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Prevalence of Enterohaemorrhagic *Escherichia Coli* O157:H7 in Stool Samples of Patients Attending Selected Hospitals in Tarka and Otukpo Local Government Areas of Benue State, Nigeria

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Abstract

Enterohaemorrhagic *Escherichia coli* (EHEC) O157:H7 is a major cause of gastrointestinal illnesses, particularly among Patients. It is associated with severe complications such as hemorrhagic colitis and hemolytic uremic syndrome (HUS), posing a serious public health threat. Despite its global relevance, there is limited data on the prevalence and molecular characteristics of EHEC O157:H7 in Nigeria. This study investigated the prevalence, virulence profile, and associated risk factors of EHEC O157:H7 among Patients with acute diarrhoea in Tarka and Otukpo Local Government Areas (LGAs) of Benue State, Nigeria. A cross-sectional study was employed involving 400 stool samples collected from Patients presenting with acute diarrhoea at selected hospitals in the study areas. Socio-demographic and environmental data were obtained from caregivers using structured questionnaires. *E. coli* isolates were cultured. Descriptive statistics and chi-square tests were used to determine prevalence and associations with risk factors. The study identified the high prevalence of *E. coli* O157:H7 (85.5%) in the stool samples analyzed. While most households had water sources within their premises, a considerable proportion relied on streams (41%) and stored drinking water in wide-mouthed containers (55.8%). Chi-square statistical analysis revealed no significant associations between *E. coli* O157:H7 prevalence and the assessed risk factors, which included water source, storage methods, sanitation practices (open defecation reported in 20.8% of households), and hygiene habits. Despite the absence of statistically significant associations, the high prevalence of EHEC O157:H7, coupled with inadequate water sources and storage practices, underscores the urgent need for targeted public health interventions. Recommendations include improving sanitation and hygiene education, promoting safe water handling and storage, and implementing continuous surveillance to mitigate the risks associated with EHEC infections in Patients in the region. In addition, the high percentage of isolates with *stx1* and *stx2* genes indicates a concerning potential for severe disease outcomes.

Keywords: Diarrhoea; *Escherichia coli* O157:H7; Public Health; Prevalence; Risk Factors

1. Introduction

Escherichia coli is a facultative anaerobic bacterium that exists in the gut of warm blood animals, including humans. It plays an important role as a normal microbiota that exerts mutual benefits to the hosts [1]. *Escherichia coli* can also be found in the physical environment such as water, soil and vegetation and are thus referred to as being ubiquitous. Many *Escherichia coli* strains are usually not harmful and act as commensals in the intestine of warm-blooded animals, but some few strains have been found to cause mild to severe disease in man [2] . *Escherichia coli O157:H7* was first identified as a possible human pathogen in 1975 in a California Patients with bloody diarrhea and was first associated with a foodborne (ground beef) outbreak of disease in 1982. However, some strains of *Escherichia coli* possess virulence

