

Prevalence of Salmonella and Shigella carriage among food handlers at a tertiary hospital in North Central Nigeria

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Abstract

Food borne diseases such as salmonellosis and shigellosis remain a major public health problem across the globe especially in the developing countries. Food handlers are potential transmitters of food borne bacteria that cause these diseases. Periodic screening of food handlers can prevent life threatening outbreaks in hospitals and the larger community. This study therefore aimed at determining the carriage rate of *Salmonella* and *Shigella spp.* among food handlers at the University of Ilorin Teaching Hospital, Ilorin. This was an observational study of all the food handlers in the hospital who met the inclusion criteria for this study. They were screened for specific food borne pathogens from May to June, 2018. Hand swabs and fresh stool specimens collected from the food handlers were examined specifically for *Salmonella* and *Shigella spp.* using standard microbiological techniques. The socio-demographic characteristics of the food handlers were also obtained using structured questionnaires specifically designed for the study. Of 81 participants recruited into the study, *Salmonella spp* was isolated from the stool of 1 (1.2%) of the food handlers. No *Shigella spp.* was isolated from the stool cultures. The hand swabs revealed no isolate. The colonization rate of food handlers by *Salmonella spp* in this study, there is very low yet epidemiologically significant. Periodic screening and FBP eradication therapy for carrying/ infected FBHs is recommended to avoid outbreaks of food borne infections in the hospital.

Keywords: Food borne disease, food handlers, food borne pathogens, salmonellosis, shigellosis

Introduction

Food borne diseases (FBDs) are important causes of morbidity and mortality worldwide, especially in developing nations (Pires, 2013). FBDs pose a significant threat to the health of the population in Africa, with accompanying massive economic losses (Mengist, Mengistu, & Reta, 2018). The World Health Organization (WHO) recently put the estimates of deaths due to food and water-borne related diseases in Africa at 700,000 per year (Mama & Alemu, 2016). These diseases have a substantially higher impact in low- and middle-income countries (LMIC) that are often plagued with challenges such as lack of potable water, poor sanitation and inadequate food safety measures (Ifeadike et al., 2012).

The WHO defines FBD as a disease caused by the consumption of food or water contaminated by food borne pathogens (FBPs) or toxins (Le Loir, Baron, & Gautier, 2003). The FBPs responsible for FBDs include bacteria, viruses, parasites, and fungi (Zain & Naing, 2002). Food and water are excellent vehicles through which these pathogens can be transmitted to humans. These pathogens can contaminate food at any of the different stages of its preparation which include the farm, the stage of preparation & processing, packaging and distribution. A Food handler (FH) is defined as a person in food trade or someone professionally associated with it, such as a food inspector, who in his or her routine work comes into direct contact with food in the course of production, processing, packaging, or distribution; its procurement, preparation, and consumption (Zain & Naing, 2002). FHs, with poor personal hygiene and poor knowledge of FBD preventive strategies, working in hospitality sectors or hospitals could spread FBPs and cause deadly outbreaks; thus the health status, personal hygiene, and the knowledge and practice of food hygiene of FHs play important roles in food contamination by FBPs and/or toxins (Mudey et al., 2010).

Pathogens from faeces, nose, throat and skin can be transferred to food via the hands, and this underscores the importance of proper and effective hand hygiene (Linscott, 2011). A common symptom of FBDs is diarrhea which sometimes is associated with nausea and vomiting. In the hospital setting, nosocomial infection is a common problem that increases the average length of hospital stay and hospital cost and often affects patients' quality of life, survival, and response to treatment. Poor hygiene of FHs in hospital kitchens has been reported to be the cause of outbreaks of infections in hospitals, some of them resulting in the death of patients (Bhattacharya, Talati, Gupta, Malhotra, & Singh, 2019).

Salmonella and *Shigella spp.* still remain very common bacterial agents of FBDs especially in the developing countries (Ifeadike et al., 2012). Hospitalized patients including pregnant women, infants, the elderly and the immune-compromised persons with Human immunodeficiency virus (HIV) infection, or individuals on

chemotherapy for malignancies are at greater risk of developing FBDs due to their compromised immunity (Lund & O'Brein, 2011).

FHs, who work in the hospital environs, are also potential transmitters of agents of FBDs. The potential roles of such FHs in the transmission of food borne infections within hospitals in the Nigeria have not been well elucidated. This study, therefore, determined the prevalence of *Salmonella* and *Shigella spp* among apparently healthy FHs at a tertiary hospital in Ilorin, the North Central region of Nigeria.

