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Original Research Article

Parasites in plain sight: Gastrointestinal carriage in food handlers working at a tertiary care hospital in piparia, Vadodara, Gujarat

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Abstract

Background: Food handlers are essential in maintaining food safety and hygiene. However, they can unintentionally transmit parasitic infections due to inadequate hygiene practices. This study aims to investigate the prevalence of gastrointestinal parasites among food service employees and vendors at the university.

Materials and Methods: This prospective cross-sectional study was conducted from September 2021 to August 2022 at the Microbiology laboratory of a tertiary care hospital in Gujarat, involving 90 food handlers in and around the university campus. Participants included campus mess employees, cafeteria employees, hospital-affiliated canteen employees, Nescafe booth workers, and stall vendors outside the campus. After the consent, Data on demographics and hygiene practices were collected using a validated questionnaire. Stool samples were analyzed using the wet mount, iodine mount, and concentration methods.

Results: Parasitic forms were detected in 13 out of 90 food handlers (14.44%). The most common parasitic forms identified were the fertilized eggs of *Ascaris lumbricoides*, eggs of *Taenia* species, and the cysts of *Giardia lamblia*. A comparison between vendors inside and outside the campus revealed a higher rate among campus vendors (34.2% vs. 25%). An increase in the parasitic carriage rate was significantly associated with various factors such as insufficient handwashing before cooking food ($P = 0.005$, OR: 5.743) and after excretion ($P < 0.0001$, OR: 6.01). Even prolonged storage of raw products without refrigeration ($P = 0.0002$, OR: 12.08), lack of glove use while cooking and serving ($P = 0.0006$, OR: 9.103), use of unfiltered water ($P = 0.04$), and presence of a dustbin near the eating area ($P = 0.006$, OR: 5.647) were suggestively linked to the parasitic carriage.

Conclusion: The outcomes highlight the inevitability of periodic screenings of food handlers for parasitic carriage along with the conduction of regular educational workshops, focussing mainly on WASH (Water, Sanitation, and Hygiene) behaviors and parasitic infections.

Keywords: Carriers, Food handlers, Hygiene, Intestinal parasites, Screening, Sanitation

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1. Introduction

Developing countries are at relentless risk for various parasitic infections which lead to diarrhoea, amoebic dysentery, etc., which spread mainly because of unhygienic and substandard practices followed by the food handlers. Food handlers are the essential mediators in the food supply chain and play a crucial role in mitigating pathogen transmission.[1] Developing nations, predominantly India, show heightened susceptibility to gastrointestinal parasitic infections with an overall prevalence ranging from 12.5% to 67%.[1] Among the most prevalent diseases is *Ascariasis*, affecting approximately 820 million individuals globally each year[2] *Amoebiasis*, with regional prevalence rates varying from 3.6% to 47.4%[3] hookworm infections, affecting around 460 million people worldwide.[3,4] Among the most common of these are *Ascariasis* (estimated at infecting about 820 million people worldwide annually,[2] *Amoebiasis* (with prevalence rates ranging from 3.6 to 47.4,[3] and Hookworm infections (About 460 million cases globally.[3,4] In 2015, the WHO Foodborne Disease Burden Epidemiology Reference Group identified *Taenia Solium* as a leading cause of deaths from foodborne diseases causing an estimate of about 2.56-

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8.30 million symptomatic and asymptomatic neurocysticercosis cases.[5,6]

These parasites transmit through numerous ways, encompassing fecal-oral contamination, ingestion of undercooked meat, consumption of contaminated food or water, etc.[6,7] Asymptomatic carriers, who harbor parasites without exhibiting symptoms, pose a substantial public health risk by inadvertently transmitting infections and perpetuating the disease cycle.[6,7] The factors that contribute to parasite carriage include inadequate sanitation, poor hygiene practices, and limited access to clean water.[6,7] Health promotion and specific protective measures are crucial at the same level of prevention. While treatment for symptomatic clinical cases is available, asymptomatic chronic or acute carriers often remain undetected, and become epidemiologically more dangerous than clinical cases. This issue stems from not only the lack of education and awareness regarding proper food sanitation practices among street vendors and food handlers but also from inadequate resources, poor management, and short sightedness concerning the consequences of ignorance. Maintaining stringent hygiene and food safety protocols is indispensable in large institutions, such as university campuses, which house a diverse population including students, staff, healthcare workers, and patients. High-risk groups, such as immune compromised patients and healthcare workers, are particularly vulnerable to foodborne infections. This study aims to investigate the prevalence of gastrointestinal parasites among food service employees and vendors at the university. By identifying the prevalence of these infections, targeted interventions can be implemented to reduce the risk of foodborne illness transmission and enhance public health.