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factors and are pathogenic to humans. Five pathotypes of *Escherichia coli* have been classified based on their pathogenic mechanisms; *Enteropathogenic E. coli (EPEC), Enteroaggregative E. coli (EAEC), Enteroinvasive E. coli (EIEC), Enterotoxigenic E. coli (ETEC) and Enterohemorrhagic E. coli (EHEC)*[1] *Escherichia coli* presents a large array of genetic subtypes defined by the somatic (O) and flagellar antigen (H). Most subtypes are harmless whilst some can cause severe diarrhoea (U.S. Department of Agriculture's Food Safety and Inspection Service). *Escherichia coli O157:H7* is an important subtype that causes many foodborne outbreaks worldwide in the past decades [3]. Other serotypes such as *E. coli* O26:H11, O111:H8, O103:H2, O113:H21 and O104:H21 have also been implicated in causing foodborne outbreaks [4,5]. *Escherichia coli O157:H7 is* a pathogenic strain of *Escherichia coli* that is known to cause diarrhoea and other severe complications such as Haemolytic colitis, Haemolytic uraemic syndrome and thrombotic thrombocytopenic pupura in humans. *Escherichia coli O157:H7 can* grow in temperatures ranging from 7 °C to 50 °C, with an optimum temperature of 37°C [4]. It is destroyed by thorough cooking of foods until all parts reach a temperature of 70°C or higher [5]. The majority of *E. coli O157:H7* strains can be distinguished from most *E. coli* by their inability to ferment sorbitol rapidly and by their lack of production of glucuronidase (U.S. Department of Agriculture's Food Safety and Inspection Service)[6]. They also differ from other *E. coli* because of their ability to produce verocytotoxins (VT) or shiga toxins (ST). *Escherichia coli O157:H7* is a zoonotic food borne and waterborne pathogens with cattle serving as the main reservoir for this organism which they shed in their faeces and is often used as manure by farmers. Transmission of this organism is usually through faecal oral route and Humans become infected with this pathogen through consumption of faecally contaminated fruits, vegetables and water or through person to person contact and direct contact with infected faeces. *Escherichia coli O157:H7* infection is transmitted by faecal-oral route through contaminated food or water. Shiga-toxin producing strains have a high potential for person-to-person transmission since a very low infective dose is required and ingestion of as few as 10 organisms may be sufficient to cause infection [7]. The rate of secondary household transmission for sporadic Shiga-toxin producing strains has been estimated to range from about 4% to 15% [7]. Institutional outbreaks due to person-to-person transmission have also been reported in nursing homes, schools and daycare centers for Patients [8]. The incubation period is around 3 to 4 days but can range from one to ten days [9]. The spectrum of infection with *Escherichia coli O157:H7* includes asymptomatic faecal shedding of the organism; non-bloody or bloody diarrhoea accompanied by abdominal cramps, vomiting and occasionally fever; post- diarrheal Hemolytic Uremic Syndrome (HUS); and Thrombotic Thrombocytopenic Purpura (TTP) most Patients recover within 10 days [4]. About 8% to 10% of Patients, especially young Patients under 5 years old and the elderly, may progress to HUS ~ a condition characterized by microangiopathic haemolytic anaemia, acute renal failure and thrombocytopenia [5]. *Escherichia coli O157:H7* infection has been reported as the predominant cause of HUS, which is in turn the most common cause of acute renal failure in young Patients in many parts of the world [8,10]. Neurological complications (such as seizure, stroke and coma) occur in around 25% of HUS Patients, and chronic renal sequelae are seen in around 50% of HUS survivors [4]. The estimated case fatality rate of HUS ranges from 3 % to 5% (Centre for Health Protection)[11]. In spite of the wide knowledge of the organism and its interaction, there seem to be no report on the prevalence of the organism in Africa and particularly Nigeria. In the light of these prevailing circumstances, and an increased reported cases of *E. coli* 0157 infection outbreak worldwide Shiga toxin-producing *Escherichia coli O157:H7* isolation has been reported from all zones of Africa (East, Central, South, North and West Africa) from humans, animals, food products and the environment. The first case of human infection was reported back in 1990 in Johannesburg, South Africa [12]. In central Africa, the pathogen has been isolated in humans with Haemorrhagic colitis in Bangui, Central African Republic in 1996, which led to mortalities [13]. In 1998, STEC O157:H7 isolation from humans was reported following an outbreak of bloody diarrhea in Cameroun [14]. Their ability to survive in the environment and the environmental contamination with *Escherichia coli O157:H7* may be an important public health problem [15, 16]. Also another major problem with *Escherichia coli O157:H7* is that it is not detected by the usual methods used to isolate and identify "traditional" enteric bacterial pathogens therefore, most microbiology laboratories in many countries of Africa do not routinely test for *Escherichia coli O157:H7,* hence many infections may go unrecognized. This study aims to determine the prevalence of Enterohaemorrhagic *Escherichia Coli* O157:H7 in stool samples of patients attending selected Hospitals in Tarka and Otukpo Local Government Areas of Benue State, Nigeria.

2. Materials and methods

2.1. The Study Area

Tarka and Otukpo Local Government Areas (LGAs), located in Benue State, Nigeria, present contrasting yet complementary socio-economic profiles, each offering distinct characteristics that reflect the broader diversity within the state. Tarka LGA is predominantly rural, with its economy deeply rooted in agricultural practices. The residents primarily engage in subsistence farming, cultivating crops such as yams, maize, cassava, and rice, alongside livestock rearing. The area benefits from fertile soil and favourable climatic conditions, making it suitable for farming activities. Tarka is also known for its rich cultural heritage, as it is inhabited by multiple ethnic groups that contribute to its vibrant traditions and communal lifestyle. However, the rural nature of the area means it faces significant development

challenges, including poor road networks, limited access to quality healthcare services, and under-resourced educational institutions. In contrast, Otukpo LGA serves as one of the more urbanized centres in Benue State. It functions as a commercial and administrative hub, featuring a more structured economy supported by markets, schools, health facilities, and government offices. The population of Otukpo is diverse and engaged in various occupations such as trading, civil service, education, and small-scale businesses. The urban setting of Otukpo offers relatively better access to infrastructure and social services compared to Tarka, yet it also grapples with urban-specific issues such as overcrowding, unemployment, and strains on public utilities. Both LGAs, despite their differences, face overlapping developmental needs including improvements in healthcare delivery, education quality, and infrastructure development. These shared and unique challenges make Tarka and Otukpo ideal focal points for targeted research and interventions aimed at enhancing the well-being of their populations and fostering inclusive development across Benue State.

