

## Full Length Research Paper

# Distribution of enteric bacterial pathogens among patients with gastrointestinal tract infections and food vendors in Lagos, Nigeria

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Stool samples from 2,200 patients with gastrointestinal tract (GIT) infections and 900 apparently healthy food vendors were collected in Lagos, Nigeria and examined to determine incidence and distribution of bacterial pathogens using standard microbiological methods. The isolates recovered were identified to belong to seven genera which include *Salmonella*, *Shigella*, *Escherichia*, *Proteus*, *Klebsiella*, *Vibrio* and *Enterobacter*. *Salmonella typhi* was the most prevalent, followed by *Escherichia coli*, while *Klebsiella* species was the least encountered. Most of the food vendors fell within the age range of 21 years and above constituting 78.4% of the food vendors examined. This study underscores the need to monitor the carriage of enteric pathogens among patients and apparently healthy food vendors. This study further implicates food vendors as a great threat to the health of the public since some of them were carriers of the pathogenic bacteria. Therefore, it is recommended that there should be enlightenment, training for, and vaccination of the vendors accordingly as well as periodic surveillance.

**Key words:** Enteric pathogens, patients, infections, food vendors, *Salmonella* species.

## INTRODUCTION

Enteric pathogens have been implicated in most food- and water-borne infections that have been responsible for rising morbidity and mortality globally especially in Africa (Payment and Riley, 2002; Nma and Oruese, 2013; Ogunleye et al., 2013). Though some of the organisms in this group are normal microbiota of gut of man and other higher animals, they get their way into the food through environmental contamination (Karshima et al., 2013; Ogunleye et al., 2013; Kemal, 2014). They are mainly Gram-negative bacteria which cause different

gastrointestinal diseases in man while quite a number of other animals serve as either carrier or secondary host. Gastrointestinal tract (GIT) infection in humans usually originates from pets, other humans and through the ingestion of contaminated water or animal food products, most often eggs, poultry, and raw meat (Bhan et al., 2005; Centers for Disease Control and Prevention, 2005; Swanson et al., 2007; Smith et al., 2012; Karshima et al., 2013). Following ingestion of the organisms, the likelihood of infection developing, as well as the severity

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**Table 1.** Age and sex distribution of subjects examined for enteric bacterial pathogens.

Age group	Patients (%)		Vendor	Total
	Male	Female	Female	
11-20	261 (11.9)	608 (27.6)	194 (21.6)	1063 (34.3)
21 and above	590 (26.8)	741 (33.7)	706 (78.4)	2037 (65.7)
Total	851 (38.7)	1349 (61.3)	900	3,100
Grand total	2,200			

of infection, is related to the dose and virulence of the organism in question or its strain and the status of host's defense mechanisms (Payment and Riley, 2002).

In most cases, diagnosis of GIT infection is often missed or delayed, which is a reflection of the multi-system nature of the diseases. Consequent upon development and availability of modern sewage and water treatment facilities, these diseases have become rare in developed countries but remain a serious health challenge in low resource countries with inadequate sanitation and safe water supply. Although enteric fever is a major global public health problem; data on the relative risk of contracting travel-associated enteric fever is not documented in most developed world, while adequate epidemiological data are grossly inadequate in developing countries (Crump et al., 2004). Vending of street food, particularly in urban areas, is a growing and global phenomenon and today street vended foods are important sources of daily meals for massive urban populations as well as in African. However, food poisoning, food borne diseases and food safety have been declared a major public health concern by international health agencies, while in many studies, street vended foods have been associated with microbiological contamination and low hygienic standards (WHO, 2006). Hence, street food vendors play a significant role in public health since this group of individuals alone influences the life and health of thousands of people daily.