Methods

Study design and area: This was a cross-sectional study that was carried out at the University of Ilorin Teaching Hospital (UITH), Ilorin. It is a hospital with 450 beds and an average of 10,000 and 12,000 annual admissions and Out-patient visits respectively. Ilorin, located on latitude 8° 24' N and 83°6' N and longitude 4° 10' E and 4°36' E, is the capital city of Kwara State situated in the middle belt region of Nigeria (Ajadi, Adaramola, Adeniyi, & Abubakar, 2016).

Inclusion criteria: A food handler is defined as a person in the food trade or someone professionally associated with it, such as a food inspector who, in his or her routine work, comes into direct contact with food in the course of its production, processing, packaging or distribution.⁶ All consenting professional FHs, irrespective of their age and gender, were recruited and studied.

Exclusion criteria: FHs who had used antibiotics within one week of recruitment or were still on such drugs were excluded.

Study protocol: The study population comprised 81 FHs and these consisted of the hospital kitchen staff, self-employed FHs at the Doctors' and Nurses' lounge, and those at the various canteens situated within the hospital premises. An informed written consent was obtained from each FH after the introduction and explanation of the purpose of the study. Thereafter, each FH completed a structured questionnaire specifically designed for the study. The confidentiality of the FHs was maintained by using codes instead of names and keeping the data away from non-members of the research team.

Sampling technique: All the FHs within the vicinity of the hospital who met the inclusion criteria were recruited consecutively and in a non-repetitive manner.

Ethical approval: Ethical approval was obtained from the Ethical Review Committee (ERC) of the hospital before the commencement of the study.

Specimen collection: Hand swabs and fresh stool samples were collected from the FHs over a period of two months spanning between May 2018 and June 2018. The swabs were taken by the researchers, from the inter-digital clefts of the hands and

the nail beds of each study participant using a sterile, normal saline-moistened cotton-tipped swab stick. Each swab stick was immediately placed into a labeled sterile bijou bottle containing peptone water before transportation to the laboratory for processing.

Each participant was then given a clean, dry, leak-proof, wide mouthed and well labeled specimen bottle for stool collection. Where the participants could not immediately produce the stool samples, the specimen bottles were left with such participants who were instructed to call any of the researchers on phone as soon as they were about to provide the stool specimen while on duty. These participants were adequately trained on proper handling of the stool specimen in order to prevent cross-contamination. The samples were transported to Medical Microbiology and Parasitology laboratory of the hospital within one hour of collection for prompt processing. The socio-demographic characteristics of the FHs were obtained using a structured questionnaire specifically designed for the study.

Laboratory analysis: At the laboratory, all samples were inoculated onto Salmonella-Shigella (SS) agar and incubated aerobically for 18-24 hours at 35–37 °C.

Handling and processing of hand swab specimens: A flamed and cooled calibrated loop was inserted vertically into the specimen bottle and a loopful of sample was then inoculated on each plate of Salmonella-Shigella (SS) agar by making a straight line down the center and then a series of close perpendicular streaks throughout the first line. This was followed by fingernail microscopy following the appropriate procedures (Adams & Moss, 2008).

Handling and processing of the stool specimens: The stool samples were first visually inspected for the presence of blood and/or mucous and worms. Where present, the blood or mucous containing parts of the stool were used for stool wet preparation and inoculation onto the culture medium. Wet stool preparations were made in saline and eosin which were transferred onto slides and microscopically examined under 10X and 40X objectives having applied cover slips on a pre-warmed compound light microscope stage specifically for trophozoites of intestinal parasites. The stool samples were concentrated by formol ether concentration technique and used to identify specifically cysts of intestinal parasites (Adams & Moss, 2008). Suspected *Salmonella* and *Shigella* colonies obtained after culture were identified with Gram stain reaction, urease test, oxidase test and Analytical Profile Index (API) 20E (Bio Merieux, France). *Escherichia coli* ATCC 25922 and *Staphylococcus aureus* ATCC 25923 were used as controls.

