

The burden of *Shigella* and *Salmonella*, Antibiotics Susceptibility Pattern and Associated Risk Factors among Diarrheic Children visited Alamura Health Center Southern Ethiopia: a cross-sectional study

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Abstract

Background: *Salmonella* and *Shigella* is a major health problem worldwide, in developing countries like Ethiopia, it is responsible for high morbidity and mortality of children. This study aimed to determine the prevalence of *Salmonella* and *Shigella* infection, their antibiotic susceptibility pattern and associated risk factor among the diarrheic paediatrics patients that visited Alamura Health Center in southern Ethiopia.

Method: A facility-based cross-sectional study was conducted at Alamura Health Center from April 2018 – July 2019. The study was performed on paediatrics below the age of 14 years in which consecutive children with diarrhoea were included for the study. A structured questionnaire was used to collect socio-demographic and clinical data after assent and consent obtained from parents or caretaker. The stool sample cultured as per the standard operating procedure (SOP) of the microbiology laboratory. Antibigram was performed by Kirby-Bauer disc diffusion method and was interpreted based on the Clinical and laboratory standard institute guideline (CLSI) version 2018.

Results: Out of 263 children enrolled in the study, 50.5 % were females. The overall, 21/263 (8 %) 95% CI, (4.6 - 11.4%) *Shigella* and *Salmonella* was isolated. *Shigella dysenteriae* was dominantly isolated 11 (4.2%) followed by 9(3.42%) *Shigella spp*, and 1(0.38%) *Salmonella typhi*. Highly resistance to ampicillin (71.4%), augmentin and tetracycline (61.9%) each, whereas highly sensitive to ciprofloxacin (95.2%), ceftriaxone & ceftazidime (85.9%) each, gentamycin (81%), chloramphenicol (76.2%), cefuroxime (66.7%) and cotrimoxazole (52.4%) identified. Those with habit of washing the hands of children after toilet sometimes (AOR = 235.1, 95% CI, 20.9 - 2643.3, P = .000) and store cooked food in open container for later use (AOR = 36.44, 95% CI, 5.82 - 228.06, P = .000) showed statistically significant association.

Conclusion: High level of *Shigella spp* and one *Salmonella* was isolated from diarrheic children at Alamura Health Center. *Shigella dysenteriae* was the most dominantly isolated. Ampicillin, augmentin and tetracycline are with high resistance and ciprofloxacin, ceftriaxone, ceftazidime, gentamycin, chloramphenicol, cefuroxime and cotrimoxazole relatively sensitive. Those practised hands wash for their child after defecation for sometimes was 235.1-fold at risk of infection. Similarly, those store foods for later use in an open container was 36.44 times at risk of infection. Therefore, to alleviate this infection the concerned body should focus on giving health education for hand wash after defecation and storing food in a closed container later use is mandatory.

Background

Diseases caused by the enteric pathogens are common public health problems in many parts of the world including Ethiopia(1, 2). *Salmonella* and *Shigella* are associated with a high burden of illness among children in the developing world (3). Children are one of the victims to these infections accounting for approximately 8 per cent of all deaths among children under age 5 worldwide in 2017. This interpreted to over 1,300 young children passed away each day, 480,000 children a year, regardless of the availability of humble active treatment. Most of these deaths due to diarrhoea is in South Asia and sub-Saharan

Africa (4). Studies in Ethiopia from different regions reported 4.3-17-45% (5–8) *Shigella* and 1-12.6% (6–8) *Salmonella* infection.

They are species of particular concerns as causes of enteric fevers, food poisoning and gastroenteritis (9). They are Gram-negative rods which commonly inhabit intestinal tracts of humans and many animals (10). It was estimated worldwide about 1.8 million cases of children died from diarrheal illness, a large proportion of which were attributed to *Shigella* and *Salmonella* spp.(11). Different studies have reported that *Shigella* spp. were associated with the majority of cases of bacillary dysentery which is prevalent mainly in developing nations. Whereas, *Salmonella* spp. were the most common cause of food-borne infection outbreaks in almost all over the world (12). In recent year the emergence and global dissemination of *Salmonella* and *Shigella* species resistance to ampicillin, chloramphenicol, tetracycline and co-trimoxazole increasingly documented in developing countries (13).

