

## Original Research Article

### Infection rate of *E. coli* O157:H7 among diarrhoeic patients in Southwest Nigeria

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#### ABSTRACT

#### Keywords

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al statistics;  
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The infection rate of *E. coli* O157:H7 was carried out among diarrhoeic patients in Southwest, Nigeria in this study. Stool samples were collected from one thousand and eight hundred diarrhoeic patients and subjected to standard microbiological techniques for the identification of the organism. From this investigation, 78 (4.3%) out of the people sampled were positive for the organism and this organism was found to be more frequent in females (4.5%) than males (4.2%). In respect to age group, the age group 61-70 years showed the highest occurrence rate (8.3%) while the lowest (2.7%) was found within the age group 21-30 years. Furthermore, the highest occurrence (8.3%) was found among Youth Corpers while the lowest (0.0%) was found among the commercial motorcycle riders and drivers. However on the type of water the people drink, the highest occurrence (4.5%) was found among those using well water, while the lowest (3.8%) was found among those using sachet water. In respect of toilet facilities being used by those sampled, the highest occurrence (5.8%) was found among those people using dunghill as toilet while the lowest occurrence (4.1%) was found among those using pit toilet. Based on ethnicity, the highest occurrence (7.4%) was found among Hausas while the lowest (3.7%) was found among the Igbos. In respect to the States where the patients reside, the highest occurrence (5.4%) was seen in people living in Lagos State while Ondo State had the lowest occurrence of (3.3%). This study has been able to show that 4.3% of diarrhoeic cases in South west, Nigeria are caused by *E. coli* O157:H7 and that many factors affect its distribution patterns. It is therefore suggested that efforts should be geared at coming up with control measures to prevent the infection from attaining epidemiological status.

#### Introduction

*Escherichia coli* O157:H7 is a gram negative organism that produces cytotoxins known as shiga-like toxin 1 (SLT 1) and SLT 2 (also called

verocytotoxin 1 and 2). Infection with the organism often leads to hemorrhagic diarrhoea, and occasionally to kidney failure, especially in young children and

the elderly (Karch *et al.*, 2005; Smith *et al.*, 2009). This organism was first associated with human illness in 1982, when it was isolated from the stools of patients in two food-borne outbreaks associated with the consumption of poorly cooked hamburgers (Mashood *et al.*, 2009). Since then, *E. coli* O157:H7 diarrhoeal illness has been reported from multiple locations in South Africa, Central Africa, Kenya, Gabon, Nigeria and Ivory Coast (Olatoye and Isaac, 2010).

The organism is transmitted primarily through the ingestion of faecal contaminated foods, particularly undercooked beef (Bonyadian *et al.*, 2010, Brazil *et al.*, 2007, Szalanski *et al.*, 2004 ). It can also be transmitted through the consumption of contaminated drinking water or contact with recreational water (Olatoye and Isaac (2010). Although a lot of work has been done on the infection rate of this organism in different part of the world, more is desired to know the current epidemiological statistics of this infection in southwest, Nigeria and factors predisposing individuals to the infection. This study was therefore conducted to determine the frequency of occurrence of this organism in diarrhoeic cases in Southwest Nigeria and factors predisposing individuals to the infection.

## Materials and Methods

One thousand eight hundred (1800) diarrhoeic stool samples were collected from infected patients at the Federal Medical Centre in the following States: Ondo, Ekiti, Ogun, Osun, Oyo and Lagos in Southwest Nigeria. Questionnaires were filled in respect to gender, age, occupation, type of water they use, marital status, race/ethnicity, when the samples were being collected from the patients. The

samples were immediately brought to the laboratory for analysis. The samples were first cultured on eosin methylene blue agar and the plates were incubated at 37°C for 24hrs. Bluish black with a metallic sheen colonies were transferred onto plates of sorbitol MacConkey agar (a differential medium used for culturing the organism) and also incubated at 37°C for 24hrs. Colourless colonies were taken as *E. coli* O157:H7. The following biochemical tests were done to ascertain that the organism was *E. coli*: Gram stain, blood haemolysis, methyl red, Voges-Proskauer, Indole, citrate and motility tests according to the method of Olutiola *et al.*, (2000).

## Result and Discussion

Out of 1800 diarrhoeic patients sampled during the course of this research work, 78 (4.3%) were positive for *E. coli* O157:H7. Thirty nine (4.2%) of the 932 males sampled were positive while thirty nine (4.5%) of the 868 females sampled were positive for the organism. That is, a higher proportion of the occurrence was found among the females sampled (Table 1).

