East African Medical Journal Vol. 102.9, September 2025
DETERMINANTS OF ORAL–FAECAL INFECTIONS AMONG FOOD HANDLERS IN NAIROBI COUNTY, KENYA. AN EVALUATION OF HYGIENE PRACTICES, TRAINING, AND WORKPLACE SANITATION

Munyoki Nyamai, Department of Health Science, Murang'a University of Technology, P.O.BOX 75-10200, Murang'a, Kenya, Ann Sakwa, Department of Medical Laboratory Sciences, Mount Kenya University, PO BOX 342-01000, Thika, Kenya

Corresponding author: Munyoki Nyamai, Department of Health Science, P.O.BOX 75-10200, Murang'a, Kenya, Email: munyokinyamai@gmail.com

DETERMINANTS OF ORAL–FAECAL INFECTIONS AMONG FOOD HANDLERS IN NAIROBI COUNTY, KENYA. AN EVALUATION OF HYGIENE PRACTICES, TRAINING, AND WORKPLACE SANITATION

M. Nyamai and A. Sakwa

ABSTRACT

Background: **Foodborne diseases remain a major public health challenge in sub-Saharan Africa, where inadequate hygiene infrastructure and weak regulatory enforcement increase the risk of oral–fecal pathogen transmission. Food handlers play a critical role in either preventing or facilitating the spread of these infections, yet diagnostic data from Nairobi County are limited.**

Objective: **To determine the prevalence of intestinal pathogens among food handlers in Nairobi County using stool examination as an index test, and to assess associated hygiene practices and workplace conditions.**

Results: **Among 100 food handlers studied, 62% were female, 40% had attained secondary education, and 6% had no formal education. Gastrointestinal symptoms were reported by 51%, although only 53% held valid medical certificates. Stool analysis identified intestinal parasites in 33% (*E. histolytica,* 45.5%; *G. lamblia,* 33.2%), *Salmonella spp*. in 11%, and mixed infections in 7%. Asymptomatic carriage was observed in 20%. Hygiene practices were inadequate: only 28% had received food hygiene training, 28% used soap and water for hand washing, and 22% worked in establishments without access to clean drinking water. These findings indicate a high risk of infection, particularly in informal food establishments.**

Conclusion: **This study found that, despite good access to hygiene facilities, poor compliance with safe practices sustains infection risks, with glove use the only practice linked to reduced infections. Addressing both structural and behavioural gaps is crucial to lowering foodborne infection risks among Nairobi's food handlers.**

Recommendation: **Improving food safety requires stronger regulation, routine screening, expanded training, consistent glove use, targeted behaviour change, integrated laboratory surveillance, and multi-sectoral collaboration to address both structural and behavioural gaps among food handlers.**

Keywords: **Regulation, screening, training, gloves, collaboration.**

INTRODUCTION

Foodborne diseases remain a major global public health challenge, with the World Health Organization (WHO) estimating approximately 600 million cases and 420,000 deaths annually from consumption of contaminated food.[1]

Low- and middle-income countries carry a disproportionate burden, largely due to inadequate hygiene infrastructure, weak regulatory enforcement, and limited access to safe water.[2,3]

In sub-Saharan Africa, oral–fecal transmission is a primary route for enteric pathogens, particularly in urban settings where informal food vending and overcrowding are common.[4]

Food handlers are a critical control point in either preventing or facilitating transmission. They can act as reservoirs for intestinal pathogens, both symptomatic and asymptomatic, which may be transmitted through improper food preparation, poor hand hygiene, and cross-contamination. [5.6]

Asymptomatic carriers pose a particular risk because they continue food handling without treatment, sustaining transmission cycles. [7]

Studies in Kenya report that many food handlers operate without adequate hygiene training, valid medical certification, or consistent access to clean water and sanitation facilities. [8,9]

Similar patterns have been documented in Ethiopia, Ghana, and Nigeria, where socio-demographic factors such as education, occupational role, and establishment type influence compliance with food safety protocols. [10-12.]

Poor hygiene practices, such as handwashing without soap or not using gloves when handling ready-to-eat foods, have been linked to outbreaks of protozoan, helminthic, and bacterial infections. [13,14.]

Pathogens commonly implicated in East African foodborne transmission include Entamoeba histolytica, Giardia lamblia, and Salmonella spp., all associated with diarrheal disease, malnutrition, and in severe cases, death. [14,16.]