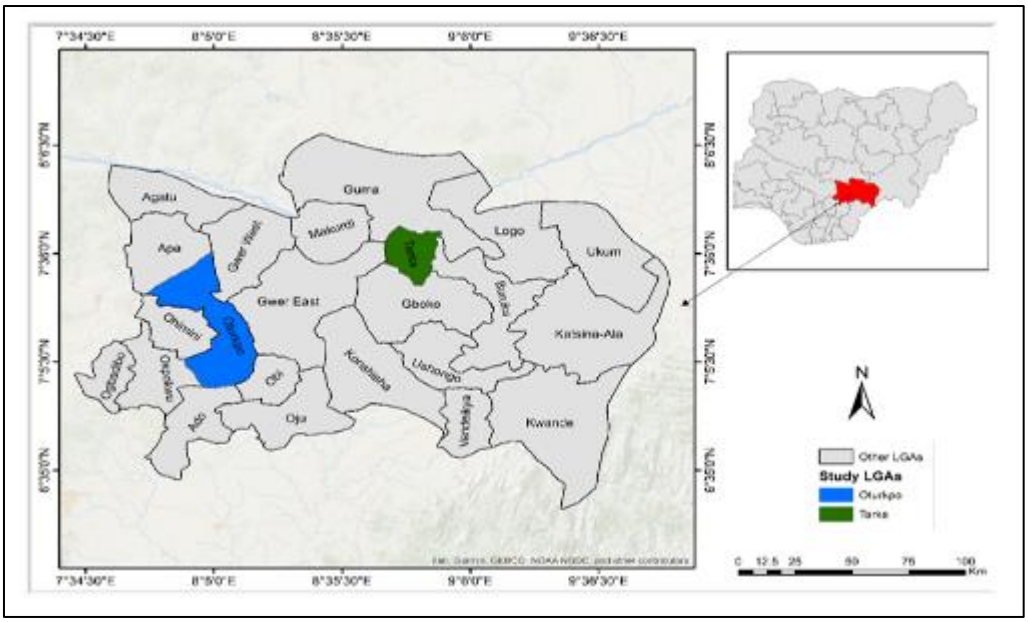

Figure 1 Map of Benue State Showing the Study Locations

2.2. Ethical Clearance

Ethical approval for sample collection was obtained for sample collection from the Benue State Ministry of Health (Hospital management board). Informed consent was obtained from the participating Patients' guardians or caregivers. All the participants were asked for permission to be interviewed. The researcher handled those who accepted to participate, and those who did not accept were left freely without any objection. Demographic and clinical information was obtained from the Patients's Guardian or Patients caregiver using a questionnaire.

2.3. Questionnaire Administration

An interviewer structured questionnaire was administered to participants before sample collection. This was to enable the identification of certain risk factors that the respondents may be exposed to as well as potentially confounding variables and some basic demographic and clinical information regarding the people and their practices.

2.3.1. Inclusive Criteria

Patients suffering from diarrhea and who seeks medical attention in the designated health care centers and ready to provide stool were considered for inclusion in the study.

2.3.2. Exclusive Criteria

Some Patients sometimes suffer from non-infectious diarrhoea due to other forms of diseases such as inflammatory bowel disorder, tumour, cancer, and diabetes. Such Patients when identified from their medical records were excluded from the study and are in the study location.

2.3.3. Study population

Samples were taken from Patients of age 1 and above in the selected hospital study locations**,** who had cases of diarrhea, both male and female were randomly chosen.

2.4. Descriptive cross-sectional

Sectional study asses the prevalence of the condition (but not the incidence) and its distribution within a population.

2.5. Sampling Size/Techniques

The sample size will be determined using the single population equation described by Naing *et al.,*[17] *using Cochran's formula*

$$\mathrm{n} = \frac{z^2 p(1-p)}{d^2}$$

Where,
n - minimum sample size
Z- is the standard normal distribution at 95% confidence interval = 1.96
P - is the known prevalence of the infection from a previous study = 0.534
d- is the desired level of precision or significance which is taken as 5% = 0.05
therefore n =400

2.6. Data collection

Pretested structured questionnaires were administered to all parents of enrolled Patients for the collection of socio-demographic information and to determine the risk factors of infection. Data were collected with the aid of a questionnaire adapted from NDHS National Demographic and Health Survey [18].

2.7. Sample Collection

A total of 400 stool samples were collected from selected hospitals. The samples were aseptically obtained using a scoop attached to the cover of the sterile universal sample bottles. The collection took place in four major hospitals: two general hospitals (General Hospital, Otukpo, and General Hospital, Wannune) and two private hospitals, which serve as primary pediatric referral centers in the two study Local Government Areas (LGAs) of Tarka and Otukpo. The stool samples were transported to the Microbiology Laboratory, under refrigeration using ice boxes for bacteriological analysis [19].

2.8. Media Used

The media used were Eosin Methylene Blue (EMB) (HKM, Guangdong, PRC), Sorbitol MacConkey Agar (SMAC) (CM 813, Oxoid, UK). Preparations of all media were according to manufacturers' specifications.

