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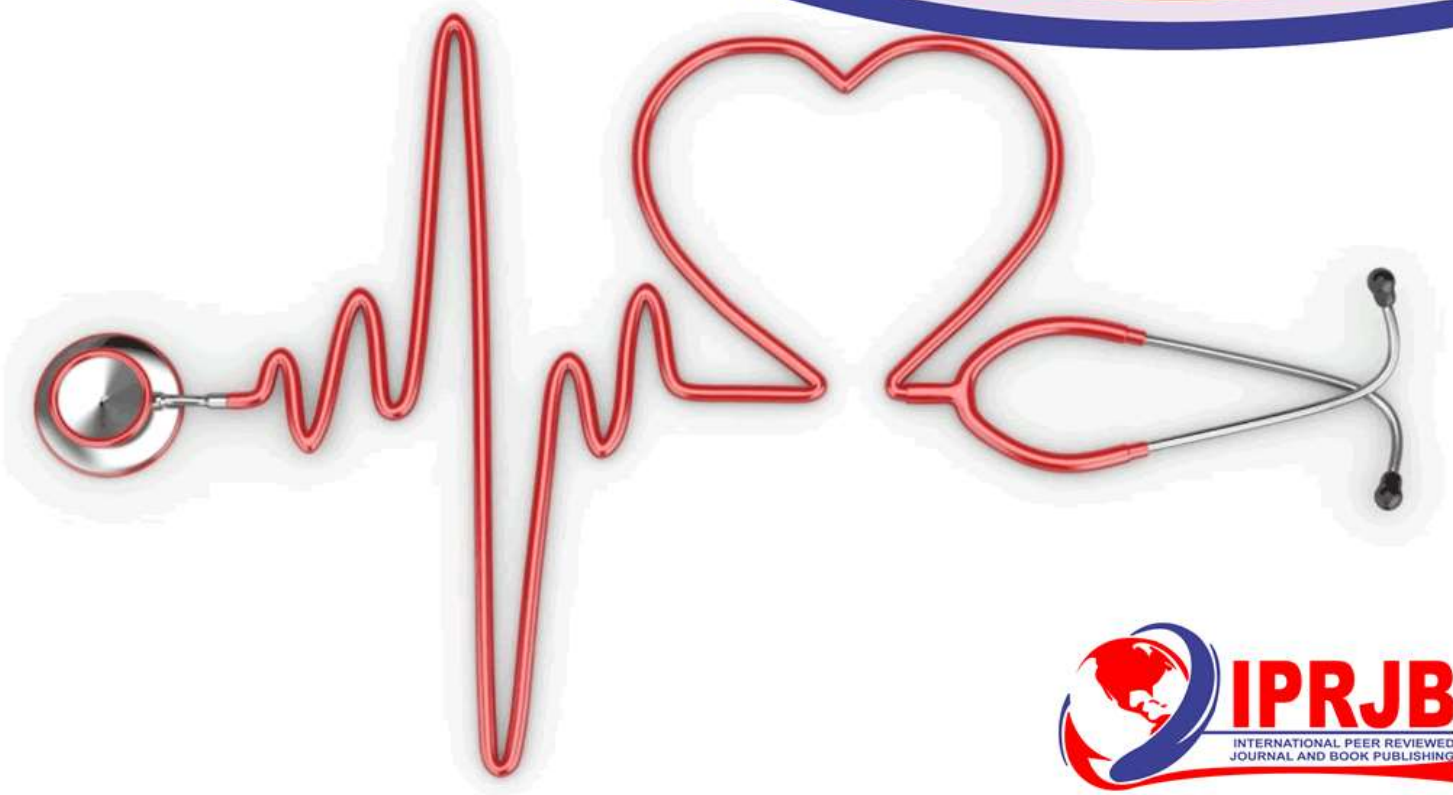

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ACUTE WATERY DIARRHEA OUTBREAK INVESTIGATION IN RAYA KOBBO DISTRICT, AMAHARA REGION OF ETHIOPIA-CONSEQUENCE OF DROUGHT AND POOR SANITATION: A CASE-CONTROL STUDY

