disinfectants. We ensured correct labelling of stool sample containers with date of sample
6
7 169 collection, and code of the study participants. All stool specimens were stored in ice box for
8
9 170 transportation and preserved at 4°C in the laboratory until analyzed for ova of parasites.
10
11 171 Triplicate examinations of stool samples were applied to improve the recovery rate of intestinal
12
13 172 parasites. Moreover, the expiry date of normal saline, ether, and formol was evaluated before
14
15 173 stool sample preparation and examination.

16 174 **Outcome variable of the study**

17
18 175 Prevalence of intestinal parasites, the primary outcome variable of the study is defined as the
19
20 176 presence of one or more intestinal parasite species in stool samples.

21 177 **Data processing and analysis**

22
23 178 Data were entered using EPI-INFO version 3.5.3 statistical package and export into Statistical
24
25 179 Package for Social Sciences (SPSS) version 20 for further analysis. For most variables, data were
26
27 180 presented by frequencies and percentages. Univariable binary logistic regression analysis was
28
29 181 used to choose variables for the multivariable binary logistic regression analysis, and variables
30
31 182 which had p - value less than 0.25 by the univariable analysis were then analyzed by
32
33 183 multivariable analysis for controlling the possible effect of confounders. In the adjusted model,
34
35 184 variables which had significant association were identified on the basis of adjusted odds ratio
36
37 185 (AOR) with 95% confidence interval (CI) and p-values < 0.05. Model fitness was check using
38
39 186 Hosmer and Lemeshow goodness-of-fit test.

40 187 **Ethics approval and consent to participate**

41
42 188 Ethical clearance was obtained from the Institutional Review Board of Yanet Health College
43
44 189 (reference number: YEC/060/21). There were no risks due to participation and the collected data
45
46 190 were used only for this research purpose with complete confidentiality and privacy of food
47
48 191 handlers during stool sample collection was assured. Written informed consent was obtained
49
50 192 from food handlers. Furthermore, we advised food handlers who had one or more ova of
51
52 193 parasites to visit health institutions for treatment. All the methods were carried out in accordance
53
54 194 with relevant guidelines and regulations.

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3 **195 Patient and public involvement**
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5
6 196 No patient involved.
7

8 **197 Results**
9

10
11 **198 Socio-demographic characteristics of study participants**
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13
14 199 We collected personal information and stool samples from a total 411 food handlers with a
15 200 response rate of 97.62%. The majority, 293 (71.3%) of the study participants were female. The
16 201 median age of the respondents was 28 and the interquartile range (IQR) was 20 and 39 years.
17 202 About half, 198 (48.18%) of the respondents aged 25 years and below. Half, 207 (50.3 %) of the
18 203 respondents reported that they completed primary school education. Two hundred and seventy-
19 204 eight (67.6%) of the food handlers reported that they had 3 years or less work experience. One
20 205 hundred and eleven (27.0%) of the food handlers earned <1500 Ethiopian birr (Table 1).
21
22
23
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25

26
27 206 Table 1: Socio-demographic characteristics of food handlers (n = 411) working in different food
28 207 establishments in the Lideta sub-city of Addis Ababa, Ethiopia, March 20 to April 20, 2021
29
30

Socio-demographic characteristics	Frequency	Percent
Sex of the respondents		
Female	293	71.3
Male	118	28.7
Age of the respondents in years		
≤25	198	48.2
26-35	113	27.5
36-50	100	24.3
Education status of the respondents		
Tertiary education	23	5.6
Secondary school	163	39.7
Primary school	207	50.3
Illiterate	18	4.4
Service year		

≤3 years	278	67.6
>3 years	133	33.4
Average monthly income in Ethiopian birr		
<1500	111	27.0
1501-2500	152	37.0
2501-3500	94	22.9
>3500	54	13.1

208 **Personal hygiene characteristics of food handlers**

209 Two hundred and forty-two (58.9%) of the food handlers did not keep their fingernails short.
 210 One hundred and ninety-four (47.2%) and 206 (50.1%) of the food handlers did not regularly
 211 wash hands with soap after visiting toilet and before eating, respectively. Two hundred and eight
 212 (50.6%) of the food handlers reported that they regularly worn clean protective clothes. About a
 213 quarter, 76 (24%) of the food handlers reported that they received food safety training and 121
 214 (29.4%) of the food handlers had medical checkup in the previous 6 months prior to the survey
 215 (Table 2).

216 Table 2: Personal hygiene characteristics of food handlers (n = 411) working in different food
 217 establishments in the Lideta sub-city of Addis Ababa, Ethiopia, March 20 to April 20, 2021

Variables	Frequency	Percent
Condition of fingernails		
Trimmed	169	41.1
Untrimmed	242	58.9
Regular hand washing with soap after toilet		
Yes	217	52.8
No	194	47.2
Regular hand washing with soap before eating		
Yes	205	49.9
No	206	50.1
Wearing clean protective clothes regularly		

Yes	208	50.6
No	203	49.4
Food safety training		
Yes	76	24
No	335	76
Medical checkup (in last 6 month)		
Yes	121	29.4
No	290	70.6

218

219 Intestinal parasites in food handlers

220 A total of 411 food handlers were examined, with 171 (41.6%) (95% CI: 36.6, 46.4%) of them
 221 had ova of one or more intestinal parasites [98 (23.8% were protozoan and 73 (17.8%) were
 222 helminth parasites], of which 14 (3.4%) had mixed parasites (Figure 2). The most common
 223 intestinal parasites were *E. histolytica/dispar* [52 (12.7%)], *G. duodenalis* [46 (11.2%)], *A.*
 224 *lumbricoides* [34 (8.3%)], Hookworms [15 (3.6%)], *T. trichuria* [14 (3.4%)], and Taenia species
 225 [10 (2.4%)] (Table 3).

226 Table 3: Common intestinal parasites detected among food handlers (n = 411) working in
 227 different food establishments in the Lideta sub-city of Addis Ababa, Ethiopia, March 20 to April
 228 20, 2021

Parasitic species	Frequency	Percent
<i>E.histolytica/dispar</i>	52	12.7
<i>G. duodenalis</i>	46	11.2
<i>A. lumbricoides</i>	34	8.3
Hookworms	15	3.6
<i>T. trichuria,</i>	14	3.4
Taenia species	10	2.4

229 Factors associated with intestinal parasites among food handlers

230 Table 4 shows factors associated with prevalence of intestinal parasites in food handlers working
 231 in different food establishments in the Lideta sub-city of Addis Ababa, Ethiopia. Prevalence of
 232 intestinal parasites among food handlers was associated with low monthly income (AOR: 2.83,

233 95% CI:1.50, 8.84), untrimmed fingernails (AOR: 4.36, 95% CI: 1.98, 11.90), no food safety
 234 training (AOR: 2.51, 95% CI: 1.20, 5.58), low level of education (AOR: 3.13, 95% CI: 1.34,
 235 7.44), poor handwashing practice (AOR: 2.16, 95% CI: 1.03, 4.22), and lack of medical
 236 checkup (AOR: 2.31, 95% CI: 1.18, 6.95).

237 Table 4: Factors associated with intestinal parasites among food handlers (n = 411) working in
 238 different food establishments in the Lideta sub-city of Addis Ababa, Ethiopia, March 20 to April
 239 20, 2021

Variables	Intestinal parasites		COR (95% CI)	AOR (95% CI)
	Yes	No		
Educational status				
Illiterate	9	9	3.60 (1.81, 10.80)	3.13 (1.34, 7.44)*
Primary school	92	115	2.88 (1.65, 6.17)	2.22 (1.10, 6.65)*
Secondary school	68	95	2.58 (1.20, 5.56)	2.16 (1.10, 5.20)*
Tertiary education	5	18	1.0	1.0
Average monthly income in Ethiopian birr				
<1500	56	55	2.91 (1.43, 7.86)	2.84 (1.50, 8.84)*
1501-2500	68	84	2.31 (1.14, 6.96)	2.28 (0.63, 8.10)
2501-3500	33	61	1.55 (1.05, 4.85)	1.41 (0.60, 5.96)
>3500	14	40	1.0	1.0
Condition of fingernails				
Untrimmed	134	108	4.43 (2.12, 12.62)	4.36 (1.98, 11.90)**
Trimmed	37	132	1.0	1.0
Hand washing with soap after toilet				
No	101	93	2.28 (1.10, 7.51)	2.19 (0.92, 5.62)
Yes	70	147	1.0	1.0
Hand washing with soap before eating				
No	112	94	2.95 (1.23, 6.72)	2.16 (1.03, 4.22)*
Yes	59	146	1.0	1.0
Food safety training				

No	153	182	2.71 (1.34, 8.53)	2.51 (1.20, 5.58)*
Yes	18	58	1.0	1.0
Medical checkup in the last 6 month				
No	140	150	2.71 (1.27, 7.56)	2.32 (1.18, 6.95)*
Yes	31	90	1.0	1.0

Note: * statistically significant at $p < 0.05$, ** statistically significant at $p < 0.01$, Hosmer and Lemeshow goodness-of-fit test =0.483

240 Discussion

241 This is an institution-based cross-sectional study assessed intestinal parasites among food
 242 handlers working in food establishments in the Lideta sub-city of Addis Ababa, Ethiopia and
 243 found that 41.6% (95% CI: 36.6, 46.4%) of the food handlers had one or more intestinal
 244 parasites. The prevalence of intestinal parasites reported in this study was comparable with
 245 findings of studies conducted among food handlers in Bule Hora (46.3%) [16] and Addis Ababa
 246 University (45.3%) [19]. The prevalence of intestinal parasites reported in this study was lower
 247 than findings of studies in Nekemte town (52.1%) [26] and Mekele University (49.4%) [15].
 248 Furthermore, the prevalence of intestinal parasites reported in the current study was higher than
 249 findings of studies conducted among food handlers in Wolaita Sodo (23.6%) [14], Jimma (33%)
 250 [27], Madda Walabu University (25.3%) [28], Motta town (27.6%) [29], Nairobi(15.7%)[30],
 251 Iran (9%) [31], Saudi Arabia (23%) [32], and Thailand (10%) [33].The high prevalence of
 252 intestinal parasites among food handlers among food handlers working in food establishments in
 253 the Lideta sub-city of Addis Ababa might be explained by poor socio-economic conditions, poor
 254 hand hygiene, and inadequate access to basic sanitation services.

255 The high prevalence of intestinal parasites among food handlers working in food
 256 establishments in the Lideta sub-city suggests that poor hygiene practices of food handlers and
 257 inadequate access to sanitation services. The results may also suggests that there might be
 258 transmission of intestinal parasitic infections from food handlers to food users, unless large
 259 scale screening and mass drug administration are done. As it is documented in literature, infected
 260 food handlers play a significant role in infection transmissions to customers of the food
 261 establishments where the infected food handlers are working [4].

1
2
3 262 This study showed that educational status of food handlers was associated with a high prevalence
4
5 263 of intestinal parasites. Prevalence of intestinal parasites was higher among food handlers who
6
7 264 were illiterate or attended primary and secondary education compared with food handlers who
8
9 265 attended tertiary education. This may be due to the fact that educated food handlers may have
10
11 266 awareness about the transmission and prevention methods of infectious diseases. Education
12
13 267 encourages changes in healthy behaviors. Other similar studies also reported the relation of
14
15 268 education with occurrence of parasitic infections [34-38].

16
17 269 The current study revealed that monthly income of food handlers was associated with intestinal
18
19 270 parasites among food handlers. Food handlers with low monthly income had higher odds of
20
21 271 intestinal parasites. This may be due to the fact that food handlers with low economic status
22
23 272 could not afford for services like soap, household water treatment, toilets and other facilities, and
24
25 273 so that will have limited opportunities to practice healthy measures. The effect of low income on
26
27 274 risk of parasites is complex and could be attributed to limited access to sanitary materials,
28
29 275 sources of drinking water and food, environment sanitation, and education [37-40].

30
31 276 The high prevalence of intestinal parasites among food handlers was associated with hand
32
33 277 hygiene. Food handlers who did not keep their fingernails short had higher odds to have
34
35 278 intestinal parasites and the odds of having intestinal parasites was also higher among food
36
37 279 handlers who did not wash hands with soap before eating. This might be due to the fact that the
38
39 280 area beneath the fingernails has the highest concentration of microorganisms on the hands and is
40
41 281 the most difficult to clean [41-44]. Moreover, food handlers may ingest diseases causing
42
43 282 pathogens when they eat without washing hands. Hands are one of the most important
44
45 283 mechanisms to transmit pathogenic microorganisms leading to infection [45]. Evidence indicates
46
47 284 that hands together with food contact or other environmental surfaces cause 60% of the spread of
48
49 285 gastrointestinal infection. Contaminated hands could also be associated with up to 50% of
50
51 286 respiratory tract infections [46].

52
53 287 This study depicted that intestinal parasites among food handlers was significantly associated
54
55 288 with food safety training. The odds of having intestinal parasites was high among food handlers
56
57 289 who did not take food safety training compared with their counterparts. This could be due to the
58
59 290 fact those food handlers who did not take food safety training may lack the necessary
60
291 knowledge and practice towards transmission and prevention of disease causing pathogens.

292 Moreover, food safety training or health education promotes health behaviors toward hygiene
293 and sanitation practices. Health education increases knowledge and acceptability of
294 interventions. It also sustains integrated control of the infection [47-49].

295 Furthermore, intestinal parasites was significantly associated with medical checkup. The odds of
296 having intestinal parasites was high among food handlers who did not take medical checkups in
297 the previous six months prior to the survey. Other studies are also reported that medical checkup
298 of food handlers is associated with intestinal parasites [15, 31, 50]. This is because food handlers
299 who did not know their health condition before employment and while working in different
300 establishments has less chance to take treatment and mass drugs as a result there may be existed
301 or new or re-infections.

302 To increase the degree to which inferences from the sample population can be generalized to a
303 larger group of population, we recruited study participants at random or in a manner in which
304 they are representative of the population that we wish to study and we granted that every member
305 of the population had an equal chance to be included in the study. In addition, we calculated
306 adequately powered sample size using sample size determination procedures appropriate to the
307 study objective with appropriate assumptions. Furthermore, our findings could be applicable to
308 other situations and settings which have similar characteristics with the study populations of the
309 current studies.

310 As a limitation, even if the use of sensitive diagnostic techniques and combination of methods
311 with triplicate examinations applied in this study would help to recover greater rate of intestinal
312 parasites that would indicate the true prevalence, this study had some limitations. The collection
313 of a single stool sample may affect the result of parasitic examination since the sensitivities of
314 the direct smear examination technique is reduced when a single stool sample is examined. The
315 procedure of FEC technique may also damage the eggs of parasites. Moreover, the handwashing
316 data assessed by self-reports may not be reliable since the study subjects may make the more
317 socially acceptable answer rather than being truthful and they may not be able to assess
318 themselves accurately.

319 **Conclusion**

320 The prevalence of intestinal parasites among food handlers working in food establishments in
321 the Lideta sub-city of Addis Ababa, Ethiopia was found to be high. This high prevalence of
322 intestinal parasites was linked to socio-economic conditions of food handlers, poor hand
323 hygiene condition, absence of food safety trainings and regular medical checkup. It is,
324 therefore, important to promote hand washing practice of food handlers, provide food
325 hygiene and safety trainings, and establishing a system to regularly check the health
326 conditions of food handlers.

327 **Data availability statement**

328 Individual participant data after deidentification that underlie the results reported in this article
329 will be made available upon requesting the primary author immediately following publication.

330 **Authors' contribution**

331 WA designed the study, facilitated data collection, and conducted data analysis. BG, TS, ZNM,
332 and ZG supervised data collection and analysis and contributed to conceptualizing the study. ZG
333 prepared the manuscript. All authors approved the final version of the manuscript.

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336 collection tools and data collectors' fee was covered by the principal investigator, i.e., WA.

337 **Competing interest**

338 None of the authors have any competing interests in the manuscript.

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3 489 **Figure caption**
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6 490 Figure 1: Map of Addis Ababa city (A) and Lideta sub-city (B) (source: Lideta sub-city
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8 491 administration)
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10 492 Figure 2: Proportion of food handlers with no, single and mixed parasites (n = 411) working
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12 493 in different food establishments in Lideta sub city of Addis Ababa, Ethiopia, March 20 to April
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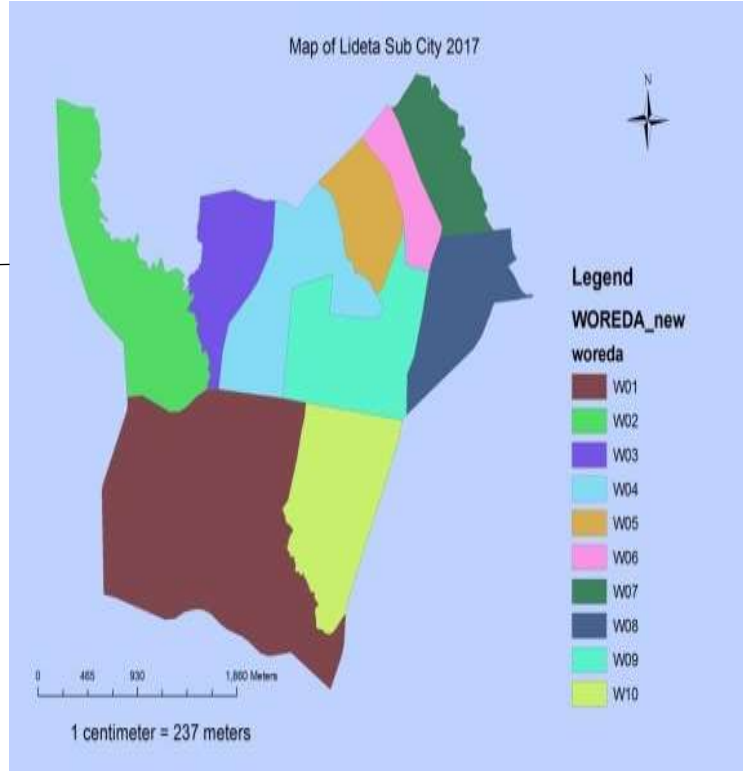
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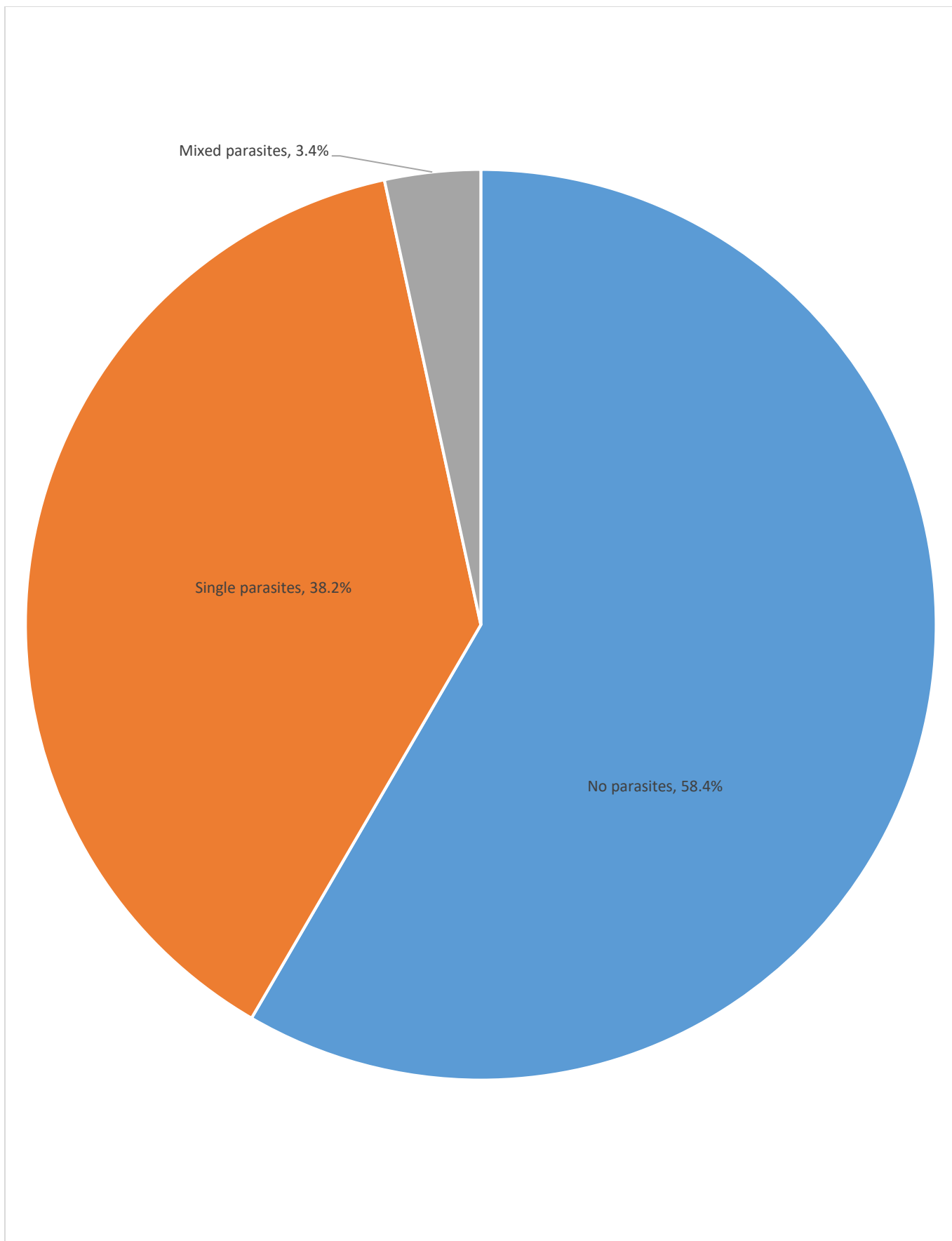


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Prevalence of intestinal parasites and associated factors among food handlers in food establishments in the Lideta sub-city of Addis Ababa, Ethiopia: an institution-based cross-sectional study

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3 1 **Prevalence of intestinal parasites and associated factors among food handlers in food**
4 **establishments in the Lideta sub-city of Addis Ababa, Ethiopia: an institution-based cross-**
5 **sectional study**
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42
43 20 **Abstract**
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46 21 **Objectives:** This study was conducted to assess the prevalence of intestinal parasites and
47 associated factors among food handlers.
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49
50 23 **Design:** An institution-based cross-sectional study design was used. Stool samples were
51 collected from food handlers and examined using direct wet mount and formalin-ether
52 concentration (FEC) techniques. Personal and establishment related information was collected
53 using pretested questionnaire with structured observation. Multivariable binary logistic
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27 regression was used to identify factors associated with prevalence of intestinal parasites on the
28 basis of adjusted odds ratio and 95% confidence interval with $p < 0.05$.