2.9. Preparation of Eosin Methylene Blue Agar

Exactly thirty-five (35) grams was suspended in 1000 ml of distilled water. The suspension was mixed, and then suspension was heated to a boil to dissolve the medium completely. Sterilization was done by autoclaving at 15 lbs pressure (121°C) for 15 minutes, avoiding overheating. It was brought to 45-50°C and the medium was shaken vigorously for 1 minute to oxidize the methylene blue (i.e. to restore its blue colour) and to suspend the flocculent precipitate.

2.10. Preparation of Sorbitol MacConkey Agar (SMAC)

The powdered media was suspended in fifty-one (51) grams in 1 litre of distilled water. It was brought to a boil to dissolve completely and then sterilized by autoclaving at 121°C for 15 minutes, sterile Petri dishes [20].

2.11. Sample Inoculation and identification of isolates

Each sample will be diluted with saline water, 1 ml of sample will be plated on Eosin methylene blue (EMB) agar, then incubated at 37°C for over-nigh incubation. Pure cultures of all colonies exhibiting typical dark to purple red colonies with metallic sheen which is characteristic of *E. coli* on EMB Identification of *E. coli O157:H7* on Sorbitol MacConkey

Agar (SMAC) Pure cultures of all positive *E. coli will* be sub-plated on SMAC and incubated at 37°C for 18 -24 h. Colonies of *E coli 0157:H7* (colourless) will be confirmed using slide agglutination test with *E. coli 0157: H7* antiserum.

2.12. Biochemical test and identification of Isolate

A representative colony from each growth was Gram-stained and the morphology compared with those of known taxa as described by Bregey's manual for identification of bacteria. Each isolate identified was further confirmed using the following biochemical tests:

2.12.1. Catalase test

Colonies of each were dropped on the glass slide, and a drop of hydrogen peroxide was added. The appearance of bubbles indicated the positive result and confirmed the presence of *E. coli* spp

2.12.2. Simmons Citrate test

Few inoculum were picked from each suspected specimen and inoculated on Simmons citrate agar slant, incubated at 37°C for 24 hours. A shift in pH above 7.6 turns the bromthymol blue indicator in the medium from green to blue, indicating A citrate-positive organism in the absence of colour change organisms his citrate negative. Positive tests confirmed the presence of *Salmonella spp. Klebsiella spp, Proteus mirabilis,* while in negative test confirmed the presence of *E. coli , Shigella spp*

2.12.3. Indole test

Each specimen to be tested was inoculated in peptone broth in the sterile test tube incubated at 37°C for 24 hours after incubation few drop of kovac's reagent were added and properly mixed let to stand for a few seconds color change observed, and the results interpreted formation of pink to red color (Cherry-red ring) in the top layer indicates indole positives the absence of color indicate indole negative. A positive indole test confirmed the presence of *E. coli* spp

2.12.4. Urease test

Colonies from each specimen most inoculated on urea agar slant in sterile tube, incubated with loosened caps at 37°C color change were observed as from 8 to 24 hours and the results interpreted, they changed from orange yellow color to bright pink indicates the positive urease test while a negative urease test still retain the original orange yellow color. A positive urease test confirms the presence of *Klebsiella spp, Enterobacter spp, Proteus Spp,* while a negative test confirms the presence of *E. coli , Shigella spp, Salmonella spp.*