Infections of *Shigella* and *Salmonella* can be asymptomatic and can be treated with rehydration solutions unless the infection is by invasive strains (14). Prescribing antibiotics might shorten the extent of diarrhoea and control the shedding of the organisms which otherwise might continue to spread among people and into the environment and further pose a risk of spread of infections (15). Children are at high risk of these infections due to their weekend immune status and ease of contamination(16). In developing countries, this increased due to poor sanitation, personal hygiene and lack of appropriate food supply that leads children to contaminate themselves (17). Therefore, this study aimed to identify *Shigella* and *Salmonella* infections, their antibiotics susceptibility and associated risk factors among children with diarrhoea that visited Alamura health centre.

Method And Materials

Study Area and Period

The study was conducted in the southern nation, nationalities and peoples region (SNNPR) at Hawassa Alamura Health Center. Hawassa is the capital city of Southern Nation Nationality People Region (SNNPR), located in the Southern part of Ethiopia, on the shores of Lake Hawassa which is one of the Great Rift Valley lakes and 270 km from the capital city of Ethiopia. Mean annual rainfall of about 950 mm, the temperature of 20⁰c and humidity of 70% – 80%. The mean rainy season generally extends from June to October (18), gives the estimated population of Hawassa for 2015 as 351,469, with annual population growth, rate of just over 4%. The Hawassa city has seven sub-cities with five privates, one general and one comprehensive specialized Hospital and ten health centres. Alamura Health Centers was located in the Tabor sub-city and borderline between Fara and Hitata kebele near Alamura Mountain.

Study Design and population

A facility-based cross-sectional study conducted at Alamura Health Center. A convenient sampling technique was employed in which diarrheic paediatrics patients that their family or guidance is volunteer to participate in the study were consecutively included until the calculated sample size was achieved. All

diarrheic paediatrics patients that were visited Alamura Health Center for the diarrheal case of illness. Selected diarrheic paediatrics patient that visited Alamura Health Center during the study period was the study population. Paediatrics patients under 14 years of age whom his/her parents or guardians consented for the participation of the study included for the study. That parents/caretaker is involuntary to sign consent and paediatrics refuse for assent excluded from the study.

Variable of the Study

The dependent variables were the presence of *Salmonella* and *Shigella*. The independent variables were sociodemographic factors that are age, sex, place of residence, educational status of the mothers, marital status, family size, monthly income, occupation of the family. Clinical and behavioural factors are history and type of diarrhoea, drinking water source, washing of child's hand after toilet, food/drink taken before illness, storage of cooked food for later use, the habit of handwashing before and after meal, washing habit of food containers, history of malnutrition and history of contact with domestic animals were assessed with a structured questionnaire.

Data Collection

The socio-demographic and clinical data collected after the parents/ caregiver informed about the aim of the study. Face-to-face interview conducted to collect the data with a structured questionnaire from parents or caretaker of the children who complained of diarrhoea after they signed the consent and the child accepted the assent.

Laboratory diagnosis

The stool was collected using a screw cup container. The parents/caregiver instructed to bring a fresh stool sample before 30 minutes of collection and avoid contamination with urine and other materials. All stool specimens placed into Carry Blair transport medium & transported to the microbiology laboratory of Hawassa University Comprehensive Specialized Hospital (HUCSH). The stool was inoculated on prepared culture media that is MacConkey, Xylose lysine deoxycholate (XLD) and selenite F-broth (Abtek, UK). The culture plates incubated aerobically at 37°C for 24 hours.

Bacterial identification

The colonies examined morphologically for size, shape, and ability to ferment lactose. Those bacterial colonies with non-lactose fermenting characteristics with H₂S for *Salmonella* and without H₂S for *Shigella* picked for biochemical identification. Indole test, urease production, mannitol fermentation, hydrogen sulphide, gas production test, citrate utilization test, motility test, carbohydrate fermentation test, lysine decarboxylase test (LDC) and oxidase test were used to differentiate to genus and species level (19).