These organisms are primarily spread via contaminated water or food and persist in environments with poor sanitation. [15.]

Laboratory stool examination remains essential for detecting these pathogens and estimating prevalence, though its role in

public health surveillance is often constrained by low screening coverage and absence of confirmatory reference standards. [16]

In Nairobi County, rapid urbanization, expansion of informal food markets, and weak enforcement of public health regulations heighten the risk of intestinal infection outbreaks. Despite the importance of food handlers in maintaining food safety, recent data on pathogen prevalence and associated hygiene practices are scarce. Such evidence is critical to guide targeted interventions in health education, training, certification, and infrastructure improvement aimed at reducing foodborne disease burden.

This study sought to determine the prevalence of intestinal pathogens among food handlers in Nairobi County using stool examination as the index test, and to assess hygiene practices and workplace conditions to inform evidence-based public health strategies.

Methodology

Study Design and Setting

A cross-sectional descriptive diagnostic accuracy study was conducted in Nairobi County, Kenya. The county was chosen for its high density of formal and informal food establishments, diverse socio-economic population, and the potential public health impact of intestinal infections in these environments. The study was conducted across hotels, restaurants, street food vending sites, schools, and informal food outlets.

Participants

Eligible participants were adult food handlers (≥18 years) directly engaged in food preparation, serving, or cleaning. Participants were recruited if they were willing to provide informed consent and stool specimens for testing. Those unwilling or unable to provide consent were excluded.

Intended Use and Clinical Role of Index Test

The index test, stool examination, was intended for the detection of intestinal parasites and Salmonella spp. among asymptomatic and symptomatic food handlers. It was applied as a screening tool to assess infection prevalence and inform food safety interventions.

Sample size determination

The sample size was calculated using the Fisher formula (11):$n = Z^2 \cdot p(1 - p) / d^2$, With $Z = 1.96$, $p = 0.5$, and $d = 0.05$, the calculated value was $n = 384$. Sensitivity analysis indicated a range of 96–384 depending on the assumed values of p and d. Considering feasibility constraints and the exploratory nature of the study, a minimum sample size of 100 participants was adopted. The researchers divided the entire population of food establishments into two distinct groups (strata): formal and informal. This was done to ensure that the final sample would accurately represent the proportion of each type of establishment in the overall population. After defining the two strata, the researchers applied a systematic sampling method within each group. The researchers

selected every seventh establishment from a list of formal establishments and every fifth establishment from a list of informal establishments until they reached their required sample size for each stratum.

Index Test

Stool specimens were examined for intestinal parasites using direct microscopic examination in accordance with standard parasitological procedures (e.g., WHO Bench Aids for the Diagnosis of Intestinal Parasites and the formalin–ether concentration technique as described by Ritchie [12-13]. Detection of Salmonella spp. was performed using a validated rapid diagnostic assay following the manufacturer's instructions and established microbiological guidelines (ISO 6579:2017) 14

All laboratory analyses were conducted by certified medical laboratory technologists in strict compliance with standardized operating procedures. Laboratory personnel were blinded to participants' hygiene practices and occupational settings to reduce the risk of observer bias.

Data Collection

A structured interviewer-administered questionnaire collected socio-demographic data, hygiene practices, workplace sanitation, and clinical history. An observational checklist evaluated hygiene infrastructure. Stool specimens were analysed in the laboratory for parasitic and bacterial pathogens.

Data analysis and presentation.

Data were cleaned in Microsoft Excel and analyzed using IBM SPSS Statistics version 26. Categorical variables were numerically coded, and continuous variables were tested for normality. Missing data in key variables were excluded from bivariate analyses. Adequate hygiene practice was defined as meeting at least three of the following four criteria: consistent handwashing, use of protective clothing, avoidance of bare-hand contact with ready-to-eat foods, and receipt of recent food hygiene training. Infection status was defined as detection of at least one intestinal parasite or Salmonella spp. Descriptive statistics summarized socio-demographic characteristics, hygiene practices, workplace infrastructure, and laboratory results. Analytical findings were presented in tables and figures, with chi-square tests used to assess associations and Cramér's V to quantify effect sizes. Statistical significance was set at $p < 0.05$.

Ethical and administrative considerations

Administrative permission to carry out the research was obtained from the Nairobi City County Public Health Department. No. MMUST/IERC/28/19. All participants provided informed consent prior to participation. Confidentiality and anonymity were maintained throughout the study, and data collected were used solely for academic and public health purposes.

