ORIGINAL ARTICLE

Prevalence and pattern of bacteria and intestinal parasites among food handlers in the Federal Capital Territory of Nigeria

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ABSTRACT

Background: In developing countries, biological contaminants largely bacteria and other parasites constitute the major causes of food-borne diseases often transmitted through food, water, nails, and fingers contaminated with faeces. Accordingly, food-handlers with poor personal hygiene could be potential sources of infections by these micro-organisms. **Objective:** This study was aimed at determining the prevalence and pattern of bacteria and intestinal parasites among food handlers in the Federal Capital Territory. **Materials and Methods:** The study was a descriptive one in which a multistage sampling technique was employed to select 168 food handlers of various types. Subjects' stool, urine, and fingernail analyses were carried out and the result scientifically scrutinized. **Results:** Fingernail bacteria isolates include: *E. Coli* (1.8%), coagulase-negative *staphylococcus* (17.9%), *Staphylococcus aureus*(7.1%), *Klebsiella species* (2.4%), *Serratia species* (1.2%), *Citrobacter species* (1.2%), and *Enterococcus species* (1.8%). The subjects' stool samples tested positive: For *A. lumbricoides* (14.9%), *T. trichuria* (1.8%), *S. starcolaris* (3.0%), *E. histolytica* (10.7%), *G. lambilia* (1.8%), *S. mansoni* (1.2%), and *Taenia* species (4.8%). Furthermore, 42.3% and 15.5% of the stool specimen tested positive for *Salmonella* and *Shigella* species, respectively. **Conclusion:** Food establishments should screen and treat staff with active illness, and regularly train them on good personal and workplace hygiene practices.

Key words: Bacteria, federal capital territory, food handlers, intestinal parasites

INTRODUCTION

All food handlers are required to use proper hygiene and sanitation methods when working with food; however, different food handling jobs require different duties.[1] The food manufacturer prepares food or beverages in a factory setting. The packaging food handler holds the product in clean or gloved hands and places the food product into protective packaging to prevent the food from becoming stale or being exposed to pathogenic microbes during transportation of the product from the factory to consumers.[1] Cooks prepare food in a restaurant setting mixing various foods together to create different flavours, dishes to delight, and sustain their customers.[1] Cooks are required to follow health standards of handling food and keeping their cooking areas clean and bacteria free. Waiters and servers do not always directly touch the food they are transporting; they still are required to follow rules and regulations of other food handlers.

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An adequate supply of safe, wholesome, and healthy food is essential to the health and well-being of humans.[2] The consumption of contaminated or unsafe foods may result in illness, also referred to as food-borne disease.[3,4] Such diseases remain a major public health problem globally, but particularly in developing countries due to difficulties in securing optimal hygienic food handling practices. An estimated 70% of cases of diarrhoeal disease are associated with the consumption of contaminated food.[2,5] Reliable statistics on food-borne diseases are not available due to poor or non-existent reporting systems in most developing countries.[5]

Diarrhoeal diseases, mostly caused by food- or water-borne microbial pathogens, are leading causes of illness and

deaths in developing countries, killing an estimated 1.9 million people annually at the global level. Even in developed countries, an estimated one-third of the population are affected by microbiological food-borne diseases each year.[2] In contrast, Kaferstein and Abdussalam reported that up to 10% of the population of industrialized countries might suffer annually from food-borne diseases.[6] Diagnosis of a food-borne illness can only be made after considering the recent food-consumption history of a patient and performing proper laboratory tests for disease-producing parasites, bacteria, and bacterial toxins.[4]

Transmission of intestinal parasites and entero-pathogenic bacteria is effected through objects contaminated with faeces. These include food, water, fingernails, and fingers, indicating the importance of faecal-oral human-to-human transmission.[6] Accordingly, food-handlers with poor personal hygiene working in food-serving establishments could be potential sources of infections of many intestinal helminths, protozoa, and entero-pathogenic bacteria.[7] Compared to other parts of the hand, the area beneath fingernails harbours the most micro-organisms and is most difficult to clean.[8]

In developing countries, biological contaminants are responsible for a wide range of diseases, including cholera, campylobacteriosis, *E. coli* gastroenteritis, *salmonellosis*, shigellosis, typhoid and paratyphoid fevers, brucellosis, amoebiasis, and poliomyelitis.[9] General good house-keeping, food handling, preparation, servicing practices, dishwashing facilities, conditions of cooking utensils, food storage systems (time and temperature), as well as food handlers' knowledge and practices all affect food safety directly or indirectly.[10-12]

Therefore, this study seeks to determine the prevalence and examine the pattern of bacteria and intestinal parasites among food handlers in the FCT with a view to making appropriate recommendations for the improvement of food safety and sanitary conditions within food establishments in the territory.