Antibiotic susceptibility testing of *Salmonella* isolates was performed by the modified Kirby-Bauer disc diffusion technique using Mueller-Hinton agar and the results interpreted according to the Clinical and Laboratory Standards Institute

(CLSI) guidelines (CLSI, 2017). Antibiotic discs to which isolates were tested included Amoxycillin/Clavulanate (20/10µg), Ciprofloxacin (5µg), Gentamicin (10µg), Ceftazidime (30µg) and Imipenem (10µg)

Statistical analysis: Data analysis was performed using Statistical Package for Social Sciences (SPSS) version 20. Continuous variables were presented using mean, standard deviation and range. Categorical variables were presented in proportions and percentages.

Results

The ages of the 81 FHs who met the inclusion criteria ranged from 13 to 70 years (mean age $\pm$ SD = 37 $\pm$ 15 years). Majority of FHs were females 69 (85.2%). The other socio-demographic characteristics of the study population are as shown in Table 1.

The hand carriage rate of *Salmonella* and *Shigella spp.* among the FHs was 0.0% since none of these organisms was isolated from the hand swabs. *Salmonella spp.* was however isolated from the stool of one food handler giving a prevalence rate of 1.2%. The occurrence of *Salmonella spp.* in stool of the FHs across the various age groups is shown in Table 2. The affected FH was a female and not a staff of the hospital. The *Salmonella* isolate was biochemically identified as *Salmonella enterica* using API 20E (Bio Merieux, France). No *Shigella spp.* was isolated from the stool of any of the FHs.

Table 1: Socio-Demographic Characteristics of the Food handlers

Variable	Frequency (N=81)	Percentage (%)
Age		
Mean $\pm$ S.D	36.96 $\pm$ 14.580	
Range	13 - 70	
Age group in years		
≤ 20	15	18.5
21 – 30	17	21.0
31 – 40	15	18.5
41 – 50	18	22.2
> 50	16	19.8
Gender		
Male	12	14.8
Female	69	85.2
Tribe		
Yoruba	72	88.9
Hausa	4	4.9
Igbo	2	2.5
Others	3	3.7
Other tribes (n=3)		
Ogori	1	33.3
Togolese	2	66.7
Religion		
Islam	39	48.1
Christianity	42	51.9
Marital status		
Single	16	19.8
Married	65	80.2
Education		
None	15	18.5
Primary	17	21.0
Secondary	28	34.6
Tertiary	21	25.9
Years of working experience		
<1 year	12	14.8
1 – 5 years	22	27.2
6 – 10 years	26	32.1
11 – 15 years	2	2.5
>15 years	19	23.5

Table 2: The occurrence of *Salmonella spp* in stool of the Food handlers across the age groups

Age groups in years	Frequency of <i>Salmonella spp</i> in stool		Total (N)
	Yes (n)	No (n)	
≤ 20	0	15	15
21- 30	1	16	17
31-40	0	15	15
41-50	0	18	18
> 50	0	16	16
Total	1	80	81

Antibiotic susceptibility test result: The *Salmonella enterica* that was isolated from the stool of one of the food handlers was sensitive to all the antibiotics that were used for susceptibility testing using the Kirby–Bauer Disc Diffusion Method that was performed according to the Clinical and Laboratory Standards Institute (CLSI) guidelines. Clear zones of inhibition of growth of the organism were observed with the Amoxycillin/Clavulanate (20/10µg), Ciprofloxacin (5µg), Gentamicin (10µg), Ceftazidime (30µg) and Imipenem (10µg) discs indicating the organism's susceptibility to these antibiotics.

Discussion

In this study, the age of the FHs ranged from 13 to 70 years, majority were females, 81.5% of them had formal education and *Salmonella spp.* was isolated from the feces of only one of the FHs giving a prevalence rate of 1.2%. Neither of the finger swabs nor fecal specimens taken from the FHs yielded any *Shigella spp* isolate. The age range of the FHs is comparable to that of the kitchen staff of a tertiary care hospital in a similar study conducted in Saudi Arabia (Zaglool, Khodari, Othman, & Farooq, 2011). It however contrasts with the age range of the food service staff in another study in a hospital in Qatar where none of the FHs was less than 20 years of age (Al Kaabi, Ibrahim, & Salama, 2010). The inclusion of FHs who are not staff of the hospital in this study may account for this observed difference.