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ABSTRACT

Background: Acute Watery Diarrhoea (AWD) is an acute bacterial infection of the intestine caused by ingestion of food or water containing Vibrio cholerae, serogroups O1 or O139. The outbreak of AWD in Raya Kobbo of Wollo zone district started during epidemiological week 33 of 2016 when 3-suspected cases reported to the town and rural health office. Three of the samples investigated in the 33 epidemiological weeks by RDT Kit confirmed that positive for Vibrio cholera. The index case was a 15-year-old male from town kebele 02 of the district. Stool specimen taken from index case on the date of reporting and positive for Vibrio cholerae o1.
Objective: We aimed to assess the magnitude and risk factors associated with acute watery diarrhoea in Raya Kobbo district, Northern Amahara region of Ethiopia in 2016.
Method: An age and sex matched case-control study design was conducted to investigate risk factors for AWD outbreak in Raya Kobbo. All the data collected from cases and controls were entered into a computer using MS Excel and Epi info. To determine the sample size we did not use Epi info statistical calculation, because the numbers of cases were few. We established cases to control ratio of 1:3 with a total of 10 cases and 30 controls.
Result: Ten cases and zero deaths were registered during August 20 to September 1, 2016 in the two town kebeles and one rural kebele with an Attack Rate (AR) of 86, 23 and 33 per 100,000 populations in town kebeles of 02, 04 and Arefa rural kebele respectively. Among cases, 6 (60%) were males and four (30%) were in the age category of 21-25 years old which also the median interval age. The unadjusted matched analysis indicated that exposure to dirty latrine [OR = 7.67, 95% C.I (1.56, 37.78), P = 0.011] and contact of patient with diarrhoea and vomiting at home [OR = 9.0, 95% C.I (1.61, 50.27), P = 0.014] were at greater risk of having AWD. Cooking vegetables [OR=0.07, 95%C.I (0.01, 0.77), P=0.03] hand washing with soap [OR=0.78, 95%C.I (0.14, 0.81), P=0.04] and cleanliness around home [OR=0.10, 95%C.I (0.01, 0.87), P=0.01] were among protective factors.
Conclusion: There was a significant association between dirty latrine and contact history with AWD. The most affected age group was adults 20-25 year-old. Health education and social mobilization on personal, community hygiene and sanitation particularly maintaining latrine sanitation at home was recommended.

Key words: *case-control, analytical, descriptive, AWD, Raya Kobbo*

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1. INTRODUCTION

Acute watery diarrhoea (AWD) is an acute bacterial infection of the intestine caused by ingestion of food or water containing *Vibrio cholerae*, serogroups O1 or O139. Symptoms include acute watery diarrhoea and vomiting which can result in severe dehydration. It is transmitted through contaminated food or drinking water, as well as by person-to person contact through the faco-oral route. Sanitary conditions in the environment play an important role since the *V. cholerae* bacterium survives and multiplies outside the human body and can spread rapidly where living conditions are crowded and water sources unprotected and where there is no safe disposal of faeces [1].
There are about 200 serogroups of *V. cholerae*, but only two, *V. cholerae* O1 and O139 are known to cause the specific disease known as cholera. Serogroup O1 is further divided into three serotypes, Inaba, Ogawa, and the rare Hikojima and into two biotypes, classical and El Tor.

These two characteristics of cholera have yielded a reputation that evokes fear and often panic. However, with prompt and appropriate treatment, mortality can be kept low. Furthermore, cholera outbreaks can be prevented through a combination of public health interventions predominately through disease surveillance and early warning. Moreover, provision of safe water, adequate sanitation, health and hygiene promotion and early detection and treatment are another way of controlling the disease [2].
To date, there have been seven cholera pandemics, six of which have been most likely due to the classical biotype. The current pandemic began on the Indonesian island of Sulawesi in 1961 and resulted from the El Tor biotype. During this current pandemic, the classical form seems to have been almost entirely replaced by El Tor, which survives well on zooplankton and other aqueous flora and fauna. This fact is commonly cited as one reason for the persistence of the current pandemic, along with the fact that El Tor evokes less durable immunity than does the classical biotype.
Generally, 75% of people infected are asymptomatic. Of the symptomatic cases (25%), a minority leads to severe cholera (20% of those with symptoms, or 5% of all infected cases) with a greater proportion presenting mild to moderate disease (80% of those with symptoms, or 20% of all infected) [2]. About 20% of those who are infected develop acute, watery diarrhoea, 10% to 20% of these individuals develop severe, watery diarrhoea with vomiting. The case-fatality rate (CFR) in untreated cases may reach 30%–50%.

