Prevalence and factors associated with intestinal protozoan and helminthic infections among certified food handlers in Eldoret town, Uasin Gishu county in Kenya

Abstract

Background: Food and water remain a major source of most these intestinal parasites with food handlers acting as reservoirs and transmission agents.

Objective: This study aimed at determining the prevalence and factors associated with intestinal parasitic infections among certified food handlers in Eldoret Town.

Methods: The study area was Eldoret town in Uasin Gishu County. Data collection took place between the month of May and June 2015. The cross sectional study enrolled 249 certified food handlers with valid medical certificates in various food establishments in Eldoret town.

Results: The overall prevalence of intestinal parasitic infection among the certified food handlers was 30.4% (58/191). E. histolytica (32.8%; n=19) was the most prevalent intestinal parasite. The prevalence of intestinal parasites differed significantly by food handlers’ age groups, per capita monthly income, type of organic waste receptacle inside the food premise, and hand washing habit after visiting a toilet/latrine (p<0.05). Food handlers’ failure to wash their hands after visiting a toilet/latrine was a risk factor associated with intestinal parasitic infections (OR, 0.35; p=0.013).

Conclusion: The high prevalence of intestinal parasitic infections reported among the certified food handlers in Eldoret is a clear indication of poor food handling practices in the town.

Keywords: protozoa, helminthic, parasites, intestinal parasites, food handlers

Background

Intestinal protozoan and helminthic infections remain a major public health issue in the poorest regions of the world.1-3 Such regions are usually characterised by poor levels of education, hygiene and sanitation practices, and a high disease burden1,2,4 including intestinal parasitic infections. Food and water remains a major source of most intestinal parasites with food handlers being the reservoirs and transmission agents.5,6

Globally, studies on intestinal parasitic infections among food handlers are vast.8,9 In Kenya, the prevalence of intestinal parasitic infections among food handlers remains exceptionally high. This figure varies from 13.8%7 to 24%.9 A variance attributed to different to socio-demographic characteristics of the food handlers, climatic conditions and geographical location.

The population of Eldoret has increased rapidly over the last 15 years. As of March 2015, the town had more than 6,967 registered food handlers. Chapter 254 (Regulation 15) of the laws of Kenya governs certification of food handlers.7 These include screening and ensuring food handlers comply with the law. A 6-month medical certificate is always issued to food handlers who successfully fulfill the requirements. However, there is always no follow-up to ascertain if the certified food handlers’ remain healthy during the certification period. This include free from intestinal parasitic infections. This study therefore, aimed at determining the prevalence and factors associated with intestinal helminthiasis among certified food handlers in Eldoret Town.

Materials and methods

Study areas and population

The study area was Eldoret town in Uasin Gishu County. A cosmopolitan town located 315 km North West of Kenyan capital Nairobi and which serves as the headquarters of Uasin Gishu County. Data collection took place between the month of May and June 2015. The study enrolled only certified food handlers with valid medical certificates recruited from 108 registered food premises in Eldoret town.

Study design

The study was cross-sectional in design.

Data collection

Data was collected using a pretested interviewer administered questionnaire and a checklist. The questionnaire was used to capture socio-demographic characteristics, sanitation and hygienic practices of the food handlers. Data collectors were trained for two days on how to administer the questionnaire. A checklist was used to verify the...
type of organic waste container inside the premise, the toilet facilities available and the status of the food handlers’ fingernails.

**Sample size and sampling technique**

Six months prior to the study, the researcher, updated the database of all food handlers who came to apply for certification in the health department of the County. Valuable data, which would enable the researcher to trace the food handler after certification such as cell phone number and the premise where the food handler was working were entered into the database. A total of 2,407 food handlers successfully obtained their medical certificate during the study period. A sample size was calculated using a single population formula from this total. The researcher assumed a prevalence of 15.7%,7 95% confidence interval (CI) and a 5% margin error. Two hundred and forty nine randomly selected food handlers participated in the study.