3. Results

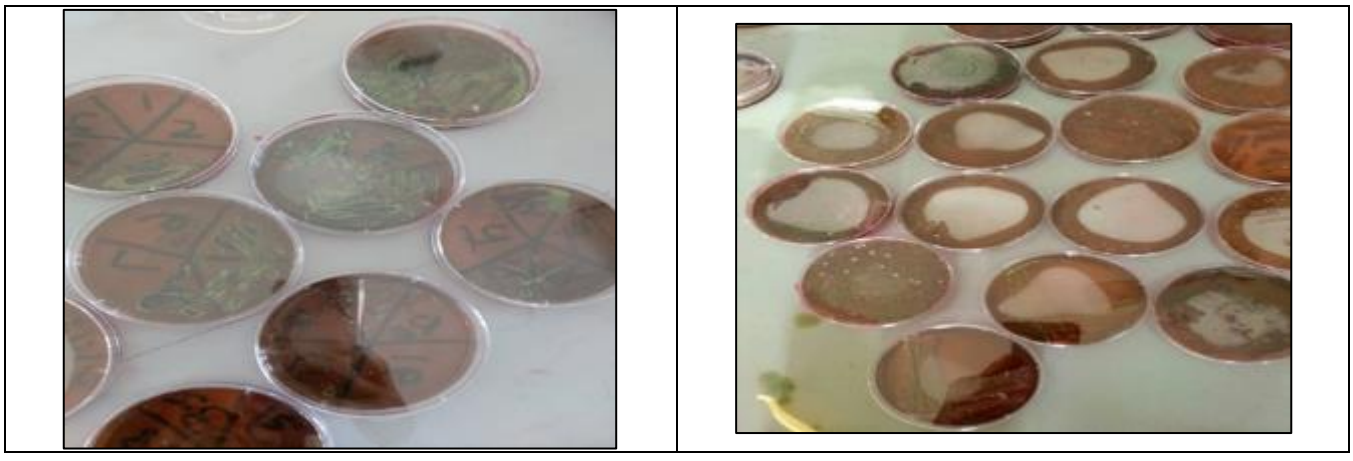

Figure Plates of *E. coli* Isolates

3.1. Plates of *E. coli* Isolates

Table 1shows the prevalence and growth characteristics of *E. coli* O157:H7 in samples analyzed. Data from 400 stool samples, 342 (85.5%) were infected revealing a high prevalence of *E. coli* O157:H7. Additionally, 306 (76.5%) of the samples showed the presence of other microbial growths, while a small proportion (1.0%) remained unclassified. In

terms of growth characteristics, 76.5% of samples exhibited the typical green metallic sheen on Eosin Methylene Blue (EMB) agar, a hallmark of lactose-fermenting bacteria like *E. coli*, whereas 23.5% showed unclassified growth.

Table 2 presents data on the prevalence of *E. coli* O157:H7 among 400 individuals, by gender and age group. Females recorded a higher prevalence 181 (86.2%) than their males counterpart showed high prevalence 161 (84.7%), respectively. The difference between these proportions is minimal, and the chi-square test confirms that the association between gender and infection status is not statistically significant (p = 0.680).

The distribution across age groups reveals some variability in infection rates. the youngest age group (≤1 year) showed the highest prevalence at 95.0%, and the 22+ age group had a 100% infection rate, Other age groups had prevalence rates between 80% and 85.7%, the differences indicates that age was not statistical significantly (p = 0.384) associated with the presence of the pathogen. This implies that the exposure or risk of infection with *E. coli* O157:H7 may be widespread and not confined to a particular demographic group.

Table 3 shows the relationship Between *E. coli* O157:H7, Water Sources and Storage Methods. Out of the 400 respondents based on water sources. Stream water source had the highest prevalence 141 (86.0%) this was closely followed by well water source 121 (85.2%) while Borehole water source had the lowest prevalence 80 (85.1%). Analysis of data revealed no statistical association between water sources and *E. coli* O157:H7 in this study (P value = 0.975 at P ≤ 0.05). For storage methods, *E. coli* was found in 153 (86.4%) respondent indicating a higher prevalence than wide-mouthed plastic containers 189 (84.8 %). The statistical analysis using chi-square tests showed no significant association between the water storage method (p = 0.634), and the presence of *E. coli* O157:H7.

Table 4 Prevalence *E. coli* O157:H7 in relation to Waste Disposal Method and Hygiene. The presence of a waste bin in the house demonstrated a significant association with *E. coli* O157:H7 prevalence (p= 0.037), as 252 (87.8%) of households with a waste bin had *E. coli* contamination compared to 90 (79.6%) of those without one.

Concerning waste disposal methods, *E. coli* was higher 243 (86.8%) in households that burned their waste and lower 99 (82.5%) in respondents in those using public disposal; however, the difference was not statistically significant (p = 0.265).

Those who had close proximity to public disposal had the highest prevalence 20 (87.0%), followed by those who could not state 243 (86.8%) while those who had no proximity with public disposal had the lowest prevalence 79(81.4%). the difference was not statistically significant (p = 0.427).

Table 5 presents the distribution of *E. coli* O157:H7 infection in relation to the type of toilet used Out of the 400 respondent. Those using water closets had the highest Prevalence 49 (90%), followed by those with no toilet facilities had prevalence 73 (88.0) while those using public toilets had the lowest prevalence 220 (83.7%) A Chi-square test showed significant association between toilet type and *E. coli* infection status. The result (χ^2= 2.325, df = 2, p = 0.31)

Table 6 presents data on the presence of *E. coli* O157:H7 in relation to the place of defecation. Those who defecated in the bush recorded a higher prevalence 73 (88.0%) than those using others (latrine) 269 (84.9%) Statistical analysis using the Chi-square test (χ^2 = 0.508, df = 1, P = 0.476) suggests that the association between the place of defecation and the presence of *E. coli* O157:H7 is not statistically significant.