The greatest risk of cholera occurs in over-populated communities and refugee settings characterized by poor sanitation, unsafe drinking water, and increased person-to-person transmission. As the incubation period of cholera is very short, 2 hours to 5 days, the number of cases can rise extremely quickly [3].

The global burden of cholera is largely unknown because the majority of cases are not reported. The low reporting can be attributed to limited capacity of epidemiological surveillance and laboratories, as well as social, political, and economic disincentives for reporting. It was estimated that 1.3 billion people are at risk for cholera in endemic countries. An estimated 2.86 million cholera cases occur annually in endemic countries. Among these cases, there are an estimated 95,000 deaths [4-6].

In most developed countries of Americas and Europe, most of the cholera cases were imported from developing countries with CFR ranging from 0.07% to 1.08%. However, in African continent the number of cases and deaths increased from time to time with CFR range up to 1.79% [7, 8]. History in Ethiopia revealed that, outbreak of cholera started during 1834 when it affected great mortality in the population. Most of the outbreak in the country occurred following drought [9]. New, more virulent and drug-resistant strains of *Vibrio cholerae* continue to emerge, and the frequency of large protracted outbreaks with high CFR has increased, reflecting the lack of early

detection, prevention and access to timely health care. Cholera remains a major public health problem in many parts of the world and is often a relatively neglected disease[10].

The epidemic of the cholera is highly associated with low coverage of pure water supply and poor sanitation in the community [11-13]. Poverty, rapid population growth and instability of the population lead to cholera outbreak [14].

Common cholera-prevention water, sanitation and hygiene (WASH) interventions include water supply, water treatment (well, pot, or bucket chlorination and household treatment), sanitation including latrines and promotion of hand washing and environmental hygiene [2]. The effectiveness of these interventions varies [15]. Water supply and chlorine-based, filtration, and solar disinfection household options have been shown to reduce cholera transmission among users, well/pot chlorination effectively treats water only for a few hours [16].

The most successful programme provided an effective method such as chlorine tablets with the necessary supplies to use it (bucket and tap), and ongoing training by local community health workers to people using contaminated water who were familiar with chlorination before the emergency [17].

High case fatality rates (CFRs) of cholera can be predicted, prevented and treated. In areas with limited access to health care facilities, poor sanitation and access to safe water are considered at higher risk for cholera infection. In all contexts, prevention and preparedness, as well as timely detection through surveillance, will enable health authorities to allocate resources, implement adequate preventive, and control measures.
Key factors for effective surveillance include existence of a standard case definition, clear and simple data collection mechanisms, reporting procedures and analysis, rapid diagnosis of suspected cases and laboratory confirmation, routine feedback of surveillance data and appropriate coordination at all levels of community, health facility, district, national, and international levels. Cholera surveillance should be part of an integrated disease surveillance system that includes feedback at the local level and information sharing at the global level.

Therefore, we aimed to determine risk factors of cases, characterize the epidemiology of the disease that occurred from 23 August to 1 September 2016 and guide the intervention measures in the districts of Raya Kobbo.

2. METHODS AND MATERIALS

2.1 Study area and period

Raya Kobbo is located 409 km Northern Bahir Dar, capital city of Amahara regional state, 55 km North-eastern Weldiya, capital town of north Wollo zone and 555 km north of Addis Ababa, capital city of Ethiopia respectively. It is one of the 10 districts in the Northern Wollo zone, Amahara region of Ethiopia. It is bordered on the west by Gidam district, on the south by Logiya river (Habru and Guba Lafto districts), on the north by Tigray region and on the East by Afar region. According to the 2007 population census, the projected total populations of the district for the year 2016/17 were 270,722 (rural 215,915 and urban 54,807). Of the total population 136,101 were males and 134,621 were females [18]. Administratively the district divided into 42 Kebeles. In the district, there were 54 public health facilities (2 hospitals, 8 health centers and 44 health posts). Under one and five years of age were 8420 and 7211 respectively. Health service coverage of 2016 was 76 %. The AWD outbreak investigation was conducted in the district for the period of 23-31 August 2016.