**Stool sample collection and processing**

Stool samples were collected in a tight lid plastic container. The food handlers were trained on how to collect stool in the provided tight lid plastic containers. Microscopic parasitological assessments of the stools were conducted at Mount Kenya University, Eldoret Campus laboratories by a qualified technician. Both direct iodine wets mount and Formol ether concentration assessment as described elsewhere was employed.8 Both direct iodine wet mount and Formol ether concentrations yielded the same results.

**Data analysis**

Statistical analysis was performed by SPSS version 20.0 for windows. Prevalence is reported in percentages. The chi-square test was used to compare prevalence among various groups. Significant factors at univariate level were further analysed using regression analysis after controlling for confounding. A p-value <0.05 was considered statistically significant.

**Ethical consideration**

The study obtained ethical clearance from Mount Kenya University ethical committee. Informed consent was obtained from all food handlers who participated in the study. Participation was purely voluntary. Microscopically confirmed cases of intestinal protozoa or helminthic infections were referred to the nearest public health facility for treatment.

**Results**

**Socio-demographic characteristics of the food handlers**

Two hundred and forty nine food handlers with valid medical certificates were screened for intestinal worms between the month of May and June 2015. The food handlers were between the ages of 18 and 57 years, with a mean age of 23.9 years. The majority of the food handlers were above 25 years (n=205; 82.3%). Most of the food handlers who participated in the study were females (n=168; 67.4%). Seventy-six (30.5%) food handlers were illiterate, 25.7% (n=64) educated to primary level, 26.5% (n=66) to secondary and 17.3% (n=43) to tertiary level. The majority of the certified food handlers interviewed were based in urban centres (n=146; 58.6%), trimmed their hands (n=160; 64.3%), had access to basic toilet facilities (n=170, 68.3%), worked in a food premise with closed organic waste receptacle (n=177; 71.1%), wore shoes (n=218; 87.6%), and had access to safe drinking water (n=170; 68.3%). A high proportion occasionally washed their hands after visiting a toilet/latrine (n=127; 51.0%) (Table 1).

| Table 1 Number and distribution of intestinal parasites among the food handlers’ socio-demographic characteristics |
|---------------------------------------------------------------|
| **Socio-demographic characteristics** | **E.h n=19 (32.8%)** | **A.1 n=11 (19.0%)** | **T.t n=9 (15.5%)** | **G.i n=7 (12.0%)** | **Hookworm spp n=12 (20.7%)** | **p-value** |
| Age | | | | | | |
| ≤25 | 11 (57.9%) | 1 (9.1%) | 2 (22.2%) | 0 (0.0%) | 1 (8.3%) | 0.001 |
| 26-35 | 6 (31.6%) | 9 (81.8%) | 4 (44.4%) | 6 (57.1%) | 4 (33.3%) |
| ≥35 | 2 (10.5%) | 1 (9.1%) | 3 (33.3%) | 1 (14.3%) | 7 (58.3%) |
| Gender | | | | | | |
| Male | 6 (31.6%) | 3 (27.3%) | 6 (66.7%) | 2 (28.6%) | 3 (25.0%) | 0.284 |
| Female | 13 (68.4%) | 8 (72.7%) | 3 (33.3%) | 5 (71.4%) | 9 (75.0%) |
| Level of education | | | | | | |
| Illiterate | 9 (47.4%) | 5 (45.5%) | 1 (11.1%) | 4 (57.1%) | 6 (47.4%) | 0.295 |
| Primary | 5 (26.3%) | 2 (18.2%) | 6 (66.7%) | 1 (14.3%) | 5 (26.3%) |
| Secondary | 3 (15.8%) | 1 (9.1%) | 2 (22.2%) | 1 (14.3%) | 1 (8.3%) |
| Tertiary | 2 (10.5%) | 3 (27.3%) | 0 (0.0%) | 1 (14.3%) | 0 (0.0%) |
| Area | | | | | | |
| Peri-urban | 7 (36.8%) | 4 (36.4%) | 1 (11.1%) | 1 (14.3%) | 0 (0.0%) | 0.190 |
| Urban | 10 (52.6%) | 6 (54.5%) | 0 (0.0%) | 4 (57.1%) | 10 (83.3%) |