Antibiotics susceptibility testing

A pure colony of isolated bacteria was mixed with normal saline to make a 0.5 McFarland standards suspension for susceptibility testing then swabbed on Mueller Hinton agar. The susceptibility pattern of the isolates was determined for ciprofloxacin-CIP (5 µg), augmentin -AUG (30 µg), gentamicin - GEN (10 µg), chloramphenicol - CAF (30 µg), co-cotrimoxazole-COT (25 µg), tetracycline - TAT (30 µg), ampicillin - AMP (10 µg), ceftriaxone - CRO (30 µg), cefuroxime - CRX (30 µg) and ceftazidime - CAZ (30 µg). After incubation for 24 hours at 37 C⁰, the diameter of each zone of inhibition was measured with a ruler in mm. The results then interpreted according

to CLSI guidelines antimicrobial susceptibility breaking points 2018 and recorded as sensitive (S), intermediate (I) or resistance (R) (20).

Data analysis

Data was entered to statistical package for the social science (SPSS) versions 20 and was analyzed to make inferences on the frequency of occurrence of enteric pathogens associated with diarrhoea and to show bacterial resistance pattern to locally prescribe antibiotic substances. Descriptive statistics were performed to get the frequency of dependent and independent variables. Binary logistic regression analysis was conducted to identify real predictor of *Shigella* and *Salmonella*. The strength of association was presented by odds ratio at 95% confidence interval and p-values ≤ 0.05 was considered as a statistically significant association.

Ethical Consideration

The study was conducted after formal permission was obtained from Southern Nation Nationality and People Regional Health Office, Hawassa city administration health office, Alamura Health centre manager and laboratory head. The patients were included in the study if their parents or caretaker sign the consent. Culture results and antimicrobial susceptibility results were communicated to the concerned bodies of in health centre within 72 hrs and treatment accordingly.

Result

Socio-demographic characteristics

A total of 263 diarrheic pediatric patients from Alamura Health Center was enrolled for the study with a mean and standard deviation of age 6.8 ± 3.7 years. The frequency and percentage of paediatrics age range enrolled for the study were, 0–4, 88(33.5%), 5–9, 103(39.2%) and 10–14, 72 (27.4%). The almost equal ration of male to female enrolled for the study (130:133). Regarding the residence, most of the study subjects 155(58.9%) were from Urban area and 108(41.1) was from rural. Concerning the paediatrics' mother educational status most of them (81%) were educated which was included from reading and writing to university graduate level the rest 19% are illiterates. The marital status of their mother 178 (67.7%) was married, 43(16.3%) divorced and 41(15.6%) widowed. The mean and standard deviation of the family size was 5.6 ± 1.9 persons. The average income of the family was 3743.3 ± 2568.1 Ethiopian birr. Most of the study participants have a large family size with relatively low income earned < 1500 birr per month from this number diarrhoea positive was 12(57.1%) (Table 2).

The magnitude of *Shigella* and *Salmonella*

The overall magnitude of *Shigella* and *Salmonella* among diarrheic paediatrics patients in Alamura Health Center was 8.0% (21/263) 95% CI (4.6–11.4%). *Shigella* spp isolated from 7.6% (20/263)95% CI [4.6–11.0] of children. *Shigella* dysentery was frequently isolated from 4.2% (11/263) 95% CI [1.9–6.8] followed by other *Shigella* spp 3.42% (9/263), 95% CI [1.5–5.7] and *Salmonella* spp 0.4% (1/263) 95% CI [0.0-1.1]. In the rest, 92% (242/263) diarrheic paediatrics patients' *Shigella* and *Salmonella* were not isolated (Fig. 1).

Antimicrobial susceptibility pattern

Salmonella typhi

There was only one *Salmonella typhi* isolated. It was sensitive for ciprofloxacin, gentamicin, ceftazidime, chloramphenicol, cefuroxime, ceftriaxone and co-trimoxazole and resistance for ampicillin and tetracycline.

Other Shigella species

Shigella spp isolate was 100.0% sensitive to both ceftriaxone and ciprofloxacin, 77.8% for both ceftazidime and chloramphenicol, were as 66.7% for cefuroxime and 55.6% for gentamycin. Resistance was seen 81.8% for ampicillin, 72.7% for tetracycline, and 55.6% for both co-trimoxazole and augmentin.