In the study from Qatar, unlike in this study, there were more male FHs than their female counterparts with a male to female ratio of 8:1(Al Kaabi et al., 2010). Most

studies have reported higher proportion of females involved in food handling (Akabanda, Hlortsi, & Owusu-Kwarteng, 2017; Baluka, Miller, & Kaneene, 2015). Analyzing the level of education; 49 (60.5%) of the 81 FHs in this study had secondary level of education, and this is at variance with a study in Saudi Arabia where 17 (8.5%) of the FHs has secondary education. Majority of the food handlers in the study from Saudi Arabia either had no formal education 64 (32.0%) or primary level of education alone 119 (59.5%) (Zaglool et al., 2011). In a study from Qatar, more than 80.0% of the 43 food handlers studied had a minimum of secondary level education (Al Kaabi et al., 2010). This percentage is higher than the 60.5% in this study but may be due to the lower sample size in the Qatar study.

Only *Salmonella spp.* was isolated from the stool of one of the 81FHs in this study giving a total bacteria isolation rate of 1.2%. It is however higher than the rate observed in a similar study of 200 FHs in a tertiary hospital in Saudi Arabia, where none of the two organisms was isolated from neither the finger swabs nor stool specimens of the FHs (Zaglool et al., 2011). It is consistent with the range of 0-13.3% reported in a hospital in India over a period of 6 years (Khurana, Taneja, Thapar, Sharma, & Malla, 2008). Higher combined stool carriage rates for *Salmonella* and *Shigella spp.* ranging from 3.5% and 5.0% in a study from Ethiopia to 35.1% obtained in Nigeria, have been reported among FHs in institutions other than hospitals specifically Universities (Aklilu et al., 2015; David & Oluyeye, 2015; Marami, Hailu, & Tolera, 2018). Higher carriage rates were recorded among street FHs (Ifeadike et al., 2012; Mobolaji & Olubunm, 2014; Smith et al., 2008). This may be due to a better knowledge of FBD and hygienic practice among FHs who work in the health sector than FHs in other institutions and street FHs which has been documented in literature (Modiwala & Wavare, 2015).

Limitation of the study

Examination for the presence of bacterial food pathogens in the hand swabs and faeces was restricted to *Salmonella* and *Shigella spp.* only. Other medically important enteric pathogens such as *Campylobacter spp.*, and *Yersinia enterocolitica* were not studied due to their challenging culture requirements.

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Conflict of interest statement

The authors declare no conflict of interest

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References

- Adams, M., & Moss, M. (2008). Food microbiology (3rd ed., pp. 252-256). UK: RSC press.
- Ajadi, B. S., Adaramola, M. A., Adeniyi, A., & Abubakar, M. I. (2016). Effect of effluents discharge on public health in Ilorin metropolis, Nigeria. *Ethiopian Journal of Environmental Studies & Management*, 9(4), 389-404. doi: <http://dx.doi.org/10.4314/ejesm.v9i4.1>
- Akabanda, F., Hlorts, E. H., & Owusu-Kwarteng, J. (2017). Food safety knowledge, attitudes and practices of institutional food-handlers in Ghana. *BioMed Central Public Health*, 17, 40-49.
- Aklilu, A., Kahse, D., Dessalegn, M., Tarekegn, N., Gebremichael, S., Zenebe, S., . . . Mama, M. (2015). Prevalence of intestinal parasites, salmonella and shigella among apparently health food handlers of Addis Ababa University student's cafeteria, Addis Ababa, Ethiopia. *BioMed Central Research Notes*, 8, 17.
- Al Kaabi, S. K., Ibrahim, A. A. E., & Salama, R. E. (2010). Assessment of Knowledge, Attitude and Practice of Food Safety Among Food Service Staff at Hamad General Hospital in 2006. *Qatar Medical Journal*, 19(2), 14-16.
- Baluka, S. A., Miller, R., & Kaneene, J. B. (2015). Hygiene practices and food contamination in managed food service facilities in Uganda. *African Journal of Food Science*, 9(1), 31-42.
- Bhattacharya, S., Talati, S., Gupta, A. K., Malhotra, S., & Singh, A. (2019). Implementing a skill development program among food handlers in tertiary care hospital to improve their personal hygiene: A pilot study. *Journal of Education and Health Promotion*, 8, 129. doi: 10.4103/jehp.jehp_452_18
- CLSI. (2017). Performance Standards for Antimicrobial Susceptibility Testing. Clinical Laboratory Standard Institute supplement M100. In 27th (Series Ed.). Wayne, Pennsylvania: Clinical Laboratory Standard Institute.

