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Prevalence of Intestinal Parasitic Infections among Food Vendors in Accra, Ghana

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Abstract

The operation and patronage of fast-food joints, restaurants, and chop bars have increased and become common in the Ghanaian community, especially in urban areas. Despite the benefits derived from these food joints, their operation raises public health issues, since food vendors could be a major transmission source for intestinal parasitic infections. The environmental risk factors of these practices in Ghana have not yet been clearly elucidated. This study sought to determine the prevalence of intestinal parasites associated with food vendors in Accra, and assess the risk for consumers of street-food. Random sampling was used to select 204 food vendors from 7 metropolitan areas in Accra. The parasitological profiles of stool samples from the vendors sampled were developed using direct smear, formalin-ethyl acetate sedimentation method, modified Ziehl Neelsen, and trichrome staining techniques. Vendors were also interviewed using a questionnaire. The overall prevalence of parasitic infection was 21.6%, with helminthic (15.2%) predominating over protozoan (6.4%) infections. Seven different parasites were identified: *Ascaris lumbricoides* (5.0%), *Strongyloides stercoralis* (4.4%), *Enterobius vermicularis* (4.1%), *Cryptosporidium parvum* (2.5%), *Giardia lamblia* (2.0%), *Ancylostoma duodenale* (2.0%), and *Entamoeba histolytica* (2.0%). The study indicated high levels of gastrointestinal parasitic infection among food vendors in the metropolis, and raised the need for education on safe handling of food, and improved sanitation and personal hygiene, to avert potential health threats to patrons.

Keywords: gastrointestinal parasites, food vendors, food safety, prevalence, Ghana

Introduction

Gastrointestinal parasites are frequently transmitted via food and contaminated drinking water, but may also be spread from person to person through fecal-oral contact. Over 70 species of protozoan and helminthic parasites can infect humans through food and water contamination [1].

In developing countries, particularly those with tropical climates and at low altitudes, such infections remain a serious medical and public-health problem [2]. They are more prevalent

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among the poor, who are negatively affected by low socio-economic conditions, poor personal and environmental hygiene, over-crowding, and limited access to clean water [3,4].

The main transmission route for most intestinal parasites is fecal-oral, through contaminated food or water. Protozoan parasites, such as *C. parvum, G. lamblia, E. histolytica,* and *Cyclospora* sp, and helminthic parasites, including *Ascaris lumbricoides*, hookworms (*Necator americanus* and *Ancylostoma duodenale*), and whipworm (*Trichuris trichiura*), are causes of water- and food-borne diseases [5-8]. These parasites are widespread in the environment, and major disease outbreaks have occurred as a result of contaminated drinking water and food. Recently, it has been estimated that over one quarter of the world's population is infected with one or more helminthic parasites [9,10]. In addition, there are about 20 major helminthic infections of public health importance [11].

In Ghana and elsewhere, food vendors are noted for selling foods and drinks at reduced prices, so providing more affordable means for people to obtain nutritionally balanced meals outside the home [12,13]. An estimated 2.5 billion people patronize food-vendors world-wide [14]. Although street food has become an indispensable part of both urban and rural diets, in developing countries, some public health risk is associated with the consumption of street food. While it is expected that street food meets the nutritional needs of consumers, it is also necessary to ensure its safety from contaminants and microorganisms [15].

In recent times, technologies such as refrigeration and modern cooking facilities, have been used to prolong the storage, transport, and shelf-life of prepared foods, to minimize the risk of contamination by parasitic organisms. However, many food vendors lack the necessary facilities to prevent food contamination. A survey conducted by the Food and Agriculture Organization (FAO) in 2001 recorded a higher incidence of food-borne illnesses in areas of increased food vendor activity [16]. A similar study conducted in the Kisii District of Kenya had similar results, and reported a high incidence of *A. lumbricoides* and *E. histolytica* infections among food vendors [17]. These parasites could be transmitted to consumers via the contaminated hands and poor hygiene practices of the vendors, hence increasing the risk of infection [18].

Illness due to contaminated food has also been reported by the World Health Organization (WHO) as the most widespread health problem in the contemporary world, and an important cause of reduced economic productivity [19]. Food-borne illness can, therefore, be considered a major international health problem and an important cause of reduced economic growth [20,21].