Shigella dysentery

Shigella dysentery isolate was 100% susceptible for gentamicin, 90.9% for ciprofloxacin, 90% for ceftazidime, 72% for both ceftriaxone and chloramphenicol. Resistance was seen 45.5% for ampicillin, 55% for co-trimoxazole, 72.7% for tetracycline and 91% for augmentin (Table 1).

Table 1
antimicrobial susceptibility profile of *Salmonella* species, *Shigella spp* and *Shigella dysentery* isolated from diarrheic paediatrics patients in Alamura Health Center, South Ethiopia, 2019.

Antibiotics	Isolates											
	<i>S. Typhi</i> (1)		<i>Shigella spp</i> (9)			<i>S. dysentery</i> (11)			Total (21)			
	S	R	S	I	R	S	I	R	S(%)	I (%)	R (%)	
AMP	0	1	0	4	5	0	2	9	0(0.0)	6(28.6)	15(71.4)	
COT	1	-	5	0	4	5	3	3	11(52.4)	3(14.3)	7(33.3)	
CIP	1	-	9	0	0	10	1	0	20(95.2)	1(4.8)	0(0.0)	
CRO	1	0	9	0	0	8	0	3	18(85.7)	0(0.0)	3(14.3)	
CAZ	1	0	7	1	1	10	1	0	18(85.7)	2(9.5)	1(4.8)	
GEN	1	0	5	4	0	11	0	0	17(81.0)	4(19.0)	0(0.0)	
CAF	1	0	7	1	1	8	2	1	16(76.2)	3(14.3)	2(9.5)	
CRX	1	0	6	2	1	7	1	3	14(66.7)	3(14.3)	4(19.0)	
AUG	0	1	1	4	4	0	3	8	1(4.8)	7(33.7)	13(61.9)	
TAT	0	1	0	5	4	0	3	8	0(0.0)	8(38.1)	13(61.9)	

Associated risk factors

Among the study participant, 162 (61.6%) of them had a history of diarrhoea, of this 17(81.0%) were positive for current infection. Of all diarrheic children, the type of diarrhoea was watery for 111(42.2%), mucoid for 103(39.3%) and bloody for 49(18.6%). Children with mucoid diarrhoea affected more that are 13 (61.9%) as compared to the rest patients. Most of the children 170(64.6%) had diarrhoea once in a day and most of the bacteria 11(52.4%) was isolated form this patient. Most of the children used a piped water 159 (60.9%), similarly, the children in these categories were infected more 17 (81.0%).

Regarding hand wash, after defecation, most of the children practised hand wash after toilet always 221 (84.0%) but those who practised hand wash sometimes was infected more 20 (95.2%). Most of the food taken by the children before the illness was cooked food 82(31.2%) even if the bacterial infection was dominantly isolated from children that feed overnight food 8(38.1%). Most of the children enrolled for the study was those who store their food in closed container 223(84.8%), lack habit of hand wash before and after meal 178(67.7%), had a habit of washing of food container 157(59.7%), those are well-nourished 238(90.5%), those who had vaccinated 202 (76.8%), and had animal contact 137(52.1%).

Correspondingly, most of the bacteria were isolated from those who store food in an open container

16(76.2%), lack of habit of hand wash after or before meal 15 (71.4%), washing of food container for sometimes 17(81.0%), well-nourished 18 (85.7%), vaccinated 14(66.7%) and had animal contacts 13(61.9%) (Table 2).

Table 2

bivariate analysis of socio-demographic characteristics and clinical data of diarrheic paediatrics patients in the Alamura Health Center, southern Ethiopia, 2019.