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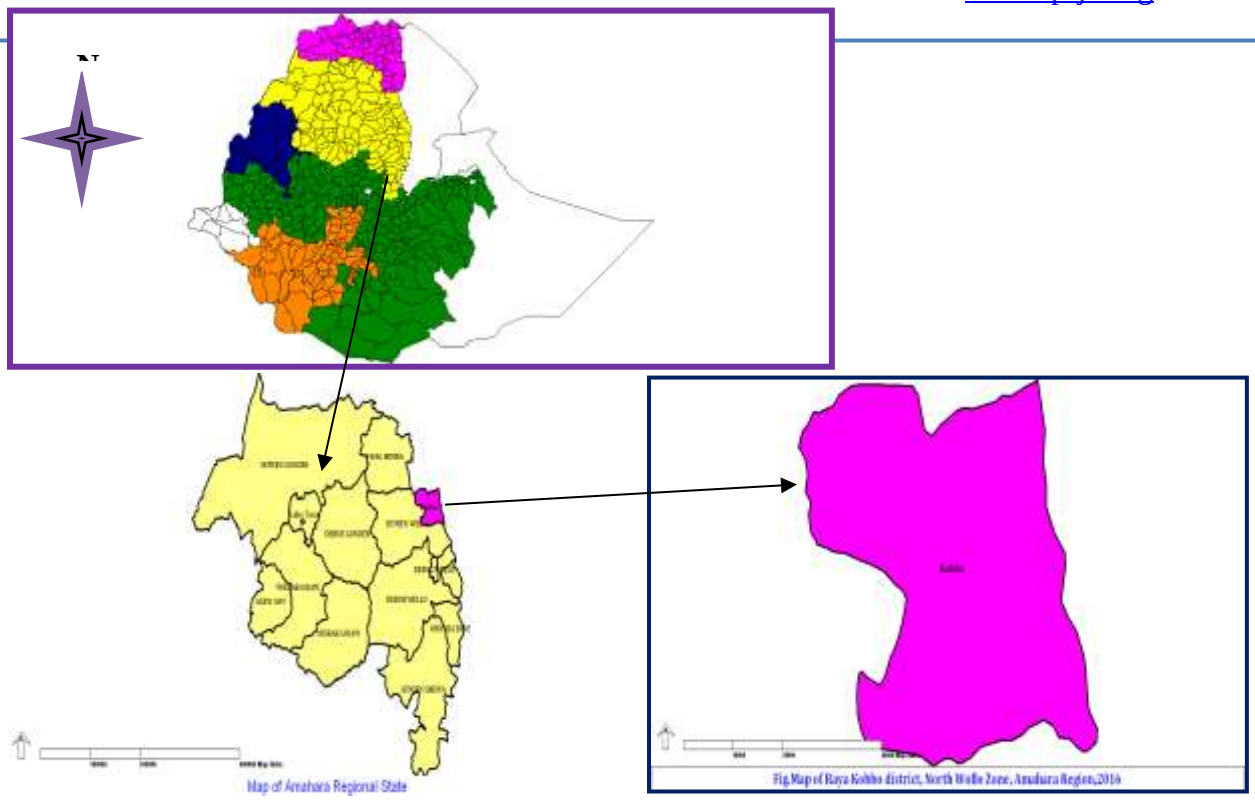

Map of Amahara Regional State and Raya Kobbo district, Ethiopia, 2016

2.2 Study design

A matched case-control study design was conducted to investigate risk factors for AWD outbreak in the district in 2016. All the data collected from cases and controls were cleaned and entered into a computer using MS Excel and Epi info 3.5.1.

2.3 Study Population

All population living in Raya Kobbo district during the study period, those interviewed as AWD cases and not AWD cases were our study population.

2.4 Sample size and sampling technique

To determine the sample size we did not use statistical calculation of Epi info because the numbers of cases were few in number. We established cases to control ratio of 1:3 with a total of 10 cases and 30 controls. Some confirmed cases (n=7) were interviewed at AWD treatment centre (ATC) and some of them were interviewed at their house after they discharged. Three of the cases were epidemiologically linked (stool examination was not performed).