Table 1 Prevalence and Growth Characteristics of *E. coli* O157:H7 in Samples Analyzed

Category	**Frequency**	**Percentage (%)**
***E. coli* O157:H7 present**		
No	58	14.5
Yes	342	85.5
Total	400	100.0
Other growths		
Unclassified	4	1.0
No	90	22.5

Yes	306	76.5
Total	400	100.0
Type of growth		
Unclassified	94	23.5
green metallic sheen on Eosine Methylene Blue agar	306	76.5

Table 2 Prevalence of *E. coli* O157:H7 by Gender and Age Group

Category	**No (%)**	**Yes (%)**	**Total Count (%)**	**χ^2 Value**	**P – value**
Gender					
Female	29 (13.8)	181(86.2)	210 (100)	0.170a	0.680
Male	29 (15.3)	161 (84.7)	190 (100)		
Total	58 (14.5)	342 (85.5)	400 (100)		
Age - Groups					
≤ 1	2 (5.0)	38 (95.0)	40 (100)	5.268a	0.384
2 – 6	41(15.5)	224 (84.5)	265(100)		
7 – 11	6 (14.3)	36 (85.7)	42(100)		
12 – 16	6 (20.0%)	24 (80.0%)	30 (100%)		
17 – 21	3 (18.8%)	13 (81.3%)	16 (100%)		
22+	0 (0.0%)	7 (100.0%)	7 (100%)		
Total	58 (14.5%)	342 (85.5%)	400 (100%)		

Table 3 Association Between Water Sources and Storage and Presence of *E. coli* O157:H7

Variable	***E. coli* O157:H7 Present**		**Total**	**χ^2 Value**	**P-value**
	No (n, %)	**Yes (n, %)**	**(n, %)**		
Source of Water					
Boreholes	14 (14.9)	80 (85.1)	94 (100.0)	0.051	0.975
Streams	23 (14.0)	141 (86.0)	164 (100.0)		
Wells	21 (14.8)	121 (85.2)	142 (100.0)		
Total	58 (14.5)	342 (85.5)	400 (100.0)		
Water Storage Method					
Jerry Can	24 (13.6)	153 (86.4)	177 (100.0)	0.227	0.634
Wide-Mouthed Plastic Container	34 (15.2)	189 (84.8)	223 (100.0)		
Total	58 (14.5)	342 (85.5)	400 (100.0)		

Table 4 Prevalence *E. coli* O157:H7 in relation to Waste Disposal Method and Hygiene Practices

Variable	***E. coli* O157:H7 Presence**		**Total**	**χ^2 Value**	**P-value**
	No (n, %)	Yes (n, %)	(n, %)		
Trash Bin in the House					
No	23 (20.4)	90 (79.6)	113 (100.0)	4.353	0.037
Yes	35 (12.2)	252 (87.8)	287 (100.0)		
Total	58 (14.5)	342 (85.5)	400 (100.0)		
Waste Disposal Method					
Burning	37 (13.2)	243 (86.8)	280 (100.0)	1.244	0.265
Public Disposal	21 (17.5)	99 (82.5)	120 (100.0)		
Total	58 (14.5)	342 (85.5)	400 (100.0)		
Public Disposal Proximity					
No	18 (18.6)	79 (81.4)	97 (100.0)	1.700	0.427
Yes	3 (13.0)	20 (87.0)	23 (100.0)		
Not Stated	37 (13.2)	243 (86.8)	280 (100.0)		
Total	58 (14.5)	342 (85.5)	400 (100.0)		

Table 5 Occurrence of *E. coli* O157:H7 based on Household Toilet Type

Type of Toilet in the House	***E. coli* O157:H7 Presence**			**χ^2 Value**	**Df**	**P-value**
	No (%)	Yes (%)	Total (%)			
Public Toilet	43 (16.3)	220 (83.7)	263 (100.0)	2.325	2	0.313
Water Closet	5 (9.3)	49 (90.0)	54 (100.0)			
No Toilet	10 (12.0)	73 (88.0)	83(100.0)			
Total	58 (14.5)	342 (88.0)	400 (100.0)			

Table 6 Occurrence of *E. coli* O157:H7 based on Place for Defecation

Place of Defecation	***E. coli* O157:H7 Presence**			**χ^2 Value**	**P-value**
	No (%)	Yes (%)	Total (%)		
Others	48 (15.1)	269 (84.9)	317 (100.0)	0.508	0.476
Bush	10 (12.0)	73 (88.0)	83 (100.0)		
Total	58 (14.5)	342 (88.5)	400 (100.0)		

Table 7 presents the relationship between the material used for handwashing and the presence of *E. coli* O157:H7. Among the 351 individuals who used water only for handwashing, 85.5% tested positive for *E. coli* O157:H7 while 49 individuals who used water with antiseptic, 85.7% tested positive while 14.3% tested negative. There is no significant differences between the material used for handwashing and the presence of *E. coli* O157:H7.

The analysis shows some variation in infection rates across different subgroups. Otukpo had a slightly higher infection rate (88%) compared to Tarka (83%), and younger Patients, particularly those under 1 year, exhibited the highest positivity rates (95%). Despite these differences, none of the associations were statistically significant (p = 0.156 for location, p = 0.384 for age).

The analysis of *Escherichia coli* O157:H7 prevalence in relation to various health symptoms revealed notable trends, although none of the associations was statistical significance. Among individuals experiencing abdominal cramps, *E. coli* prevalence was 85.2%, compared to 87.1% in those without cramps. The Chi-Square test (χ^2= 0.151, df = 1, p = 0.698) indicated no significant association.