Food handlers have been reported to greatly contribute to the dissemination and distribution of pathogens due in most cases to their low level of education, poor personal and environment hygiene (Nkere et al., 2011; CDC, 2013). Moreover, some of the food vendors are carriers of most of the enteric bacterial pathogens and consequently introduce the pathogens into the food they handle (Chukwu et al., 2010; Oranusi and Olorunfemi, 2011). Food from local vendors, though most of the time are prepared under unhygienic conditions and by people with very low knowledge of hygiene, they still enjoy high patronage due essentially to their affordability, easy accessibility and claimed palatability or organoleptic quality (Karshima et al., 2013). This study therefore investigated incidence and distribution of enteric pathogens among patients with GTIs and food vendors in Lagos, Nigeria.

## MATERIALS AND METHODS

A total of three thousand and one hundred (3,100) non-repeat stool samples made up of 2,200 from patients with GITs and 900 apparently healthy food vendors were collected in Lagos, Nigeria and examined by standard microbiological procedures. Oral informed consent was obtained from the patients and vendors recruited for this study prior to sample collection. The samples were homogenized in sterile distilled water and 1.0 ml of diluted stool samples were plated on MacConkey Agar and Plate Count Agar and plated at 37°C for 24 h. *Salmonella* species was isolated by Ifeanyi et al. (2013). Faecal samples (1 g) was pre-enriched in 9 ml of buffered peptone water for 24 h at 37°C after which 0.1 ml of the pre-enriched culture was plated into Selenite Cysteine Broth (10 ml) and Rappaport-Vassilidis Broth, and incubated for 24 h at 37 and 42°C, respectively. The enriched cultures were inoculated on to Xylose Lysine Deoxycholate Agar and incubated at 37°C for 24 h. The methods Holt et al. (1994) were used to identify the isolates.

## RESULTS AND DISCUSSION

Distribution of enteric bacteria associated with GITs and food vendors in the study areas was investigated in this study. Sex and age distribution of patients and food vendors show that out of a total of 2,200 patients examined, 851 (38.7%) were male while 1,349 (61.3%) were female. In a similar study, Madukosiri et al. (2013) observed higher incidence among female than male in Port-Harcourt, Nigeria. A total of 869 (39.5%) of the patients were under 21 years of age, while the remaining 1,331 (60.5%) were above 21 years of age. All the food vendors examined were female (Table 1). Table 2 depicts 1,670 (53.9%) of the subjects with enteric fever. The incidence was higher among the patients compared with the food vendors. The incidence rate of enteric fever was higher among subjects aged above 20 years with 749 (24.2%). Out of 900 food vendors examined, 110 (12.2%) had enteric fever. This carrier rate of *Salmonella typhi* found among the vendors presents a serious health concern as this group of individuals occupies an epidemiologically strategic positions in the society (Chukwu et al., 2010; Oranusi and Olorunfemi, 2011; Nyenje et al., 2012; Nma and Oruese, 2013; Ogunleye et al., 2013).

Different bacteria were recovered from the stool samples from both patients and food vendors. These were observed to belong to eight genera of bacteria including *Staphylococcus*, *Salmonella*, *Shigella*,

**Table 2.** Age and sex distribution of enteric fever among patients and food vendors in Lagos.

Age group	Patients (%)		Vendor (%)	Total (n=3100)
	Male (n=851)	Female (n=1349)	Female (n=900)	
11-20	176 (20.7)	300 (22.2)	45 (5.0)	521 (16.8)
21 and above	336 (39.5)	348 (25.8)	65 (7.2)	749 (24.2)
Total	512 (60.2)	648 (48.0)	110 (12.2)	1670 (53.9)

**Table 3.** Distribution of bacterial isolates among patients and food vendors in Lagos.

Organism	Patients [n=2,200 (%)]	Vendors [n=900 (%)]
<i>Escherichia coli</i>	558 (25.4)	222 (24.7)
<i>Enterobacter</i> spp.	0	28 (3.1)
<i>Klebsiella</i> spp.	105 (4.8)	117 (13.0)
<i>Proteus</i> spp.	300 (13.6)	123 (13.7)
<i>Salmonella typhi</i>	885 (40.2)	87 (9.7)
<i>Salmonella</i> spp.	108 (4.9)	63 (7.0)
<i>Shigella</i> spp.	681 (31.0)	0
<i>Vibrio</i> spp.	100 (4.5)	33 (3.7)