Results

Socio-Demographic information of the study participants.

Socio-demographic characteristics help assess oral–faecal infection risks by

influencing hygiene behaviour, pathogen exposure, and public health responsiveness.

Table 1 presents the distribution of key demographic variables, including age, sex, education level, occupational role, type of establishment, and years of experience among the respondents.

Table 1: Socio-demographic characteristics of study participants.

Variable	Category	Frequency (n)	Percentage (%)
Sex	Female	62	62.0
	Male	38	38.0
Education level	None	06	06.0
	Primary	32	32.0
	Secondary	40	40.0
	Tertiary	22	22.0
Role in food handling	Cleaner	32	32.0
	Cook	14	14.0
	Manager	06	06.0
	Server	27	27.0
	Vendor	21	21.0
Type of establishment	Hotel	26	26.0
	Other	27	27.0
	Restaurant	16	16.0
	School/Institution	13	13.0
	Street vendor	18	18.0
Age in years.	Mean ± SD	38.7 ± 12.5	—
Years of experience	Mean ± SD	12.2 ± 7.4	—

Data are presented as number (n) and percentage (%) of food handlers by category, including their age, sex, education level, occupational role, years of experience, and type of food establishment. Mean and standard deviation (SD) are reported for continuous variables.

Clinical and Diagnostic History

Clinical and diagnostic histories reveal infection risks, exposure patterns, and compliance gaps, guiding surveillance and targeted training interventions.

Table 2 presents Clinical and diagnostic history of food handlers in Nairobi County

Table 2: Clinical and diagnostic history of food handlers in Nairobi County

Variable	Category	Frequency (n)	Percentage (%)
Gastrointestinal symptoms (4 weeks)	No	49	49.0
Gastrointestinal symptoms (4 weeks)	Yes	51	51.0
Currently symptomatic	No	57	57.0
Currently symptomatic	Yes	43	43.0
Taken antibiotics/antiparasitic	No	46	46.0
Taken antibiotics/antiparasitic	Yes	54	54.0
Diagnosed previously	No	33	33.0
Diagnosed previously	Not sure	28	28.0
Diagnosed previously	Yes	39	39.0
Cause of infection	Bacteria	11	28.2
Cause of infection	Both	8	20.5
Cause of infection	Don't know	11	28.2
Cause of infection	Parasites	9	23.1
Treated for foodborne illness	No	44	44.0
Treated for foodborne illness	Yes	56	56.0
Willing to provide specimen	No	48	48.0
Willing to provide specimen	Yes	52	52.0
Valid medical certificate	No	47	47.0
Valid medical certificate	Yes	53	53.0
Last medical screening	6–12 months ago	23	23.0
Last medical screening	Less than 6 months ago	31	31.0
Last medical screening	Never	22	22.0
Last medical screening	Over a year ago	24	24.0

Data are presented as number (n) and percentage (%) of food handlers by clinical and diagnostic categories, including gastrointestinal symptoms, history of infection, recent antibiotic use, medical certification, and willingness to provide stool specimens.

Hygiene Practices.

Proper hygiene in food handling prevents contamination, yet resource and knowledge gaps cause variation; training ensures safer, consistent practices.

Table 3 presents the distribution of hygiene behaviors, including handwashing frequency and method, use of gloves, and participation in food hygiene training

Table 3: Gastrointestinal practices among food handlers in Nairobi County

Variable	Category	Frequency (n)	Percentage (%)
Handwashing before food	Always	70	60
	Never	06	28.0
	Sometimes	24	29.0
Handwashing method	Hand sanitizer	15	41.0
	Water and soap	25	28.0
	Water only	60	31.0
Wash hands after toilet	Always	65	65.0
	Never	8	8.0
	Sometimes	27	27.0
Use gloves	Always	3	3.0
	Never	80	80.0
	Sometimes	17	17.0
Food gastrointestinal training	No	72	72.0
	Yes	28	28.0

Data are presented as number (n) and percentage (%) of food handlers by gastrointestinal behavior categories, including handwashing frequency, handwashing method, hand gastrointestinal after toilet use, glove use during food handling, and participation in food gastrointestinal training.

Workplace Environment and Infection Control

Table 4 presents the frequency and percentage distribution of food handlers based on the availability of clean water, accessible toilets, functional handwashing facilities, record-keeping practices, and reported co-worker illness in the past month.