Citation: Ogolla JO. Prevalence and factors associated with intestinal protozoan and helminthic infections among certified food handlers in Eldoret town, Uasin Gishu county in Kenya. Int Clin Pathol J. 2018;6(3):124–128. DOI: 10.15406/icpjl.2018.06.00171
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Prevalence of intestinal parasites

Five types of intestinal parasites namely E. histolytica, hookworm spp, A. lumbricoides, T. trichiura and G. intestinalis were found in the stools of 58 certified food handlers in Eldoret town. The overall prevalence of intestinal parasitic infection among the certified food handlers was 30.4% (58/191). E. histolytica (32.8%; n=19) was the most prevalent intestinal parasite found in the stools of the food handlers followed by hookworm spp (20.7%), A. lumbricoides (19.0%), T. trichiura (15.5%), and then G. intestinalis (12.0%). The prevalence of intestinal parasites differed significantly by food handlers’ age groups, per capita monthly income, type of organic waste receptacle inside the food premise, and hand washing habit after visiting a toilet/latrine ($p<0.05$).

The prevalence of A. lumbricoides (n=9; 81.8%) and G. intestinalis (n=6; 85.7%) was significantly higher among food handlers aged 26–35 years ($\chi^2=1.019; p=0.001$). Food handlers whose per capita monthly income were between Ksh.5001–Ksh.10,000 reported significantly high prevalence of G. intestinalis (n=5; 91.7%) and hookworm spp (n=11; 91.7%) ($\chi^2=22.925; p=0.003$). Premises with closed organic waste receptacles had the highest number of

| Table Continued |
|-----------------|
| Intestinal Parasites | E.h n=19 (32.8%) | A.l n=11 (19.0%) | T.t n=9 (15.5%) | G.i n=7 (12.0%) | Hookworm spp n=12 (20.7%) | p-value |
| Socio-demographic characteristics | Rural | Per capita monthly income | ≤Ksh.5000 | 7 (36.8%) | 5 (45.5%) | 5 (55.6%) | 1 (14.3%) | 1 (8.3%) | 0.003 |
| | | Ksh.5001-10,000 | 5 (26.4%) | 2 (18.2%) | 4 (44.4%) | 5 (71.4%) | 11 (91.7%) | | |
| | | ≥Ksh.10,001 | 7 (36.8%) | 4 (36.4%) | 0 (0.0%) | 1 (14.3%) | 0 (0.0%) | | |
| Water source | Safe | 10 (52.6%) | 6 (54.5%) | 8 (88.9%) | 3 (42.9%) | 8 (66.7%) | 0.310 |
| | Unsafe | 9 (47.4%) | 5 (45.5%) | 1 (11.1%) | 4 (57.1%) | 4 (33.3%) | | |
| Hand washing before meals | Occasionally | 2 (10.5%) | 6 (54.5%) | 3 (33.3%) | 5 (71.4%) | 6 (50.0%) | 0.083 |
| | Often | 12 (63.2%) | 3 (27.3%) | 2 (22.2%) | 0 (0.0%) | 3 (25.0%) | | |
| | Rarely | 5 (26.3%) | 1 (9.1%) | 3 (33.3%) | 2 (28.6%) | 2 (16.7%) | | |
| | Always | 0 (0.0%) | 1 (9.1%) | 1 (11.2%) | 0 (0.0%) | 1 (8.3%) | | |
| Shoe wearing habit | No | 2 (10.5%) | 0 (0.0%) | 1 (11.1%) | 2 (28.6%) | 1 (8.3%) | 0.429 |
| | Yes | 17 (89.5%) | 11 (100.0%) | 8 (88.9%) | 5 (71.4%) | 11 (91.7%) | | |
| Type of organic waste receptacle inside the premise | Open | 1 (5.3%) | 4 (36.4%) | 5 (55.6%) | 3 (42.9%) | 1 (8.3%) | 0.014 |
| | Closed | 18 (94.7%) | 7 (63.6%) | 4 (44.4%) | 4 (57.1%) | 11 (91.7%) | | |
| Basic toilet facility | Absent | 3 (15.8%) | 3 (27.3%) | 4 (44.4%) | 0 (0.0%) | 1 (8.3%) | 0.139 |
| | Present | 16 (84.2%) | 8 (72.7%) | 5 (55.6%) | 7 (100.0%) | 11 (91.7%) | | |
| Finger nails status | Trimmed | 9 (47.4%) | 5 (45.5%) | 6 (66.7%) | 1 (14.3%) | 7 (58.3%) | 0.289 |
| | Untrimmed | 10 (52.6%) | 6 (54.5%) | 3 (33.3%) | 6 (85.7%) | 5 (41.7%) | | |
| Wash hands after visiting a toilet/latrine | Never | 4 (21.1%) | 1 (9.1%) | 2 (22.2%) | 2 (28.6%) | 0 (0.0%) | 0.030 |
| | Occasionally | 7 (36.8%) | 7 (63.6%) | 6 (66.7%) | 5 (71.4%) | 12 (100.0%) | | |
| | Often | 8 (42.1%) | 3 (27.3%) | 1 (11.1%) | 0 (0.0%) | 0 (0.0%) | | |