MATERIALS AND METHODS

The study area Abuja is Nigeria's federal capital territory (FCT) and was created in 1976. It covers an area of 800 square kilometers bounded to the north by Kaduna state, to the west by Niger state and on the east and south by Nasarawa and Kogi sates, respectively. The scenic splendor of Abuja characterized by an avalanche of low hills, mountains, transverse shallow valleys, deep green vegetation, rich topography, and a friendly weather is a tourist haven awaiting exploration. With the presence of an international airport and world standard first class hotels, the FCT today has become the preferred conference venue of the West African sub-region, and the melting pot of Nigeria's political and social development. These attributes, together with hospitality and industry of residents have attracted many visitors to the city of Abuja. It has been reported that more than 70% of the land is rural.[13] The FCT is subdivided into 6 area councils, namely Abaji, Abuja municipal, Bwari, Gwagwalada, Kuje, and Kwali. The urban areas are in the federal capital city and the area council headquarters. It also includes some notable satellite towns like Kubwa and some remote villages like Kuchingoro. Abuja is intended as an inclusive city for all Nigerians with no indigene/settler dichotomy. All are considered to be residents of FCT. Today (2010), the National population census puts the population figure of Abuja at about 1.4 million with an annual growth rate of 13% with only two development phases completed thus creating an over stretch of existing infrastructure.[13]

The study design was descriptive, while a multistage sampling technique was used to select participants: First, out of the six council areas in Abuja, two (Abuja municipal and Kuje) council areas were selected by a simple random sampling method. Secondly, a comprehensive list of existing catering establishments was obtained from the department of public/occupational health FCDA Abuja. This list was then stratified by the type of service they provide into the following strata: restaurant 16, bar 8, butcher shop 12, juice vendor 9. Stratification was aimed at avoiding over or under-representation of certain types of establishments. A proportional sample size was then determined for each stratum, and selection performed using a table of random numbers to obtain a sample size of 168 from an estimated total population size of 285. Four categories of food handlers were identified, these include: Production staff, cook, butcher, and waiter.

Using the formula: z^2pq/d^2 [14]

Where Z is the standard normal deviate at 95% confidence interval = 1.96, P is the percentage picking a choice = 0.5, q is the complementary percentage picking a choice = 0.5, d is the degree of precision based on the assumption of 5% expected margin of error=0.05.

$$\text{Sample size } (n)=\frac{(1.96)^2\times(0.5)\times(0.5)}{(0.5)^2}=384$$

Applying correction for finite population gives the New sample size[14] $= \dfrac{n/1+n-1}{\text{Population estimate}}$

$$\text{Study Population} = \frac{384}{\dfrac{1+384-1}{285}} = 168$$

Participants were selected from the list of worker groups included all staff that prepare and serve food; cooks, production staff, butchers, and waiters working in restaurants, butcher/suya shop, ice cream/fruit juice shop, and bars.

Structured and pre-tested interviewer administered questionnaires were used to obtain information on socio-demographic characteristics of establishment owners/managers and food handlers, repair conditions of premises, availability of water supply, toilet facility, refuse management, dish/hand washing facility. Five sanitarians were recruited for data collection and supervision after 3 days of training on the purpose of the study, the format of the questionnaire, interviewing techniques, and data quality management. Data quality was also ensured by regular supervision, spot checking, and reviewing the completeness and consistency of questionnaires on a daily basis. Three medical laboratory technicians were recruited for sample collection of participants in establishments. Inoculation and isolation of the desired organisms were performed in a laboratory using standard procedures and culture medias as recommended.[15] Biological samples required from the subjects for examination include: Stool, Urine, and Fingernail content.

Laboratory stool analysis was designed to detect the most common bacteria including *Salmonella, Shigella, Yersinia, Aeromonas, Vibrio, Campylobacter*, enterohaemorrhagic *Escherichia coli*, and *Clostridium difficile*. To isolate these agents from the very complex microbial milieu of feces, several selective and differential media were employed.[15] Stool microscopy using formol ether concentration technique was also done to isolate and identify intestinal parasites from stool samples of food handlers.

For urinalysis and culture it was extremely critical to ensure that urine specimen was collected to avoid urethral contamination. The clean-catch technique involved in collection was based on discarding the first portion of urine, which is most likely to be contaminated. It was recommended that the first voided morning specimen be collected so bacteria will have multiplied to high levels after overnight incubation in the bladder. Where this was not possible, participants were advised to allow the urine to incubate in the bladder as long as possible before collection. Because urine is an excellent culture medium for bacteria, it was ensured that urine specimens were sent to the laboratory as soon as possible and specimens plated within 2hours of collection. Where this was not possible, the specimen was refrigerated for a maximum of 24h before plating. Quantitative cultures were performed using appropriate procedure, on all urine specimens so that the number of bacteria per milliliter of urine was determined and expressed as CFU/ml.