Variables	Frequency (%)	Shigella/Salmonella		COR 95%CI	p-value	AOR 95%CI	P-value
		Yes (%)	No (%)				
Age in group (years)	88(33.5)	7(33.3)	81(33.5)	1.158(.35-3.82)	.809		
0-4	103(39.2)	9(42.9)	94(38.8)	1.283(.41 -	.668		
5-9	72(27.4)	5(23.8)	67(27.7)	4.00)			
10-14				1			
Sex Male	130(49.4)	8(38.1)	122(50.4)	1	.283		
Female	133(50.6)	13(61.9)	120(49.6)	1.652(.66-4.13)			
Residence Rural	108(41.1)	8(38.1)	100(41.3)	1	.773		
Urban	155(58.9)	13(61.9)	142(58.7)	.874(.35 - 2.2)			
Mother's educational	50(19.0)	2(9.5)	48(19.8)	1.125(0.10-	.925		
No formal education	56(21.3)	9(42.9)	47(19.4)	12.99)	.129		
Read and write	76(28.9)	5(23.8)	71(29.3)	5.170(.62-	.566		
Elementary school	53(20.2)	4(19.0)	49(20.2)	43.05)	.489		
Secondary school	28(10.6)	1(4.8)	27(11.2)	1.901(.21-			
Collage/university				17.03)			
				2.204(.23-20.7)			
				1			
Mothers marital status	178(67.7)	14(67.7)	164(67.8)	1	.919		
Married	43(16.3)	5(23.2)	38(15.7)	1.057(.37-	.584		
Divorced	41(15.6)	2(9.5)	39(16.1)	3.044)			
Widowed				.560(.070-			
				4.468)			
Family size (person)	23(8.8)	2(9.5)	21(8.7)	1	.926		
2-3	129(49.2)	12(57.1)	117(48.5)	1.077(.23-	.687		
4-5	110(42.0)	7(33.3)	103(42.7)	5.163)			
≥6				.714(.138-			
				3.679)			
Monthly income birr/ETB	51(19.4)	7(33.3)	44(18.2)	1	.099		
500-1500	212(80.6)	14(66.7)	198(81.8)	.444 (.169-			
>1500				1.166)			
Previous diarrhoea	162(61.6)	17(81.0)	145(59.9)	2.843(.928-	.067		
Yes	101(38.4)	4(19.0)	97(40.1)	8.706)			
No				1			
Type of diarrhoea	111 (42.2)	1(6.3)	76(51.4)	1	.051		
Bloody	49(18.6)	2(12.5)	13(8.8)	11.69(.99-	.007		
Watery	103(39.2)	13(81.3)	59(39.9)	138.44)			
Mucoid				16.75(2.130-			
				131.67)			
Frequency of diarrhoea	170(64.6)	11(52.4)	159(65.7)	1.038(.125-	.973		
Once	77(29.3)	9(42.9)	68(28.1)	8.598)	.530		
Twice	16(6.1)	1(4.8)	14(5.8)	1.985(.234-			
>three				16.88)			
				1			
Drinking H ₂ O Sources	159 (60.9)	17(81.0)	142(58.7)	2.993(.978-	.055		
Pipe	104(39.5)	4(19.0)	100(41.3)	9.162)			
Other				1			
Child's hand wash after toilet	221(84.0)	1(4.8)	220(90.9)	1	.000	235.1(20.9-	.000
Always	42(16.0)	20(95.20)	22(9.1)	200(25.6-		2643.3)	
Sometimes				1562.35)			

Variables	Frequency (%)	Shigella/Salmonella		COR 95%CI	p-value	AOR 95%CI	P-value
		Yes (%)	No (%)				
Food has taken before illness	82(31.2)	5(23.8)	77(31.8)	.801(.182-	.769		
Cooked food	77(29.3)	8(38.1)	69(28.5)	3.533)	.613		
Overnight food	64(24.3)	5(23.8)	59(24.4)	1.430(.358-	.954		
Raw vegetable	40(15.2)	3(14.3)	37(15.3)	5.716)			
Raw milk				1.045(.236-			
				4.634)			
				1			
Storage of cooked food	40(15.2)	16(76.2)	24(9.9)	29.1(9.78-	.000	36.44(5.82-	.000
Open containers	223(84.8)	5(23.8)	218(90.1)	86.372)		228.06)	
Closed containers				1			
Hand washing before & after a meal	85(32.3)	6(28.6)	79(32.6)	1	.702		
Yes	178(67.7)	15(71.4)	160(66.1)	1.212(.453-			
No				3.242)			
Cleaning of cooking containers	157(59.7)	4(19.0)	153(63.2)	1	.001	4.94 (.795-	.087
Always	106(40.3)	17(81.0)	89(36.8)	7.306(2.38-		30.74)	
Sometimes				22.4)			
Malnutrition Yes	25(9.5)	3(14.3)	22(9.1)	1	.441		
No	238(90.5)	18(85.7)	220(90.9)	1.67 (.46-6.121)			
Vaccination Yes	202(76.8)	14(66.7)	188(77.7)	.574(.221-	.256		
No	61(23.2)	7(33.3)	54(22.3)	1.495)			
				1			
Contact with animals Yes	137(52.1)	13(61.9)	124(51.2)	1.546(.62-	.351		
No	126(47.9)	8(38.1)	118(48.8)	3.865)			
				1			