E.h, E. histolytica; A.l, A. lumbricoides; T.t, T. trichiura; G. intestinalis
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Of the 11 predictors analysed, only availability of toilet facility and hand washing after visiting a toilet were associated with intestinal parasitic infections in univariate analysis (p<0.05). No association was found between age, gender, level of education, area, per capita monthly income, water source, hand washing before meals, shoe wearing habit, types of organic waste receptacle in the premise, finger nails status and intestinal parasitic infections (p>0.05) (Table 2). In multivariate analysis, failure to wash hands after visiting a toilet/latrine was found to be a risk factor associated with intestinal parasitic infections (OR, 0.35; p=0.013) (Table 3).

### Predictors of intestinal parasitic infection(s)

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### Table 2 Univariate model showing association between intestinal parasitic infection among food handlers and socio-demographic characteristics

| Potential predictors | Absent n=191 | Present n=58 | p-Value |
|----------------------|--------------|--------------|---------|
| **Age**              |              |              |         |
| ≤25                  | 29 (15.1%)   | 15 (25.9%)   | 0.262   |
| 26–35                | 104 (54.5%)  | 29 (50.0%)   |         |
| ≥35                  | 58 (30.4%)   | 14 (24.1%)   |         |
| **Gender**           |              |              |         |
| Male                 | 61 (31.9%)   | 20 (34.5%)   | 0.694   |
| Female               | 130 (68.1%)  | 38 (65.5%)   |         |
| **Level of education** |             |              |         |
| Illiterate           | 51 (26.6%)   | 25 (43.1%)   | 0.071   |
| Primary              | 45 (23.6%)   | 19 (32.8%)   |         |
| Secondary            | 58 (30.4%)   | 8 (13.8%)    |         |
| Tertiary             | 37 (19.4%)   | 6 (10.3%)    |         |
| **Area**             |              |              |         |
| Peri-urban           | 57 (29.8%)   | 13 (22.4%)   | 0.231   |
| Urban                | 108 (56.6%)  | 38 (65.5%)   |         |
| Rural                | 26 (13.6%)   | 7 (12.1%)    |         |
| **Per capita monthly income** |        |              |         |
| ≤Ksh.5000            | 89 (46.6%)   | 19 (32.8%)   | 0.083   |
| Ksh.5001–Ksh.10,000  | 83 (43.5%)   | 27 (46.6%)   |         |
| ≥Ksh.10,001          | 19 (9.9%)    | 12 (20.6%)   |         |
| **Water source**     |              |              |         |
| Safe                 | 135 (70.7%)  | 35 (60.3%)   | 0.117   |
| Unsafe               | 56 (29.3%)   | 23 (39.7%)   |         |
| **Hand washing before meals** | | | |