The hygiene of foods sold on the streets of Accra has been a major source of concern for food control officers in Ghana. In the light of these developments, and in an attempt to curtail the public-health concerns about eating contaminated food, it is prudent to investigate and document the presence and prevalence of parasites associated with food vendors in Accra. The study suggests some likely sources of contamination, and novel strategies for preventing contamination of foods sold at various food joints. This study aimed to determine possible parasitic organisms associated with food vendors in selected suburbs of Accra.

Material and methods

Study area and population

The metropolitan area of Accra is densely populated and most of the population/food vendors depend on open-air markets as the sole source of meat, fish, vegetables, and other foodstuffs. A sizable area is characterized by poor drainage and sanitation, and garbage dumps nearby. Vendors often operate near choked, polluted, with little or no access to clean water, and are often in close proximity to heaps of garbage that serve as favorable environments for intestinal-parasite transmission. Adult male and female food vendors from the sampled suburbs were randomly selected for screening.

A total of 204 food vendors from 7

metropolitan areas of Accra–Ablekuma-South (49 vendors), Adjabeng-Central (53), Ayawaso-Central (55), Okai-koi South (47), Osu Klottey (52), Okaikoi North (30), and La Market (48 vendors)– were selected. The research was approved by the research and ethical review committee of the School of Allied Health Sciences, University of Ghana. Informed consent was obtained from the study participants before the start of the study. The study was conducted at the Department of Microbiology, University of Ghana Medical School, and the Department of Medical Laboratory Sciences, School of Allied Health Sciences, Korle-Bu, Accra, in February-May 2008.

Sample collection and analysis

Each of the participating food vendors was given a plastic stool container and requested to provide a sample of about 2 g of fresh stool within the following 24 hours. The samples were surveyed for parasites by direct smear method, formalin-ethyl acetate sedimentation, and modified Ziehl Neelsen and trichrome staining techniques. The vendors were also interviewed using a questionnaire. Stool samples were transported to the laboratory within 30-60 minutes of collection and examined. Samples that could not be examined immediately were stored at 4°C. Evidence of infection was based on the identification of trophozoites, cysts, oocysts, ova and larvae from direct saline wet mount, iodine preparation, and concentration technique (formalin-ether sedimentation technique). Trichrome and modified Ziehl Neelsen permanent staining techniques were used to identify trophozoites or cysts that could not readily be identified by wet-mount technique.

Wet-mount technique

The stool samples were examined macroscopically for the presence of adult worms, for consistency, and for any other physical abnormalities. The stool samples were emulsified with 3-4 ml normal saline, then a drop of emulsified sample was placed on a glass slide, a few drops of iodine were added, and all covered with a cover slip. The preparation was first examined under a 10x objective lens, then 40x for detailed identification of parasites under low light intensity. This process helped to identify motile trophozoites, larvae, eggs and cysts.

Formol-ether concentration technique

One gram (1 g) of each stool sample was emulsified with 3-4 ml of 10% formol saline. An additional 3-4 ml of 10% formol saline was added; this was mixed thoroughly and passed through a gauze. Three to four (3-4) ml of diethyl ether were added and mixed by inverting and intermittent shaking for 1 minute, and centrifuged at 3,000 rpm for 5 minutes. After centrifugation, the supernatant (layers of ether, debris, and formol saline) was discarded and the sediment (containing the parasites at the bottom of the test tube) was re-suspended in formol saline. The sediment was examined microscopically under 10x and 40x magnification, for the presence of parasitic organisms. Smears from the deposits were made and stained with modified Ziehl Neelsen and trichrome stains.

Modified Ziehl Neelsen staining technique

A thin smear of sediment from the concentration technique was prepared, air-dried and fixed in methanol for 2-3 minutes. The slides were stained with cold carbolfuchsin for 5-10 minutes. The slides were then differentiated in 1% hydrochloric acid-ethanol solution. The slides were rinsed in distilled water and then counter-stained with 0.3% methylene blue for 30 seconds. These were then rinsed in tap water, air-dried, and examined microscopically under a 100x objective oil-immersion lens.

Trichrome staining technique

The prepared slides were fixed in 70% alcohol for 2 minutes; a mixture of Lugol's iodine and 70% ethanol was then added for 5 minutes. The slides were passed through two changes of ethanol, *ie*, 80% and 70%. The slides were further stained in undiluted trichrome stain for 10 minutes, then removed, drained, and placed in 90% acidified

alcohol for 2-3 seconds. The slides were further dipped in a 95% alcohol rinse, then dehydrated through 100% ethanol and 100% xylene. The smear was finally mounted in DPX mount and examined microscopically. As a precautionary measure, the smears were kept wet in mountant until examined.