The bivariate analyses indicates that family with monthly income > 1500 (COR = 2.250, 95% CI, 0.86–5.902, p = .099), educational status of mother that can able read and write (COR = 5.170, 95% CI, 0.62–43.05, p = .129), those had previous history of diarrhea (COR = 0.35, 95% CI, 0.115-0 .078, p = .067), watery diarrheal type (COR = 11.69, 95% CI, 0.988–138.44, p = .051), mucoid (COR = 16.75, 95% CI, 2.130-131.67, p = .007). Similarly, those who used pipe water source (COR = 2.993, 95% CI, 0.978–9.16, p = .055). Who wash the hands of their child sometime (COR = 200.0, 95% CI, 25.602-1562.348, p = .000). Store food in open containers (COR = 29.1, 95% CI, 9.78–86.37, p = .000) and had washing habit of food containers sometimes (COR = 7.306, 95% CI, 2.38–22.4, p = .001) was candidate variables for multivariable analysis with p - value ≤ 0.25 (Table 2).

However, in multivariate analysis, after adjustment, those who had a habit of washing the hands of children after toilet (AOR = 235.1, 95% CI, 20.9–2643.3, P = .000) and store cooked food in open container (AOR = 36.44, 95% CI, 5.82–228.06, P = .000) showed statistically significant association for *Shigella* and *Salmonella* infection with p-values ≤ .05. However, factors like the type of diarrhoea, history of contact with domestic animals, a habit of handwashing before meal and handwashing after a meal, and washing of food container were not statically significant associated factors (Table 2).

Discussion

Our study does not indicate the total prevalence of *Salmonella* and *Shigella* infection in Hawassa town were, it does not identify bacteria at species level this was due to lack of anti-sera in the market. The

study determined the prevalence of *Shigella* and *Salmonella*, their antibiotics susceptibility pattern and associated risk factor among pediatric patient at Altamura Health Center.

The overall prevalence of *Shigella* and *Salmonella* isolated in this study was 8.0% [4.6–11.4%] which is lower than compared with studies conducted in Tanzania 42.7% (21), Mozambique 27.2% (22), Ethiopia 22.3% (23) and 22.2% (24). It is comparable with a study reported from Ethiopia 9.0% (25) and 8.3% (6). The possible reason for such difference could be sample size, a method implemented and the age variation.

In this study 20 (7.6%) 95% CI [4.6–11.0] of *Shigella spp* was isolated which is comparable with a study conducted in Ethiopia 8.3% (6), 9.5% (26), in contrast to our finding a lower rate of *Shigella* species was reported from China 1.4% (27). Our study tried to identify *Shigella dysenteriae* from another *Shigella spp* with available biochemical tests accordingly 11 (4.2%) 95% CI [1.9–6.8%] identified as *Shigella dysenteriae*. This rate is lower than a study reported from Nepal 14.5% (28), 12% Senegal. It is comparable with the finding from Central Africa 3% (29). The other nine (3.42%), 95% CI [1.5–5.7] was other species of *Shigella* was higher compared with results reported from China 1.4% (27), Nigeria 1.4% (30), Ethiopia 1.3% (31) and 1.1% (32). Our finding was lower than study reported from Jimma 20.1% (33), Gondar 16.9%(34), Bahir Dar 14.9% (35), Harar 14.6% (36), Bahir Dar 9.5% (37), Addis Ababa 9.1% (26), Iran 8.5% (38), Southwest Ethiopia 8.4% (39), Sudan 8% (40), Bahir Dar 7.8% (37), southern Ethiopia 7.0% (24), Eastern Ethiopia 6.9% (41) and Northern Ethiopia 6.9% (42). This variation is may be due to the geographical location, climatic change and the age variation of the participant. Comparable result was reported from Gondar 4.6% (43), Nepal 4.6% (44), Butajira 4.5% (45) and 4.0% Kenya(46), Turkey 3.2% (47), and Ethiopia 2.3% (39).