29 **Setting:** This study was conducted in different food establishments in the Lideta sub-city of
30 Addis Ababa, Ethiopia.

31 **Participants:** Four hundred and eleven food handlers were participated in this study.

32 **Outcome measures:** The primary outcome is prevalence of intestinal parasites, which was
33 defined as presence of one or more intestinal parasitic species in stool samples.

34 **Results:** One or more intestinal parasites were detected in 171 (41.6%) (95% CI: 36.6, 46.4%)
35 of the stool samples. The most common intestinal parasites were *E. histolytica/dispar* (12.7 %),
36 *G. duodenalis* (11.2%), and *A. lumbricoides* (8.3%). This high prevalence of intestinal parasites
37 among food handlers was associated with low monthly income (AOR: 2.83, 95% CI:1.50,
38 8.84), untrimmed fingernails (AOR: 4.36, 95% CI: 1.98, 11.90), no food safety training
39 (AOR: 2.51, 95% CI: 1.20, 5.58), low level of education (AOR: 3.13, 95% CI: 1.34, 7.44),
40 poor handwashing practice (AOR: 2.16, 95% CI: 1.03, 4.22), and lack of medical checkup
41 (AOR: 2.31, 95% CI: 1.18, 6.95).

42 **Conclusion:** The prevalence of intestinal parasites among food handlers in food
43 establishments in the Lideta sub-city of Addis Ababa was high. This was linked to socio-
44 economic conditions, poor hand hygiene condition, and absence of food safety trainings. It is,
45 therefore, important to promote hand washing practice and providing food hygiene and safety
46 training is critical.

47 **Key words:** Intestinal parasites, food handlers, food establishments, hand hygiene, Ethiopia

48 **Strengths and limitations of this study**

- 49 - The study has focused on one of the most potential groups, i.e., food handlers that had
50 potential to spread food borne infections to the consumers.

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3 51 - The use of sensitive diagnostic techniques and combination of methods with triplicate
4 52 examinations applied in this study would help to recover greater rate of intestinal parasites
5 53 that would indicate the true prevalence.
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7
8 54 - As a limitation, the collection of a single stool sample may affect the result of parasitic
9 55 examination since the sensitivities of the direct smear examination technique is reduced when
10 56 a single stool sample is examined and the procedure of FEC technique may also damage the
11 57 eggs of parasites.

16 58 **Introduction**

19 59 Foodborne diseases are increasingly becoming a serious global public health problem. The
20 60 World Health Organization (WHO) estimate indicates that each year worldwide, unsafe food
21 61 causes 600 million cases of foodborne diseases and 420 000 deaths. WHO estimated that 33
22 62 million years of healthy lives are lost due to eating unsafe food globally each year, and this
23 63 number is likely an underestimation [1]. One of the causes of foodborne diseases is
24 64 contamination during food preparation; food handlers carrying pathogens might be involved in
25 65 the origin of this condition. Foods can be contaminated with fecal material at the point of
26 66 production or during food preparation, in both the home and in commercial premises [2]. Food
27 67 handlers with poor personal hygiene and inadequate knowledge on food safety could be potential
28 68 sources of infections. Food handlers who harbor and excrete enteropathogens may contaminate
29 69 foods from their feces via contaminated hands, then to food or food contact surfaces, and finally
30 70 to healthy individuals [3-7].

31 71 The contribution of the infected food worker (whether symptomatic or not) to food borne disease
32 72 outbreaks has been difficult to establish. However, reports showed that food workers in many
33 73 settings have been responsible for foodborne disease outbreaks for decades. For instance,
34 74 members of the Committee on Control of Foodborne Illnesses of the International Association
35 75 for Food Protection analyzed 816 foodborne disease outbreaks with 80,682 cases in different
36 76 countries where food workers were implicated as the source of the contamination. The report
37 77 also estimated that infected food worker was documented as responsible for 18% of 766
38 78 outbreaks occurring in the United States [8, 9]. Moreover, according to the Centers for Disease
39 79 Control (CDC), as cited in Mathew RR (2019), 20 to 40% of food borne illness associated with
40 80 the consumption of contaminated food originated in catering establishments [10].

1
2
3 81 Food handling personnel play a role in the transmission of food borne diseases. The health of
4 82 food handlers is of great importance for maintaining quality of food products. Accordingly, pre-
5 83 employment and periodic medical checkup is very important to safeguard the consumers from
6 84 getting diseases from contaminated foods along with other food safety measures [11, 12].
7
8 85 However, pre-employment and periodic medical checkups are not commonly practiced in
9 86 Ethiopia. As a result of this, many of the food handlers working in different food establishments
10 87 all over the country may harbor one or more enteropathogens. For instance, a systematic review
11 88 and meta-analysis reported that the overall pooled prevalence estimate of intestinal parasites
12 89 among food handlers of food service establishments in Ethiopia was 33.6% (95% CI: 27.6,
13 90 39.6%) [13] and the common factors associated to high prevalence of intestinal pathogens among
14 91 food handlers are poor hand hygiene, inadequate access to water and sanitation facilities, and
15 92 poor socio-economic conditions [13-18]. However, the prevalence and risk factors may be
16 93 different across various settings. Accordingly, this study was conducted to assess the prevalence
17 94 of intestinal parasites and associated factors among food handlers working in food establishment
18 95 in the Lideta sub-city of Addis Ababa, Ethiopia.

96 **Methods**

97 **Study design and setting**

98 This an institution-based cross-sectional study with laboratory investigations was conducted in
99 the Lideta sub-city of Addis Ababa from March 20 to April 20, 2021. Lideta sub-city is one of
100 the 10 sub cities of Addis Ababa, the capital of Ethiopia. The sub-city is located at the global
101 positioning system (GPS) coordinates of 9°0'N and 38°45'E. The sub city is divided into 10
102 districts (Figure 1). In the Lideta sub-city, there are a total of 281 food establishments and 1124
103 food handlers working in the food establishments.

104 **Sample size calculation and sampling techniques**

105 The sample size was calculated using single population proportion formula with the following
106 assumptions: prevalence of intestinal parasites among food handlers in Addis Ababa University
107 students cafeteria, Addis Ababa, Ethiopia (p) = 45.3% [19], level of significance (α) = 5%, 95%
108 confidence interval (standard normal probability), z : the standard normal tabulated value, and
109 margin of error (d) = 5%.

$$n = \frac{(Z_{\alpha/2})^2 P(1 - P)}{d^2} = \frac{(1.96)^2 0.453(1 - 0.453)}{0.05^2} = 381$$

The final sample size was 419 after considering 10% non-response rate. The Lideta sub-city was selected at random from a total of 10 sub-cities of Addis Ababa, Ethiopia. Using lists of food handlers working in different food establishments in the sub-city obtained from Addis Ababa food, medicines, and healthcare administration authority (AAFMHACA) as a sampling frame, we used computer generated random number to select food handlers. Food handlers who treated with anti-helminthes and anti-protozoan drugs in the last four weeks were excluded from the study.

118 **Stool sample collection**

Stool sample collectors first explained the purpose of collecting stool to the randomly selected food handlers, and then asked them to urinate first without pooping to avoid urine contamination of the stool. Stool sample collectors then handed out paper to food handlers and instructing them to defecate on it to avoid stool contamination with stored feces and dirt. Food handlers were asked to bring approximately 50 g of the last part of the stool, the softest part, into the collection container after defecating on the paper. Stool sample collectors didn't violate privacy of food handlers during stool sample collection. Stool sample collectors then immediately stored the stool sample in to a cold box after labeled a code on the outer surface of the plastic cup.

127 **Personal and food establishment data collection**

We used structured questionnaire and observational checklist to collect food handlers' personal data and food establishments' related information. The questionnaire was developed by reviewing related published articles [15, 20-24]. The tool was first prepared in English language and translated to the local Amharic language by two native Amharic speakers fluent in English, and back-translated into English by two independent English language experts fluent in Amharic to check consistency. The questionnaire consisted of three parts: i) socio-demographic characteristics of food handlers, ii) food handlers' personal hygiene conditions, and iii) food establishment related factors (supplementary file). The questionnaire was pretested to evaluate the instructions, response format, and questions work as intended and are understood by those individuals who are likely to respond to them. Data collectors were trained in the data collection

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2
3 138 tool as well as ethical issues during interviewing and observing. Supervisors supervised the data
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5 139 collection process and checked the completeness of the data on a daily basis. We gathered
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7 140 handwashing data by assessing food handlers' usual handwashing behavior using self-reports.
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9 141 We also looked at the hands of food handlers to see the general cleanliness and conditions of
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11 142 fingernails. In addition, we asked food handlers to demonstrate how they wash their hands on a
12
13 143 regular basis, which we evaluated using checklists for effective handwashing.

14 144 **Detection of ova of parasites in stool samples**

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16
17 145 We used direct stool examination (wet mount) and FEC techniques to detect ova of intestinal
18
19 146 parasites in stool samples. One drop of physiological saline was placed on a clean slide. Using an
20
21 147 applicator stick, a small amount of stool specimen was emulsified in saline solution. The
22
23 148 preparation was covered with a cover slip and examined under the microscope for the absence or
24
25 149 presence of an intestinal parasites. The entire saline preparation was systematically examined for
26
27 150 helminthes eggs, larvae, ciliates, cysts and oocysts using 10× objective with condenser iris closed
28
29 151 sufficiently to give good contrast, while 40 × objectives was used to assist in the detection of
30
31 152 eggs, cysts, and oocytes [25].

32 153 For the FEC technique, an estimated 1 g of formed stool sample or 2 ml of watery stool was
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34 154 emulsified in about 4 ml of 10% formol water contained in a screw-cap bottle. A further 3 ml of
35
36 155 10% formol water was added and mixed well by shaking. The emulsified stool samples were
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38 156 sieved and the sieved suspension transferred to a conical (centrifuge). 3 ml of diethyl ether was
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40 157 added and the tube was stoppered mixed for 1 minute with a tissue wrapped around the top of the
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42 158 tube, the stopper was loosen. It was then centrifuge at 3000 rpm for 1 minute. Using a stick, the
43
44 159 layer of feces debris from the side of the tube was loosen and the tube inverted to discard the
45
46 160 ether, fecal debris, and formol water leaving behind the sediment. The tube was returned to its
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48 161 upright position and the fluid from the sides of the tube allowed draining to the bottom. The
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50 162 bottom of the tube was taped to re-suspend and mix the sediment. The sediment was transferred
51
52 163 to a slide and covered with a cover glass and was examined microscopically using the 10x
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54 164 objective for focusing and 40× objective for proper identification.

55 165 Standard operating procedures were used for every laboratory procedure during lab examination,
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57 166 stool specimen collection, transportation, and storing. We used stool sample collection and

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3 167 transportation containers which are leak-proof, dry clean and free from any traces of
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5 168 disinfectants. We ensured correct labelling of stool sample containers with date of sample
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7 169 collection, and code of the study participants. All stool specimens were stored in ice box for
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9 170 transportation and preserved at 4°C in the laboratory until analyzed for ova of parasites.
10
11 171 Triplicate examinations of stool samples were applied to improve the recovery rate of intestinal
12
13 172 parasites. Moreover, the expiry date of normal saline, ether, and formol was evaluated before
14
15 173 stool sample preparation and examination.

16 174 **Outcome variable of the study**

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18 175 Prevalence of intestinal parasites, the primary outcome variable of the study is defined as the
19
20 176 presence of one or more intestinal parasite species in stool samples.

21 177 **Data processing and analysis**

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23 178 Data were entered using EPI-INFO version 3.5.3 statistical package and export into Statistical
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25 179 Package for Social Sciences (SPSS) version 20 for further analysis. For most variables, data were
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27 180 presented by frequencies and percentages. Univariable binary logistic regression analysis was
28
29 181 used to choose variables for the multivariable binary logistic regression analysis, and variables
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31 182 which had p-value less than 0.25 by the univariable analysis and other well-known
32
33 183 confounders from the literature were then analyzed by multivariable analysis for controlling the
34
35 184 possible effect of confounders and to predict the prevalence of intestinal parasites among food
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37 185 handlers based on the predictors. In the adjusted model, variables which had significant
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39 186 association were identified on the basis of adjusted odds ratio (AOR) with 95% confidence
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41 187 interval (CI) and p-values < 0.05. The predictive power of the model was checked using
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43 188 McFadden's pseudo R-squared.

44 45 189 **Ethics approval and consent to participate**

46
47 190 Ethical clearance was obtained from the Institutional Review Board of Yanet Health College
48
49 191 (reference number: YEC/060/21). There were no risks due to participation and the collected data
50
51 192 were used only for this research purpose with complete confidentiality and privacy of food
52
53 193 handlers during stool sample collection was assured. Written informed consent was obtained
54
55 194 from food handlers. Furthermore, we advised food handlers who had one or more ova of

195 parasites to visit health institutions for treatment. All the methods were carried out in accordance
196 with relevant guidelines and regulations.

197 **Patient and public involvement**

198 There was no patient or public involvement in the study.

199 **Results**

200 **Socio-demographic characteristics of study participants**

201 We collected personal information and stool samples from a total 411 food handlers with a
202 response rate of 97.62%. The majority, 293 (71.3%) of the study participants were female. The
203 median age of the respondents was 28 and the interquartile range (IQR) was 20 and 39 years.
204 About half, 198 (48.18%) of the respondents aged 25 years and below. Half, 207 (50.3 %) of the
205 respondents reported that they completed primary school education. Two hundred and seventy-
206 eight (67.6%) of the food handlers reported that they had 3 years or less work experience. One
207 hundred and eleven (27.0%) of the food handlers earned <1500 Ethiopian birr (Table 1).

208 Table 1: Socio-demographic characteristics of food handlers (n = 411) working in different food
209 establishments in the Lideta sub-city of Addis Ababa, Ethiopia, March 20 to April 20, 2021

Socio-demographic characteristics	Frequency	Percent
Sex of the respondents		
Female	293	71.3
Male	118	28.7
Age of the respondents in years		
≤25	198	48.2
26-35	113	27.5
36-50	100	24.3
Education status of the respondents		
Tertiary education	23	5.6
Secondary school	163	39.7
Primary school	207	50.3

Illiterate	18	4.4
Service year		
≤ 3 years	278	67.6
> 3 years	133	33.4
Average monthly income in Ethiopian birr		
< 1500	111	27.0
1501-2500	152	37.0
2501-3500	94	22.9
> 3500	54	13.1

210 Personal hygiene characteristics of food handlers

211 Two hundred and forty-two (58.9%) of the food handlers did not keep their fingernails short.
 212 One hundred and ninety-four (47.2%) and 206 (50.1%) of the food handlers did not regularly
 213 wash hands with soap after visiting toilet and before eating, respectively. Two hundred and eight
 214 (50.6%) of the food handlers reported that they regularly worn clean protective clothes. About a
 215 quarter, 76 (24%) of the food handlers reported that they received food safety training and 121
 216 (29.4%) of the food handlers had medical checkup in the previous 6 months prior to the survey
 217 (Table 2).

218 Table 2: Personal hygiene characteristics of food handlers (n = 411) working in different food
 219 establishments in the Lideta sub-city of Addis Ababa, Ethiopia, March 20 to April 20, 2021

Variables	Frequency	Percent
Condition of fingernails		
Trimmed	169	41.1
Untrimmed	242	58.9
Regular hand washing with soap after toilet		
Yes	217	52.8
No	194	47.2
Regular hand washing with soap before eating		
Yes	205	49.9

No	206	50.1
Wearing clean protective clothes regularly		
Yes	208	50.6
No	203	49.4
Food safety training		
Yes	76	24
No	335	76
Medical checkup (in last 6 month)		
Yes	121	29.4
No	290	70.6

220

221 Intestinal parasites in food handlers

222 A total of 411 food handlers were examined, with 171 (41.6%) (95% CI: 36.6, 46.4%) of them
 223 had ova of one or more intestinal parasites [98 (23.8% were protozoan and 73 (17.8%) were
 224 helminth parasites], of which 14 (3.4%) had mixed parasites (Figure 2). The most common
 225 intestinal parasites were *E. histolytica/dispar* [52 (12.7%)], *G. duodenalis* [46 (11.2%)], *A.*
 226 *lumbricoides* [34 (8.3%)], Hookworms [15 (3.6%)], *T. trichuria* [14 (3.4%)], and Taenia species
 227 [10 (2.4%)] (Table 3).

228 Table 3: Common intestinal parasites detected among food handlers (n = 411) working in
 229 different food establishments in the Lideta sub-city of Addis Ababa, Ethiopia, March 20 to April
 230 20, 2021

Parasitic species	Frequency	Percent
<i>E.histolytica/dispar</i>	52	12.7
<i>G. duodenalis</i>	46	11.2
<i>A. lumbricoides</i>	34	8.3
Hookworms	15	3.6
<i>T. trichuria,</i>	14	3.4
Taenia species	10	2.4

231 Factors associated with intestinal parasites among food handlers

232 Educational status, average monthly income, condition of fingernails, hand washing with soap
 233 before eating, food safety training, and medical checkup in the last six month were the candidate
 234 variables for the final model which were selected based on $p < 0.25$ in the univariable binary
 235 logistic regression analysis and hand washing with soap after visiting toilet was a well-known
 236 confounder in the literature included in the final model even if its p value is greater than 0.25 in
 237 the univariable binary logistic regression analysis. In the multivariable binary logistic regression
 238 analysis, prevalence of intestinal parasites among food handlers was associated with low
 239 monthly income (AOR: 2.83, 95% CI:1.50, 8.84), untrimmed fingernails (AOR: 4.36, 95%
 240 CI: 1.98, 11.90), no food safety training (AOR: 2.51, 95% CI: 1.20, 5.58), low level of
 241 education (AOR: 3.13, 95% CI: 1.34, 7.44), poor handwashing practice (AOR: 2.16, 95% CI:
 242 1.03, 4.22), and lack of medical checkup (AOR: 2.31, 95% CI: 1.18, 6.95) (Table 4).