Results

A total of 204 food vendors were screened. One hundred and sixty-three (80%) were females, whilst the remaining 41 (20%) were males. Most of the female vendors sold a variety of dishes, whilst the male subjects sold mainly fried rice. Thirty-seven percent (37%) of those enrolled had no knowledge of parasitic infections and their transmission, 63.2% reported using public toilet (KVIP) facilities, 8.0% using water closets, while the rest did not disclose the type of toilet facility used. Over 90% of the vendors used pipe-borne water as their main source of water supply.

Age distribution and educational background of food vendors

The ages of the vendors ranged between 15-60 years; the majority (86.8%) were between 21-40 years and of these, 59.8% were infected with gastrointestinal parasitic organisms. The highest level of infection (46.8%) was recorded in the 21-30 year age group, as shown in Table 1. The educational background of the vendors varied, ranging from primary school level through vocational school (Table 2). One hundred and ninety-two (95%) were formally educated, while 12 (5%) had no formal education. Of the educated, 59.4% were infected, and of the uneducated, 83.3%. In general, the highest level of infection (64.5%) was associated with basic school education.

De-worming history of vendors

Some vendors considered de-worming, at least once per year, as a preventive measure. Of all vendors screened, 60.1% had a history of de-worming either once; twice, or thrice in the past 12 months, whereas the remaining 39.9% did not remember taking any de-worming medication in the previous 3 years (Table 3). A significant proportion (55.6%) of those who had a de-worming history were found to be infected, while 68.0% of those with no de-worming history were also infected.

Parasitological profiles of the vendors

The stool examinations revealed that, of the 204 food vendors examined, 44 were infected with gastrointestinal parasitic organisms, giving a prevalence rate of 21.6%. Seven different parasites were identified: *A. lumbricoides* (5.0%), *S. stercoralis* (4.4%), *E. vermicularis* (4.1%), *C. parvum* (2.5%), *G. lamblia* (2.0%), *A. duodenale* (2.0%), and *E. histolytica* (2.0%). Of those infected, 31 (15.2%) had parasitic worm infections, while the remaining 13 (6.4%) had protozoan infections (Table 4). Twenty-six (12.8%) of those infected had mixed infections, while the remaining 18 (8.8%)

Table 1 Infection prevalence among food vendors, by age group.

Age group	Infected		Uninfected	
	No.	%	No.	%
≤ 20	1	0.8	-	-
21-30	58	46.8	46	57.5
31-40	46	37.1	24	30.0
41-50	18	14.5	9	11.2
≥ 51	1	0.8	1	1.3
Total	124	100	80	100

Table 2 Educational levels of food vendors.

Level of education	Infected		Uninfected	
	No.	%	No.	%
Primary	17	13.7	12	15.0
Basic	80	64.5	40	50.0
Secondary	13	10.5	16	20.0
Vocational	4	3.2	10	12.5
None	10	8.1	2	2.5
Total	124	100	80	100

Table 3 De-worming history of food vendors.

No. of times de-wormed	Infected		Uninfected	
	No.	%	No.	%
None	55	44.4	25	31.3
Onece	50	40.3	39	48.7
Twoice	18	14.5	15	18.7
Threeice	1	0.8	1	1.3
Total	124	100	80	100

had single infections. Mixed infections involving a combination of worms and protozoan organisms were higher (13; 6.4%) than co-infections involving only protozoan organisms (10; 4.9%), and co-infections involving helminthic parasites only (3; 1.5%).

The study did not find any statistically significant difference between the various intestinal parasites isolated, among the food handlers ($p < 0.012$). The prevalence of parasitic infections in the various suburbs was as follows: Ayawaso-Central (3.4%), Ablekuma-South (3.4%), Okai-Koi South (2.9%), Adjabeng-Central (2.9%), Osu Klottey (2.9%), Okai-Koi North (2.2%), and La Market (3.9%) (Table 4).

Discussion

In Ghana, street-food consumption and the patronage of fast-food joints have increased tremendously. This practice has the potential to promote high transmission rates of various intestinal parasites, leading to the high prevalence of food-borne diseases, as reported in some African countries [14]. The high prevalence among our study group may be due to poverty or low socio-economic conditions, poor personal and environmental hygiene, over-crowding, limited access to clean water, the tropical climate, low altitude, and lack of knowledge about parasite transmission [3,4].