A single *S. Typhi* 0.4% 95% CI [0-1.1%] was isolated in this study which is in line with the findings reported from the same country in Addis Ababa, 0% (31), 1.1% (43), in contrast to our finding higher rates was reported from Sudan 4.0% (40), China 4.3% (27), Addis Ababa, Ethiopia 3.95% (26), Kenya 3.4% (46), Turkey 3% (47), Gondar 1.6%(48), and Hawassa 1.5% (24). This difference might be due to sampling size, weather condition and study subjects age differences.

Our study revealed that the highest rates of antibiotic resistance of *Shigella apps* were against Ampicillin 81.8% which is comparable with the study reported from a different area of Ethiopia 70.1% from Jimma (33), 79.9% Gonder (49), 86.7%(25), and 88.9% from Mekelle (50). Our study also showed relatively low resistance compared to findings from Nigeria 90.5% (51), Harar 100% (41), Jimma 100% (39), Hawassa 93% (34). This may be due to widespread resistance strain throughout the countries. Another antibiotic resistance of *Shigella spp* was seen against tetracycline 71.4% and this was comparable with findings reported from Harar 70.6% (41), Jimma 63.6% (33) and Mekelle 77.8% (42). The result was slightly lower than the study reported from Butajira 82.4% (45), Gondar 86% (52) & 86% (49), Hawassa 90% (34). This may be due to those strains moderately susceptible for tetracycline at a certain corner of the country. Our result also indicated that 52.4% resistance was seen against co-trimoxazole and this was comparable with a study done in Hawassa 56.0% (43), Addis Ababa 45.7% (53) and Mekelle 55.6% (42). Inconstant to

our finding higher result reported from Gonder 73.4% (49). Several factors may contribute to resistance by pathogens causing gastroenteritis in developing countries like Ethiopia. These include frequent overuse, misuse and factors related to the potency and quality of antimicrobials and the distribution of resistant strains (53).

Our finding in the multivariate analysis showed that who had a habit of washing the hands of a child after toilet sometimes as compared to those practice hand washing always 235.1 times at risk of infection. Similarly, those who store cooked food in an open container for later use was 34.44 times at risk of infection as compared to those who practice closing of the container with p-value ≤ 0.05 which is in agreement with a study conducted in Southern Ethiopia Arbaminch (8, 25, 54).

Conclusion

Our study indicated that there was a high rate of *Shigellosis* among diarrheic paediatrics patients that visited Alamura Health Center during the study period and single *Salmonella was isolated*. Ampicillin, augmentin and tetracycline are with high resistance and ciprofloxacin, ceftriaxone, ceftazidime, gentamycin, chloramphenicol, cefuroxime and cotrimoxazole relatively sensitive. Those practised hands wash for their child after defecation for sometimes was 235.1-fold at risk of infection. Similarly, those store foods for later use in an open container was 36.44 times at risk of infection. Therefore, to alleviate this infection the concerned body should focus on giving health education for hand wash after defecation and storing food in a closed container later use is mandatory.

Declarations

Ethical Clearance: The study was conducted after formal permission was obtained from Southern Nation Nationality and People Regional Health Office, Hawassa city administration health office, Alamura Health centre manager and laboratory head. The patients were included in the study if their parents or caretaker sign the consent. Culture results and antimicrobial susceptibility results were communicated to the concerned bodies of in health centre within 72 hrs and treatment accordingly.

Consent for publication: Not applicable

Availability of data and material: All the data supporting the findings can be obtained from the corresponding author.

Competing of interest: The authors declare that they have no competing interests

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Authors' contribution: MH, TA, BT, EM, ZB equally conceived the idea, develop the proposal, collected the data, perform the analysis and prepared the manuscript, TA & ZB has made a final edition of the document. All authors have read and approved the manuscript.