Fingernail content was obtained with the aid of a sterile swab stick which was then introduced into a sterile bijou bottle containing peptone water, a flamed and cooled calibrated loop was vertically inserted into the specimen bottle, a loopful of sample was then inoculated on each plate of MacConkey and CLED agar by making a straight line down the canter and then a series of close perpendicular streaks throughout the first line. This was followed by fingernail microscopy following the appropriate procedures.[15]

Data were entered and analyzed electronically using the SPSS (version 14) statistical packages (chi square) and results presented in tables.

Ethical clearance was obtained from the NAUTH Ethics committee Nnewi, while the participants/establishments were also acquainted with the objective, importance and implications of the study to get their written informed consent. Ethical issues that may arise from the result of this study were further circumvented by ensuring that the names of establishments were not mentioned in the study.

RESULTS

Table 1 shows the socio-demographic characteristics of food handlers studied. Of the four categories of food handlers identified, 42.3% of participants were male while 57.7% were females. While 51.8% of participants are married, 47.6% are single, and only a small proportion had no formal education. 63.7% of participants have secondary while 20.8% had primary education. A majority (39.3%) are semi-urban dwellers, while 36.9% and 23.8% resides in rural and urban centres, respectively.

Table 2 depicts the frequency and type of bacteria isolated from fingernail content of the 168 food-handlers studied. Bacteria isolated include *E. coli* (1.8%), *coagulase* negative *staphylococcus* (17.9%), *Staphylococcus aureus* (7.1%), *Klebsiella species* (2.4%), *Serratia species* (1.2%), *Citrobacter species* (1.2%), *Enterococcus species* (1.8%), while no bacteria was isolated from the finger nail content of 66.7% of participants. Also no parasite was isolated from majority of participants (98.2%), only 1.8% had *A. lumbricoides* isolated from their fingernail content.

Table 1: Socio-demographic characteristics of the food handlers

Parameter	Frequency	%
Sex		
Male	71	42.3
Female	97	57.7
Marital status		
Married	87	51.8
Single	81	47.2
Educational status		
No formal education	11	6.5
Primary	35	20.8
Secondary	107	63.7
Tertiary	15	8.9
Place of residence		
Rural	62	36.9
Semi-urban	66	39.3
Urban	40	23.8

Direct wet mounts and concentration techniques were used for identifying intestinal parasite from 168 stool specimens [Table 3]. Sixty four of the stool samples (38.1%) tested positive: For *A. lumbricoides* (14.9%), *T. trichuria* (1.8%), *S. starcolaris* (3.0%), *E. histolytica* (10.7%), *G. lambilia* (1.8%), *S. mansoni* (1.2%), *Taenia species* (4.8%). Seventy-one (62.6%) of the stool specimen tested positive for bacteria; *Salmonella species* (42.3%) had a higher frequency compared to *Shigella spp* (15.5%).

Table 4 shows that 51 (30.4%) tested positive for bacteria: *E. coli.* (4.8%), coagulase. negative *staph spp* (8.3%), *S. aureus* (7.7%), *Klebsiella species* (1.8%), *Proteus species* (4.2%) *Enterococcus species* (3.0%) *Psuedomonas arginosa* (0.6%).

DISCUSSION

Poor and faulty food-handling practices have been identified as the leading cause of the majority of food-borne disease.[16] However, pathogens that are most commonly associated with poor hygienic practices are the entero-bacteriaceae, such as Escherichia coli and other coliforms, as well as members of the genera Salmonella, Shigella, Yersinia, Proteus, and Klebsiella.[17.]

The high (38.1%) and (62.6%) prevalence of intestinal parasites and bacteria respectively in the stools of the food-handlers in this study was in agreement with the findings of other studies. Costa-Cruz[18] and co-authors reported intestinal parasites in 47.1% of the food handlers in public elementary schools. Among the 49 infected food handlers, 32 (65.3%) carried one parasite and 17 (34.7%) carried two parasites. The most common intestinal parasites were *Giardia lamblia* (21.1%), *Entamoeba coli* (21.1%), and hookworms (9.6%). In another study that was carried out in public hospitals, Laurenco, Uchoa, and Bastos[19] reported that 17.1% of food handlers had intestinal parasitism. The most frequent parasite was *Entamoeba coli*, detected in 48.5% of the samples with positive results. Al-Lahham and co-authors also reported the most common parasites as *A. lumbricoides* (4.9%), *G. lamblia* (3.9%), S mansoni(2.8%), and hookworms (2.5%).[20]