2. Materials and Methods

2.1. Study design

It was a prospective cross-sectional study.

2.2. Study period

The study was conducted for a period of 1 year starting from September 2021 to August 2022.

2.3. Study place

Microbiology laboratory of a tertiary care hospital in Gujarat.

2.4. Sample size

The study included 90 food handlers in and around the tertiary care hospital, comprising: Campus mess employees, Cafeteria employees, Hospital-affiliated canteen employees, Nescafe booth workers, Stall vendors outside the campus.

2.5. Ethical approval

The Institutional Ethical Committee approved the study protocol (SVIEC/ON/MEDI/SRP/21015). Informed consent was obtained from all participants. A preformatted questionnaire in the local language was administered to gather demographic details and hygiene practices during food preparation.

2.6. Inclusion criteria

All asymptomatic individuals working at the hospital campus mess, cafeteria, Nescafe booth, hospital-affiliated canteen, and food stalls outside the campus, irrespective of age or gender.

2.7. Exclusion criteria

Food handlers residing away from the campus and those who refused to provide consent were excluded.

2.8. Sample collection and methodology[6,7]

A sterile, clean, and wide-mouth container was given to each participant a day before and Stool samples were brought to the laboratory the next morning. It was processed immediately.

1. Macroscopic examination: Stool samples were visually examined for color, consistency, form, and the presence of adult worms or segments.
2. Microscopic examination:
    a. Direct Saline Wet Mount: [6,7] Performed to detect worms, eggs, larvae, and trophozoites.
    b. Iodine Wet Mount: [6,7] Used to stain glycogen and nuclei of cysts for enhanced visualization.
    c. Stool concentration technique: [6,7] Due to the asymptomatic nature of participants, parasite detection was enhanced by concentrating the samples using the Formalin-Ether Concentration technique. This technique concentrates eggs, cysts, and larvae, while trophozoites may be destroyed, necessitating an initial direct wet mount examination. The procedure was done according to the protocol given in the parasitology reference book.

2.9. Data analysis

Collected data were compiled and analyzed using SPSS software version 25. A P-value of <0.05 was considered statistically significant. Odds ratios were calculated to determine risk factors.

2.10. Post-intervention

1. Education on Clinical Signs and Symptoms: Participants were informed about the clinical signs and symptoms associated with gastrointestinal parasitic infections to enhance their understanding of these diseases' severity.
2. WASH (Water, Sanitation, and Hygiene): Information was provided to improve participants' knowledge and implementation of hygienic practices based on the assessment.
3. Prevention of Transmission: Participants were educated on preventive strategies for parasitic infections using

posters, flashcards, and presentations. The educational content aligned with WHO Food Safety Guidelines and covered key points such as proper handwashing techniques, adequate cooking temperatures, separation of raw and cooked food, use of safe water and raw materials, and proper storage of food and raw materials.

3. Results

Of 110 employees working in the food sector in and around the university campus, 90 met the inclusion criteria and were subsequently examined. Among these 90 individuals, parasitic forms were detected in 13 food handlers (14.44%), with 11 (84.6%) being male and 2 (15.38%) being female. The most prevalent parasitic forms identified were fertilized eggs of *Ascaris lumbricoides*, eggs of *Taenia* species, and cysts of *Giardia lamblia*, followed by the eggs of *Ancylostoma duodenale* and cyst of *Entamoeba histolytica*. (**Table 1**).

Table 2 presents no significant gender-based difference in the incidence of parasitic carriage (P-value = 0.81). However, the carriage rate was notably higher in the age group of 36-45 years (42.8%, P-value = 0.03). When comparing the carriage rate among vendors inside and outside the campus, it was observed that the rate was higher among vendors inside the campus (34.2 %, 7/24) compared to those outside (25%, 6/24). Although the p-value for the relationship between family size and parasitic carriage was insignificant, the data indicate that larger family sizes are associated with higher parasitic carriage rates.

Table 3 exemplifies various factors significantly proportional to the increase in the rate of parasitic carriage, where Hygiene parameters are at top notch. Not using soap to wash the hands before cooking (P-value = 0.005, OR: 5.743) and after defecation (P-value < 0.0001, OR: 6.01) were significantly associated with an increase in the parasitic carriage rate. Similarly, the storage of raw fruits and vegetables outside for more than one week (P-value = 0.0002, OR: 12.08), the absence of glove use while cooking and serving food (P-value = 0.0006, OR: 9.103), the use of unfiltered water (P-value = 0.04), and the presence of a dustbin near the eating area (P-value = 0.006, OR: 5.647) were also suggestively associated with parasitic infections.