243 Table 4: Factors associated with intestinal parasites among food handlers (n = 411) working in
 244 different food establishments in the Lideta sub-city of Addis Ababa, Ethiopia, March 20 to April
 245 20, 2021

Variables	Intestinal parasites		COR (95% CI)	AOR (95% CI)
	Yes	No		
Educational status				
Illiterate	9	9	3.60 (1.81, 10.80)	3.13 (1.34, 7.44)*
Primary school	92	115	2.88 (1.65, 6.17)	2.22 (1.10, 6.65)*
Secondary school	68	95	2.58 (1.20, 5.56)	2.16 (1.10, 5.20)*
Tertiary education	5	18	1.0	1.0
Average monthly income in Ethiopian birr				
<1500	56	55	2.91 (1.43, 7.86)	2.84 (1.50, 8.84)*
1501-2500	68	84	2.31 (1.14, 6.96)	2.28 (0.63, 8.10)
2501-3500	33	61	1.55 (1.05, 4.85)	1.41 (0.60, 5.96)
>3500	14	40	1.0	1.0
Condition of fingernails				
Untrimmed	134	108	4.43 (2.12, 12.62)	4.36 (1.98, 11.90)**
Trimmed	37	132	1.0	1.0

Hand washing with soap after toilet				
No	101	93	2.28 (1.10, 7.51)	2.19 (0.92, 5.62)
Yes	70	147	1.0	1.0
Hand washing with soap before eating				
No	112	94	2.95 (1.23, 6.72)	2.16 (1.03, 4.22)*
Yes	59	146	1.0	1.0
Food safety training				
No	153	182	2.71 (1.34, 8.53)	2.51 (1.20, 5.58)*
Yes	18	58	1.0	1.0
Medical checkup in the last 6 month				
No	140	150	2.71 (1.27, 7.56)	2.32 (1.18, 6.95)*
Yes	31	90	1.0	1.0

Note: * statistically significant at $p < 0.05$, ** statistically significant at $p < 0.01$, and McFadden's pseudo R-squared = 0.492

246 Discussion

247 This is an institution-based cross-sectional study assessed intestinal parasites among food
 248 handlers working in food establishments in the Lideta sub-city of Addis Ababa, Ethiopia and
 249 found that 41.6% (95% CI: 36.6, 46.4%) of the food handlers had one or more intestinal
 250 parasites. The prevalence of intestinal parasites reported in this study was comparable with
 251 findings of studies conducted among food handlers in Bule Hora (46.3%) [16] and Addis Ababa
 252 University (45.3%) [19]. The prevalence of intestinal parasites reported in this study was lower
 253 than findings of studies in Nekemte town (52.1%) [26] and Mekele University (49.4%) [15].
 254 Furthermore, the prevalence of intestinal parasites reported in the current study was higher than
 255 findings of studies conducted among food handlers in Wolaita Sodo (23.6%) [14], Jimma (33%)
 256 [27], Madda Walabu University (25.3%) [28], Motta town (27.6%) [29], Nairobi(15.7%)[30],
 257 Iran (9%) [31], Saudi Arabia (23%) [32], and Thailand (10%) [33].The high prevalence of
 258 intestinal parasites among food handlers among food handlers working in food establishments in
 259 the Lideta sub-city of Addis Ababa might be explained by poor socio-economic conditions, poor
 260 hand hygiene, and inadequate access to basic sanitation services.

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3 261 The high prevalence of intestinal parasites among food handlers working in food
4 262 establishments in the Lideta sub-city suggests that poor hygiene practices of food handlers and
5 263 inadequate access to sanitation services. The results may also suggests that there might be
6 264 transmission of intestinal parasitic infections from food handlers to food users, unless large
7 265 scale screening and mass drug administration are done. As it is documented in literature, infected
8 266 food handlers play a significant role in infection transmissions to customers of the food
9 267 establishments where the infected food handlers are working [4].

16 268 This study showed that educational status of food handlers was associated with a high prevalence
17 269 of intestinal parasites. Prevalence of intestinal parasites was higher among food handlers who
18 270 were illiterate or attended primary and secondary education compared with food handlers who
19 271 attended tertiary education. This may be due to the fact that educated food handlers may have
20 272 awareness about the transmission and prevention methods of infectious diseases. Education
21 273 encourages changes in healthy behaviors. Other similar studies also reported the relation of
22 274 education with occurrence of parasitic infections [34-38].

29 275 The current study revealed that monthly income of food handlers was associated with intestinal
30 276 parasites among food handlers. Food handlers with low monthly income had higher odds of
31 277 intestinal parasites. This may be due to the fact that food handlers with low economic status
32 278 could not afford for services like soap, household water treatment, toilets and other facilities, and
33 279 so that will have limited opportunities to practice healthy measures. The effect of low income on
34 280 risk of parasites is complex and could be attributed to limited access to sanitary materials,
35 281 sources of drinking water and food, environment sanitation, and education [37-40].

42 282 The high prevalence of intestinal parasites among food handlers was associated with hand
43 283 hygiene. Food handlers who did not keep their fingernails short had higher odds to have
44 284 intestinal parasites and the odds of having intestinal parasites was also higher among food
45 285 handlers who did not wash hands with soap before eating. This might be due to the fact that the
46 286 area beneath the fingernails has the highest concentration of microorganisms on the hands and is
47 287 the most difficult to clean [41-44]. Moreover, food handlers may ingest diseases causing
48 288 pathogens when they eat without washing hands. Hands are one of the most important
49 289 mechanisms to transmit pathogenic microorganisms leading to infection [45]. Evidence indicates

290 that hands together with food contact or other environmental surfaces cause 60% of the spread of
291 gastrointestinal infection. Contaminated hands could also be associated with up to 50% of
292 respiratory tract infections [46].

293 This study depicted that intestinal parasites among food handlers was significantly associated
294 with food safety training. The odds of having intestinal parasites was high among food handlers
295 who did not take food safety training compared with their counterparts. This could be due to the
296 fact those food handlers who did not take food safety training may lack the necessary
297 knowledge and practice towards transmission and prevention of disease causing pathogens.
298 Moreover, food safety training or health education promotes health behaviors toward hygiene
299 and sanitation practices. Health education increases knowledge and acceptability of
300 interventions. It also sustains integrated control of the infection [47-49].

301 Furthermore, intestinal parasites was significantly associated with medical checkup. The odds of
302 having intestinal parasites was high among food handlers who did not take medical checkups in
303 the previous six months prior to the survey. Other studies are also reported that medical checkup
304 of food handlers is associated with intestinal parasites [15, 31, 50]. This is because food handlers
305 who did not know their health condition before employment and while working in different
306 establishments has less chance to take treatment and mass drugs as a result there may be existed
307 or new or re-infections.

308 To increase the degree to which inferences from the sample population can be generalized to a
309 larger group of population, we recruited study participants at random or in a manner in which
310 they are representative of the population that we wish to study and we granted that every member
311 of the population had an equal chance to be included in the study. In addition, we calculated
312 adequately powered sample size using sample size determination procedures appropriate to the
313 study objective with appropriate assumptions. Furthermore, our findings could be applicable to
314 other situations and settings which have similar characteristics with the study populations of the
315 current studies.

316 As a limitation, even if the use of sensitive diagnostic techniques and combination of methods
317 with triplicate examinations applied in this study would help to recover greater rate of intestinal
318 parasites that would indicate the true prevalence, this study had some limitations. The collection

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3 319 of a single stool sample may affect the result of parasitic examination since the sensitivities of
4 320 the direct smear examination technique is reduced when a single stool sample is examined. The
5 321 procedure of FEC technique may also damage the eggs of parasites. Moreover, the handwashing
6 322 data assessed by self-reports may not be reliable since the study subjects may make the more
7 323 socially acceptable answer rather than being truthful and they may not be able to assess
8 324 themselves accurately.

14 325 **Conclusion**

17 326 The prevalence of intestinal parasites among food handlers working in food establishments in
18 327 the Lideta sub-city of Addis Ababa, Ethiopia was found to be high. This high prevalence of
19 328 intestinal parasites was linked to socio-economic conditions of food handlers, poor hand
20 329 hygiene condition, absence of food safety trainings and regular medical checkup. It is,
21 330 therefore, important to promote hand washing practice of food handlers, provide food
22 331 hygiene and safety trainings, and establishing a system to regularly check the health
23 332 conditions of food handlers.

30 333 **Data availability statement**

32 334 Individual participant data after deidentification that underlie the results reported in this article
33 335 will be made available upon requesting the primary author immediately following publication.

36 336 **Authors' contribution**

39 337 WA designed the study, facilitated data collection, and conducted data analysis. BG, TS, ZNM,
40 338 and ZG supervised data collection and analysis and contributed to conceptualizing the study. ZG
41 339 prepared the manuscript. All authors approved the final version of the manuscript.

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52 343 **Competing interest**

55 344 None of the authors have any competing interests in the manuscript.

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16 495 **Figure caption**

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19 496 Figure 1: Map of Addis Ababa city (A) and Lideta sub-city (B) (source: Lideta sub-city
20 497 administration)

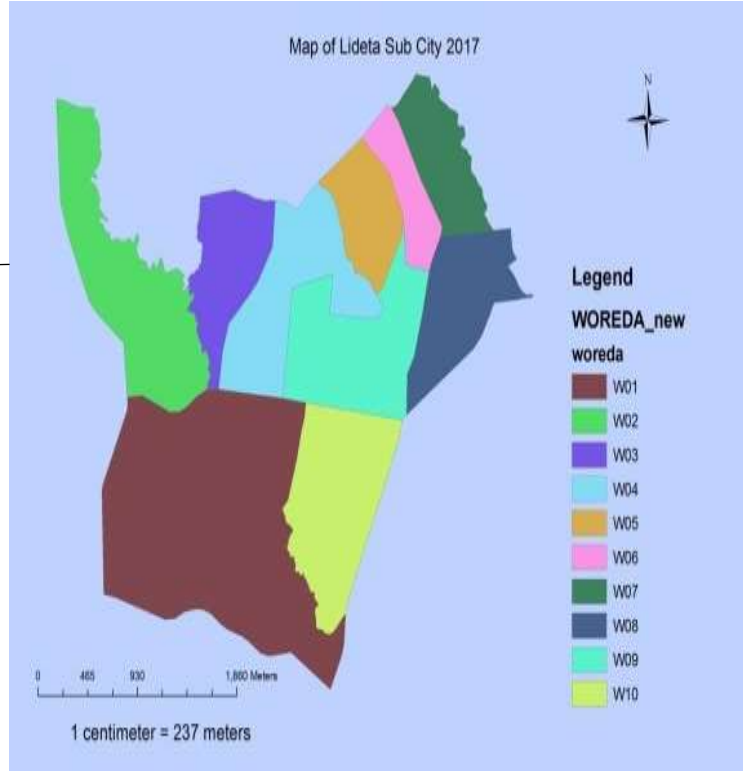
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22
23 498 Figure 2: Proportion of food handlers with no, single and mixed parasites (n = 411) working
24 499 in different food establishments in Lideta sub city of Addis Ababa, Ethiopia, March 20 to April
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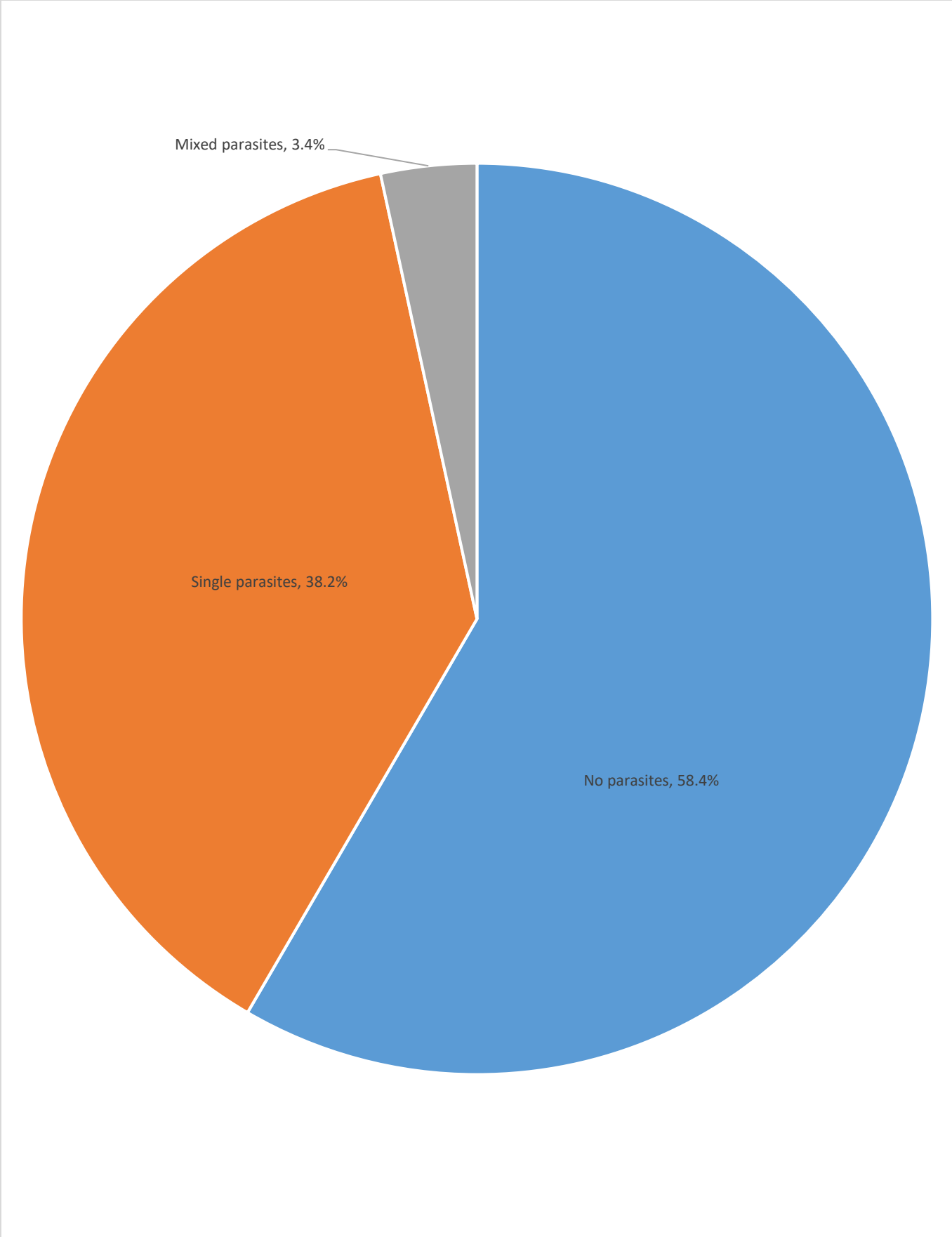


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Supplementary file: Data collection tool

Questionnaire Identification Code: _____

Consent Form

Hello, I am _____ working with a research team from Yanet Health Science College. We are contacting you to collect information for a study conducted to assess “Prevalence of intestinal parasites and associated factors among food handlers in food establishments in the Lideta sub-city of Addis Ababa, Ethiopia”. This questionnaire is prepared to collect food handlers personal and food establishment related information.

Thank you so much for agreeing to be interviewed for this research work. All of the information we got from you will be completely confidential and coded with unique number. Your name will not be written down and will never be used in connection with any of the information you provided. There will not be any direct benefit that you will get associated with participation in this study. If you do not want to answer all or some of the questions, you have the right to refuse participation at any time. However, we would greatly appreciate your help in responding to this questionnaire. This questionnaire is expected to be completed in 10 minutes.

Do I have your permission to continue?

1. **Yes**, continue your interview with thanks after signing the consent

2. **If no**, skip to the next participant by writing reasons for his/ her refusal;

Data collector: Name: _____ Signature: _____ Date: _____
Time started: _____ Time completed: _____

Filled by field supervisors

Result of interview:

1. Completed
2. Not completed
3. The respondent does not complete the whole questions

Name of Supervisor: _____ Signature: _____ Date: _____

Code	Questions	Response	Skip
Part 1: Socio-demographic information of food handlers			
101	Sex	1. Male 2. Female	
102	Age (in complete years)	_____	
103	Educational status	1. Illiterate 2. Primary school 3. Secondary School 4. Tertiary	
104	What is your monthly income?	_____	
105	How many years of work experience do you have in food handling?	_____	
Part 2: Food handlers' personal hygiene conditions			
201	Condition of fingernails	1. Trimmed 2. Untrimmed	
202	Regular hand washing with soap after toilet	1. Yes 2. No	
203	Regular hand washing with soap before eating	1. Yes 2. No	
204	Wearing clean protective clothes regularly	1. Yes 2. No	
Part 3: Food establishment related factors			
301	Food safety training	1. Yes 2. No	
302	Medical checkup (in last 6 month)	1. Yes 2. No	
Intestinal parasites identified (to be filled based on the laboratory results)			
Please carefully read the laboratory reports and write the intestinal parasites identified in the space provided. If no ova of parasites detected, write "No ova of parasites detected".			

BMJ Open

Prevalence of intestinal parasites and associated factors among food handlers in food establishments in the Lideta sub-city of Addis Ababa, Ethiopia: an institution-based cross-sectional study

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3 **1 Prevalence of intestinal parasites and associated factors among food handlers in food**
4 **2 establishments in the Lideta sub-city of Addis Ababa, Ethiopia: an institution-based cross-**
5 **3 sectional study**

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43 20 **Abstract**

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46 21 **Objectives:** This study was conducted to assess the prevalence of intestinal parasites and
47 22 associated factors among food handlers.

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51 23 **Design:** An institution-based cross-sectional study design was used. Stool samples were
52 24 collected from food handlers and examined using direct wet mount and formalin-ether
53 25 concentration (FEC) techniques. Personal and establishment related information was collected
54 26 using pretested questionnaire with structured observation. Multivariable binary logistic

27 regression was used to identify factors associated with prevalence of intestinal parasites on the
28 basis of adjusted odds ratio and 95% confidence interval with $p < 0.05$.

29 **Setting:** This study was conducted in different food establishments in the Lideta sub-city of
30 Addis Ababa, Ethiopia.

31 **Participants:** Four hundred and eleven food handlers were participated in this study.

32 **Outcome measures:** The primary outcome is prevalence of intestinal parasites, which was
33 defined as presence of one or more intestinal parasitic species in stool samples.

34 **Results:** One or more intestinal parasites were detected in 171 (41.6%) (95% CI: 36.6, 46.4%)
35 of the stool samples. The most common intestinal parasites were *E. histolytica/dispar* (12.7 %),
36 *G. duodenalis* (11.2%), and *A. lumbricoides* (8.3%). This high prevalence of intestinal parasites
37 among food handlers was associated with low monthly income (AOR: 2.83, 95% CI:1.50,
38 8.84), untrimmed fingernails (AOR: 4.36, 95% CI: 1.98, 11.90), no food safety training
39 (AOR: 2.51, 95% CI: 1.20, 5.58), low level of education (AOR: 3.13, 95% CI: 1.34, 7.44),
40 poor handwashing practice (AOR: 2.16, 95% CI: 1.03, 4.22), and lack of medical checkup
41 (AOR: 2.31, 95% CI: 1.18, 6.95).

42 **Conclusion:** The prevalence of intestinal parasites among food handlers in food
43 establishments in the Lideta sub-city of Addis Ababa was high. This was linked to socio-
44 economic conditions, poor hand hygiene condition, and absence of food safety trainings. It is,
45 therefore, important to promote hand washing practice and providing food hygiene and safety
46 training is critical.

47 **Key words:** Intestinal parasites, food handlers, food establishments, hand hygiene, Ethiopia

48 **Strengths and limitations of this study**

- 49 - The study has focused on one of the most potential groups, i.e., food handlers that had
50 potential to spread food borne infections to the consumers.

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3 51 - The use of sensitive diagnostic techniques and combination of methods with triplicate
4 52 examinations applied in this study would help to recover greater rate of intestinal parasites
5 53 that would indicate the true prevalence.
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8 54 - As a limitation, the collection of a single stool sample may affect the result of parasitic
9 55 examination since the sensitivities of the direct smear examination technique is reduced when
10 56 a single stool sample is examined and the procedure of FEC technique may also damage the
11 57 eggs of parasites.

16 58 **Introduction**

19 59 Foodborne diseases are increasingly becoming a serious global public health problem. The
20 60 World Health Organization (WHO) estimate indicates that each year worldwide, unsafe food
21 61 causes 600 million cases of foodborne diseases and 420 000 deaths. WHO estimated that 33
22 62 million years of healthy lives are lost due to eating unsafe food globally each year, and this
23 63 number is likely an underestimation [1]. One of the causes of foodborne diseases is
24 64 contamination during food preparation; food handlers carrying pathogens might be involved in
25 65 the origin of this condition. Foods can be contaminated with fecal material at the point of
26 66 production or during food preparation, in both the home and in commercial premises [2]. Food
27 67 handlers with poor personal hygiene and inadequate knowledge on food safety could be potential
28 68 sources of infections. Food handlers who harbor and excrete enteropathogens may contaminate
29 69 foods from their feces via contaminated hands, then to food or food contact surfaces, and finally
30 70 to healthy individuals [3-7].

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40 71 The contribution of the infected food worker (whether symptomatic or not) to food borne disease
41 72 outbreaks has been difficult to establish. However, reports showed that food workers in many
42 73 settings have been responsible for foodborne disease outbreaks for decades. For instance,
43 74 members of the Committee on Control of Foodborne Illnesses of the International Association
44 75 for Food Protection analyzed 816 foodborne disease outbreaks with 80,682 cases in different
45 76 countries where food workers were implicated as the source of the contamination. The report
46 77 also estimated that infected food worker was documented as responsible for 18% of 766
47 78 outbreaks occurring in the United States [8, 9]. Moreover, according to the Centers for Disease
48 79 Control (CDC), as cited in Mathew RR (2019), 20 to 40% of food borne illness associated with
49 80 the consumption of contaminated food originated in catering establishments [10].