The hygiene condition of fast food joints and restaurants was further challenged because of the isolation of *Staphylococcus aureus* and other bacteria from 30.4% of food handlers, as well as *Shigella* species and *E. coli* from stool cultures. Another shocking revelation was the establishment of *Salmonella* carriage among participants. The high *Salmonella* carrier rate of 42.3% determined may be an indication of low educational level, poor toilet facilities, and lifestyle. This high value is however not in agreement with the rate of 0.13% quoted for the developed world like the USA;[21] neither does it agree with Mensah *et al*.study which reported 3.2 % in Accra.[22]

Table 2: Type of bacteria and parasites isolated from fingernail content of food handlers

	Frequency	%
Bacteria		
E. coli	3	1.8
Coag. Neg. *Staph*	30	17.9
S. aureus	12	7.1
Klebseilla Spp	4	2.4
Serratia species	2	1.2
Enterococcus Spp	3	1.8
Citrobacter species	2	1.2
None	117	66.7
Total	168	100.0
Parasite		
A. lumbricoides	3	1.8
None	165	98.2
Total	168	100

Table 3: Parasites and bacteria isolated from stool samples of food handlers in the FCT

	Frequency	%
Parasite		
A. lumbricoid	25	14.9
T. trichura	3	1.8
S. starcolaris	5	3.0
E. histolytica	18	10.7
G. lambilia	3	1.8
S. mansoni	2	1.2
Teania Spp	8	4.8
None	104	61.9
Total	168	100.0
Bacteria		
Salmonella Species	71	42.3
Shigella Species	26	15.5
Escherichia coli	8	4.8
None	63	37.5
Total	168	100.0

Table 4: Bacteria isolated from urine sample of food handler in the FCT

Bacteria	Frequency	%
E. coli	8	4.8
Coag. Neg. *Staph*	14	8.3
S. aureus	13	7.7
Klebseilla Spp	3	1.8
Proteus Spp	7	4.2
Enterococcus Spp	5	3.0
Psuedomonas arginosa	1	0.6
None	117	69.6
Total	168	100.0

With the increase in tourism and commerce in the FCT, mass catering has become very important and when this is viewed against the background of the public health problem posed by carriers of *Salmonella* species, it becomes vital that a close attention be paid to the health of people engaged in the food industry. Although the urban centers

of the FCT have barely adequate water supply,[23] many food handlers and consumers, in the course of the day, make use of the public toilets, but are unlikely to wash their hands afterwards due to the paucity of water at these public toilets. The intensity of surveillance for food-borne disease can markedly influence the number of food-borne disease outbreaks reported in the FCT. However, a substantial proportion of restaurant-associated food-borne illnesses probably goes unreported.

In order to meet the huge challenge of food safety in the 21st century, a coordinative and cooperative approach is required. This will be a major task of the public health community and will require the use of new methods of identifying, monitoring, and assessing of food-borne hazards, including the wide application of the hazard analysis and critical control point system. Both traditional and new technologies for assuring food safety should be improved and fully exploited. This needs to be done through public/private partnership, legislative measures where suitable but much greater reliance will have to be placed on voluntary compliance and on education of consumers and other food-handlers. However, this study would specifically recommend the following:

Establishments should train and re-train staff on good hygienic practices clearly pointing out among others:

The importance of good hygiene and the untoward effect of poor personal cleanliness and unsanitary practices on food safety.

Avoidance of insanitary personal practices such as scratching the head, placing finger in or about the mouth or nose and indiscriminate and uncovered sneezing.

Thorough and proper hand washing after using the toilet/bathroom, before and after eating.

The FCT public health departments in collaboration with public and private health facilities enforce compliance to routine periodic medical examination and pre-employment medical examination of food handlers in the FCT, and issuance of a certificate of fitness to the employee by a competent medical practitioner.

Establishments should ensure compulsory and proper treatment of staff with active illness. Disposable rubber gloves, plasters and other first-aid items for management of minor cuts/injuries should be provided for use by the food handlers when necessary.

Food handlers who are symptomatically ill, therefore, present a serious health hazard occupational safety Any agent or activity posing a potential hazard to health. Cf Physical hazard. and should be excluded from work. Such individuals should furthermore be made aware of the need to immediately report illnesses and should be assured that if exclusion is necessary it will not result in loss of employment or wages.

Any behaviour that could result in the contamination of food, such as eating and chewing (of gum, sticks, and sweets) should also be prevented in food-handling establishments. It is also essential, when unprotected food or raw food materials are handled, that personnel remove jewelry from their hands, while fingernails should be kept short and clean to reduce microbial contamination of food.

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