The relationship between the rate of occurrence and age group can be seen in Table 2. The occurrence was higher in age group of 61-70 years (8.3%), followed by age group 31-40 years (5.7%), then age group 1-10 years (4.8%), and age group 71-80 years (4.8%). The rate of occurrence in the other age groups are as follows; 4.0% for age group 41-50 years , 4.0% for age group 11-20 years, 3.3% for age group 81-90 years, 3.1% for age group 51-60 years and 2.7% for age group 21-30 years. The relationship between the rate of occurrence and occupation is seen in Table 3. The rate of occurrence was highest among Youth Corpers (8.3%), followed by farmers (6.7%), traders (6.1%), day care

**Table.1** Rate of occurrence of *E. coli* O157:H7 among diarrhoeic patients in South West Nigeria based on gender.

Gender	No. of sample collected	No. positive	% positive
Male	932	39	4.2
Female	868	39	4.4
Total	1800	78	4.3

**Table.2** Rate of occurrence of *E. coli* O157:H7 among diarrhoeic patients in South West Nigeria based on age group.

Age group (years)	No. of samples	No. positive	% positive
1-10	498	24	4.8
11-20	324	13	4.0
21-30	336	9	2.7
31-40	192	11	5.7
41-50	198	8	4.0
51-60	96	3	3.1
61-70	84	7	8.3
71-80	42	2	4.8
81-90	30	1	3.3
Total	1800	78	4.3

**Table.3** Rate of occurrence of *E. coli* O157:H7 among diarrhoeic patients in South West Nigeria based on occupation

Occupation	No. of samples	No. positive	% positive
Students	486	16	3.4
Pupils	348	13	3.7
Day-care	162	9	5.6
Artisan	108	6	5.6
Apprentice	48	2	4.2
Civil servant	144	6	4.2
Commercial motorcycle rider	6	0	0.0
Farmer	30	2	6.7
Teacher	96	4	4.2
Trader	180	11	6.1
Tailor	18	0	0.0
Pensioner	108	5	4.6
Youth Corper	48	4	8.3
Driver	18	0	0.0
Total	1800	78	4.3

workers and artisans (5.6%) respectively, pensioners (4.6%), civil servants (4.2%), apprentices, and teachers (4.2%), pupils (3.7%), students (3.2%) while none (0.0%) was found among the commercial motorcycle rider and drivers sampled.

The water used by individual patient also had influence on the rate of occurrence of the organism, Table 4. Rate of occurrence was higher among those using tap water (4.5%), followed by those using well water (4.4%). The least occurrence rate was found among those that are using sachet water (3.8%). The relationship between the toilet facility and the occurrence rate can be seen in Table 5. Occurrence rate was highest among individuals using dunghill method (5.8%), followed by children using nappy (4.8%) and those using water system (4.2%). The least occurrence rate was found among those that are using pit toilet (4.1%). The race/ethnicity of individuals also had correlation in the rate of occurrence (Table 6). The infection rate was highest among the Hausas (7.4%), followed by Ijaws (4.6%), Ebiras (4.4%), Yorubas (4.3%) while the Igbos had the least occurrence rate (3.7%).

The State senatorial districts where individual patients are living also contributed to the rate of occurrence as seen in Table 7. Patients that are living in the central senatorial districts of their States had the highest rate of occurrence of 5.4%, followed by those living in the north senatorial district (4.5%). The least occurrence rate (3.0%) was found among those that are living in south senatorial district of their States.

Table 9 shows the rate of occurrence of *E. coli* O157:H7 based on States in which the patients resides. Rate of occurrence

was highest in Lagos State (5.3%), followed by Osun State (5.0%), Ekiti and Ogun States, 4.3% respectively, Oyo State (3.7%) while the least occurrence rate (3.3%) was found in Ondo State.

Temperature range also had influence on the rate of occurrence of *E. coli* O157:H7 in Southwest Nigeria. The occurrence rate was highest (5.3%) in Lagos State with temperature range of 15-30°C, followed by Osun State (5.0%) with temperature range of 22-30°C, Ekiti and Ogun States (4.3%), with also a temperature range of 22-30°C respectively. The least occurrence rate was found in Ondo State (3.3%) with the temperature range of 21-29°C (Table 10).

Another factor that influenced the occurrence rate of the organism in Southwest Nigeria is the annual rainfall. The occurrence rate was highest (5.3%) in Lagos State with annual rainfall of 4000mm, followed by Osun State (5.0%) with annual rainfall of 1330mm, Ekiti and Ogun States with 4.3% occurrence with annual rainfalls of 2400mm and 1280mm respectively. The least occurrence rate (3.3%) was found in Ondo State with annual rainfalls of 1150mm (Table 11).