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Figures

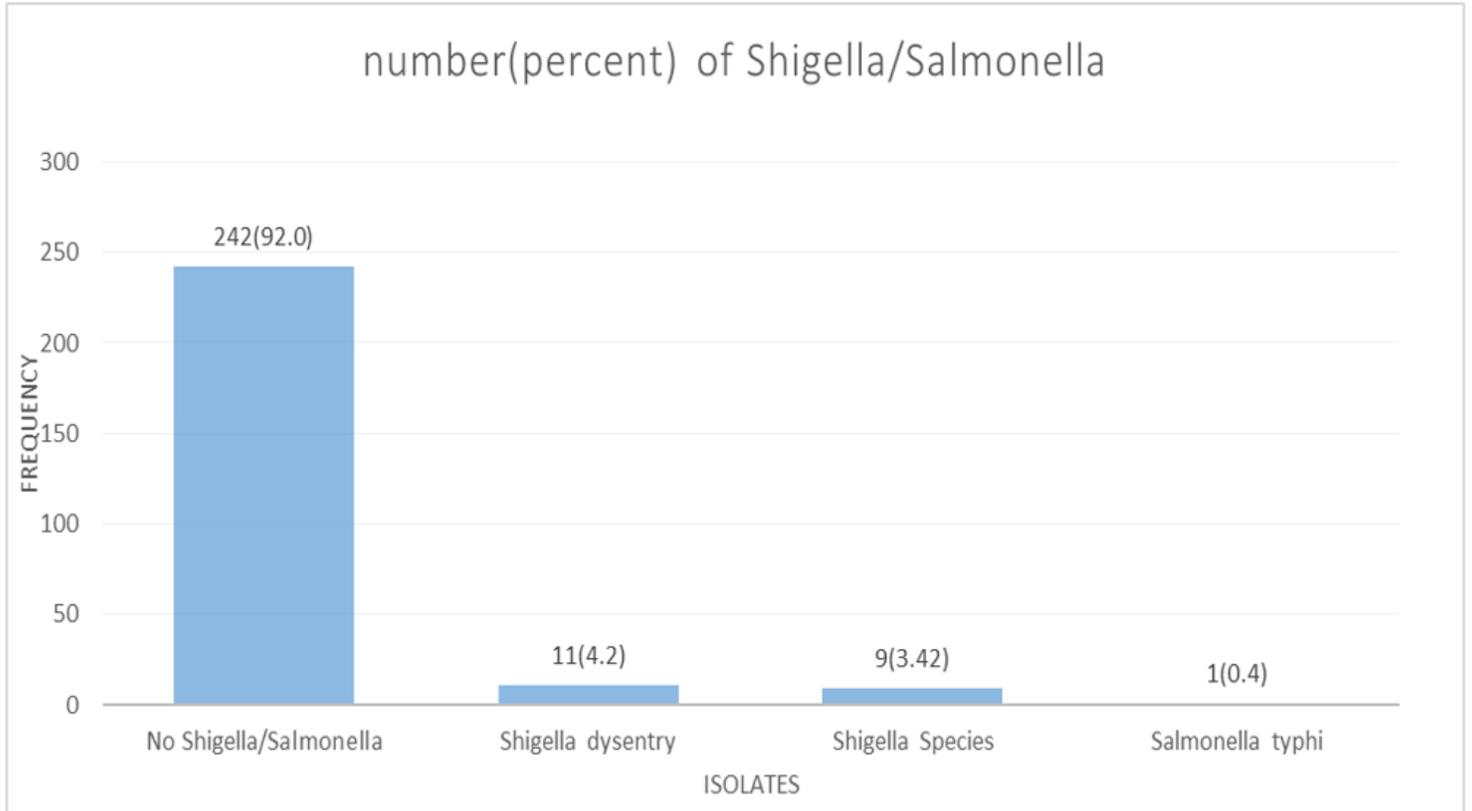


Figure 1

Magnitude of Shigella Spp, Shigella dysentery and Salmonella typhi in diarrheic paediatrics patients from Alamura Health Center, southern Ethiopia, 2019.