2.5 Data collection method and analysis procedure

Exposure and risk factor information was collected by face-to-face interview of cases and controls by using structured questionnaire. Additional data was collected from medical record at cholera treatment center and WHO case definition was used to classify study participants as case or control. During the active case searching and interviewing both cases and controls, observation was made about sanitation of latrine and the environment as the whole.

The data were entered and analyzed using Epi-Info version 3.5.1. Descriptive statistics were used to determine the frequency of different variables. Bivariate and multivariate logistic regression analysis was applied. Results were displayed using tables and graphs and it was interpreted using Odd ratio, P- value <0.05 and 95% confidence interval for the significance of the study. Attack rate and case fatality rate were also calculated.

2.6 Data quality control

All data were checked for completeness before entry and analysis. Prior to entering the data into the computer, the missing variables and consistency of filling of questionnaires and completeness of data was checked out cautiously by using the list command of Epi Info.

2.7 Selection of cases/Inclusion criteria

A person age 5 years or more with history of sudden onset of acute watery diarrhoea (three or more episodes of loose watery stool per day) with or without vomiting residing in the district from 23rd to 27th August 2016 was selected as case. All cases admitted to hospital were included from cholera treatment center (CTC) at Raya Kobbo primary hospital and those discharged interviewed at their home in the visited village.

2.8 Selection of controls

A person whose age 5 years or more without a history of loose watery stool and vomiting, in the last two weeks residing in Raya Kobbo district within the same period was selected as control.
For each case, three controls selected and interviewed during cases interviewed. Controls were selected from the same neighbourhood communities of cases. All controls were matched by residence, sex and age ($\pm$5 years difference in age with the same case). After the first control selection, the second control randomly selected from the immediate household following the first control in the same direction and we continued until the third control obtained. We visited as many households as needed to find appropriate controls for all the 10 cases.

2.9 Epidemic threshold definition

In Ethiopia, one confirmed case of cholera is enough to declare an outbreak. Based on the case definition, a health worker should suspect cholera (AWD) upon encountering a single case of profuse, acute, watery diarrhoea. Confirmation of 5 to 10 stool or vomit samples is sufficient per district. In this study, there were seven confirmed species of *Vibrio cholerae* (two cases were both o1 and o139; the rest 5 cases were o1 Serogroup).

2.10 Ethical clearance

Letter of permission was written from field base to Raya Kobbo district health office (both rural and urban) and to the hospital, where the outbreak took place. The outbreak investigation was done after permission obtained from Raya Kobbo primary hospital medical director where Acute watery diarrhoea (AWD) Treatment Center (ATC) established to review medical records and interview AWD cases admitted. Verbal consent was also obtained from study participants.

3. RESULTS

3.1 Descriptive Epidemiology

3.1.1 Outbreak Evolution

The AWD outbreak in Raya Kobbo district started during epidemiological week 33 of 2016 (16^{th} – 22^{nd} August 2016) when three suspected cases reported to the town and rural health office in the Raya Kobbo district of Wollo zone. Three of the samples investigated in the 33 epidemiological weeks by RDT Kit at the district primary hospital, tested and positive for *Vibrio cholera*. The index case (the first confirmed cholera case in the district) was a 15-year-old male from town kebele 02 of Raya Kobbo. The date of onset of diarrhoea was 20 August 2016 and was admitted on 21 August 2016 at the district primary hospital. He survived the infection after being managed with Intravenous infusions (IV) such as ringer lactate and ORS, and Erythromycin antibiotic. Stool specimen taken from him on the date of reporting tested positive for *Vibrio cholerae* o1. In evening before onset of diarrhoea, the index case ate meet (locally called konta) and banana from a street food vendor at Kobbo, a town of district. However, on the 24^{th}, 25^{th},30^{th},31^{st} August 2016 seven cases with profuse watery diarrhoea reported at Raya Kobbo hospital, four of them tested and positive by Cholera Rapid Diagnostic test (RDT).