The infection rate of *E. coli* O157:H7 as a cause of diarrhoea in South west Nigeria was carried out among diarrhoeic patients in the region. It was found that 4.3% diarrhoeal cases were caused by *E. coli* O157:H7. This case was lower than that reported in Iran, which was 27.6% by Bonyandian *et al.*, (2010), the one reported in Washington by Linda *et al.*, (1995) which was 97.3% and the one in Ibadan (Nigeria), which was reported to be 28.4% by Olatoye *et al.*, (2010). The discrepancy might probably be due to the level of hygiene standard of the individual countries, the time frame the studies were

**Table.4** Rate of occurrence of *E. coli* O157:H7 among diarrhoeic patients in South West Nigeria based on water used by individuals

Water used	No. of sample collected	No. positive	% positive
Well water	444	20	4.5
Tap water	1092	48	4.4
Sachet	264	10	3.8
Total	1800	78	4.3

**Table.5** Rate of occurrence of *E. coli* O157:H7 among diarrhoeic patients in South West Nigeria based on toilet facility

Toilet facility	No. of samples collected	No. positive	% positive
Water system	768	32	4.2
Pit toilet	774	32	4.1
Dunghill	174	10	5.8
Nappy	84	4	4.8
Total	1800	78	4.3

**Table.6** Rate of occurrence *E. coli* O157:H7 in diarrhoeic patients in South West Nigeria based on marital status

Marital status	No.of samples collected	No. positive	% positive
Married	720	33	4.5
Singled	1080	45	4.3
Total	1800	78	4.3

**Table. 7** Rate of occurrence of *E. coli* O157:H7 among diarrhoeic patients in South West Nigeria based on race/ ethnicity

Race/Ethnicity	No. of samples collected	No. positive	% positive
Yoruba	1128	49	4.3
Hausa	54	4	7.4
Igbo	354	13	3.7
I jaw	174	8	4.6
Ebira	90	4	4.4
Total	1800	78	4.3

**Table.8** Rate of occurrence of *E. coli* O157:H7 among diarrhoeic patients in South West Nigeria based on senatorial districts of each State.

Senatorial district	No. of samples collected	No. positive	% positive
North	600	27	4.5
South	570	17	3.0
Central	630	34	5.4
Total	1800	78	4.3

**Table.9** Rate of occurrence of *E. coli* O157:H7 among diarrhoeic patients in South West Nigeria based on individual State

State	No. of samples	No positive	% positive
Ondo	300	10	3.3
Ekiti	300	13	4.3
Lagos	300	16	5.3
Ogun	300	13	4.3
Osun	300	15	5.0
Oyo	300	11	3.6
Total	300	78	4.3

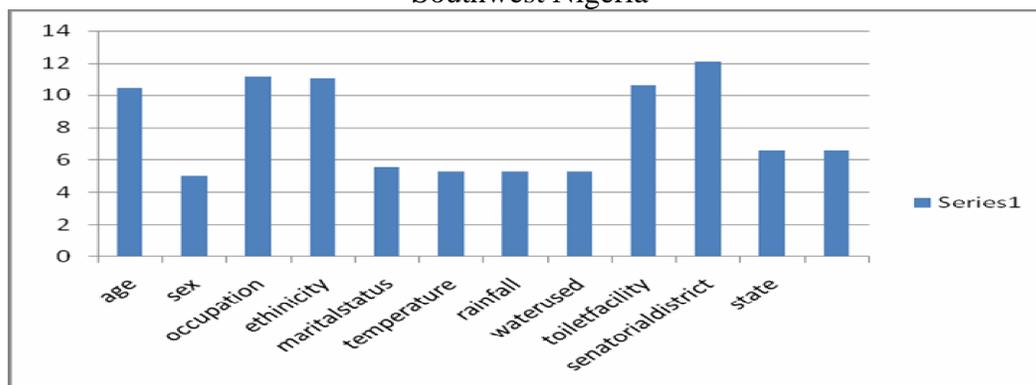
**Table.10** Rate of occurrence of *E. coli* O157:H7 among diarrhoeic patients in South West Nigeria based on temperature range of each State

Temp. range (°C)	No. of samples collected	No. positive	% positive
21-29	300	10	3.3
22-30	300	13	4.0
15-31	300	16	5.3
26-32	300	15	5.0
23-32	300	13	4.3
25-35	300	11	3.6
Total	1800	78	4.3

**Table.11** Rate of occurrence of *E. coli* O157:H7 among diarrhoeic patients in South West Nigeria based on annual rainfall of each State