Fever was reported in 83.1% of infected individuals, while those without fever had an *E coli* prevalence of 89.7%. The Chi-Square test (χ^2= 3.312, df = 1, p = 0.069) showed no significance, differences between fever and *E. coli* O157:H7..

The prevalence of *E. coli* was 85.0% among those experiencing frequent stooling and 86.1% in those without. The Chi-Square test (χ^2= 0.103, df = 1, p = 0.748) showed no significant relationship, despite frequent stooling being a characteristic symptom of diarrheagenic *E. coli* infections.

Vomiting was present in 83.5% of infected individuals and 88.1% of those without it, with a Chi-Square test result of (χ^2= 1.672, df = 1, p = 0.196), indicating no significant association. Among individuals reporting bloody stool, *E. coli* prevalence was 95.6%, compared to 85.0% in those without this symptom. The Chi-Square test (χ^2= 2.643, df = 1, p = 0.104) suggested a non-significant trend.

Headaches were reported in 83.1% of *E. coli* -positive individuals, compared to 89.7% of those without headaches. The Chi-Square test (χ^2= 3.312, df = 1, p = 0.069) showed no significant differences. suggesting a potential link. While headaches are not a primary symptom of *E. coli* infections,

Table 9 presents a bivariate analysis exploring the association between various Patients-related factors and antibiotic use outcomes among 400 participants. Chi-square tests were applied to determine the statistical significance of the associations. For most variables, such as "Other Symptoms," "Self-Medication," and "Source of Medication," the p-values (0.685, 0.102, and 0.063 respectively) exceed the 0.05 significance threshold, indicating no statistically significant association between these factors and antibiotic use. Although a higher percentage of participants who self-medicated (16.5%) reported antibiotic use compared to those who did not (10.4%), the difference was not statistically significant. Similarly, the type of symptoms and the source of medication did not show a significant influence on antibiotic use behaviour. However, a statistically significant association was observed between the length of days drugs were administered and antibiotic use, with a p-value of 0.025. Participants who used antibiotics for five days were significantly more likely to report use (16.6%) compared to those who used them for only three days (7.0%).

Table 7 Relationship Between Material Used in Hand washing and ***E. coli*** O157:H7 Presence

Agent used in handwashing	***E. coli* O157:H7 Presence**			**χ^2 Value**	**P-value**
	No (%)	**Yes (%)**	**Total (%)**		
Water only	51 (14.5)	300 (85.5.9)	351 (100.0)	0.002	0.964
Water & antiseptic	7 (14.3)	85 (85.7)	49 (100.0)		
Total	58 (14.5)	342 (88.5)	400 (100.0)		

Table 8 Analysis of the relationship Between Socio-Demographic and Clinical Characteristics and *E. coli* O157:H7 Infection

Category	**No (%)**	**Yes (%)**	**Total (%)**	**χ^2 Value**	**P-Value**
Location					
Otukpo	24 (12.0)	176 (88.0)	200 (100)	2.017	0.156
Tarka	34 (17.0)	166 (83.0)	200 (100)		

Total	58 (29.0)	342 (71.0)	400 (100)		
Age					
<1	2 (5.0)	38 (95.0)	40 (100)	5.268	0.384
2-6	41(15.5)	224 (84.5)	265 (100)		
7-11	6 (14.3)	36 (85.7)	42(100)		
12-16	6 (20.0)	24 (80.0)	30(100)		
17-21	3 (18.8)	13 (81.3)	16(100)		
>22	0 (0.0)	7 (100)	7(100)		
Total	58 (14.5)	342 (85.5)	400 (100)		
Gender					
Female	29 (13.8)	181 (86.2%)	210 (100%)	0.170[a]	0.680
Male	29 (13.3)	161 (84.7%)	190 (100%)		
Total	58 (14.5)	342 (85.5%)	400 (100%)		
Diarrhoea					
Yes	58 (14.5)	342(85.5)	400 (100)	-	-
Abdominal Cramps					
No	8 (12.9)	54 (87.1)	62 (100)	0.151[a]	0.698
Yes	50 (14.8)	288 (85.2)	338 (100)		
Total	58 (14.5)	342(85.5)	400 (100)		
Fever					
No	15 (10.3)	131 (89.7)	146 (100)	3.312[a]	0.69
Yes	43(16.9)	211 (83.1)	254 (100)		
Total	58 (14.5)	342 (85.5)	400 (100)		
Frequent Stool					
No	27 (13.9)	167 (86.1)	194 (100)	0.103[a]	0.748
Yes	31 (15.0)	175 (85.0)	206 (100)		
Total	58 (14.5)	342 (85.5)	400 (100)		
Vomiting					
No	21 (11.9)	155 (88.1)	176 (100)	1.672[a]	0.196
Yes	37 (16.5)	187 (83.5)	224 (100)		
Total	58 (14.5)	342 (85.5)	400 (100)		
Bloody Stool					
No	58 (15.1)	327(84.9)	385 (100)	2.643[a]	0.104
Yes	0 (0.00)	15 (100)	15 (100)		
Total	58 (14.5)	342 (85.5)	400 (100)		
Headache					
No	15 (10.3)	131 (89.7)	146 (100)	3.312[a]	0.069