*Escherichia*, *Proteus*, *Klebsiella*, *Vibrio* and *Enterobacter*. These organisms have been reported to be associated with food especially the vended types (Payment and Riley, 2002; Ameko et al., 2012; Chukwu et al., 2013; Nma and Oruese, 2013; Karshima et al., 2013; Ogunleye et al., 2013). *Enterobacter* species was isolated only from the food vendors while *Shigella* species was isolated from some of the patients examined. *S. typhi* was recovered from 885 (40.2%) of the patients studied, and was the predominant organism. *Escherichia coli* was isolated from 558 (25.4%) patients and 222 (24.7%) among the food vendors while *Proteus* species was isolated from 300 (13.6%) patients and 123 (13.7%) of food vendors (Table 3). The high incidence of Enterobacteriaceae has been reported to be as a result of poor personal hygiene (Ojo and Adetosoye, 2009; Esan, 2011).

It has been reported that most food vendors in the developing nations grossly lack formal knowledge of food preparation and hygiene (Mensah et al., 2002; Muinde and Kuria, 2005; Omemu and Aderoju, 2008; Adjarah et al., 2013). Omemu and Aderoju (2008) and Chukuezi (2010) reported that food vending knowledge is acquired mainly either from parents or through observation of others. They also stated that some of the food vendors in Nigeria acquired theirs by trial and error methods.

Table 4 shows the distribution of bacterial species among subjects according to their age group. Patients within 21 years age bracket and above were generally more infected with the various bacterial isolates. *S. typhi* was isolated from stool culture 825/885 (93.2%) of the patients, and from 79/87 (90.8%) of food vendors. *Salmonella* spp. was equally recovered from stool cul-

tures of 102/108 (94.4%) patients and from stool cultures of 54/163 food vendors. *Shigella* spp. was isolated only from patients with 91.0% (620/681) of the same age bracket. *E. coli* which was the third most prevalent was recovered from stool cultures of 298/558 (53.4%) patients and 174/222 (78.4%) food vendors. This trend may be a pointer to the exposure and activity of this age group who are most likely to be economically engaged to care for their households. It also goes well to point to the position this group occupies in public health and the significant role it plays in the epidemiology of the organisms (Nyenje et al., 2012). Some of the isolates are important food-borne pathogens (Mensah et al., 2002; Nkere et al., 2011; Nyenje et al., 2012; Nma and Oruese, 2013; Adeyanju and Ishola, 2014). *E. coli* has been widely implicated in cases of diarrhoea and urinary tract infections, suggesting the probability of endogenous infection within the individuals (Steffen et al., 2003; Olowe et al., 2014).

There is likelihood that the vendors are carriers of these pathogens as obvious from the result of this study and become common sources and aid easy transfer of pathogens to food they handled. There is a need for periodic monitoring of bacterial carrier state of food vendors in particular. Bacterial diseases increasingly constitute an important cause of morbidity and mortality among humans and also animals, and the impact of bacterial diseases on public health has become increasingly enormous for various reasons (Ojo and Adetosoye, 2009; Donkor, 2014; Olawale et al., 2014). Therefore, it is recommended that there should be periodic enlightenment, training for, and vaccination of the vendors.

**Table 4.** Distribution of bacterial species among subject according to their age group.

Pathogen	Age group (year)				Total	
	11-20		21 and above		PT	VD
	PT	VD	PT	VD		
<i>Escherichia coli</i>	260	48	298	174	558	222
<i>Enterobacter</i> spp.	0	5	0	13	0	28
<i>Klebsiella</i> spp.	18	26	87	91	105	117
<i>Proteus</i> spp.	15	8	285	115	300	123
<i>Salmonella typhi</i>	60	8	825	79	885	87
<i>Salmonella</i> spp.	6	9	102	54	108	63
<i>Shigella</i> spp.	58	0	620	0	681	0
<i>Vibrio</i> spp.	23	13	67	20	100	33

PT: Patients; VD: Vendor.

## Conflict of interest

The author declared he has no conflict of interest.

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