Table 4: Workplace environment and infection control practices among food handlers in Nairobi County

Variable	Category	Frequency (n)	Percentage (%)
Clean water available	No	22	22.0
Toilets accessible	Yes	78	78.0
	No	8	08.0
Handwashing facilities present	Yes	92	92.0
	No	10	10.0
	Yes	90	90.0
	Yes	47	47.0
Workplace keeps records	No	25	25.0
		75	75.0
	Yes	51	51.0
Coworkers reported illness	No	50	50.0
	Not sure	40	40.0
	Yes	10	10.0

Data are presented as number (n) and percentage (%) of food handlers by workplace environment and infection control categories, including access to clean water, availability of toilets and handwashing facilities, maintenance of health records, and recent reports of illness among co-workers.

Diagnostic Service Linkage

Table 5 presents the distribution of laboratory-confirmed infections among food handlers, including whether a stool specimen was provided, and the detection rates of parasites, *Salmonella spp.*, mixed infections, and asymptomatic carrier status

Table 5: Diagnostic Service Linkage

Variable	Category	Frequency (n)	Percentage (%)
Stool specimen provided	Yes	100	100.0
Parasites detected	No	67	67.0
	Yes	33	33.0
Salmonella detected	No	89	89.0
	Yes	11	11.0
Mixed infection	No	93	93.0
	Yes	07	07.0
Asymptomatic carrier	No	80	80.0
	Yes	20	20.0

Data are presented as number (n) and percentage (%) of food handlers by laboratory-confirmed categories, including stool specimen submission, detection of intestinal parasites, presence of Salmonella, occurrence of mixed infections, and asymptomatic carrier status.

Parasite Category

Intestinal parasitic infections remain a significant public health concern, particularly in food handling environments where poor hygiene can facilitate transmission. Food handlers infected with these parasites can unknowingly contaminate food, posing a risk to consumers. Identifying the specific parasites present and their prevalence is essential for understanding infection dynamics, prioritizing interventions, and developing effective control measures. Table 6 summarizes the types of intestinal parasites detected among food handlers, along with their frequency and percentage distribution.

Table 6: Parasite Category

Parasite	Frequency (n)	Percentage (%)
Gardia lamblia	11	33.2
Entamoeba histolytica	15	45.5
Ascaris lumbricoides	3	09.3
Hookworms	2	06.0
Trichuris trichiura	2	06.0

Distribution of food handlers by intestinal parasite category based on stool specimen analysis. Data include frequency (n) and percentage (%) of laboratory-confirmed cases.

Relationship between Gastrointestinal Practices, Infection Status, and Effect Size

Hygiene practices are a critical component in preventing the spread of oral–faecal pathogens among food handlers. This table presents the relationship between selected hygiene behaviors and laboratory-confirmed infection status, based on stool specimen analysis. Table 7 summarizes the association between hygiene practices and infection status among food handlers. It presents the observed frequencies for negative and positive cases, chi-square statistics, p-values, and Cramér's V effect sizes, highlighting the strength and significance of each association

Table 7: Relationship between Gastrointestinal Practices, Infection Status, and Effect Size

Gastrointestinal Variable	Chi-square (χ^2)	p-value	Interpretation	Cramér's V
Handwashing before food	1.186	0.553	No significant association between handwashing before food and infection status.	0.109
Handwashing method	0.633	0.729	No significant association between handwashing method and infection status.	0.08
Wash hands after toilet	0.071	0.965	No significant association between washing hands after toilet and infection status.	0.027
Use gloves	10.153	0.006	Significant association between glove use and infection status ($p < 0.05$).	0.319
Food gastrointestinal training	0.059	0.808	No significant association between food gastrointestinal training and infection status.	0.024

Association between gastrointestinal practices and infection status among food handlers. Data show observed counts (Negative, Positive), chi-square test results, p-values, and Cramér's V effect sizes."

Discussion

The study found that females constituted 62% of food handlers in Nairobi County, with most having attained secondary (40%) or tertiary (22%) education and an average of 12.2 years of work experience. This distribution is similar to that previously reported among food handlers in informal Nairobi settings. However, education levels in this study were higher than those reported in Ethiopia, where over half of the handlers had only primary education[10]. Such differences may reflect disparities in access to education, which can influence baseline knowledge and adherence to food safety practices [14].