- David, O. M., & Oluyeye, A. O. (2015). Antibiotic resistance and plasmid carriage among *Salmonella typhi* isolated from food and hands of food handlers in a Nigeria University. *International Journal of Current Microbiology and Applied Sciences*, 4(3), 906-914.
- Ifeadike, C. O., Ironkwe, O. C., Adogu, P. O., Nnebue, C. C., Emelumadu, O. F., Nwabueze, S. A., & Ubajaka, C. F. (2012). Prevalence and pattern of bacteria and intestinal parasites among food handlers in the Federal Capital Territory of Nigeria. *Nigerian Medical Journal*, 53(3), 166-171. doi: 10.4103/0300-1652.104389
- Khurana, S., Taneja, N., Thapar, R., Sharma, M., & Malla, N. (2008). Intestinal bacterial and parasitic infections among food handlers in a tertiary care hospital of North India. *Tropical Gastroenterology*, 29(4), 207-209.
- Le Loir, Y., Baron, F., & Gautier, M. (2003). *Staphylococcus aureus* and food poisoning. *Genet Mol Res*, 2(1), 63-76. doi: <https://www.ncbi.nlm.nih.gov/pubmed/12917803>
- Linscott, A. J. (2011). Food-borne illnesses. *Clinical Microbiology Newsletter*, 33(6), 41-45. doi:10.1016/j.clinmicnews.2011.02.004
- Lund, B. M., & O'Brein, S. J. (2011). The occurrence and prevention of foodborne disease in vulnerable people. *Foodborne Pathogens and Disease*, 8(9), 961-973.
- Mama, M., & Alemu, G. (2016). Prevalence, antimicrobial susceptibility patterns and associated risk factors of *Shigella* and *Salmonella* among food handlers in Arba Minch University, South Ethiopia. *BioMed Central Infectious Diseases*, 16(1), 686. doi: 10.1186/s12879-016-2035-8
- Marami, D., Hailu, K., & Tolera, M. (2018). Prevalence and antimicrobial susceptibility pattern of *Salmonella* and *Shigella* species among asymptomatic food handlers working in Haramaya University cafeterias, Eastern Ethiopia. *BioMed Central Research Notes*, 11(1), 74. doi: 10.1186/s13104-018-3189-9
- Mengist, A., Mengistu, G., & Reta, A. (2018). Prevalence and antimicrobial susceptibility pattern of *Salmonella* and *Shigella* among food handlers in catering establishments at Debre Markos University, Northwest Ethiopia. *International Journal of Infectious Diseases*, 75, 74-79.
- Mobolaji, O. A., & Olubunm, O. F. (2014). Assessment of the hygienic practices and the incidence of enteric bacteria in food handlers in small businesses in

an urban area in Abeokuta. *International Journal of Microbiology Research*, 5(3), 41-49.

- Modiwala, A., & Wavare, R. R. (2015). Hygienic practice and knowledge of food borne diseases in home kitchen handlers. *Journal of Community Medicine and Primary Health Care*, 6(4), 541-546.
- Mudey, A. B., Kesharwani, N., Mudey, G. A., Goyal, R. C., Dawale, A. K., & Wagh, V. V. (2010). Health status and personal hygiene among food handlers working at food establishment around a rural teaching hospital in Wardha District of Maharashtra, India. *Global Journal of Health Science*, 2(2), 198.
- Pires, S. M. (2013). Assessing the applicability of currently available methods for attributing foodborne disease to sources, including food and food commodities. *Foodborne Pathogens and Disease*, 10(3), 206-213.
- Smith, S. I., Alao, F., Goodluck, H. T., Fowora, M., Bamidele, M., Omonigbehin, E., & Coker, A. O. (2008). Prevalence of *Salmonella typhi* among food handlers from bukkas in Nigeria. *British Journal of Biomedical Science*, 65(3), 158-160.
- Zaglool, D. A., Khodari, Y. A., Othman, R. A. M., & Farooq, M. U. (2011). Prevalence of intestinal parasites and bacteria among food handlers in a tertiary care hospital. *Nigerian Medical Journal*, 52(4), 266-270. doi: 10.4103/0300-1652.93802
- Zain, M. M., & Naing, N. N. (2002). Sociodemographic characteristics of food handlers and their knowledge, attitude and practice towards food sanitation: a preliminary report. *Southeast Asian Journal of Tropical Medicine and Public Health*, 33(2), 410-417.