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3 81 Food handling personnel play a role in the transmission of food borne diseases. The health of
4 82 food handlers is of great importance for maintaining quality of food products. Accordingly, pre-
5 83 employment and periodic medical checkup is very important to safeguard the consumers from
6 84 getting diseases from contaminated foods along with other food safety measures [11, 12].
7
8 85 However, pre-employment and periodic medical checkups are not commonly practiced in
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10 86 Ethiopia. As a result of this, many of the food handlers working in different food establishments
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12 87 all over the country may harbor one or more enteropathogens. For instance, a systematic review
13
14 88 and meta-analysis reported that the overall pooled prevalence estimate of intestinal parasites
15 89 among food handlers of food service establishments in Ethiopia was 33.6% (95% CI: 27.6,
16 90 39.6%) [13] and the common factors associated to high prevalence of intestinal pathogens among
17 91 food handlers are poor hand hygiene, inadequate access to water and sanitation facilities, and
18 92 poor socio-economic conditions [13-18]. However, the prevalence and risk factors may be
19 93 different across various settings. Accordingly, this study was conducted to assess the prevalence
20 94 of intestinal parasites and associated factors among food handlers working in food establishment
21 95 in the Lideta sub-city of Addis Ababa, Ethiopia.

22 96 **Methods**

23 97 **Study design and setting**

24 98 This an institution-based cross-sectional study with laboratory investigations was conducted in
25 99 the Lideta sub-city of Addis Ababa from March 20 to April 20, 2021. Lideta sub-city is one of
26 100 the 10 sub cities of Addis Ababa, the capital of Ethiopia. The sub-city is located at the global
27 101 positioning system (GPS) coordinates of 9°0'N and 38°45'E. The sub city is divided into 10
28 102 districts (Figure 1). In the Lideta sub-city, there are a total of 281 food establishments and 1124
29 103 food handlers working in the food establishments.

30 104 **Sample size calculation and sampling techniques**

31 105 The sample size was calculated using single population proportion formula with the following
32 106 assumptions: prevalence of intestinal parasites among food handlers in Addis Ababa University
33 107 students cafeteria, Addis Ababa, Ethiopia (p) = 45.3% [19], level of significance (α) = 5%, 95%
34 108 confidence interval (standard normal probability), z : the standard normal tabulated value, and
35 109 margin of error (d) = 5%.

$$n = \frac{(Z_{\alpha/2})^2 P(1 - P)}{d^2} = \frac{(1.96)^2 0.453(1 - 0.453)}{0.05^2} = 381$$

The final sample size was 419 after considering 10% non-response rate. The Lideta sub-city was selected at random from a total of 10 sub-cities of Addis Ababa, Ethiopia. Using lists of food handlers working in different food establishments in the sub-city obtained from Addis Ababa food, medicines, and healthcare administration authority (AAFMHACA) as a sampling frame, we used computer generated random number to select food handlers. Food handlers who treated with anti-helminthes and anti-protozoan drugs in the last four weeks were excluded from the study.

118 **Stool sample collection**

Stool sample collectors first explained the purpose of collecting stool to the randomly selected food handlers, and then asked them to urinate first without pooping to avoid urine contamination of the stool. Stool sample collectors then handed out paper to food handlers and instructing them to defecate on it to avoid stool contamination with stored feces and dirt. Food handlers were asked to bring approximately 50 g of the last part of the stool, the softest part, into the collection container after defecating on the paper. Stool sample collectors didn't violate privacy of food handlers during stool sample collection. Stool sample collectors then immediately stored the stool sample in to a cold box after labeled a code on the outer surface of the plastic cup.

127 **Personal and food establishment data collection**

We used structured questionnaire and observational checklist to collect food handlers' personal data and food establishments' related information. The questionnaire was developed by reviewing related published articles [15, 20-24]. The tool was first prepared in English language and translated to the local Amharic language by two native Amharic speakers fluent in English, and back-translated into English by two independent English language experts fluent in Amharic to check consistency. The questionnaire consisted of three parts: i) socio-demographic characteristics of food handlers, ii) food handlers' personal hygiene conditions, and iii) food establishment related factors (supplementary file). The questionnaire was pretested to evaluate the instructions, response format, and questions work as intended and are understood by those individuals who are likely to respond to them. Data collectors were trained in the data collection

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2
3 138 tool as well as ethical issues during interviewing and observing. Supervisors supervised the data
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5 139 collection process and checked the completeness of the data on a daily basis. We gathered
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7 140 handwashing data by assessing food handlers' usual handwashing behavior using self-reports.
8
9 141 We also looked at the hands of food handlers to see the general cleanliness and conditions of
10
11 142 fingernails. In addition, we asked food handlers to demonstrate how they wash their hands on a
12
13 143 regular basis, which we evaluated using checklists for effective handwashing.

14 144 **Detection of ova of parasites in stool samples**

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16
17 145 We used direct stool examination (wet mount) and FEC techniques to detect ova of intestinal
18
19 146 parasites in stool samples. One drop of physiological saline was placed on a clean slide. Using an
20
21 147 applicator stick, a small amount of stool specimen was emulsified in saline solution. The
22
23 148 preparation was covered with a cover slip and examined under the microscope for the absence or
24
25 149 presence of an intestinal parasites. The entire saline preparation was systematically examined for
26
27 150 helminthes eggs, larvae, ciliates, cysts and oocysts using 10× objective with condenser iris closed
28
29 151 sufficiently to give good contrast, while 40 × objectives was used to assist in the detection of
30
31 152 eggs, cysts, and oocytes [25].

32 153 For the FEC technique, an estimated 1 g of formed stool sample or 2 ml of watery stool was
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34 154 emulsified in about 4 ml of 10% formol water contained in a screw-cap bottle. A further 3 ml of
35
36 155 10% formol water was added and mixed well by shaking. The emulsified stool samples were
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38 156 sieved and the sieved suspension transferred to a conical (centrifuge). 3 ml of diethyl ether was
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40 157 added and the tube was stoppered mixed for 1 minute with a tissue wrapped around the top of the
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42 158 tube, the stopper was loosen. It was then centrifuge at 3000 rpm for 1 minute. Using a stick, the
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44 159 layer of feces debris from the side of the tube was loosen and the tube inverted to discard the
45
46 160 ether, fecal debris, and formol water leaving behind the sediment. The tube was returned to its
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48 161 upright position and the fluid from the sides of the tube allowed draining to the bottom. The
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50 162 bottom of the tube was taped to re-suspend and mix the sediment. The sediment was transferred
51
52 163 to a slide and covered with a cover glass and was examined microscopically using the 10x
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54 164 objective for focusing and 40× objective for proper identification.

55 165 Standard operating procedures were used for every laboratory procedure during lab examination,
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57 166 stool specimen collection, transportation, and storing. We used stool sample collection and

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3 167 transportation containers which are leak-proof, dry clean and free from any traces of
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5 168 disinfectants. We ensured correct labelling of stool sample containers with date of sample
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7 169 collection, and code of the study participants. All stool specimens were stored in ice box for
8
9 170 transportation and preserved at 4°C in the laboratory until analyzed for ova of parasites.
10
11 171 Triplicate examinations of stool samples were applied to improve the recovery rate of intestinal
12
13 172 parasites. Moreover, the expiry date of normal saline, ether, and formol was evaluated before
14
15 173 stool sample preparation and examination.

16 174 **Outcome variable of the study**

17
18 175 Prevalence of intestinal parasites, the primary outcome variable of the study is defined as the
19
20 176 presence of one or more intestinal parasite species in stool samples.

21 177 **Data processing and analysis**

22
23 178 Data were entered using EPI-INFO version 3.5.3 statistical package and export into Statistical
24
25 179 Package for Social Sciences (SPSS) version 20 for further analysis. For most variables, data were
26
27 180 presented by frequencies and percentages. Univariable binary logistic regression analysis was
28
29 181 used to choose variables for the multivariable binary logistic regression analysis, and variables
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31 182 which had p-value less than 0.25 by the univariable analysis and other well-known
32
33 183 confounders from the literature were then analyzed by multivariable analysis for controlling the
34
35 184 possible effect of confounders and to predict the prevalence of intestinal parasites among food
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37 185 handlers based on the predictors. In the adjusted model, variables which had significant
38
39 186 association were identified on the basis of adjusted odds ratio (AOR) with 95% confidence
40
41 187 interval (CI) and p-values < 0.05. The predictive power of the model was checked using
42
43 188 McFadden's pseudo R-squared.

44 45 189 **Ethics approval and consent to participate**

46
47 190 Ethical clearance was obtained from the Institutional Review Board of Yanet Health College
48
49 191 (reference number: YEC/060/21). There were no risks due to participation and the collected data
50
51 192 were used only for this research purpose with complete confidentiality and privacy of food
52
53 193 handlers during stool sample collection was assured. Written informed consent was obtained
54
55 194 from food handlers. Furthermore, we advised food handlers who had one or more ova of

195 parasites to visit health institutions for treatment. All the methods were carried out in accordance
196 with relevant guidelines and regulations.

197 **Patient and public involvement**

198 There was no patient or public involvement in the study.

199 **Results**

200 **Socio-demographic characteristics of study participants**

201 We collected personal information and stool samples from a total 411 food handlers with a
202 response rate of 97.62%. The majority, 293 (71.3%) of the study participants were female. The
203 median age of the respondents was 28 and the interquartile range (IQR) was 20 and 39 years.
204 About half, 198 (48.18%) of the respondents aged 25 years and below. Half, 207 (50.3 %) of the
205 respondents reported that they completed primary school education. Two hundred and seventy-
206 eight (67.6%) of the food handlers reported that they had 3 years or less work experience. One
207 hundred and eleven (27.0%) of the food handlers earned <1500 Ethiopian birr (Table 1).

208 Table 1: Socio-demographic characteristics of food handlers (n = 411) working in different food
209 establishments in the Lideta sub-city of Addis Ababa, Ethiopia, March 20 to April 20, 2021

Socio-demographic characteristics	Frequency	Percent
Sex of the respondents		
Female	293	71.3
Male	118	28.7
Age of the respondents in years		
≤25	198	48.2
26-35	113	27.5
36-50	100	24.3
Education status of the respondents		
Tertiary education	23	5.6
Secondary school	163	39.7
Primary school	207	50.3

Illiterate	18	4.4
Service year		
≤ 3 years	278	67.6
> 3 years	133	33.4
Average monthly income in Ethiopian birr		
< 1500	111	27.0
1501-2500	152	37.0
2501-3500	94	22.9
> 3500	54	13.1

210 Personal hygiene characteristics of food handlers

211 Two hundred and forty-two (58.9%) of the food handlers did not keep their fingernails short.
 212 One hundred and ninety-four (47.2%) and 206 (50.1%) of the food handlers did not regularly
 213 wash hands with soap after visiting toilet and before eating, respectively. Two hundred and eight
 214 (50.6%) of the food handlers reported that they regularly worn clean protective clothes. About a
 215 quarter, 76 (24%) of the food handlers reported that they received food safety training and 121
 216 (29.4%) of the food handlers had medical checkup in the previous 6 months prior to the survey
 217 (Table 2).

218 Table 2: Personal hygiene characteristics of food handlers (n = 411) working in different food
 219 establishments in the Lideta sub-city of Addis Ababa, Ethiopia, March 20 to April 20, 2021

Variables	Frequency	Percent
Condition of fingernails		
Trimmed	169	41.1
Untrimmed	242	58.9
Regular hand washing with soap after toilet		
Yes	217	52.8
No	194	47.2
Regular hand washing with soap before eating		
Yes	205	49.9

No	206	50.1
Wearing clean protective clothes regularly		
Yes	208	50.6
No	203	49.4
Food safety training		
Yes	76	24
No	335	76
Medical checkup (in last 6 month)		
Yes	121	29.4
No	290	70.6

220

221 **Intestinal parasites in food handlers**

222 A total of 411 food handlers were examined, with 171 (41.6%) (95% CI: 36.6, 46.4%) of them
 223 had ova of one or more intestinal parasites [98 (23.8% were protozoan and 73 (17.8%) were
 224 helminth parasites], of which 14 (3.4%) had mixed parasites (Figure 2). The most common
 225 intestinal parasites were *E. histolytica/dispar* [52 (12.7%)], *G. duodenalis* [46 (11.2%)], *A.*
 226 *lumbricoides* [34 (8.3%)], Hookworms [15 (3.6%)], *T. trichuria* [14 (3.4%)], and Taenia species
 227 [10 (2.4%)] (Table 3).

228 Table 3: Common intestinal parasites detected among food handlers (n = 411) working in
 229 different food establishments in the Lideta sub-city of Addis Ababa, Ethiopia, March 20 to April
 230 20, 2021

Parasitic species	Frequency	Percent
<i>E.histolytica/dispar</i>	52	12.7
<i>G. duodenalis</i>	46	11.2
<i>A. lumbricoides</i>	34	8.3
Hookworms	15	3.6
<i>T. trichuria,</i>	14	3.4
Taenia species	10	2.4

231 **Factors associated with intestinal parasites among food handlers**

232 Sex, age, educational level, work experience, monthly income, wearing clean protective clothes,
 233 finger nail status, hand washing after toilet, hand washing before eating, food safety training, and
 234 medical checkup were the variables entered in to the univariable binary logistic regression
 235 analysis, of which educational status, average monthly income, condition of fingernails, hand
 236 washing with soap before eating, food safety training, and medical checkup in the last six month
 237 were the candidate variables for the final model which were selected based on $p < 0.25$ and hand
 238 washing with soap after visiting toilet was a well-known confounder in the literature included in
 239 the final model even if its p value is greater than 0.25. In the multivariable binary logistic
 240 regression analysis, prevalence of intestinal parasites among food handlers was significantly
 241 associated with poor handwashing practice (AOR: 2.16, 95% CI: 1.03, 4.22), untrimmed
 242 fingernails (AOR: 4.36, 95% CI: 1.98, 11.90), lack of medical checkup (AOR: 2.31, 95% CI:
 243 1.18, 6.95), no food safety training (AOR: 2.51, 95% CI: 1.20, 5.58), low level of education
 244 (AOR: 3.13, 95% CI: 1.34, 7.44), and low monthly income (AOR: 2.83, 95% CI: 1.50, 8.84)
 245 (Table 4). Table 4 included effect estimates from the model with all the seven variables. In that
 246 case, one should now that that the educational status and monthly income estimates are for direct
 247 effects.

248 Table 4: Factors associated with intestinal parasites among food handlers (n = 411) working in
 249 different food establishments in the Lideta sub-city of Addis Ababa, Ethiopia, March 20 to April
 250 20, 2021

Variables	Intestinal parasites		COR (95% CI)	AOR (95% CI)
	Yes	No		
Educational status				
Illiterate	9	9	3.60 (1.81, 10.80)	3.13 (1.34, 7.44)*
Primary school	92	115	2.88 (1.65, 6.17)	2.22 (1.10, 6.65)*
Secondary school	68	95	2.58 (1.20, 5.56)	2.16 (1.10, 5.20)*
Tertiary education	5	18	1.0	1.0
Average monthly income in Ethiopian birr				
<1500	56	55	2.91 (1.43, 7.86)	2.84 (1.50, 8.84)*
1501-2500	68	84	2.31 (1.14, 6.96)	2.28 (0.63, 8.10)
2501-3500	33	61	1.55 (1.05, 4.85)	1.41 (0.60, 5.96)

>3500	14	40	1.0	1.0
Condition of fingernails				
Untrimmed	134	108	4.43 (2.12, 12.62)	4.36 (1.98, 11.90)**
Trimmed	37	132	1.0	1.0
Hand washing with soap after toilet				
No	101	93	2.28 (1.10, 7.51)	2.19 (0.92, 5.62)
Yes	70	147	1.0	1.0
Hand washing with soap before eating				
No	112	94	2.95 (1.23, 6.72)	2.16 (1.03, 4.22)*
Yes	59	146	1.0	1.0
Food safety training				
No	153	182	2.71 (1.34, 8.53)	2.51 (1.20, 5.58)*
Yes	18	58	1.0	1.0
Medical checkup in the last 6 month				
No	140	150	2.71 (1.27, 7.56)	2.32 (1.18, 6.95)*
Yes	31	90	1.0	1.0

Note: * statistically significant at $p < 0.05$, ** statistically significant at $p < 0.01$, and McFadden's pseudo R-squared = 0.492

251 Discussion

252 This is an institution-based cross-sectional study assessed intestinal parasites among food
 253 handlers working in food establishments in the Lideta sub-city of Addis Ababa, Ethiopia and
 254 found that 41.6% (95% CI: 36.6, 46.4%) of the food handlers had one or more intestinal
 255 parasites. The prevalence of intestinal parasites reported in this study was comparable with
 256 findings of studies conducted among food handlers in Bule Hora (46.3%) [16] and Addis Ababa
 257 University (45.3%) [19]. The prevalence of intestinal parasites reported in this study was lower
 258 than findings of studies in Nekemte town (52.1%) [26] and Mekele University (49.4%) [15].
 259 Furthermore, the prevalence of intestinal parasites reported in the current study was higher than
 260 findings of studies conducted among food handlers in Wolaita Sodo (23.6%) [14], Jimma (33%)
 261 [27], Madda Walabu University (25.3%) [28], Motta town (27.6%) [29], Nairobi(15.7%)[30],

1
2
3 262 Iran (9%) [31], Saudi Arabia (23%) [32], and Thailand (10%) [33]. The high prevalence of
4
5 263 intestinal parasites among food handlers among food handlers working in food establishments in
6
7 264 the Lideta sub-city of Addis Ababa might be explained by poor socio-economic conditions, poor
8
9 265 hand hygiene, and inadequate access to basic sanitation services.

10
11 266 The high prevalence of intestinal parasites among food handlers working in food
12
13 267 establishments in the Lideta sub-city suggests that poor hygiene practices of food handlers and
14
15 268 inadequate access to sanitation services. The results may also suggest that there might be
16
17 269 transmission of intestinal parasitic infections from food handlers to food users, unless large
18
19 270 scale screening and mass drug administration are done. As it is documented in literature, infected
20
21 271 food handlers play a significant role in infection transmissions to customers of the food
22
23 272 establishments where the infected food handlers are working [4].

24
25 273 This study showed that educational status of food handlers was associated with a high prevalence
26
27 274 of intestinal parasites. Prevalence of intestinal parasites was higher among food handlers who
28
29 275 were illiterate or attended primary and secondary education compared with food handlers who
30
31 276 attended tertiary education. This may be due to the fact that educated food handlers may have
32
33 277 awareness about the transmission and prevention methods of infectious diseases. Education
34
35 278 encourages changes in healthy behaviors. Other similar studies also reported the relation of
36
37 279 education with occurrence of parasitic infections [34-38].

38
39 280 The current study revealed that monthly income of food handlers was associated with intestinal
40
41 281 parasites among food handlers. Food handlers with low monthly income had higher odds of
42
43 282 intestinal parasites. This may be due to the fact that food handlers with low economic status
44
45 283 could not afford for services like soap, household water treatment, toilets and other facilities, and
46
47 284 so that will have limited opportunities to practice healthy measures. The effect of low income on
48
49 285 risk of parasites is complex and could be attributed to limited access to sanitary materials,
50
51 286 sources of drinking water and food, environment sanitation, and education [37-40].

52
53 287 The high prevalence of intestinal parasites among food handlers was associated with hand
54
55 288 hygiene. Food handlers who did not keep their fingernails short had higher odds to have
56
57 289 intestinal parasites and the odds of having intestinal parasites was also higher among food
58
59 290 handlers who did not wash hands with soap before eating. This might be due to the fact that the

1
2
3 291 area beneath the fingernails has the highest concentration of microorganisms on the hands and is
4
5 292 the most difficult to clean [41-44]. Moreover, food handlers may ingest diseases causing
6
7 293 pathogens when they eat without washing hands. Hands are one of the most important
8
9 294 mechanisms to transmit pathogenic microorganisms leading to infection [45]. Evidence indicates
10
11 295 that hands together with food contact or other environmental surfaces cause 60% of the spread of
12
13 296 gastrointestinal infection. Contaminated hands could also be associated with up to 50% of
14
15 297 respiratory tract infections [46].

16 298 This study depicted that intestinal parasites among food handlers was significantly associated
17
18 299 with food safety training. The odds of having intestinal parasites was high among food handlers
19
20 300 who did not take food safety training compared with their counterparts. This could be due to the
21
22 301 fact those food handlers who did not take food safety training may lack the necessary
23
24 302 knowledge and practice towards transmission and prevention of disease causing pathogens.
25
26 303 Moreover, food safety training or health education promotes health behaviors toward hygiene
27
28 304 and sanitation practices. Health education increases knowledge and acceptability of
29
30 305 interventions. It also sustains integrated control of the infection [47-49].

31 306 Furthermore, intestinal parasites was significantly associated with medical checkup. The odds of
32
33 307 having intestinal parasites was high among food handlers who did not take medical checkups in
34
35 308 the previous six months prior to the survey. Other studies are also reported that medical checkup
36
37 309 of food handlers is associated with intestinal parasites [15, 31, 50]. This is because food handlers
38
39 310 who did not know their health condition before employment and while working in different
40
41 311 establishments has less chance to take treatment and mass drugs as a result there may be existed
42
43 312 or new or re-infections.