Yes	43 (16.9)	211 (83.7)	254 (100)		
Total	58 (14.5)	342 (85.5)	400 (100)		

Table 9 Relationship Between Patients Characteristics and Outcomes of Antibiotic Use

Category	**No (%)**	**Yes (%)**	**Total (%)**	**χ^2Value**	**P-Value**
Other symptoms					
Unknown	4 (10.8)	33 (89.2)	37 (100)	0.756[a]	0.685
Cold	27(13.9)	167(86.1)	194 (100)		
Weakness	27 (16.6)	142 (84.0)	169 (100)		
Total	58 (14.5)	342 (85.5)	400 (100)		
Self-Medication					
No	14 (10.4)	120 (89.6)	134 (100)	2.669[a]	0.102
Yes	44 (16.5)	222 (83.5)	266 (100)		
Total	58 (14.5)	342 (85.5)	400 (100)		
Source of Medication					
Non-Hospital	43 (17.0)	210 (83.0)	253 (100)	3.460[a]	0.063
Hospital	15 (10.2)	132 (89.8)	147 (100)		
Total	58 (14.5)	342 (85.5)	400 (100)		
Medication Type					
Antibiotics	58 (14.5)	342 (85.5)	400 (100)	-	-
Length of days drug was administered					
3 days	6 (7.0)	80 (93.0)	86 (100)	5.002[a]	0.025
5 days	52 (16.6)	262 (83.4)	314 (100)		
Total	58 (14.5)	342 (85.5)	400 (100)		

4. Discussion

Despite the lack of statistical significance, notable trends emerged that align with previous epidemiological studies. The high prevalence of *E. coli* O157:H7 among younger Patients supports findings that highlight their increased susceptibility due to behavioral and immunological factors [21] Although no strong statistical association was found between infection and specific symptoms such as fever and headaches, the observed patterns suggest a potential relationship that warrants further investigation. A larger sample size or more sensitive statistical models may be required to uncover subtle associations [10].

The study underscores the high prevalence of diarrheal diseases among Patients aged 0-5 years, reaffirming that age remains a major risk factor for gastrointestinal infections. The prevalence of 9.8% diarrheal cases among Patients under five in this study is higher than the 2.6% reported by Yilgwan *et al*. [22] in Jos, Plateau State, but lower than the 43.1% recorded by Ifeanyi *et al*. [23] in Abuja. These variations may be attributed to differences in sanitation infrastructure, hygiene practices, and access to clean water across these locations. The high incidence of diarrhea among younger Patients is likely due to their inability to differentiate between safe and contaminated food, lack of adherence to hygienic practices, and weaker immunity following weaning from breast milk. Additionally, Patients have higher metabolic rates and reduced kidney efficiency, making them more vulnerable to dehydration and the severe consequences of diarrheal diseases.

In contrast, the study observed a lower prevalence of diarrhea among adults, possibly due to differences in healthcare-seeking behavior. Adults in the study area may only visit health facilities when diarrhea is perceived as severe, particularly when bloody stools are present [24] The 1.39% prevalence of *E. coli* O157:H7 in this study is lower than the 6% reported by Olorunshola *et al*. [25] in Lagos and 20% recorded by Esumeh *et al*. [26] in Benin. While variations in prevalence rates exist across different regions of Nigeria, the findings confirm that *E. coli* O157:H7 remains an important etiological agent of diarrheal diseases in the country. The presence of *E. coli* O157:H7 in stool samples is likely linked to exposure to unsanitary conditions, including the consumption of contaminated water, food, fruits, and vegetables. These results emphasize the urgent need for improved sanitation, enhanced water quality, and public health interventions to mitigate the risks associated with *E. coli* infections.

5. Conclusion

This study has established that diarrhoea is higher among younger Patients than adults and confirms the fact that *Escherichia coli* O157:H7, even though it is not part of the routine tests carried out for enteric pathogens in most laboratories visited, is still an important aetiology for diarrhoea. It is pertinent to note that an exceptionally low dose of this organism is able to cause infection and once introduced into a closed group or family, it can spread by person-to-person transmission, especially by Patients who are not toilet trained.

Recommendation

Thorough Cooking of Meat, Tailored Health Advice, Strict Hygiene and Food Handling should be encourage to reduce the spread of the infection.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of ethical approval

Ethical approval for sample collection was obtained for sample collection from the Benue State Ministry of Health (Hospital management board) Benue State.

Statement of informed consent

Informed consent and assent was obtained from the participating Patients,' guardians or caregivers.n the study.

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