Annual rainfall (mm)	No. of samples	No. positive	% positive
1150	300	10	3.3
2400	300	13	4.3
4000	300	16	5.3
1280	300	15	5.0
1330	300	13	4.3
1330	300	11	3.6
11490	1800	78	4.3

**Figure.1** Comparison among the factors responsible for infection of *E. coli* O157:H7 in the Southwest Nigeria



**Table.12** Biochemical tests of 78 isolates of *E. coli* O157:H7 among diarrhoeic patients in South West Nigeria

Isolate	G.S	C.T	I	MR	M	H.	V.P	S.M	E.M.B
1	-	+	+	+	+	+	-	-	purple
2	-	+	+	+	+	+	-	-	purple
3	-	+	+	+	+	+	-	-	purple
4	-	+	+	+	+	+	-	-	purple
5	-	+	+	+	+	+	-	-	purple
6	-	+	+	+	+	+	-	-	purple
7	-	+	+	+	+	+	-	-	Purple
8	-	+	+	+	+	+	-	-	purple
9	-	+	+	+	+	+	-	-	purple
10	-	+	+	+	+	+	-	-	Purple
11	-	+	+	+	+	+	-	-	purple
12	-	+	+	+	+	+	-	-	Purple
13	-	+	+	+	+	+	-	-	Purple
14	-	+	+	+	+	+	-	-	purple
15	-	+	+	+	+	+	-	-	purple
16	-	+	+	+	+	+	-	-	Purple
17	-	+	+	+	+	+	-	-	Purple
18	-	+	+	+	+	+	-	-	Purple
19	-	+	+	+	+	+	-	-	Purple
20	-	+	+	+	+	+	-	-	Purple
21	-	+	+	+	+	+	-	-	Purple
22	-	+	+	+	+	+	-	-	Purple
23	-	+	+	+	+	+	-	-	Purple
24	-	+	+	+	+	+	-	-	Purple
25	-	+	+	+	+	+	-	-	Purple
26	-	+	+	+	+	+	-	-	Purple
27	-	+	+	+	+	+	-	-	Purple
28	-	+	+	+	+	+	-	-	Purple
29	-	+	+	+	+	+	-	-	Purple
30	-	+	+	+	+	+	-	-	Purple
31	-	+	+	+	+	+	-	-	Purple
32	-	+	+	+	+	+	-	-	Purple
33	-	+	+	+	+	+	-	-	Purple
34	-	+	+	+	+	+	-	-	purple
35	-	+	+	+	+	+	-	-	Purple
36	-	+	+	+	+	+	-	-	Purple
37	-	+	+	+	+	+	-	-	Purple
38	-	+	+	+	+	+	-	-	Purple
39	-	+	+	+	+	+	-	-	Purple
40	-	+	+	+	+	+	-	-	Purple
41	-	+	+	+	+	+	-	-	Purple
42	-	+	+	+	+	+	-	-	Purple
43	-	+	+	+	+	+	-	-	Purple
44	-	+	+	+	+	+	-	-	purple
45	-	+	+	+	+	+	-	-	Purple

46	-	+	+	+	+	+	-	-	purple
47	-	+	+	+	+	+	-	-	Purple
48	-	+	+	+	+	+	-	-	Purple
49	-	+	+	+	+	+	-	-	Purple
50	-	+	+	+	+	+	-	-	Purple
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57	-	+	+	+	+	+	-	-	Purple
58	-	+	+	+	+	+	-	-	Purple
59	-	+	+	+	+	+	-	-	Purple
60	-	+	+	+	+	+	-	-	Purple
61	-	+	+	+	+	+	-	-	Purple
62	-	+	+	+	+	+	-	-	Purple
63	-	+	+	+	+	+	-	-	Purple
64	-	+	+	+	+	+	-	-	Purple
65	-	+	+	+	+	+	-	-	Purple
66	-	+	+	+	+	+	-	-	Purple
67	-	+	+	+	+	+	-	-	Purple
68	-	+	+	+	+	+	-	-	Purple
69	-	+	+	+	+	+	-	-	Purple
70	-	+	+	+	+	+	-	-	Purple
71	-	+	+	+	+	+	-	-	Purple
72	-	+	+	+	+	+	-	-	Purple
73	-	+	+	+	+	+	-	-	Purple
74	-	+	+	+	+	+	-	-	Purple
75	-	+	+	+	+	+	-	-	Purple
76	-	+	+	+	+	+	-	-	Purple
77	-	+	+	+	+	+	-	-	Purple
78	-	+	+	+	+	+	-	-	Purple