Table 1: Prevalence of protozoan and helminthic forms in the stool of healthy carriers. (n=90, 13 positive)

Parasites found in the stool sample	Incidence out of total tested (%) (n=90)	Incidence out of total positive stool samples % (n=13)
Fertilized egg of Ascaris lumbricoides	3 (3.33%)	23.07%
Giardia lamblia	3(3.33%)	23.07%
Ancylostoma duodenale	2 (2.22%)	15.38%
Taenia species	3 (3.33%)	23.07%
Entamoeba histolytica	2 (2.22%)	15.38%
Total	13 (14.60%)	100%

Table 2: Incidence of intestinal parasitic carriage among food handlers and its correlation with demographic variables

Variable	Number of samples	Stool positive for parasites	Stool negative for parasites	P value
Gender				
Male	78	11 (14.1%)	67 (85.89%)	0.81
Female	12	2 (16.67%)	10 (83.33%)	
Age- Group				
18-26	60	9 (15%)	51 (85%)	0.03
27-35	23	1 (4.34%)	22 (95.66%)	
36-45	7	3 (42.8%)	4 (57.1%)	
Designation				
Chef in the canteen of the medical college	25	04 (16%)	21 (84%)	0.25
Stall vendors outside the campus	24	06 (25%)	18 (75%)	
Chef in the Kitchen of the hospital	22	02(9.09%)	20 (90.9%)	
Nescafe booth workers on campus	19	01 (5.26)	18 (94.74)	
Family Size (Members in One House)				
<5	38	4 (10.5%)	34 (89.5%)	0.27
5-10	50	8 (16%)	42 (84%)	
>10	2	1 (50%)	1 (50%)	

Table 3: Impact of Hygiene Parameters in food handlers with and without the parasitic carriage.

Variables	Practices followed by the food handlers	Parasitic form seen (n=13)	Parasitic form not seen (n=77)	P value	Odd ratio
Hand Hygiene habits	Wash hands with soap and water before cooking. (n=70)	06(8.5%)	64(91.5%)	0.005	5.743
	Wash hands with only water before cooking (n=20)	07(35%)	13(65%)		
	With soap and water after defecation (n=80)	5(6.2%)	75(93.8%)	<0.0001	6.010
	With only water after defecation. (n=10)	8(80%)	2(20%)		
Use of refrigeration for storage of raw vegetables	Refrigeration of raw vegetables and fruits. (n=73)	05 (6.8%)	68(93.2%)	0.0002	12.08
	Raw vegetables kept outside for more than a week (n=17)	08 (47.1%)	09 (52.9%)		
Use of gloves	Use gloves while handling or cooking food. (n=50)	02(4%)	48(96%)	0.0006	9.103
	Gloves are not used while cooking or handling food. (n=40)	11(27.5%)	29(72.5%)		
Flies and pest control	The presence of flies and cockroaches in the kitchen and pest control are not done. (n=44)	08(18.1%)	36(81.8%)	0.32	1.822
	Fewer flies and pest control done. (n=46)	05(10.9%)	41(89.1%)		
Source of water in Kitchen	RO water (n=69)	07(10.1%)	62(89.9%)	0.04	0.2823
	Tap water- unfiltered. (n=21)	06(28.6%)	15(71.4)		
Food disposal habits	In the dustbin, with sufficient distance from the place of eating. (n=65)	05(7.7%)	60(92.3%)	0.006	5.647
	In the dustbin, near to place of eating. (n=25)	08(32%)	17(68%)		

4. Discussion

Food hygiene ranges from preparing to handling and storing the food in a way that ensures food safety and Hygiene. Food handlers and Hygiene go hand in hand; however, they can also be vectors for transmitting parasitic infections if they are not trained in safe food handling practices. In the present study, 14.4% of food handlers tested positive for intestinal parasites, which is comparable to the study done in a 2013 study in Gujarat, which is 15.19%.[8] The rate is notably higher than the rates reported by Sumeeta Khurana *et al*.[9] in food handlers at a tertiary care centre in North India which is 7%. Though the values may vary, the consequences are significantly more severe in the context of a healthcare centre. This amplifies the risks for patients admitted to the hospital and staff who might become infected.