44 313 To increase the degree to which inferences from the sample population can be generalized to a
45
46 314 larger group of population, we recruited study participants at random or in a manner in which
47
48 315 they are representative of the population that we wish to study and we granted that every member
49
50 316 of the population had an equal chance to be included in the study. In addition, we calculated
51
52 317 adequately powered sample size using sample size determination procedures appropriate to the
53
54 318 study objective with appropriate assumptions. Furthermore, our findings could be applicable to
55
56 319 other situations and settings which have similar characteristics with the study populations of the
57
58 320 current studies.

321 As a limitation, even if the use of sensitive diagnostic techniques and combination of methods
322 with triplicate examinations applied in this study would help to recover greater rate of intestinal
323 parasites that would indicate the true prevalence, this study had some limitations. The collection
324 of a single stool sample may affect the result of parasitic examination since the sensitivities of
325 the direct smear examination technique is reduced when a single stool sample is examined. The
326 procedure of FEC technique may also damage the eggs of parasites. The handwashing data
327 assessed by self-reports may not be reliable since the study subjects may make the more socially
328 acceptable answer rather than being truthful and they may not be able to assess themselves
329 accurately. Moreover, we pre-screened variables using univariable analysis ($p < 0.25$), even
330 though we retained some well-known confounders from the literature regardless of their
331 univariable p-value. This could lead to the incorrect exclusion of a potential confounder and
332 hence led to an inadequate adjustment for confounding.

333 **Conclusion**

334 The prevalence of intestinal parasites among food handlers working in food establishments in
335 the Lideta sub-city of Addis Ababa, Ethiopia was found to be high. This high prevalence of
336 intestinal parasites was linked to socio-economic conditions of food handlers, poor hand
337 hygiene condition, absence of food safety trainings and regular medical checkup. It is,
338 therefore, important to promote hand washing practice of food handlers, provide food
339 hygiene and safety trainings, and establishing a system to regularly check the health
340 conditions of food handlers.

341 **Data availability statement**

342 Individual participant data after deidentification that underlie the results reported in this article
343 will be made available upon requesting the primary author immediately following publication.

344 **Authors' contribution**

345 WA designed the study, facilitated data collection, and conducted data analysis. BG, TS, ZNM,
346 and ZG supervised data collection and analysis and contributed to conceptualizing the study. ZG
347 prepared the manuscript. All authors approved the final version of the manuscript.

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350 collection tools and data collectors' fee was covered by the principal investigator, i.e., WA.

351 **Competing interest**

352 None of the authors have any competing interests in the manuscript.

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356 contribution in the study.

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503 **Figure caption**

504 Figure 1: Map of Addis Ababa city (A) and Lideta sub-city (B) (source: Lideta sub-city
505 administration)

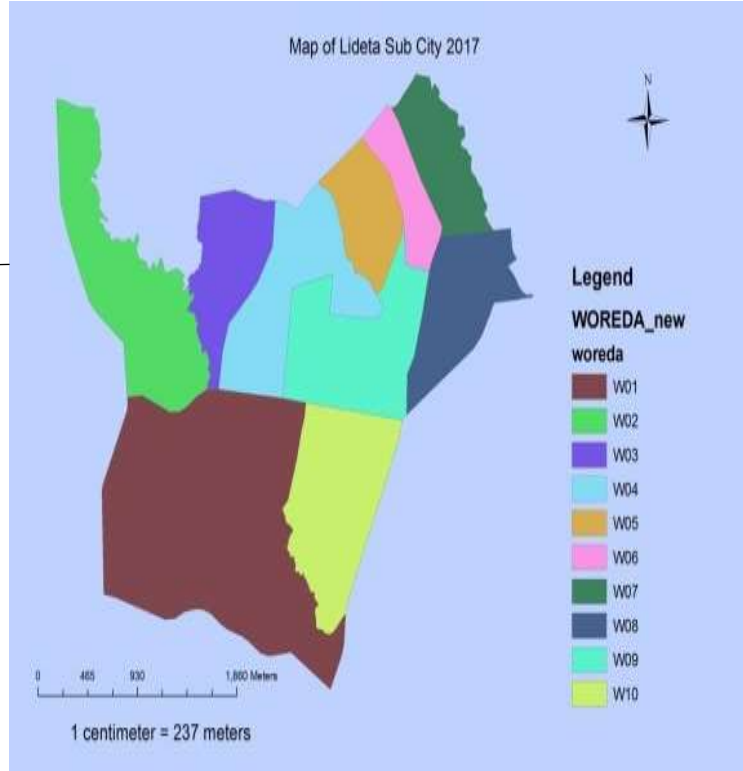
506 Figure 2: Proportion of food handlers with no, single and mixed parasites (n = 411) working
507 in different food establishments in Lideta sub city of Addis Ababa, Ethiopia, March 20 to April
508 20, 2021

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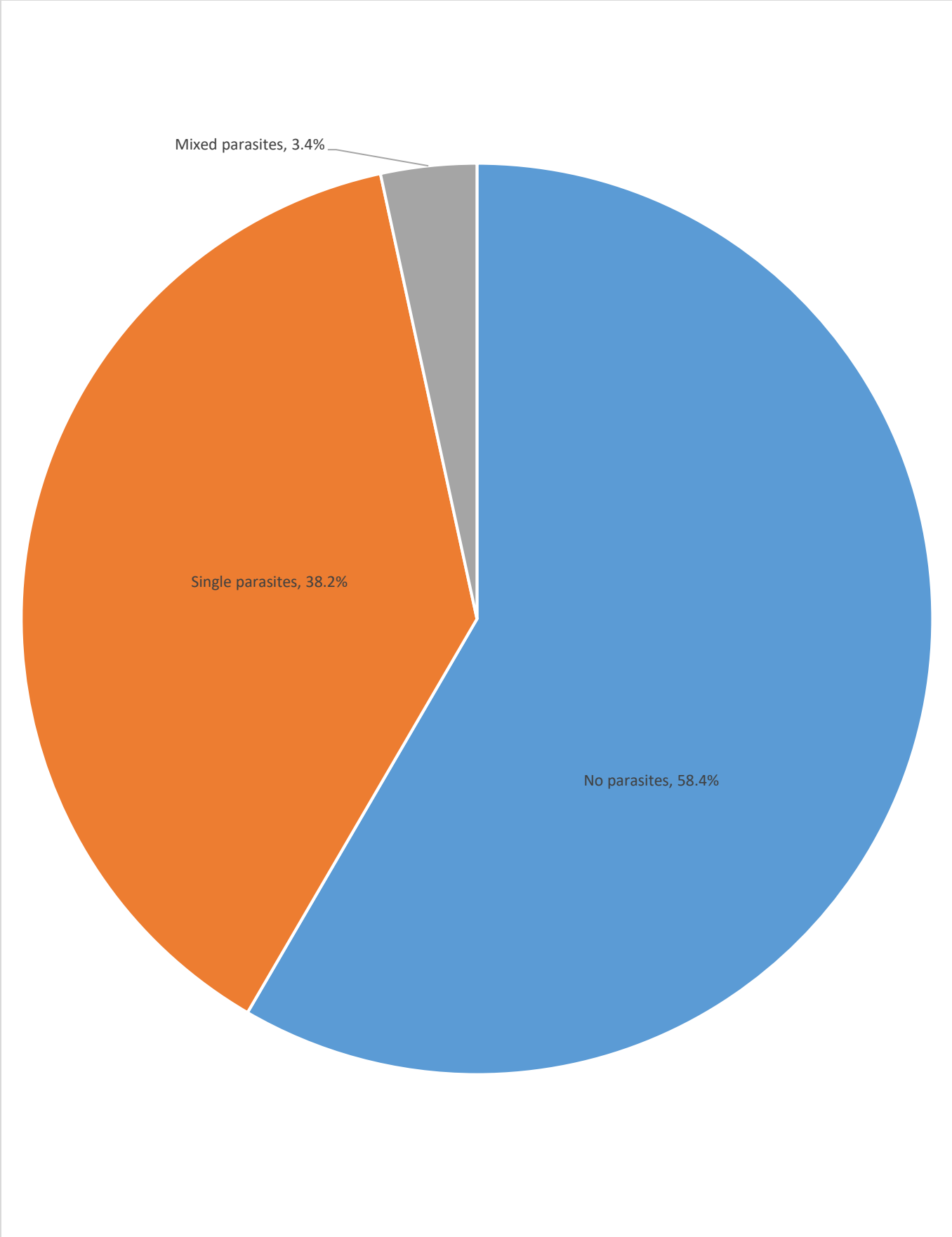


B

“review only”

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Supplementary file: Data collection tool

Questionnaire Identification Code: _____

Consent Form

Hello, I am _____ working with a research team from Yanet Health Science College. We are contacting you to collect information for a study conducted to assess “Prevalence of intestinal parasites and associated factors among food handlers in food establishments in the Lideta sub-city of Addis Ababa, Ethiopia”. This questionnaire is prepared to collect food handlers personal and food establishment related information.

Thank you so much for agreeing to be interviewed for this research work. All of the information we got from you will be completely confidential and coded with unique number. Your name will not be written down and will never be used in connection with any of the information you provided. There will not be any direct benefit that you will get associated with participation in this study. If you do not want to answer all or some of the questions, you have the right to refuse participation at any time. However, we would greatly appreciate your help in responding to this questionnaire. This questionnaire is expected to be completed in 10 minutes.

Do I have your permission to continue?

1. **Yes**, continue your interview with thanks after signing the consent

2. **If no**, skip to the next participant by writing reasons for his/ her refusal;

Data collector: Name: _____ Signature: _____ Date: _____
Time started: _____ Time completed: _____

Filled by field supervisors

Result of interview:

1. Completed
2. Not completed
3. The respondent does not complete the whole questions

Name of Supervisor: _____ Signature: _____ Date: _____

Code	Questions	Response	Skip
Part 1: Socio-demographic information of food handlers			
101	Sex	1. Male 2. Female	
102	Age (in complete years)	_____	
103	Educational status	1. Illiterate 2. Primary school 3. Secondary School 4. Tertiary	
104	What is your monthly income?	_____	
105	How many years of work experience do you have in food handling?	_____	
Part 2: Food handlers' personal hygiene conditions			
201	Condition of fingernails	1. Trimmed 2. Untrimmed	
202	Regular hand washing with soap after toilet	1. Yes 2. No	
203	Regular hand washing with soap before eating	1. Yes 2. No	
204	Wearing clean protective clothes regularly	1. Yes 2. No	
Part 3: Food establishment related factors			
301	Food safety training	1. Yes 2. No	
302	Medical checkup (in last 6 month)	1. Yes 2. No	
Intestinal parasites identified (to be filled based on the laboratory results)			
Please carefully read the laboratory reports and write the intestinal parasites identified in the space provided. If no ova of parasites detected, write "No ova of parasites detected".			

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Prevalence of intestinal parasites and associated factors among food handlers in food establishments in the Lideta sub-city of Addis Ababa, Ethiopia: an institution-based cross-sectional study

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3 1 **Prevalence of intestinal parasites and associated factors among food handlers in food**
4 **establishments in the Lideta sub-city of Addis Ababa, Ethiopia: an institution-based cross-**
5 **sectional study**
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43
44 20 **Abstract**
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46 21 **Objectives:** This study was conducted to assess the prevalence of intestinal parasites and
47 associated factors among food handlers.
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51 23 **Design:** An institution-based cross-sectional study design was used. Stool samples were
52 collected from food handlers and examined using direct wet mount and formalin-ether
53 24 concentration (FEC) techniques. Personal and establishment related information was collected
54 25 using pretested questionnaire with structured observation. Multivariable binary logistic
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27 regression was used to identify factors associated with prevalence of intestinal parasites on the
28 basis of adjusted odds ratio and 95% confidence interval with $p < 0.05$.

29 **Setting:** This study was conducted in different food establishments in the Lideta sub-city of
30 Addis Ababa, Ethiopia.

31 **Participants:** Four hundred and eleven food handlers were participated in this study.

32 **Outcome measures:** The primary outcome is prevalence of intestinal parasites, which was
33 defined as presence of one or more intestinal parasitic species in stool samples.

34 **Results:** One or more intestinal parasites were detected in 171 (41.6%) (95% CI: 36.6, 46.4%)
35 of the stool samples. The most common intestinal parasites were *E. histolytica/dispar* (12.7 %),
36 *G. duodenalis* (11.2%), and *A. lumbricoides* (8.3%). This high prevalence of intestinal parasites
37 among food handlers was associated with low monthly income (AOR: 2.83, 95% CI:1.50,
38 8.84), untrimmed fingernails (AOR: 4.36, 95% CI: 1.98, 11.90), no food safety training
39 (AOR: 2.51, 95% CI: 1.20, 5.58), low level of education (AOR: 3.13, 95% CI: 1.34, 7.44),
40 poor handwashing practice (AOR: 2.16, 95% CI: 1.03, 4.22), and lack of medical checkup
41 (AOR: 2.31, 95% CI: 1.18, 6.95).

42 **Conclusion:** The prevalence of intestinal parasites among food handlers in food
43 establishments in the Lideta sub-city of Addis Ababa was high. This was linked to socio-
44 economic conditions, poor hand hygiene condition, and absence of food safety trainings. It is,
45 therefore, important to promote hand washing practice and providing food hygiene and safety
46 training is critical.

47 **Key words:** Intestinal parasites, food handlers, food establishments, hand hygiene, Ethiopia

48 **Strengths and limitations of this study**

- 49 - The study has focused on one of the most potential groups, i.e., food handlers that had
50 potential to spread food borne infections to the consumers.

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3 51 - The use of sensitive diagnostic techniques and combination of methods with triplicate
4 52 examinations applied in this study would help to recover greater rate of intestinal parasites
5 53 that would indicate the true prevalence.
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8 54 - As a limitation, the collection of a single stool sample may affect the result of parasitic
9 55 examination since the sensitivities of the direct smear examination technique is reduced when
10 56 a single stool sample is examined and the procedure of FEC technique may also damage the
11 57 eggs of parasites.

16 58 **Introduction**

19 59 Foodborne diseases are increasingly becoming a serious global public health problem. The
20 60 World Health Organization (WHO) estimate indicates that each year worldwide, unsafe food
21 61 causes 600 million cases of foodborne diseases and 420 000 deaths. WHO estimated that 33
22 62 million years of healthy lives are lost due to eating unsafe food globally each year, and this
23 63 number is likely an underestimation [1]. One of the causes of foodborne diseases is
24 64 contamination during food preparation; food handlers carrying pathogens might be involved in
25 65 the origin of this condition. Foods can be contaminated with fecal material at the point of
26 66 production or during food preparation, in both the home and in commercial premises [2]. Food
27 67 handlers with poor personal hygiene and inadequate knowledge on food safety could be potential
28 68 sources of infections. Food handlers who harbor and excrete enteropathogens may contaminate
29 69 foods from their feces via contaminated hands, then to food or food contact surfaces, and finally
30 70 to healthy individuals [3-7].

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40 71 The contribution of the infected food worker (whether symptomatic or not) to food borne disease
41 72 outbreaks has been difficult to establish. However, reports showed that food workers in many
42 73 settings have been responsible for foodborne disease outbreaks for decades. For instance,
43 74 members of the Committee on Control of Foodborne Illnesses of the International Association
44 75 for Food Protection analyzed 816 foodborne disease outbreaks with 80,682 cases in different
45 76 countries where food workers were implicated as the source of the contamination. The report
46 77 also estimated that infected food worker was documented as responsible for 18% of 766
47 78 outbreaks occurring in the United States [8, 9]. Moreover, according to the Centers for Disease
48 79 Control (CDC), as cited in Mathew RR (2019), 20 to 40% of food borne illness associated with
49 80 the consumption of contaminated food originated in catering establishments [10].

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3 81 Food handling personnel play a role in the transmission of food borne diseases. The health of
4 82 food handlers is of great importance for maintaining quality of food products. Accordingly, pre-
5 83 employment and periodic medical checkup is very important to safeguard the consumers from
6 84 getting diseases from contaminated foods along with other food safety measures [11, 12].
7
8 85 However, pre-employment and periodic medical checkups are not commonly practiced in
9 86 Ethiopia. As a result of this, many of the food handlers working in different food establishments
10 87 all over the country may harbor one or more enteropathogens. For instance, a systematic review
11 88 and meta-analysis reported that the overall pooled prevalence estimate of intestinal parasites
12 89 among food handlers of food service establishments in Ethiopia was 33.6% (95% CI: 27.6,
13 90 39.6%) [13] and the common factors associated to high prevalence of intestinal pathogens among
14 91 food handlers are poor hand hygiene, inadequate access to water and sanitation facilities, and
15 92 poor socio-economic conditions [13-18]. However, the prevalence and risk factors may be
16 93 different across various settings. Accordingly, this study was conducted to assess the prevalence
17 94 of intestinal parasites and associated factors among food handlers working in food establishment
18 95 in the Lideta sub-city of Addis Ababa, Ethiopia.

96 **Methods**

97 **Study design and setting**

98 This an institution-based cross-sectional study with laboratory investigations was conducted in
99 the Lideta sub-city of Addis Ababa from March 20 to April 20, 2021. Lideta sub-city is one of
100 the 10 sub cities of Addis Ababa, the capital of Ethiopia. The sub-city is located at the global
101 positioning system (GPS) coordinates of 9°0'N and 38°45'E. The sub city is divided into 10
102 districts (Figure 1). In the Lideta sub-city, there are a total of 281 food establishments and 1124
103 food handlers working in the food establishments.

104 **Sample size calculation and sampling techniques**

105 The sample size was calculated using single population proportion formula with the following
106 assumptions: prevalence of intestinal parasites among food handlers in Addis Ababa University
107 students cafeteria, Addis Ababa, Ethiopia (p) = 45.3% [19], level of significance (α) = 5%, 95%
108 confidence interval (standard normal probability), z : the standard normal tabulated value, and
109 margin of error (d) = 5%.

$$n = \frac{(Z_{\alpha/2})^2 P(1 - P)}{d^2} = \frac{(1.96)^2 0.453(1 - 0.453)}{0.05^2} = 381$$

The final sample size was 419 after considering 10% non-response rate. The Lideta sub-city was selected at random from a total of 10 sub-cities of Addis Ababa, Ethiopia. Using lists of food handlers working in different food establishments in the sub-city obtained from Addis Ababa food, medicines, and healthcare administration authority (AAFMHACA) as a sampling frame, we used computer generated random number to select food handlers. Food handlers who treated with anti-helminthes and anti-protozoan drugs in the last four weeks were excluded from the study.

118 **Stool sample collection**

Stool sample collectors first explained the purpose of collecting stool to the randomly selected food handlers, and then asked them to urinate first without pooping to avoid urine contamination of the stool. Stool sample collectors then handed out paper to food handlers and instructing them to defecate on it to avoid stool contamination with stored feces and dirt. Food handlers were asked to bring approximately 50 g of the last part of the stool, the softest part, into the collection container after defecating on the paper. Stool sample collectors didn't violate privacy of food handlers during stool sample collection. Stool sample collectors then immediately stored the stool sample in to a cold box after labeled a code on the outer surface of the plastic cup.

127 **Personal and food establishment data collection**

We used structured questionnaire and observational checklist to collect food handlers' personal data and food establishments' related information. The questionnaire was developed by reviewing related published articles [15, 20-24]. The tool was first prepared in English language and translated to the local Amharic language by two native Amharic speakers fluent in English, and back-translated into English by two independent English language experts fluent in Amharic to check consistency. The questionnaire consisted of three parts: i) socio-demographic characteristics of food handlers, ii) food handlers' personal hygiene conditions, and iii) food establishment related factors (supplementary file). The questionnaire was pretested to evaluate the instructions, response format, and questions work as intended and are understood by those individuals who are likely to respond to them. Data collectors were trained in the data collection

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3 138 tool as well as ethical issues during interviewing and observing. Supervisors supervised the data
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5 139 collection process and checked the completeness of the data on a daily basis. We gathered
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7 140 handwashing data by assessing food handlers' usual handwashing behavior using self-reports.
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9 141 We also looked at the hands of food handlers to see the general cleanliness and conditions of
10
11 142 fingernails. In addition, we asked food handlers to demonstrate how they wash their hands on a
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13 143 regular basis, which we evaluated using checklists for effective handwashing.

14 144 **Detection of ova of parasites in stool samples**

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16
17 145 We used direct stool examination (wet mount) and FEC techniques to detect ova of intestinal
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19 146 parasites in stool samples. One drop of physiological saline was placed on a clean slide. Using an
20
21 147 applicator stick, a small amount of stool specimen was emulsified in saline solution. The
22
23 148 preparation was covered with a cover slip and examined under the microscope for the absence or
24
25 149 presence of an intestinal parasites. The entire saline preparation was systematically examined for
26
27 150 helminthes eggs, larvae, ciliates, cysts and oocysts using 10× objective with condenser iris closed
28
29 151 sufficiently to give good contrast, while 40 × objectives was used to assist in the detection of
30
31 152 eggs, cysts, and oocytes [25].