G.S - Gram stain; C.T - Citrate utilization test; I - Indole; M.R - Methyl red; M – Motility; H - Haemolysis; V.P - Voges-Proskaur test; S.M- Sorbitol MacConkey agar; E.M.B- Eosin methylene blue test

carried out and the origin of the samples examined. For example, the work done by Olatoye *et al.*, (2010) was carried out on samples from animal carcass. The lower rate recorded in this investigation (4.3%) may not be unconnected to recent efforts of the government in mounting different campaigns on the importance of improving the level of hygiene of the communities in which people are living, instating that

proper toilets should be built by the people and the provision of potable water also for the communities. These definitely could have been responsible for the drastic reduction of infection rate of the organism. The higher proportion of occurrence rate of this organism in Lagos and Osun states compared with other States in Southwest in this study could probably be due to the teaming population of people in these

cities which might invariably give way to unhygienic environmental contamination of food and water being consumed by the people of these cities. Traditional mode of cooking food at high temperature, unfavourable for microbial growth could be responsible for low prevalence of infection observed in Ondo State as compared with other States that were more developed with numerous hotels and fast-food restaurants provide ready-to-eat food to so many residents and travellers within the cities. These foods, which may not meet with expected sanitary standards of preparation, for example adequate cooking, may be ready sources of infection with *E. coli* O157:H7.

The higher percentage rate occurrence observed in females than in males in this study however might probably be due to the fact that the physiology of the female gender is constantly subject to change than their male counterpart which may result in the females being more prone to infections. For example, during pregnancy and monthly menstrual periods, there is always a shift in the hormonal balance that affects the immune system thereby making females to be prone to infections than their male counterpart.

The higher rate occurrence observed among the people using well water than other sources of water in this study for instance sachet water could probably be due to flooding recorded in most of the States in southwest Nigeria during the cause of this study that brought about contamination of the water in the deep well used by the citizens. However, sachet water in most cases is got from boreholes and is packed under strict hygienic conditions.

This study revealed that the rate of

occurrence of *E. coli* O157:H7 in causing diarrhoeal is very low in southwest, Nigeria. The low incidence is not unconnected to the standard of living of the people which is increasing by the day. Everyday people are becoming more aware of the dangers of living in dirty environments, eating with unwashed hands, drinking any kind of water, indiscriminate defecation and other unhealthy practises.

## References

- Bonyadian, M., H. Momtaz, E. Rahim, A. Yazdani and Zamani, M.2010. Identification and characterization of shiga toxin-producing *Escherichia coli* isolates from patients with diarrhoea in Iran. Indian. J. Medi. Res. 132:328-331.
- Brazil, S.M. , C.D. Steelman and Szalanki, A.L.2007. Detection of pathogen DNA from filth flies (Diptera: Muscidae) using filter paper spot cards, J. Agricult. Urban Entomol. 24(1) (inpress).
- Karch, H., P. Tarr and Bielaszewska, M.2005. Enterohaemorrhagic *Escherichia coli* in human medicine. Inter. J.Medi. Microbiol. 295 (6-7): 405-18.
- Linda, M.G., G. Marcia, K. John, H.I.Jay, A. Dalia, P. Annmarie, I.T. Phillip, H.L. Jay, E.O. Jerry, L.M. Steve and Mansour, S.1995. Molecular Epidemiology of Fast-Food Restaurant- Associated Outbreak of *E. coli* O157:H7 in Washington State. J. Clini. Microbiol.. 2155-2158.
- Mashood, A.R., M. Uswege and Robert, M. 2009. Current epidemiological status of enterohaemorrhagic *Escherichia coli* O157:H7 in Africa. Chinese. Medi. J. 119(3):217-222
- Olatoye, I .O., 2010. The incidence and

- antibiotics susceptibility of *Escherichia coli* O157:H7 from beef in Ibadan municipal, Nigeria. *African. J. Biotechnol.* 9(8):1196-1199.
- Olutiola, P.O., O. Famurewa and Sonntag, H.G.2000. An Introduction to General Microbiology, A Practical Approach. Publishers: Hygiene-Institut Der Universitat Heidelberg.pp:262
- Smith, S. I., O.S. Bello and Goodluck, H.A.2009. Prevalence of EHEC O157:H7 from human and environmental samples from Lagos and Zaria. *Pakistan. J. Medi. Sci.* 25 (3): 398-403
- Szalanski, A.L., C.B.Owens, T. Mckay and Steelman.2004. Detection of *Campylobacter* sp. And *E. coli* O157:H7 in filth flies (Diptera: Muscidae) by polymerase chain reaction. *Medi.Veteri. Entomol.* 18:241-246.
- [www.weatherblink.com](http://www.weatherblink.com) (2012). Temperature and rainfall range of Southwest Nigeria States.