3.1.2 Distribution of AWD cases by time

A total of 10 cases and no death were registered during August 20 to 31, 2016 in the two town kebeles and one rural kebele district of Raya Kobbo with an attack rate (AR) of 86, 23 and 33 per 100,000 populations in town kebeles of 02, 04 and Arefa rural kebele respectively. Among cases, six (60%) were males and four (30%) were in the age category of 21-25 years old (21-25 years old was also the median interval age). AWD cases were notified from starting day 08/20/2016 (starting at the end of Week 33) and continued until the beginning of WHO week 35 for 11 days (until 08/31/2016). The maximum cases were two cases per day. Figure 1 below summarizes the number of AWD case per day of notification.

Journal of Health, Medicine and Nursing
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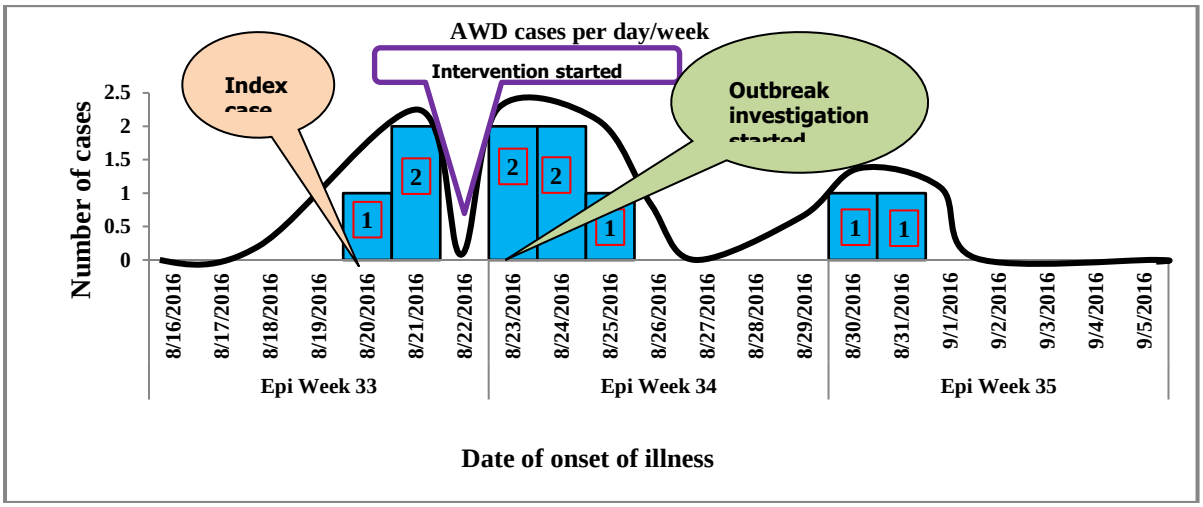

Figure 1: Number of AWD cases by date of onset in Raya Kobbo district, Northern Wollo Zone, Amahara region, Ethiopia, 2016

3.1.3 Distribution of AWD cases by kebele (place)

In Raya Kobbo district, majority of the cases, eight (80%) were in the town Kebeles (kebele 02 and 04) and the rest of the cases two (20%) were in the rural Kebeles. Most notified cases six (60%) were from town kebele 02 and two (20%) cases were from town kebele 04 and two (20%) cases were Arefa rural kebele. Out of 44 Kebeles in the rural kebele only from Arefa kebele AWD cases notified and from town Kebeles only 02 and 04 Kebeles notified AWD cases.

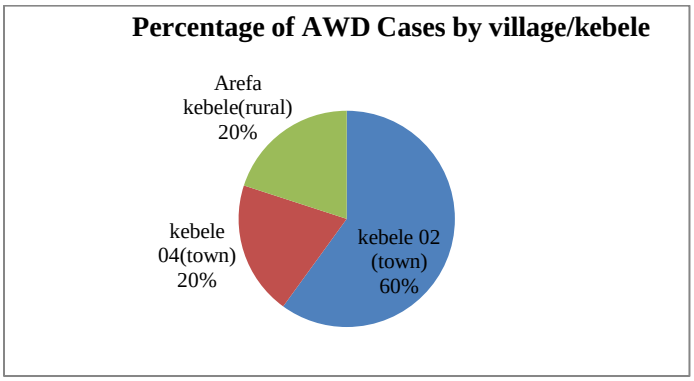

Figure 2: Percentage of AWD affected kebeles in Raya Kobbo district, Northern Wollo Zone, Ethiopia, 2016.