32 153 For the FEC technique, an estimated 1 g of formed stool sample or 2 ml of watery stool was
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34 154 emulsified in about 4 ml of 10% formol water contained in a screw-cap bottle. A further 3 ml of
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36 155 10% formol water was added and mixed well by shaking. The emulsified stool samples were
37
38 156 sieved and the sieved suspension transferred to a conical (centrifuge). 3 ml of diethyl ether was
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40 157 added and the tube was stoppered mixed for 1 minute with a tissue wrapped around the top of the
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42 158 tube, the stopper was loosen. It was then centrifuge at 3000 rpm for 1 minute. Using a stick, the
43
44 159 layer of feces debris from the side of the tube was loosen and the tube inverted to discard the
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46 160 ether, fecal debris, and formol water leaving behind the sediment. The tube was returned to its
47
48 161 upright position and the fluid from the sides of the tube allowed draining to the bottom. The
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50 162 bottom of the tube was taped to re-suspend and mix the sediment. The sediment was transferred
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52 163 to a slide and covered with a cover glass and was examined microscopically using the 10x
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54 164 objective for focusing and 40× objective for proper identification.

55 165 Standard operating procedures were used for every laboratory procedure during lab examination,
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57 166 stool specimen collection, transportation, and storing. We used stool sample collection and

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3 167 transportation containers which are leak-proof, dry clean and free from any traces of
4 168 disinfectants. We ensured correct labelling of stool sample containers with date of sample
5 169 collection, and code of the study participants. All stool specimens were stored in ice box for
6 170 transportation and preserved at 4°C in the laboratory until analyzed for ova of parasites.
7
8 171 Triplicate examinations of stool samples were applied to improve the recovery rate of intestinal
9 172 parasites. Moreover, the expiry date of normal saline, ether, and formol was evaluated before
10 173 stool sample preparation and examination.

16 174 **Outcome variable of the study**

17 175 Prevalence of intestinal parasites, the primary outcome variable of the study is defined as the
18 176 presence of one or more intestinal parasite species in stool samples.

23 177 **Data processing and analysis**

24 178 Data were entered using EPI-INFO version 3.5.3 statistical package and export into Statistical
25 179 Package for Social Sciences (SPSS) version 20 for further analysis. For most variables, data were
26 180 presented by frequencies and percentages. Univariable binary logistic regression analysis was
27 181 used to choose variables for the multivariable binary logistic regression analysis, and variables
28 182 which had p-value less than 0.25 by the univariable analysis and other well-known
29 183 confounders from the literature were then analyzed by multivariable analysis for controlling the
30 184 possible effect of confounders and to predict the prevalence of intestinal parasites among food
31 185 handlers based on the predictors. In the adjusted model, variables which had significant
32 186 association were identified on the basis of adjusted odds ratio (AOR) with 95% confidence
33 187 interval (CI) and p-values < 0.05. The predictive power of the model was checked using
34 188 McFadden's pseudo R-squared.

45 189 **Ethics approval and consent to participate**

46 190 Ethical clearance was obtained from the Institutional Review Board of Yanet Health College
47 191 (reference number: YEC/060/21). There were no risks due to participation and the collected data
48 192 were used only for this research purpose with complete confidentiality and privacy of food
49 193 handlers during stool sample collection was assured. Written informed consent was obtained
50 194 from food handlers. Furthermore, we advised food handlers who had one or more ova of

195 parasites to visit health institutions for treatment. All the methods were carried out in accordance
196 with relevant guidelines and regulations.

197 **Patient and public involvement**

198 There was no patient or public involvement in the study.

199 **Results**

200 **Socio-demographic characteristics of study participants**

201 We collected personal information and stool samples from a total 411 food handlers with a
202 response rate of 97.62%. The majority, 293 (71.3%) of the study participants were female. The
203 median age of the respondents was 28 and the interquartile range (IQR) was 20 and 39 years.
204 About half, 198 (48.18%) of the respondents aged 25 years and below. Half, 207 (50.3 %) of the
205 respondents reported that they completed primary school education. Two hundred and seventy-
206 eight (67.6%) of the food handlers reported that they had 3 years or less work experience. One
207 hundred and eleven (27.0%) of the food handlers earned <1500 Ethiopian birr (Table 1).

208 Table 1: Socio-demographic characteristics of food handlers (n = 411) working in different food
209 establishments in the Lideta sub-city of Addis Ababa, Ethiopia, March 20 to April 20, 2021

Socio-demographic characteristics	Frequency	Percent
Sex of the respondents		
Female	293	71.3
Male	118	28.7
Age of the respondents in years		
≤25	198	48.2
26-35	113	27.5
36-50	100	24.3
Education status of the respondents		
Tertiary education	23	5.6
Secondary school	163	39.7
Primary school	207	50.3

Illiterate	18	4.4
Service year		
≤ 3 years	278	67.6
> 3 years	133	33.4
Average monthly income in Ethiopian birr		
< 1500	111	27.0
1501-2500	152	37.0
2501-3500	94	22.9
> 3500	54	13.1

210 **Personal hygiene characteristics of food handlers**

211 Two hundred and forty-two (58.9%) of the food handlers did not keep their fingernails short.
 212 One hundred and ninety-four (47.2%) and 206 (50.1%) of the food handlers did not regularly
 213 wash hands with soap after visiting toilet and before eating, respectively. Two hundred and eight
 214 (50.6%) of the food handlers reported that they regularly worn clean protective clothes. About a
 215 quarter, 76 (24%) of the food handlers reported that they received food safety training and 121
 216 (29.4%) of the food handlers had medical checkup in the previous 6 months prior to the survey
 217 (Table 2).

218 Table 2: Personal hygiene characteristics of food handlers (n = 411) working in different food
 219 establishments in the Lideta sub-city of Addis Ababa, Ethiopia, March 20 to April 20, 2021

Variables	Frequency	Percent
Condition of fingernails		
Trimmed	169	41.1
Untrimmed	242	58.9
Regular hand washing with soap after toilet		
Yes	217	52.8
No	194	47.2
Regular hand washing with soap before eating		
Yes	205	49.9

No	206	50.1
Wearing clean protective clothes regularly		
Yes	208	50.6
No	203	49.4
Food safety training		
Yes	76	24
No	335	76
Medical checkup (in last 6 month)		
Yes	121	29.4
No	290	70.6

220

221 **Intestinal parasites in food handlers**

222 A total of 411 food handlers were examined, with 171 (41.6%) (95% CI: 36.6, 46.4%) of them
 223 had ova of one or more intestinal parasites [98 (23.8% were protozoan and 73 (17.8%) were
 224 helminth parasites], of which 14 (3.4%) had mixed parasites (Figure 2). The most common
 225 intestinal parasites were *E. histolytica/dispar* [52 (12.7%)], *G. duodenalis* [46 (11.2%)], *A.*
 226 *lumbricoides* [34 (8.3%)], Hookworms [15 (3.6%)], *T. trichuria* [14 (3.4%)], and Taenia species
 227 [10 (2.4%)] (Table 3).

228 Table 3: Common intestinal parasites detected among food handlers (n = 411) working in
 229 different food establishments in the Lideta sub-city of Addis Ababa, Ethiopia, March 20 to April
 230 20, 2021

Parasitic species	Frequency	Percent
<i>E.histolytica/dispar</i>	52	12.7
<i>G. duodenalis</i>	46	11.2
<i>A. lumbricoides</i>	34	8.3
Hookworms	15	3.6
<i>T. trichuria,</i>	14	3.4
Taenia species	10	2.4

231 **Factors associated with intestinal parasites among food handlers**

232 Sex, age, educational level, work experience, monthly income, wearing clean protective clothes,
 233 finger nail status, hand washing after toilet, hand washing before eating, food safety training, and
 234 medical checkup were the variables entered in to the univariable binary logistic regression
 235 analysis, of which educational status, average monthly income, condition of fingernails, hand
 236 washing with soap before eating, food safety training, and medical checkup in the last six month
 237 were the candidate variables for the final model which were selected based on $p < 0.25$ and hand
 238 washing with soap after visiting toilet was a well-known confounder in the literature included in
 239 the final model even if its p value is greater than 0.25. In the multivariable binary logistic
 240 regression analysis, prevalence of intestinal parasites among food handlers was significantly
 241 associated with poor handwashing practice (AOR: 2.16, 95% CI: 1.03, 4.22), untrimmed
 242 fingernails (AOR: 4.36, 95% CI: 1.98, 11.90), lack of medical checkup (AOR: 2.31, 95% CI:
 243 1.18, 6.95), no food safety training (AOR: 2.51, 95% CI: 1.20, 5.58), low level of education
 244 (AOR: 3.13, 95% CI: 1.34, 7.44), and low monthly income (AOR: 2.83, 95% CI: 1.50, 8.84)
 245 (Table 4).

246 Table 4: Factors associated with intestinal parasites among food handlers (n = 411) working in
 247 different food establishments in the Lideta sub-city of Addis Ababa, Ethiopia, March 20 to April
 248 20, 2021

Variables	Intestinal parasites		COR (95% CI)	AOR (95% CI)
	Yes	No		
Educational status				
Illiterate	9	9	3.60 (1.81, 10.80)	3.13 (1.34, 7.44)*
Primary school	92	115	2.88 (1.65, 6.17)	2.22 (1.10, 6.65)*
Secondary school	68	95	2.58 (1.20, 5.56)	2.16 (1.10, 5.20)*
Tertiary education	5	18	1.0	1.0
Average monthly income in Ethiopian birr				
<1500	56	55	2.91 (1.43, 7.86)	2.84 (1.50, 8.84)*
1501-2500	68	84	2.31 (1.14, 6.96)	2.28 (0.63, 8.10)
2501-3500	33	61	1.55 (1.05, 4.85)	1.41 (0.60, 5.96)
>3500	14	40	1.0	1.0
Condition of fingernails				

Untrimmed	134	108	4.43 (2.12, 12.62)	4.36 (1.98, 11.90)**
Trimmed	37	132	1.0	1.0
Hand washing with soap after toilet				
No	101	93	2.28 (1.10, 7.51)	2.19 (0.92, 5.62)
Yes	70	147	1.0	1.0
Hand washing with soap before eating				
No	112	94	2.95 (1.23, 6.72)	2.16 (1.03, 4.22)*
Yes	59	146	1.0	1.0
Food safety training				
No	153	182	2.71 (1.34, 8.53)	2.51 (1.20, 5.58)*
Yes	18	58	1.0	1.0
Medical checkup in the last 6 month				
No	140	150	2.71 (1.27, 7.56)	2.32 (1.18, 6.95)*
Yes	31	90	1.0	1.0

Note: * statistically significant at $p < 0.05$, ** statistically significant at $p < 0.01$, and McFadden's pseudo R-squared = 0.492

249 Discussion

250 This is an institution-based cross-sectional study assessed intestinal parasites among food
 251 handlers working in food establishments in the Lideta sub-city of Addis Ababa, Ethiopia and
 252 found that 41.6% (95% CI: 36.6, 46.4%) of the food handlers had one or more intestinal
 253 parasites. The prevalence of intestinal parasites reported in this study was comparable with
 254 findings of studies conducted among food handlers in Bule Hora (46.3%) [16] and Addis Ababa
 255 University (45.3%) [19]. The prevalence of intestinal parasites reported in this study was lower
 256 than findings of studies in Nekemte town (52.1%) [26] and Mekele University (49.4%) [15].
 257 Furthermore, the prevalence of intestinal parasites reported in the current study was higher than
 258 findings of studies conducted among food handlers in Wolaita Sodo (23.6%) [14], Jimma (33%)
 259 [27], Madda Walabu University (25.3%) [28], Motta town (27.6%) [29], Nairobi (15.7%) [30],
 260 Iran (9%) [31], Saudi Arabia (23%) [32], and Thailand (10%) [33]. The high prevalence of
 261 intestinal parasites among food handlers among food handlers working in food establishments in

262 the Lideta sub-city of Addis Ababa might be explained by poor socio-economic conditions, poor
263 hand hygiene, and inadequate access to basic sanitation services.

264 The high prevalence of intestinal parasites among food handlers working in food
265 establishments in the Lideta sub-city suggests that poor hygiene practices of food handlers and
266 inadequate access to sanitation services. The results may also suggests that there might be
267 transmission of intestinal parasitic infections from food handlers to food users, unless large
268 scale screening and mass drug administration are done. As it is documented in literature, infected
269 food handlers play a significant role in infection transmissions to customers of the food
270 establishments where the infected food handlers are working [4].

271 This study showed that educational status of food handlers was associated with a high prevalence
272 of intestinal parasites. Prevalence of intestinal parasites was higher among food handlers who
273 were illiterate or attended primary and secondary education compared with food handlers who
274 attended tertiary education. This may be due to the fact that educated food handlers may have
275 awareness about the transmission and prevention methods of infectious diseases. Education
276 encourages changes in healthy behaviors. Other similar studies also reported the relation of
277 education with occurrence of parasitic infections [34-38].

278 The current study revealed that monthly income of food handlers was associated with intestinal
279 parasites among food handlers. Food handlers with low monthly income had higher odds of
280 intestinal parasites. This may be due to the fact that food handlers with low economic status
281 could not afford for services like soap, household water treatment, toilets and other facilities, and
282 so that will have limited opportunities to practice healthy measures. The effect of low income on
283 risk of parasites is complex and could be attributed to limited access to sanitary materials,
284 sources of drinking water and food, environment sanitation, and education [37-40].

285 The high prevalence of intestinal parasites among food handlers was associated with hand
286 hygiene. Food handlers who did not keep their fingernails short had higher odds to have
287 intestinal parasites and the odds of having intestinal parasites was also higher among food
288 handlers who did not wash hands with soap before eating. This might be due to the fact that the
289 area beneath the fingernails has the highest concentration of microorganisms on the hands and is
290 the most difficult to clean [41-44]. Moreover, food handlers may ingest diseases causing

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2
3 291 pathogens when they eat without washing hands. Hands are one of the most important
4
5 292 mechanisms to transmit pathogenic microorganisms leading to infection [45]. Evidence indicates
6
7 293 that hands together with food contact or other environmental surfaces cause 60% of the spread of
8
9 294 gastrointestinal infection. Contaminated hands could also be associated with up to 50% of
10
11 295 respiratory tract infections [46].

12 296 This study depicted that intestinal parasites among food handlers was significantly associated
13
14 297 with food safety training. The odds of having intestinal parasites was high among food handlers
15
16 298 who did not take food safety training compared with their counterparts. This could be due to the
17
18 299 fact those food handlers who did not take food safety training may lack the necessary
19
20 300 knowledge and practice towards transmission and prevention of disease causing pathogens.
21
22 301 Moreover, food safety training or health education promotes health behaviors toward hygiene
23
24 302 and sanitation practices. Health education increases knowledge and acceptability of
25
26 303 interventions. It also sustains integrated control of the infection [47-49].

27 304 Furthermore, intestinal parasites was significantly associated with medical checkup. The odds of
28
29 305 having intestinal parasites was high among food handlers who did not take medical checkups in
30
31 306 the previous six months prior to the survey. Other studies are also reported that medical checkup
32
33 307 of food handlers is associated with intestinal parasites [15, 31, 50]. This is because food handlers
34
35 308 who did not know their health condition before employment and while working in different
36
37 309 establishments has less chance to take treatment and mass drugs as a result there may be existed
38
39 310 or new or re-infections.

40 311 To increase the degree to which inferences from the sample population can be generalized to a
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42 312 larger group of population, we recruited study participants at random or in a manner in which
43
44 313 they are representative of the population that we wish to study and we granted that every member
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46 314 of the population had an equal chance to be included in the study. In addition, we calculated
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48 315 adequately powered sample size using sample size determination procedures appropriate to the
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50 316 study objective with appropriate assumptions. Furthermore, our findings could be applicable to
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52 317 other situations and settings which have similar characteristics with the study populations of the
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54 318 current studies.

54 319 As a limitation, even if the use of sensitive diagnostic techniques and combination of methods
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56 320 with triplicate examinations applied in this study would help to recover greater rate of intestinal

321 parasites that would indicate the true prevalence, this study had some limitations. The collection
322 of a single stool sample may affect the result of parasitic examination since the sensitivities of
323 the direct smear examination technique is reduced when a single stool sample is examined. The
324 procedure of FEC technique may also damage the eggs of parasites. The handwashing data
325 assessed by self-reports may not be reliable since the study subjects may make the more socially
326 acceptable answer rather than being truthful and they may not be able to assess themselves
327 accurately. Moreover, we pre-screened variables using univariable analysis ($p < 0.25$), even
328 though we retained some well-known confounders from the literature regardless of their
329 univariable p-value. This could lead to the incorrect exclusion of a potential confounder and
330 hence led to an inadequate adjustment for confounding.

331 **Conclusion**

332 The prevalence of intestinal parasites among food handlers working in food establishments in
333 the Lideta sub-city of Addis Ababa, Ethiopia was found to be high. This high prevalence of
334 intestinal parasites was linked to socio-economic conditions of food handlers, poor hand
335 hygiene condition, absence of food safety trainings and regular medical checkup. It is,
336 therefore, important to promote hand washing practice of food handlers, provide food
337 hygiene and safety trainings, and establishing a system to regularly check the health
338 conditions of food handlers.

339 **Data availability statement**

340 Individual participant data after deidentification that underlie the results reported in this article
341 will be made available upon requesting the primary author immediately following publication.

342 **Authors' contribution**

343 WA designed the study, facilitated data collection, and conducted data analysis. BG, TS, ZNM,
344 and ZG supervised data collection and analysis and contributed to conceptualizing the study. ZG
345 prepared the manuscript. All authors approved the final version of the manuscript.

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349 **Competing interest**

350 None of the authors have any competing interests in the manuscript.

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501 **Figure caption**

502 Figure 1: Map of Addis Ababa city (A) and Lideta sub-city (B) (source: Lideta sub-city
503 administration)

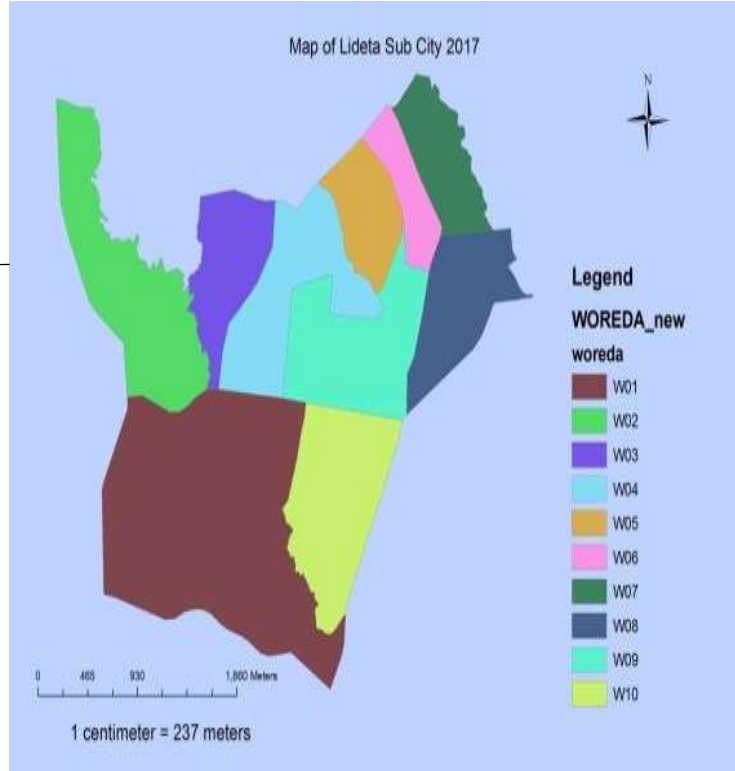
504 Figure 2: Proportion of food handlers with no, single and mixed parasites (n = 411) working
505 in different food establishments in Lideta sub city of Addis Ababa, Ethiopia, March 20 to April
506 20, 2021

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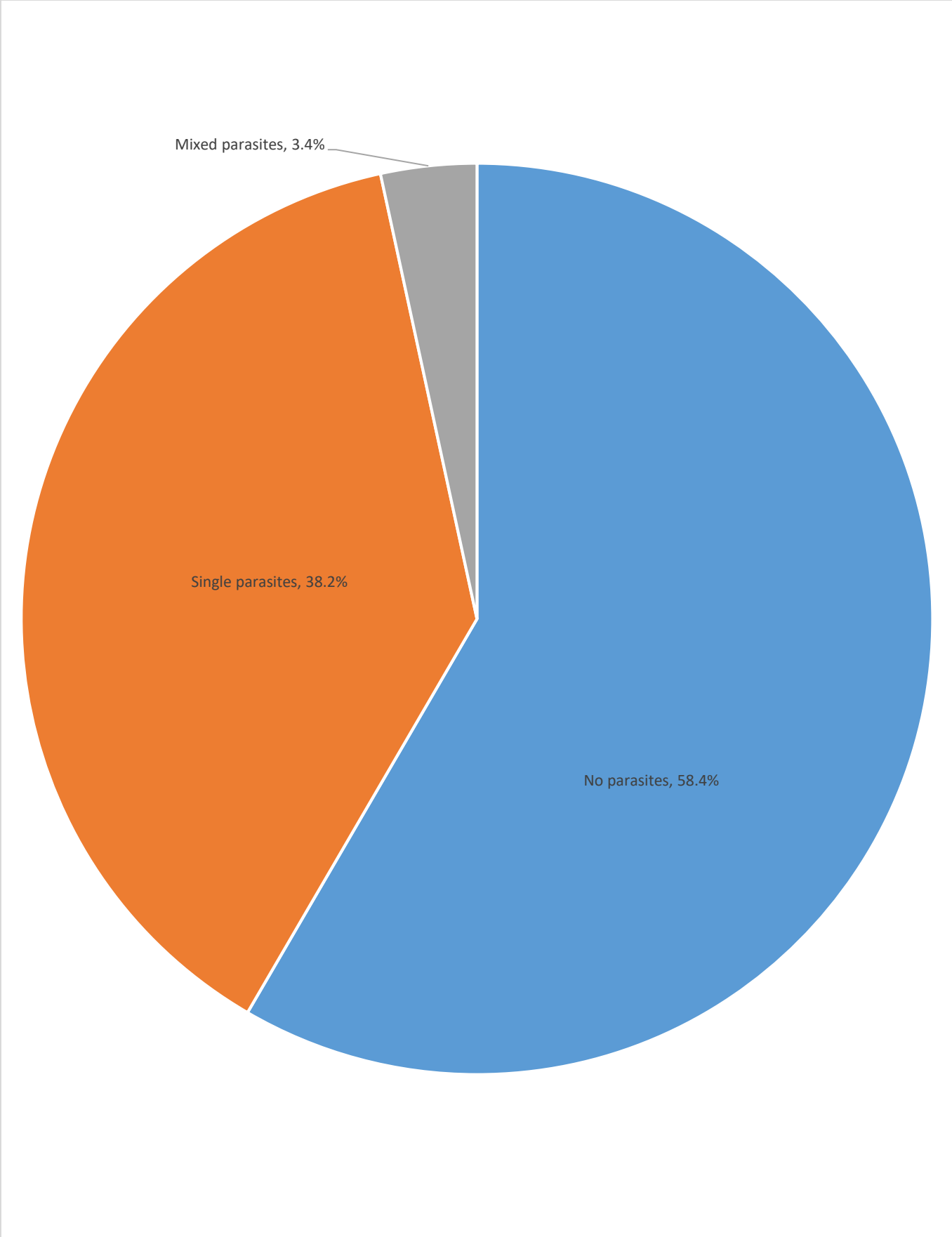


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Supplementary file: Data collection tool

Questionnaire Identification Code: _____

Consent Form

Hello, I am _____ working with a research team from Yanet Health Science College. We are contacting you to collect information for a study conducted to assess “Prevalence of intestinal parasites and associated factors among food handlers in food establishments in the Lideta sub-city of Addis Ababa, Ethiopia”. This questionnaire is prepared to collect food handlers personal and food establishment related information.