### Table 3 Multivariate model showing association between intestinal parasitic infection among food handlers and socio-demographic characteristics

| Intestinal Parasitic Infections | Potential predictors | Absent n=191 | Present n=58 | OR | p-Value |
|---------------------------------|----------------------|--------------|--------------|----|---------|
| **Toilet facility**             |                      |              |              |    |         |
| Present                         | 68 (35.6%)           | 11 (19.0%)   | 0.40         | 0.099 |
| Absent’                         | 123 (64.4%)          | 47 (81.0%)   |              |     |
| Wash hands after visiting a toilet/latrine | | | | |
| Never                           | 74 (38.7%)           | 9 (15.5%)    | 0.35         | 0.013 |
| Occasionally                    | 87 (45.6%)           | 37 (63.8%)   | 1.46         | 0.392 |
| Often’                          | 30 (15.7%)           | 12 (20.7%)   |              |     |

### Discussion

The presence of the five intestinal parasites in Eldoret is a clear indication that the prevailing environmental conditions in the town favours the transmission of a wide range of intestinal parasites. The estimated prevalence of intestinal parasites among food handlers in Eldoret town was 30.4%. A higher prevalence of intestinal parasitic infection than that reported in Nairobi of 13.8%.

Temporal variations in intestinal parasitic infections are not unique in Kenya. The variation could be due to socio-demographic characteristics of the food handlers, climatic conditions and geographical location of the study sites. Rainfall for instance, plays a significant role in the development and transmission of intestinal parasites. The wet and humid environment enhances the persistence of the protozoic and helminth eggs and cysts in the soil. In Kenya, evidence has shown

**Table 2:** Univariate model showing association between intestinal parasitic infection among food handlers and socio-demographic characteristics

**Table 3:** Multivariate model showing association between intestinal parasitic infection among food handlers and socio-demographic characteristics

**Discussion**

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that, the prevalence the prevalence of intestinal parasites tends to be high between May and June. This is a heavy rainfall season and coincides with the months data collection was carried out in this study.

Clean and safe drinking water is a major challenge in Eldoret town. Most drinking water is contaminated with faecal matters mainly attributed to the faulty sewerage system. A possible explanation as to why \textit{E. histolytica} was the most predominant intestinal parasites among the certified food handlers in this study. A similar finding, reported by another study conducted in Eldoret a year ago.

The highest prevalence of intestinal helminthiasis reported among the certified food handlers in Eldoret is a major public health concern. It is a clear indication of poor food handling practices in the town. The current state poses a major health risk not only to the food handlers, but also to the consumers who rely on the services offered by these food handlers. Considering that, food handlers are good vehicles for transmission of intestinal parasitic infections. To prevent such transmission from taking place, there is need to conduct regular screening of food handlers issued with medical certificates. Food handlers should be encouraged to wash their hands frequency after visiting a latrine or toilet. Regular supply of certified food handlers with antiamoebic and anti–helminthic medications could also help in lowering the high prevalence of intestinal parasitic infection observed in this study.

Hand washing among food handlers in Eldoret town after defection is inadequate. This may explain why failure to wash hands after visiting a toilet in this study, was a risk factor associated with intestinal parasitic infections. The food handlers who failed to wash their hands after visiting a toilet or latrine might have touched infected toilet/latrine surfaces, objects, or faecal matter after defection. This unhygienic practice might have contaminated their hands with deposits of the parasite eggs, which possibly could have been swallowed on handling and eating solid foods with unwashed hands.

Conclusion

The study revealed a high prevalence of intestinal parasitic infections in Eldoret town. Five types of intestinal parasites namely \textit{E. histolytica}, hookworm \textit{spp}, \textit{A. lumbricoides}, \textit{T. trichiura} and \textit{G. intestinalis} were found in the stools of 58 certified food handlers in Eldoret town. The prevalence of intestinal parasites differed significantly from the age group of the food handlers, per capita monthly income, type of organic waste receptacle inside the premise, and hand washing habit after visiting a toilet/latrine. Food handlers’ failure to wash their hands after visiting a toilet/latrine was a risk factor associated with intestinal parasitic infections. The highest prevalence of intestinal parasitic infections reported among the certified food handlers in Eldoret is a clear indication of poor food handling practices in the town. The current state poses a major health risk not only to the food handlers, but also to the consumers who rely on the services offered by these food handlers.

Acknowledgements

I am thankful to Mount Kenya University for logistical support. My gratitude also goes to all the food handlers who participated in the study.

Competing interest

The author has no competing interest.

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