3.1.4 Distribution of AWD cases by person

Males more affected by the outbreak than females. Out of 10 notified cases, six (60%) were males and four (40%) were females. Regarding distribution of cases by age, the most age group affected was 21-25 years; accounting 30% followed by 5-10 and 31-35 years age group accounting 20% each.

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www.iprjb.org

Table 1: Distribution of AWD cases by age group in Raya Kobbo district, Northern Wollo zone, Amahara Region, Ethiopia, 2016.

Age group	Number of cases	Percentage
5-10	2	20%
11-15	1	10%
16-20	0	0
21-25	3	30%
26-30	1	10%
31-35	2	20%
36-40	1	10%
Total	10	100%

Table 2: Socio-demographic characteristics of cases and controls in Raya Kobbo district, Northern Wollo zone, Amahara region, Ethiopia, 2016.

Socio-demographic information		**Cases (n=10)**		**Controls (n=30)**		**Total**	
		No.	%	No.	%	No.	%
Religious	Orthodox	8	80%	18	60%	26	65%
	Muslim	2	20%	12	40%	14	35%
Marital status	Married	6	60%	16	53%	22	55%
	Single	4	40%	14	47%	18	45%
Occupational status	Unemployed	4	40%	6	20%	10	25%
	Employed	0	0	5	17%	5	13%
	Farmer	2	20%	5	17%	7	18%
	Student	4	40%	13	43%	17	41%
	Merchant	0	0	1	3%	1	3%
Educational status	Illiterate	3	30%	7	24%	10	25%
	Primary	6	60%	16	53%	22	55%
	Secondary	1	10%	4	13%	5	13%
	Tertiary	0	0	2	7%	2	5%
	Non-formal	0	0	1	3%	1	2%

3.1.5 Epidemic Preparedness and response

Raya Kobbo had an epidemic plan or an epidemic preparedness committee in place prior to an outbreak. The protective materials and IV fluids, ATC establishment were provided by the support of the UNICEF and Zonal Health Department (ZHD). All sectors of the district involved on the prevention of the outbreak and supported each other during the outbreak. There was no epidemic management fund available in the district prior to the occurrence of the epidemic. Disinfectants were available at the town health center and ATC in the district that we visited. The town health office distributed chlorine for water treatment in the two town kebeles visited. Cholera treatment center was established at Raya Kobbo primary hospital. The surveillance system was not evaluated prior to the occurrence of the epidemic.

Figure 3: AWD Treatment Center (ATC) at Raya Kobbo primary hospital, Northern Wollo Zone, Amahara region, Ethiopia, 2016.

3.1.6 Environnemental investigation

During the environmental assessment, among visited latrines (n=40) 34 (85%) latrines had no hand washing facilities. Majority of household's source of drinking water in the town kebeles were tap water but there were an interruption of water supply in the visited kebeles (kebele 02 and 04). The general hygiene in the two town kebeles visited villages was poor. There were stagnant water and unclean environment in the visited households. The use of pit latrine was common but most of these latrines were poorly maintained and no hand washing facilities. When the water supply tubes assessed, there were observed leakages of water tubes and it was suddenly maintained.

3.1.7 Laboratory results

At the ATC, for those all patients admitted stool samples were taken and Rapid Diagnostic Test (RDT) was performed. Among RDT positives, two cases were positive for Vibrio cholerae both o1 and o139 serogroups and the rest 5 cases were positive for only *Vibrio cholerae* o1. The other three cases were epidemiologically linked and they took antibiotics from private clinics. A water sample was not taken for analysis. Since no stool culture was performed due to resource limited and RDT kit for cholera only identifies serogroups, it was difficult to identify biotype, serotype and to perform antibiotic sensitivity test.