Thank you so much for agreeing to be interviewed for this research work. All of the information we got from you will be completely confidential and coded with unique number. Your name will not be written down and will never be used in connection with any of the information you provided. There will not be any direct benefit that you will get associated with participation in this study. If you do not want to answer all or some of the questions, you have the right to refuse participation at any time. However, we would greatly appreciate your help in responding to this questionnaire. This questionnaire is expected to be completed in 10 minutes.

Do I have your permission to continue?

1. **Yes**, continue your interview with thanks after signing the consent

2. **If no**, skip to the next participant by writing reasons for his/ her refusal;

Data collector: Name: _____ Signature: _____ Date: _____
Time started: _____ Time completed: _____

Filled by field supervisors

Result of interview:

1. Completed
2. Not completed
3. The respondent does not complete the whole questions

Name of Supervisor: _____ Signature: _____ Date: _____

Code	Questions	Response	Skip
Part 1: Socio-demographic information of food handlers			
101	Sex	1. Male 2. Female	
102	Age (in complete years)	_____	
103	Educational status	1. Illiterate 2. Primary school 3. Secondary School 4. Tertiary	
104	What is your monthly income?	_____	
105	How many years of work experience do you have in food handling?	_____	
Part 2: Food handlers' personal hygiene conditions			
201	Condition of fingernails	1. Trimmed 2. Untrimmed	
202	Regular hand washing with soap after toilet	1. Yes 2. No	
203	Regular hand washing with soap before eating	1. Yes 2. No	
204	Wearing clean protective clothes regularly	1. Yes 2. No	
Part 3: Food establishment related factors			
301	Food safety training	1. Yes 2. No	
302	Medical checkup (in last 6 month)	1. Yes 2. No	
Intestinal parasites identified (to be filled based on the laboratory results)			
Please carefully read the laboratory reports and write the intestinal parasites identified in the space provided. If no ova of parasites detected, write "No ova of parasites detected".			

BMJ Open

Prevalence of intestinal parasites and associated factors among food handlers in food establishments in the Lideta sub-city of Addis Ababa, Ethiopia: an institution-based cross-sectional study

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Keywords:	Epidemiology < INFECTIOUS DISEASES, Public health < INFECTIOUS DISEASES, PARASITOLOGY

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3 1 **Prevalence of intestinal parasites and associated factors among food handlers in food**
4 **establishments in the Lideta sub-city of Addis Ababa, Ethiopia: an institution-based cross-**
5 **sectional study**
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9 4 Woinishet Abera¹, Binyam Gintamo^{1,2,3}, Tewoderos Shitemaw⁴, Zelalem Negash Mekuria^{1,2,5},
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43
44 20 **Abstract**
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46 21 **Objectives:** This study was conducted to assess the prevalence of intestinal parasites and
47 associated factors among food handlers in the Lideta sub-city of Addis Ababa, Ethiopia.
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50
51 23 **Design:** An institution-based, cross-sectional study design was used. Stool samples were
52 collected from food handlers and examined using direct wet mount and formalin-ether
53 24 concentration (FEC) techniques. Personal and establishment related information was collected
54 25 using a pretested questionnaire with structured observation. Multivariable binary logistic
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56 26
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27 regression was used to identify factors associated with prevalence of intestinal parasites on the
28 basis of adjusted odds ratios and 95% confidence intervals and p values <0.05.

29 **Setting:** Food establishments in the Lideta sub-city of Addis Ababa, Ethiopia.

30 **Participants:** 411 food handlers participated in the study.

31 **Outcome measures:** The primary outcome was prevalence of intestinal parasites, which was
32 defined as presence of one or more intestinal parasitic species in stool samples.

33 **Results:** One or more intestinal parasites were detected in 171 (41.6%; 95% CI: 36.6, 46.4%) of
34 the stool samples. The most common intestinal parasites were *E. histolytica/dispar* (12.7%), *G.*
35 *duodenalis* (11.2%), and *A. lumbricoides* (8.3%). Presence of intestinal parasites among food
36 handlers was associated with low monthly income (AOR: 2.83, 95% CI: 1.50, 8.84),
37 untrimmed fingernails (4.36, 1.98, 11.90), no food safety training (2.51, 1.20, 5.58), low level
38 of education (3.13, 1.34, 7.44), poor handwashing practice (2.16, 1.03, 4.22), and lack of
39 medical checkup (2.31, 1.18, 6.95).

40 **Conclusion:** The prevalence of intestinal parasites among food handlers in food
41 establishments in the Lideta sub-city of Addis Ababa was high. The presence of intestinal
42 parasites was linked to socioeconomic conditions, poor hand hygiene condition, and absence
43 of food safety trainings. It is crucially important to promote hand washing practice and
44 providing food hygiene and safety training in these settings.

45 **Keywords:** Intestinal parasites, food handlers, food establishments, hand hygiene, Ethiopia

47 **Strengths and limitations of this study**

- 48 - The study focused on a key group (food handlers) that has potential to spread foodborne
49 infections to consumers.
- 50 - The use of sensitive diagnostic techniques and a combination of methods with triplicate
51 examinations will have led to an enhanced recovery greater rate of intestinal parasites, to
52 better indicate the true prevalence.

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2
3 53 - The use of a single stool sample might have affected the results of parasitic examination
4
5 54 since the sensitivity of the direct smear examination technique is reduced when a single stool
6
7 55 sample is examined, and the procedure of formalin-ether concentration technique might
8
9 56 damage the parasite eggs.
10
11 57

13 58 **Introduction**

16 59 Foodborne diseases are increasingly becoming a serious global public health problem. The
17
18 60 World Health Organization (WHO) estimate indicates that each year worldwide, unsafe food
19
20 61 causes 600 million cases of foodborne diseases and 420 000 deaths. WHO estimated that 33
21
22 62 million years of healthy lives are lost due to eating unsafe food globally each year, and this
23
24 63 number is likely an underestimation [1]. One of the causes of foodborne diseases is
25
26 64 contamination during food preparation; food handlers carrying pathogens might be involved in
27
28 65 the origin of this condition. Foods can be contaminated with fecal material at the point of
29
30 66 production or during food preparation, in both the home and in commercial premises [2]. Food
31
32 67 handlers with poor personal hygiene and inadequate knowledge on food safety could be potential
33
34 68 sources of infections. Food handlers who harbor and excrete enteropathogens may contaminate
35
36 69 foods from their feces via contaminated hands, then to food or food contact surfaces, and finally
37
38 70 to healthy individuals [3-7].

39
40 71 The contribution of the infected food worker (whether symptomatic or not) to food borne disease
41
42 72 outbreaks has been difficult to establish. However, reports showed that food workers in many
43
44 73 settings have been responsible for foodborne disease outbreaks for decades. For instance,
45
46 74 members of the Committee on Control of Foodborne Illnesses of the International Association
47
48 75 for Food Protection analyzed 816 foodborne disease outbreaks with 80,682 cases in different
49
50 76 countries where food workers were implicated as the source of the contamination. The report
51
52 77 also estimated that infected food worker was documented as responsible for 18% of 766
53
54 78 outbreaks occurring in the United States [8, 9]. Moreover, according to the Centers for Disease
55
56 79 Control (CDC), as cited in Mathew RR (2019), 20 to 40% of food borne illness associated with
57
58 80 the consumption of contaminated food originated in catering establishments [10].
59
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1
2
3 81 Food handling personnel play a role in the transmission of food borne diseases. The health of
4 82 food handlers is of great importance for maintaining quality of food products. Accordingly, pre-
5 83 employment and periodic medical checkup is very important to safeguard the consumers from
6 84 getting diseases from contaminated foods along with other food safety measures [11, 12].
7
8 85 However, pre-employment and periodic medical checkups are not commonly practiced in
9 86 Ethiopia. As a result of this, many of the food handlers working in different food establishments
10 87 all over the country may harbor one or more enteropathogens. For instance, a systematic review
11 88 and meta-analysis reported that the overall pooled prevalence estimate of intestinal parasites
12 89 among food handlers of food service establishments in Ethiopia was 33.6% (95% CI: 27.6,
13 90 39.6%) [13] and the common factors associated to high prevalence of intestinal pathogens among
14 91 food handlers are poor hand hygiene, inadequate access to water and sanitation facilities, and
15 92 poor socioeconomic conditions [13-18]. However, the prevalence and risk factors may be
16 93 different across various settings. Accordingly, this study was conducted to assess the prevalence
17 94 of intestinal parasites and associated factors among food handlers working in food establishment
18 95 in the Lideta sub-city of Addis Ababa, Ethiopia.

96 **Methods**

97 **Study design and setting**

98 This an institution-based cross-sectional study with laboratory investigations was conducted in
99 the Lideta sub-city of Addis Ababa from March 20 to April 20, 2021. Lideta sub-city is one of
100 the 10 sub cities of Addis Ababa, the capital of Ethiopia. The sub-city is located at the global
101 positioning system (GPS) coordinates of 9°0'N and 38°45'E. The sub city is divided into 10
102 districts (Figure 1). In the Lideta sub-city, there are a total of 281 food establishments and 1124
103 food handlers working in the food establishments.

104 **Sample size calculation and sampling techniques**

105 The sample size was calculated using single population proportion formula with the following
106 assumptions: prevalence of intestinal parasites among food handlers in Addis Ababa University
107 students cafeteria, Addis Ababa, Ethiopia (p) = 45.3% [19], level of significance (α) = 5%, 95%
108 confidence interval (standard normal probability), z : the standard normal tabulated value, and
109 margin of error (d) = 5%.

$$n = \frac{(Z_{\alpha/2})^2 P(1 - P)}{d^2} = \frac{(1.96)^2 0.453(1 - 0.453)}{0.05^2} = 381$$

The final sample size was 419 after considering 10% non-response rate. The Lideta sub-city was selected at random from a total of 10 sub-cities of Addis Ababa, Ethiopia. Using lists of food handlers working in different food establishments in the sub-city obtained from Addis Ababa food, medicines, and healthcare administration authority (AAFMHACA) as a sampling frame, we used computer generated random number to select food handlers. Food handlers who treated with anti-helminth and anti-protozoan drugs in the last 4 weeks were excluded from the study.

117 **Stool sample collection**

118 Stool sample collectors first explained the purpose of collecting stool to the randomly selected
119 food handlers, and then asked them to urinate first without pooping to avoid urine contamination
120 of the stool. Stool sample collectors then handed out paper to food handlers and instructing them
121 to defecate on it to avoid stool contamination with stored feces and dirt. Food handlers were
122 asked to bring approximately 50 g of the last part of the stool, the softest part, into the collection
123 container after defecating on the paper. Stool sample collectors didn't violate privacy of food
124 handlers during stool sample collection. Stool sample collectors then immediately stored the
125 stool sample into a cold box after labeled a code on the outer surface of the plastic cup.

126 **Personal and food establishment data collection**

127 We used structured questionnaire and observational checklist to collect food handlers' personal
128 data and food establishments' related information. The questionnaire was developed by
129 reviewing related published articles [15, 20-24]. The tool was first prepared in English language
130 and translated to the local Amharic language by two native Amharic speakers fluent in English,
131 and back-translated into English by two independent English language experts fluent in Amharic
132 to check consistency. The questionnaire consisted of three parts: i) sociodemographic
133 characteristics of food handlers, ii) food handlers' personal hygiene conditions, and iii) food
134 establishment related factors (supplementary file). The questionnaire was pretested to evaluate
135 the instructions, response format, and questions work as intended and are understood by those
136 individuals who are likely to respond to them. Data collectors were trained in the data collection
137 tool as well as ethical issues during interviewing and observing. Supervisors supervised the data

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3 138 collection process and checked the completeness of the data on a daily basis. We gathered
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5 139 handwashing data by assessing food handlers' usual handwashing behavior using self-reports.
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7 140 We also looked at the hands of food handlers to see the general cleanliness and conditions of
8
9 141 fingernails. In addition, we asked food handlers to demonstrate how they wash their hands on a
10
11 142 regular basis, which we evaluated using checklists for effective handwashing.

143 **Detection of ova of parasites in stool samples**

144 We used direct stool examination (wet mount) and formalin-ether concentration (FEC)
145 techniques to detect ova of intestinal parasites in stool samples. One drop of physiological saline
146 was placed on a clean slide. Using an applicator stick, a small amount of stool specimen was
147 emulsified in saline solution. The preparation was covered with a cover slip and examined under
148 the microscope for the absence or presence of an intestinal parasites. The entire saline
149 preparation was systematically examined for helminth eggs, larvae, ciliates, cysts and oocysts
150 using 10× objective with condenser iris closed sufficiently to give good contrast, while 40 ×
151 objectives was used to assist in the detection of eggs, cysts, and oocytes [25].

152 For the FEC technique, an estimated 1 g of formed stool sample or 2 ml of watery stool was
153 emulsified in about 4 ml of 10% formol water contained in a screw-cap bottle. A further 3 ml of
154 10% formol water was added and mixed well by shaking. The emulsified stool samples were
155 sieved, and the sieved suspension transferred to a conical (centrifuge). 3 ml of diethyl ether was
156 added, and the tube was stoppered-mixed for 1 minute with a tissue wrapped around the top of
157 the tube, with the stopper loosened. It was then centrifuge at 3000 rpm for 1 minute. Using a
158 stick, the layer of feces debris from the side of the tube was loosen and the tube inverted to
159 discard the ether, fecal debris, and formol water leaving behind the sediment. The tube was
160 returned to its upright position and the fluid from the sides of the tube allowed draining to the
161 bottom. The bottom of the tube was taped to re-suspend and mix the sediment. The sediment was
162 transferred to a slide and covered with a cover glass and was examined microscopically using the
163 10x objective for focusing and 40× objective for proper identification.

164 Standard operating procedures were used for every laboratory procedure during lab examination,
165 stool specimen collection, transportation, and storing. We used stool sample collection and
166 transportation containers which are leak-proof, dry clean and free from any traces of

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3 167 disinfectants. We ensured correct labelling of stool sample containers with date of sample
4
5 168 collection, and code of the study participants. All stool specimens were stored in ice box for
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7 169 transportation and preserved at 4°C in the laboratory until analyzed for ova of parasites.
8
9 170 Triplicate examinations of stool samples were applied to improve the recovery rate of intestinal
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11 171 parasites. Moreover, the expiry date of normal saline, ether, and formol was evaluated before
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13 172 stool sample preparation and examination.

14 173 **Outcome variable of the study**

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16
17 174 Prevalence of intestinal parasites, the primary outcome variable of the study is defined as the
18
19 175 presence of one or more intestinal parasite species in stool samples.

20 21 176 **Data processing and analysis**

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23
24 177 Data were entered using EPI-INFO version 3.5.3 statistical package and export into Statistical
25
26 178 Package for Social Sciences (SPSS) version 20 for further analysis. For most variables, data were
27
28 179 presented by frequencies and percentages. Univariable binary logistic regression analysis was
29
30 180 used to choose variables for the multivariable binary logistic regression analysis, and variables
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32 181 which had p-value less than 0.25 by the univariable analysis and other well-known
33
34 182 confounders from the literature were then analyzed by multivariable analysis for controlling the
35
36 183 possible effect of confounders and to predict the prevalence of intestinal parasites among food
37
38 184 handlers based on the predictors. The adjusted analysis for the primary exposure (hand hygiene,
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40 185 food safety training, and medical checkup) and secondary risk factors (education status and
41
42 186 monthly income) focus on direct effects. In the adjusted model, variables which had significant
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44 187 association were identified on the basis of adjusted odds ratios (AORs) with 95% confidence
45
46 188 intervals (CIs) and p-values <0.05. The predictive power of the model was checked using
47
48 189 McFadden's pseudo R-squared.

49 190 **Ethics approval and consent to participate**

50
51 191 Ethical clearance was obtained from the Institutional Review Board of Yanet Health College
52
53 192 (reference number: YEC/060/21). There were no risks due to participation and the collected data
54
55 193 were used only for this research purpose with complete confidentiality and privacy of food
56
57 194 handlers during stool sample collection was assured. Written informed consent was obtained
58
59 195 from food handlers. Furthermore, we advised food handlers who had one or more ova of

196 parasites to visit health institutions for treatment. All the methods were carried out in accordance
 197 with relevant guidelines and regulations.

198 **Patient and public involvement**

199 There was no patient or public involvement in the study.

200 **Results**

201 **Sociodemographic characteristics of study participants**

202 We collected personal information and stool samples from a total 411 food handlers with a
 203 response rate of 97.62%. The majority, 293 (71.3%) of the study participants were female. The
 204 median age of the respondents was 28 and the interquartile range (IQR) was 20–39 years. About
 205 half, 198 (48.18%) of the respondents aged 25 years and below. Half (207 [50.3%]) of the
 206 respondents reported that they completed primary school education. 278 (67.6%) of the food
 207 handlers reported that they had 3 years or less work experience. 111 (27.0%) of the food handlers
 208 earned <1500 Ethiopian birr (Table 1).

209 **Table 1: Sociodemographic characteristics of food handlers (n=411) working in different**
 210 **food establishments in the Lideta sub-city of Addis Ababa, Ethiopia, March 20 to April 20,**
 211 **2021**

Sociodemographic characteristics	Frequency	Percent
Sex of the respondents		
Female	293	71.3
Male	118	28.7
Age of the respondents in years		
≤25	198	48.2
26-35	113	27.5
36-50	100	24.3
Education status of the respondents		
Tertiary education	23	5.6
Secondary school	163	39.7

Primary school	207	50.3
Illiterate	18	4.4
Service year		
≤3 years	278	67.6
>3 years	133	33.4
Average monthly income in Ethiopian birr		
<1500	111	27.0
1501-2500	152	37.0
2501-3500	94	22.9
>3500	54	13.1

212 Personal hygiene characteristics of food handlers

213 242 (58.9%) of the food handlers did not keep their fingernails short. 194 (47.2%) and 206
 214 (50.1%) of the food handlers did not regularly wash hands with soap after visiting toilet and
 215 before eating, respectively. 208 (50.6%) of the food handlers reported that they regularly worn
 216 clean protective clothes. About a quarter (76 [24%]) of the food handlers reported that they
 217 received food safety training and 121 (29.4%) of the food handlers had medical checkup in the
 218 previous 6 months prior to the survey (Table 2).