The most prevalent parasitic forms identified were fertilized eggs of *Ascaris lumbricoides*, eggs of *Taenia* species, and cysts of *Giardia lamblia*, followed by eggs of *Ancylostoma duodenale* and cysts of Entamoeba histolytica. Sumeeta Khurana *et al*.,[9] found *Giardia* as the most common parasite from stool of food handlers. These parasites are primarily transmitted through the consumption of contaminated food or water. Poor personal hygiene, such as inadequate handwashing after using the restroom, handling food with contaminated hands or utensils, and consuming food that has not been properly washed, cooked, or stored, also contribute to infections.[6,7] We evaluated the association between these risk factors and parasitic carriage. We found that Washing hands with plain water before cooking (P-value = 0.005), with a risk of 5.7 times, and after defecation (P-value < 0.0001), with 6 times risk of parasitic carriage. The incidence of *Giardiasis*, *Ascariasis*, and *Taeniasis* was directly proportional to the level of hand hygiene before cooking and after defecation. Similarly, improper washing of raw vegetables and fruits, storage of raw produce outside for more than one week (P-value = 0.0002, OR: 12.08), use of unfiltered water (P-value = 0.04), and the presence of a dustbin near the eating area (P-value = 0.006, OR: 5.647) were also significantly associated with an increase in the rate parasitic infections. Comparable results were found in one Ethiopian study, which confirms that the indicators of low socioeconomic status such as the utilization of borehole water and poor personal hygiene were the major risk factors for the high prevalence of intestinal parasitic infection among food handlers.[10]

During the study, we observed that despite the mess manager confirming the availability of gloves, several

workers did not wear them while handling food. Additionally, vendors outside the campus were unaware of the importance of using gloves. Direct contact of hands with food is a known risk factor for intestinal parasitic infections.[11] We found a significant association between the absence of glove use during cooking and serving food (P-value = 0.0006, OR: 9.103), and the presence of parasitic infections, which aligns with previous studies.[12] The prevalence of *Taenia* eggs was highest in those food handlers who neglected to wear gloves while handling food. The plausible explanation for poor hygiene parameters could be inefficient monitoring and lack of training on effective and safe food handling practices. It was observed that at many places plenty of flies and cockroaches were noted in the kitchen and still pest control measures were not taken. The carriage was 18% in locations with a high presence of flies, cockroaches, and no pest control. In contrast, the rate was 10% in areas with fewer flies, and pest control measures taken, even though this difference was statistically insignificant (P-value = 0.32, OR: 1.82). Nonetheless, we cannot overlook the importance of parasitic transmission routes by vectors. Due to their unsanitary breeding habits, feeding practices, and movement between waste and food, certain vectors like nonbiting flies and cockroaches effectively transmit human enteric protozoan parasites.[13] Numerous studies have shown that certain key factors significantly contribute to the transmission of parasites, which include; Hand washing with soap and water before cooking and after defecation.[14] Failure to refrigerate food for long-term storage. When food is not properly refrigerated, it creates an ideal environment for parasites and other pathogens to thrive and multiply and the Presence of flies, which can carry and spread parasites from contaminated surfaces or waste to food and other clean areas.[13,14,15] From the participants' responses in the study, it was evident that there was a significant lack of knowledge and awareness about proper hygiene and sanitation practices. A specific Knowledge, attitude, and Practice (KAP) study conducted in Southeast Asia also emphasized the same datum that these infections are mainly attributed to poor knowledge and practices regarding hygiene and sanitation.[16] Based on the observations, it can be inferred that many food handlers in and around tertiary care centres, do not follow adequate hygiene measures. This non-compliance increases the risk of parasite transmission. Participants who tested positive for parasites in their stool samples were referred to the hospital for treatment and provided with general education on hygiene and sanitation practices.

5. Limitation of the Study

We screened 90 food handlers, so the sample size was relatively small to generalize the findings to the wider population of food handlers, also the study was conducted within a specific university campus and its vicinity, which might limit the applicability of the findings to other regions or different types of food service establishments.

6. Conclusion

Key contributors to transmitting parasitic infections from asymptomatic food handlers mainly include poor hygiene standards, the use of unfiltered water, and improper handling of raw fruits and vegetables. Given that the campus is a healthcare sector, it is crucial to provide hygienic food to patients, their relatives, and staff members. The findings highlight the necessity of periodic parasite screenings for food handlers, and mandatory educational workshops focused on WASH (Water, Sanitation, and Hygiene) behaviour. These workshops should also include general information about parasites and the consequences of infections to improve overall public health.

7. Source of Funding

None.

8. Conflict of Interest

None.

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