About half of the respondents reported gastrointestinal symptoms in the preceding month, yet only slightly more than half had a valid medical certificate or had undergone recent screening. These findings align with earlier reports of low compliance with medical screening among Nairobi food handlers but differ from studies in Gondar, Ethiopia, where more than 80% of handlers had been examined within the past year. The lower uptake of screening in Nairobi could be linked to weaker enforcement of health regulations or a lower prioritization of preventive health checks [13,14].

Hygiene practices were generally inadequate, with 60% reporting consistent handwashing before food handling, only 3% using gloves, and 72% lacking food hygiene training. These results are consistent with observations from other Kenyan studies that documented widespread bare-handed food handling and limited training among handlers [7,8,14]. Glove use in this study was lower than the 14% reported in Ethiopia[13], suggesting potential barriers such as cost, accessibility, or workplace norms.

Access to infrastructure was relatively high, with clean water available to 78% of participants, toilets to 92%, and handwashing facilities to 90%. These levels are higher than those reported in previous Ethiopian studies, where availability often fell below 70% [10,11,13]. However, the continued presence of high infection rates supports the view that the presence of facilities alone does not guarantee consistent or correct use [14].

Laboratory analysis revealed a 33% prevalence of intestinal parasites, 11% detection of Salmonella spp., and 20% asymptomatic carriage. The predominance of *Entamoeba histolytica* (45.5%) *and Giardia lamblia* (33.2%) is consistent with findings from both Ethiopian and Kenyan contexts [10,13]. The higher protozoan prevalence in this study may be linked to local sanitation conditions, water quality, or diagnostic differences.

In the analysis of hygiene practices and infection status, glove use was the only factor significantly associated with infection ($p = 0.006$; Cramér's $V = 0.319$), indicating a moderate effect size. This finding supports evidence that protective clothing reduces microbial contamination on ready-to-eat foods.[7]. Other practices, including handwashing frequency, method, post-toilet hygiene, and training, were not significantly associated with infection. This contrasts with previous reports that identified a strong protective effect of proper handwashing [13], suggesting that differences in measurement methods, environmental exposures, or unmeasured confounders may account for the variation.

Overall, the findings indicate that while Nairobi's food handling sector benefits from relatively good infrastructure, behavioural compliance remains insufficient. Addressing this gap will require an integrated approach that combines infrastructure provision with sustained behaviour change initiatives, targeted training, and consistent regulatory enforcement. Such interventions have the potential to reduce both structural and behavioural drivers of oral–faecal infections and strengthen public health protection in the food handling industry.

Study limitations

The study found that oral–faecal infection risk among Nairobi food handlers is shaped by socio-demographic, hygiene, and workplace factors. Despite good water and sanitation access, safe handling practices remain poor. Intestinal parasites, *Salmonella spp*., and asymptomatic carriers were detected. Glove use was the only practice significantly reducing infection, highlighting its preventive value. Improving behavior, training, and regulatory enforcement is vital to address persistent foodborne infection risks.

Conclusion

This study shows that oral–faecal infection risk among food handlers in Nairobi County is influenced by socio-demographic characteristics, clinical history, hygiene behaviors, and workplace conditions. While access to clean water, toilets, and handwashing facilities is generally good, adherence to safe food handling practices remains inadequate. Laboratory findings confirmed the presence of intestinal parasites, *Salmonella* spp., and asymptomatic carriers, indicating ongoing potential for transmission even without symptoms. Glove use emerged as the only hygiene practice significantly linked to infection status, suggesting its value as a practical preventive measure. Other practices, such as handwashing frequency, method, post-toilet hygiene, and training, showed no clear association, highlighting that infrastructure and knowledge alone do not guarantee safe practices. Addressing both structural and behavioral gaps is essential to reduce foodborne infection risks in this setting.

Recommendation

To improve food safety, routine medical screening, certification, and regular inspections should be enforced. Training on glove use, hand hygiene, and cross-contamination prevention must be institutionalized with periodic refreshers. Affordable access to protective gear and workplace compliance monitoring are essential. Behavior change communication, regular laboratory surveillance, and strengthened multi-sectoral collaboration will enhance infection control, infrastructure maintenance, and worker welfare among food handlers

Transparency declaration.

The authors declare no conflicts of interest and no external funding. We thank all participants, the Nairobi County Laboratory staff, and Dr. Kinge Waithaka and Dr. Esther Mandania for their support. Contributions: M. Nyamai contributed to design, analysis, and drafting; A. Sakwa contributed to data collection, analysis, and review.

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