219 **Table 2: Personal hygiene characteristics of food handlers (n=411) working in different**
 220 **food establishments in the Lideta sub-city of Addis Ababa, Ethiopia, March 20 to April 20,**
 221 **2021**

Variables	Frequency	Percent
Condition of fingernails		
Trimmed	169	41.1
Untrimmed	242	58.9
Regular hand washing with soap after toilet		
Yes	217	52.8
No	194	47.2
Regular hand washing with soap before eating		

Yes	205	49.9
No	206	50.1
Wearing clean protective clothes regularly		
Yes	208	50.6
No	203	49.4
Food safety training		
Yes	76	24
No	335	76
Medical checkup (in last 6 month)		
Yes	121	29.4
No	290	70.6

222

223 Intestinal parasites in food handlers

224 A total of 411 food handlers were examined, with 171 (41.6%) (95% CI: 36.6, 46.4%) of them
 225 had ova of one or more intestinal parasites [98 (23.8% were protozoan and 73 (17.8%) were
 226 helminth parasites], of which 14 (3.4%) had mixed parasites (Figure 2). The most common
 227 intestinal parasites were *E. histolytica/dispar* [52 (12.7%)], *G. duodenalis* [46 (11.2%)], *A.*
 228 *lumbricoides* [34 (8.3%)], Hookworms [15 (3.6%)], *T. trichuria* [14 (3.4%)], and Taenia species
 229 [10 (2.4%)] (Table 3).

230 **Table 3: Common intestinal parasites detected among food handlers (n=411) working in**
 231 **different food establishments in the Lideta sub-city of Addis Ababa, Ethiopia, March 20 to**
 232 **April 20, 2021**

Parasitic species	Frequency	Percent
<i>E.histolytica/dispar</i>	52	12.7
<i>G. duodenalis</i>	46	11.2
<i>A. lumbricoides</i>	34	8.3
Hookworms	15	3.6
<i>T. trichuria,</i>	14	3.4
Taenia species	10	2.4

233 Factors associated with intestinal parasites among food handlers

234 Sex, age, educational level, work experience, monthly income, wearing clean protective clothes,
 235 finger nail status, hand washing after toilet, hand washing before eating, food safety training, and
 236 medical checkup were the variables entered in to the univariable binary logistic regression
 237 analysis, of which educational status, average monthly income, condition of fingernails, hand
 238 washing with soap before eating, food safety training, and medical checkup in the last 6 month
 239 were the candidate variables for the final model which were selected based on $p < 0.25$ and hand
 240 washing with soap after visiting toilet was a well-known confounder in the literature included in
 241 the final model even if its p value is greater than 0.25. In the multivariable binary logistic
 242 regression analysis, prevalence of intestinal parasites among food handlers was significantly
 243 associated with poor handwashing practice (AOR: 2.16, 95% CI: 1.03, 4.22), untrimmed
 244 fingernails (AOR: 4.36, 95% CI: 1.98, 11.90), lack of medical checkup (AOR: 2.31, 95% CI:
 245 1.18, 6.95), no food safety training (AOR: 2.51, 95% CI: 1.20, 5.58), low level of education
 246 (AOR: 3.13, 95% CI: 1.34, 7.44), and low monthly income (AOR: 2.83, 95% CI: 1.50, 8.84)
 247 (Table 4). Table 4 included effect estimates from the model with all the seven variables. In that
 248 case, one should know that the educational status and monthly income estimates are for direct
 249 effects.

250 **Table 4: Factors associated with intestinal parasites among food handlers (n=411) working**
 251 **in different food establishments in the Lideta sub-city of Addis Ababa, Ethiopia, March 20**
 252 **to April 20, 2021**

Variables	Intestinal parasites		COR (95% CI)	AOR (95% CI)
	Yes	No		
Educational status				
Illiterate	9	9	3.60 (1.81, 10.80)	3.13 (1.34, 7.44)*
Primary school	92	115	2.88 (1.65, 6.17)	2.22 (1.10, 6.65)*
Secondary school	68	95	2.58 (1.20, 5.56)	2.16 (1.10, 5.20)*
Tertiary education	5	18	1.0	1.0
Average monthly income in Ethiopian birr				
<1500	56	55	2.91 (1.43, 7.86)	2.84 (1.50, 8.84)*
1501-2500	68	84	2.31 (1.14, 6.96)	2.28 (0.63, 8.10)
2501-3500	33	61	1.55 (1.05, 4.85)	1.41 (0.60, 5.96)

>3500	14	40	1.0	1.0
Condition of fingernails				
Untrimmed	134	108	4.43 (2.12, 12.62)	4.36 (1.98, 11.90)**
Trimmed	37	132	1.0	1.0
Hand washing with soap after toilet				
No	101	93	2.28 (1.10, 7.51)	2.19 (0.92, 5.62)
Yes	70	147	1.0	1.0
Hand washing with soap before eating				
No	112	94	2.95 (1.23, 6.72)	2.16 (1.03, 4.22)*
Yes	59	146	1.0	1.0
Food safety training				
No	153	182	2.71 (1.34, 8.53)	2.51 (1.20, 5.58)*
Yes	18	58	1.0	1.0
Medical checkup in the last 6 month				
No	140	150	2.71 (1.27, 7.56)	2.32 (1.18, 6.95)*
Yes	31	90	1.0	1.0

Note: * statistically significant at $p < 0.05$, ** statistically significant at $p < 0.01$, and McFadden's pseudo R-squared = 0.492

253 Discussion

254 This is an institution-based cross-sectional study assessed intestinal parasites among food
 255 handlers working in food establishments in the Lideta sub-city of Addis Ababa, Ethiopia and
 256 found that 41.6% (95% CI: 36.6, 46.4%) of the food handlers had one or more intestinal
 257 parasites. The prevalence of intestinal parasites reported in this study was comparable with
 258 findings of studies conducted among food handlers in Bule Hora (46.3%) [16] and Addis Ababa
 259 University (45.3%) [19]. The prevalence of intestinal parasites reported in this study was lower
 260 than findings of studies in Nekemte town (52.1%) [26] and Mekele University (49.4%) [15].
 261 Furthermore, the prevalence of intestinal parasites reported in the current study was higher than
 262 findings of studies conducted among food handlers in Wolaita Sodo (23.6%) [14], Jimma (33%)
 263 [27], Mada Walabu University (25.3%) [28], Motta town (27.6%) [29], Nairobi(15.7%)[30],

264 Iran (9%) [31], Saudi Arabia (23%) [32], and Thailand (10%) [33]. The high prevalence of
265 intestinal parasites among food handlers among food handlers working in food establishments in
266 the Lideta sub-city of Addis Ababa might be explained by poor socioeconomic conditions, poor
267 hand hygiene, and inadequate access to basic sanitation services.

268 The high prevalence of intestinal parasites among food handlers working in food
269 establishments in the Lideta sub-city suggests that poor hygiene practices of food handlers and
270 inadequate access to sanitation services. The results may also suggest that there might be
271 transmission of intestinal parasitic infections from food handlers to food users, unless large
272 scale screening and mass drug administration are done. As it is documented in literature, infected
273 food handlers play a significant role in infection transmissions to customers of the food
274 establishments where the infected food handlers are working [4].

275 This study showed that educational status of food handlers was associated with a high prevalence
276 of intestinal parasites. Prevalence of intestinal parasites was higher among food handlers who
277 were illiterate or attended primary and secondary education compared with food handlers who
278 attended tertiary education. This may be due to the fact that educated food handlers may have
279 awareness about the transmission and prevention methods of infectious diseases. Education
280 encourages changes in healthy behaviors. Other similar studies also reported the relation of
281 education with occurrence of parasitic infections [34-38].

282 The current study revealed that monthly income of food handlers was associated with intestinal
283 parasites among food handlers. Food handlers with low monthly income had higher odds of
284 intestinal parasites. This may be due to the fact that food handlers with low economic status
285 could not afford for services like soap, household water treatment, toilets and other facilities, and
286 so that will have limited opportunities to practice healthy measures. The effect of low income on
287 risk of parasites is complex and could be attributed to limited access to sanitary materials,
288 sources of drinking water and food, environment sanitation, and education [37-40].

289 The high prevalence of intestinal parasites among food handlers was associated with hand
290 hygiene. Food handlers who did not keep their fingernails short had higher odds to have
291 intestinal parasites and the odds of having intestinal parasites was also higher among food
292 handlers who did not wash hands with soap before eating. This might be due to the fact that the

1
2
3 293 area beneath the fingernails has the highest concentration of microorganisms on the hands and is
4
5 294 the most difficult to clean [41-44]. Moreover, food handlers may ingest diseases causing
6
7 295 pathogens when they eat without washing hands. Hands are one of the most important
8
9 296 mechanisms to transmit pathogenic microorganisms leading to infection [45]. Evidence indicates
10
11 297 that hands together with food contact or other environmental surfaces cause 60% of the spread of
12
13 298 gastrointestinal infection. Contaminated hands could also be associated with up to 50% of
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15 299 respiratory tract infections [46].

16 300 This study showed that the presence of intestinal parasites among food handlers was significantly
17
18 301 associated with food safety training. The odds of having intestinal parasites were high among
19
20 302 food handlers who did not take food safety training compared with their counterparts. This could
21
22 303 be due to the fact those food handlers who did not take food safety training may lack the
23
24 304 necessary knowledge and practice towards transmission and prevention of disease-causing
25
26 305 pathogens. Moreover, food safety training or health education promotes health behaviors toward
27
28 306 hygiene and sanitation practices. Health education increases knowledge and acceptability of
29
30 307 interventions. It also sustains integrated control of the infection [47-49].

31 308 Furthermore, the presence of intestinal parasites was significantly associated with medical
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33 309 checkup. The odds of having intestinal parasites were high among food handlers who did not
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35 310 take medical checkups in the 6 months prior to the survey. Other studies are also reported that
36
37 311 medical checkup of food handlers is associated with intestinal parasites [15, 31, 50]. This is
38
39 312 because food handlers who did not know their health condition before employment and while
40
41 313 working in different establishments has less chance to take treatment and mass drugs as a result
42
43 314 there may be existed or new or re-infections.

44 315 To increase the degree to which inferences from the sample population can be generalized to a
45
46 316 larger group of population, we recruited study participants at random or in a manner in which
47
48 317 they are representative of the population that we wished to study, ensuring that every member of
49
50 318 the population had an equal chance to be included in the study. In addition, we calculated
51
52 319 adequately powered sample size using sample size determination procedures appropriate to the
53
54 320 study objective with appropriate assumptions. Furthermore, our findings could be applicable to
55
56 321 other situations and settings which have similar characteristics with the study populations of the
57
58 322 current studies.

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3 323 As a limitation, even if the use of sensitive diagnostic techniques and combination of methods
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5 324 with triplicate examinations applied in this study would help to recover greater rate of intestinal
6
7 325 parasites that would indicate the true prevalence, this study had some limitations. The collection
8
9 326 of a single stool sample may affect the result of parasitic examination since the sensitivities of
10
11 327 the direct smear examination technique is reduced when a single stool sample is examined. The
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13 328 procedure of FEC technique may also damage the eggs of parasites. The handwashing data
14
15 329 assessed by self-reports may not be reliable since the study subjects may make the more socially
16
17 330 acceptable answer rather than being truthful and they may not be able to assess themselves
18
19 331 accurately. Moreover, we pre-screened variables using univariable analysis ($p < 0.25$), even
20
21 332 though we retained some well-known confounders from the literature regardless of their
22
23 333 univariable p-value. This could lead to the incorrect exclusion of a potential confounder and
24
25 334 hence led to an inadequate adjustment for confounding.

335 **Conclusion**

336 The prevalence of intestinal parasites among food handlers working in food establishments in
337 the Lideta sub-city of Addis Ababa, Ethiopia was found to be high. This high prevalence of
338 intestinal parasites was linked to socioeconomic conditions of food handlers, poor hand
339 hygiene condition, absence of food safety trainings and regular medical checkup. It is,
340 therefore, important to promote hand washing practice of food handlers, provide food
341 hygiene and safety trainings, and establishing a system to regularly check the health
342 conditions of food handlers.

343

344 **Data availability statement**

345 Individual participant data after deidentification that underlie the results reported in this article
346 will be made available upon requesting the corresponding author immediately following
347 publication.

348 **Contributors**

349 WA designed the study, facilitated data collection, and conducted data analysis. BG, TS, ZNM,
350 and ZG supervised data collection and analysis and contributed to conceptualizing the study. ZG
351 prepared the manuscript. All authors approved the final version of the manuscript.

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354 collection tools and data collectors' fee was covered by the principal investigator (WA).

355 **Competing interests**

356 None of the authors have any competing interests.

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359 food establishments in Lideta sub-city of Addis Ababa, data collectors, and supervisors for their
360 contribution in the study.

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508 Figure titles and legends

509 Figure 1: Map of Addis Ababa city (A) and Lideta sub-city (B)

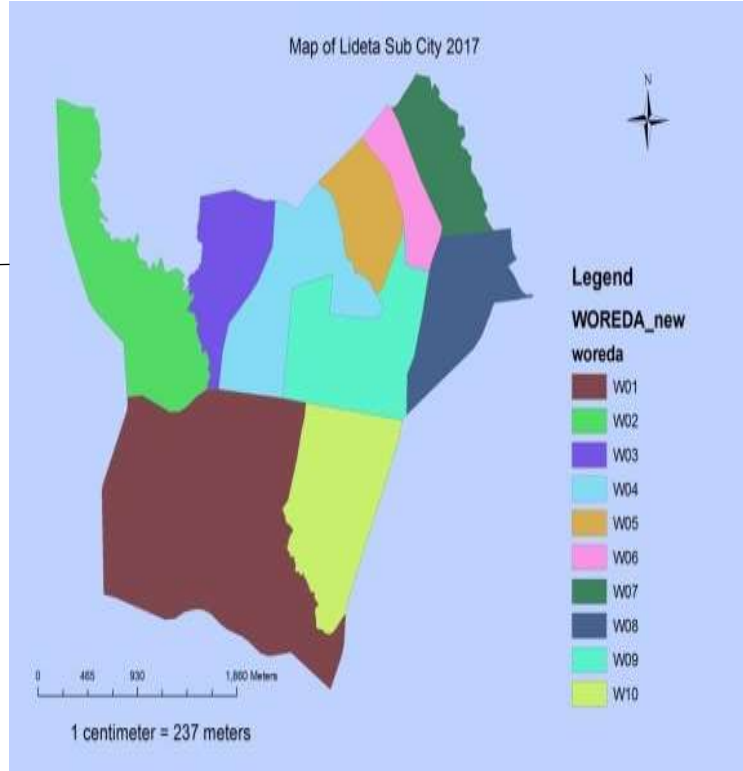
510 Source: Lideta sub-city administration.

511 Figure 2: Proportion of food handlers with no, single and mixed parasites (n=411) 512 working in different food establishments in Lideta sub city of Addis Ababa, Ethiopia, 513 March 20 to April 20, 2021

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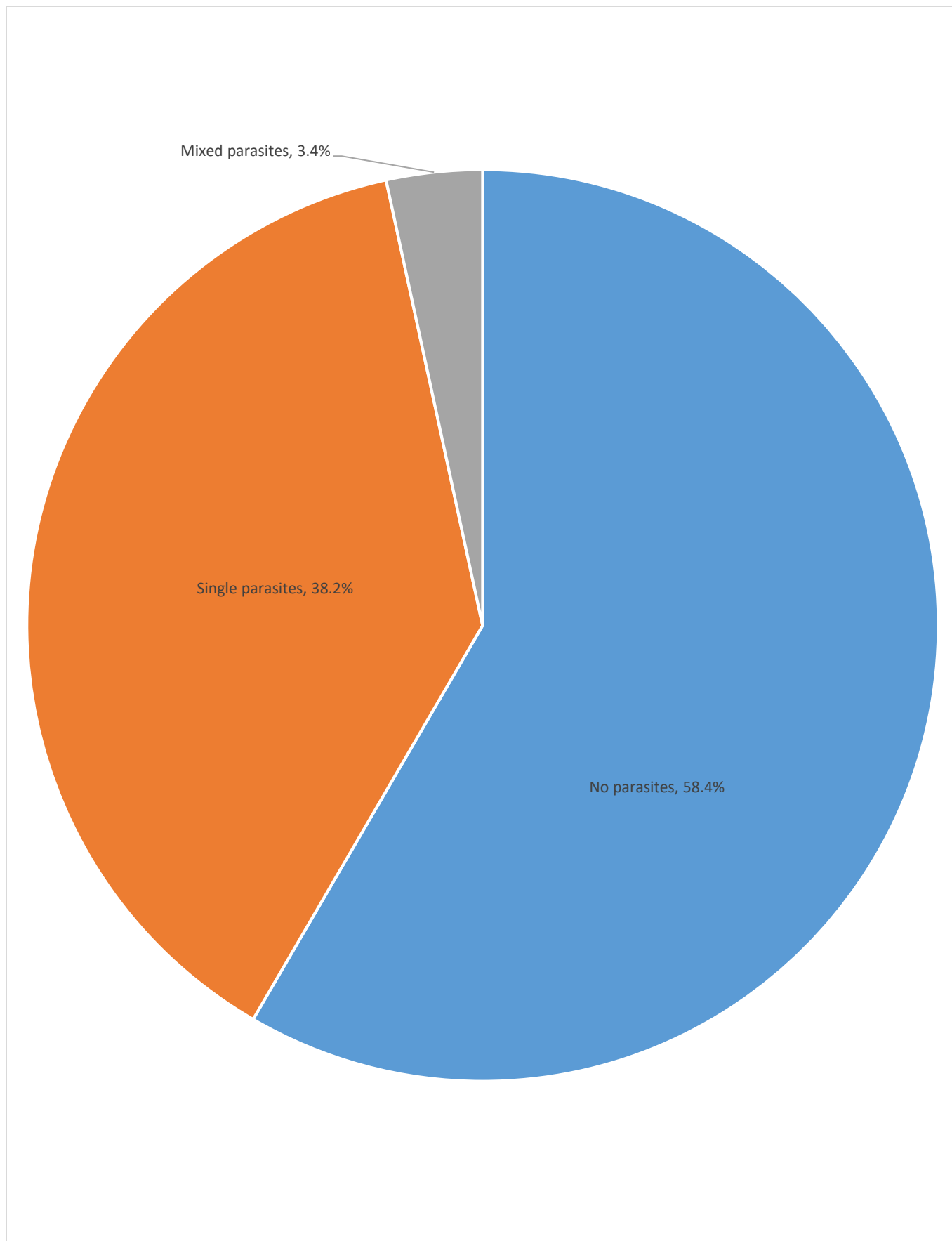
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Supplementary file: Data collection tool

Questionnaire Identification Code: _____

Consent Form

Hello, I am _____ working with a research team from Yanet Health Science College. We are contacting you to collect information for a study conducted to assess “Prevalence of intestinal parasites and associated factors among food handlers in food establishments in the Lideta sub-city of Addis Ababa, Ethiopia”. This questionnaire is prepared to collect food handlers personal and food establishment related information.

Thank you so much for agreeing to be interviewed for this research work. All of the information we got from you will be completely confidential and coded with unique number. Your name will not be written down and will never be used in connection with any of the information you provided. There will not be any direct benefit that you will get associated with participation in this study. If you do not want to answer all or some of the questions, you have the right to refuse participation at any time. However, we would greatly appreciate your help in responding to this questionnaire. This questionnaire is expected to be completed in 10 minutes.

Do I have your permission to continue?

1. **Yes**, continue your interview with thanks after signing the consent

2. **If no**, skip to the next participant by writing reasons for his/ her refusal;

Data collector: Name: _____ Signature: _____ Date: _____
Time started: _____ Time completed: _____

Filled by field supervisors

Result of interview:

1. Completed
2. Not completed
3. The respondent does not complete the whole questions

Name of Supervisor: _____ Signature: _____ Date: _____

Code	Questions	Response	Skip
Part 1: Socio-demographic information of food handlers			
101	Sex	1. Male 2. Female	
102	Age (in complete years)	_____	
103	Educational status	1. Illiterate 2. Primary school 3. Secondary School 4. Tertiary	
104	What is your monthly income?	_____	
105	How many years of work experience do you have in food handling?	_____	
Part 2: Food handlers' personal hygiene conditions			
201	Condition of fingernails	1. Trimmed 2. Untrimmed	
202	Regular hand washing with soap after toilet	1. Yes 2. No	
203	Regular hand washing with soap before eating	1. Yes 2. No	
204	Wearing clean protective clothes regularly	1. Yes 2. No	
Part 3: Food establishment related factors			
301	Food safety training	1. Yes 2. No	
302	Medical checkup (in last 6 month)	1. Yes 2. No	
Intestinal parasites identified (to be filled based on the laboratory results)			
Please carefully read the laboratory reports and write the intestinal parasites identified in the space provided. If no ova of parasites detected, write "No ova of parasites detected".			