The relatively high prevalence of parasites transmissible by oral-fecal route found in this study indicated potentially high levels of environmental fecal contamination and inadequate sanitation standards [21]. The kinds of lavatories used by food vendors may have influenced the carriage and transmission of the parasites identified. Some food vendors had no access to modern toilet facilities,

Table 4 Food vendors enrolled and prevalence in suburban areas studied.

Parasite	Ayawaso Central n=34	Ablekuma South n=30	Okai-Koi South n=28	Okai-Koi North n=19	Adjabeng Central n=33	Osu Klottey n=31	La Market n=29	Total no. of vendors Infected (%)
G. lamblia	1	0	1	0	0	1	1	4 (2.0)
E. histolytica	0	0	1	0	1	1	1	4 (2.0)
S. stercoralis	1	2	1	1	2	1	1	9 (4.4)
E. vermicularis	1	1	1	1	2	1	1	8 (4.1)
A. lumbricoides	2	2	1	1	1	1	2	10 (5.0)
A. doudenale	1	1	1	0	0	0	1	4 (2.0)
C. parvum	1	1	0	1	0	1	1	5 (2.5)
Total no. of vendors infected (%)	7 (3.4)	7 (3.4)	6 (2.9)	4 (2.2)	6 (2.9)	6 (2.9)	8 (3.9)	44 (21.6)

while a good proportion of those who used modern toilet facilities did not use appropriate methods of cleaning themselves after defecation. These practices further contaminated the hands of vendors and enhanced the transmission of gastrointestinal infections [22]. Inadequate hand-washing after defecation was a major problem among the food vendors. Most of the study subjects perceived washing of hands with soap as an extra cost that reduced their profit margin.

Even though most food vendors exhibited good personal hygiene, in terms of well-kept nails, apparently healthy skin and physical appearance, their environment and food-handling practices were not very hygienic. Most of the vending sites were poorly kept, as traces of litter and the presence of domestic animals, were observed. In a few cases, prepared dishes were sold near choked gutters and left exposed to flies without proper protection. The infective stages of intestinal parasites can be blown into these foods and thereby cause infection [23].

Some food vendors used their bare hands to handle money and dish out food to their customers, while others used spoons and forks. Some served food in plastic plates, take-away packs or polythene bags. These are examples of poor food-handling practices, which predispose customers to microbial infections [24].

In the study area, it was very common to use fresh vegetables in salads served with main dishes. This potentially increased the intestinal-parasite infection risk of the population, since these vegetables, eaten raw or undercooked to retain their natural taste and preserve heat-labile nutrients, may be unclean or contaminated [4]. To reduce this risk, there is a need for proper storage methods, such as refrigeration, to minimize the danger of contamination and to prevent exposure of food to mechanical vectors, *eg*, houseflies, cockroaches, mice, lizards and rats, which can transfer eggs and the cysts of intestinal parasites to improperly stored food [25].

The fact that these food vendors were asymptomatic carriers further increased the risk of disease transmission to their customers [26]. A similar study conducted in Abeokuta, Nigeria, which concurs with our own results, showed differences in the levels and types of parasites among infected food vendors in various areas, and found a high prevalence of worm infections [26].

Although the presence of mixed infections observed in some food vendors was alarming, it confirmed the results of studies conducted in Kenya [14]. Similarities in our environmental conditions, such as high humidity and optimal

temperatures for larval/egg development/viability, coupled with economic deprivation, may have contributed to the transmission and maintenance of infective stages of these intestinal parasites in the community. Variations in these factors from one locality to another within the study site may explain the differences in the rates of infestation observed [4].

Conclusion

The prevalence of intestinal parasitic infections among food vendors in Accra is becoming increasingly important and may pose a health problem in Ghana. There is, therefore, a need to improve the personal hygiene of food-vendors in Accra, to reduce the prevalence of fecal-oral transmissible parasites. It may be necessary to enact proper food handling policies in Ghana, with the enforcement of appropriate policy implementation.

Food vendors in Ghana should only be expected to operate from some designated places with proper facilities that ensure customer protection. The metropolitan authorities should provide the necessary infrastructure to improve the safety of street-vended foods.

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