3.1. 8 Clinical investigation

3.1.8.1 Assessment of level of dehydration and treatment

Eighty percent of cases enrolled in the study visited the ATC within 2 days of onset of cholera symptoms. All patients had diarrhoea, vomiting and abdominal cramps, seven (70%) of cases had cramps in the legs and arms. The clinical information of card reviewed at the ATC indicated that 4(40%) cases had sign of some dehydration (eye sunken, dry mouth and tongue, restless, pulse rapid and weak, drinks eagerly, skin pinch goes back slowly). One (10%) had sign of severe dehydration (in addition to signs and symptoms of some dehydration, there were very sunken eye, very dry mouth and tongue). The other five (50%) of cases had no dehydration. Majority of the cases were treated by ORS and IV Ringer lactate fluid. Erythromycin and Doxycycline antibiotics were used.

3.1.8.2 Awareness of prevention assessment

During an outbreak investigation, the level of awareness and prevention of the disease was assessed. In this regard, out of 40 households assessed nine (22.5%) and 27(67.5%) of participants used soap for hand washing before and after outbreak investigation respectively. Regarding ORS preparation, 7(17.5%) and 23(57.5%) of assessed households know how to prepare ORS before and after outbreak respectively.

3.2 Analytical epidemiology

The median age of AWD cases, calculated from 10 patients recorded was 24 years [inter-quartile range (IQR) = 12-32, mean age= 22, SD= $\pm$ 10.38] with an age range of 7 to 36 years. On the other hand, 60% of the controls were males. The median age of AWD controls, calculated from 30 non-patients was 23.5 years (IQR= 13-30, mean age =21.97, SD= $\pm$9.34) with an age range of 8-36 years.

For each case, three controls were matched by place of residence, age and sex, and then they were selected and interviewed on the same day as cases. Controls were selected from patient's neighbourhood. Data on possible risk factors were documented by a standardized questionnaire.
The unadjusted matched analysis (Table 3) indicated that exposure to dirty latrine Odds ratio (OR) = 7.67, 95% Confidence Interval (C.I) = [1.56, 37.80], P = 0.011) and contact of patient with diarrhoea and vomiting at home were at greater risk of having AWD [OR =9.0, 95%CI (1.611, 50.77), P=0.014]. The association was statistically significant at $P < 0.05$.

On the other hand, sharing food in common plate [OR=0.71, 95% C.I = (0.14, 3.51), P= 0.48], travel to other place in past 5 days [OR = 8.14, 95% C.I= (0.72, 91.89), P= 0.095], eating outside home within last 5 days [OR= 4.75, 95%CI= (0.38, 60.15), P= 0.251], sharing latrine with other families [OR=1.00, 95% CI = (0.22, 4.56), P=0.65] and eating vegetables [OR= 1.50, 95% C.I= (0.33, 6.92), P= 0.446] were not associated with having AWD.
Moreover, there were also protective factors. Cooking vegetables [OR=0.07, 95%CI = (0.01, 0.77), P=0.03], latrine correctly constructed (OR=0.17, 95% CI= [0.03, 0.92], P=0.032), cleanliness around the home [OR=0.10, 95% CI=(0.01, 0.87), P=0.01] and using soap for hand washing [OR=0.78, 95%CI = (0.14, 0.81), P=0.04] were protective factors. The risk and protective factors are summarized as follows.

Journal of Health, Medicine and Nursing
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www.iprjb.org

Table 3: Bivariate analysis of factors associated with AWD in cases and controls in Raya Kobbo district, Northern Wollo Zone, Amahara region, Ethiopia, 2016.

Risk factors	Cases,% (N=10)	Controls exposed, %(N=30)	Crude Odds of Ratio (COR)	95% CI	P-Value
Source of drinking water					
▪ River water ▪ Water sold from street ▪ Tap water ▪ Hand pump	2 1 8 1	6 9 23 5	1.00 3.22 1.22 0.55	0.17-5.98 0.18-56.88 0.21-7.11 0.06-5.42	0.66 0.44 0.60 0.53
Inadequacy of water supply	6	25	0.3	0.06-1.47	0.08
Sharing food in common plate	7	23	0.71	0.14-3.50	0.48
Attended funeral with similar case	0	0	-	-	-
Contact of patient with diarrhoea and vomiting at home	**5**	**3**	**9.00**	**1.61-50.28**	**0.014**
Travel to other place in past 5 days	3	3	3.86	0.64-23.41	0.153
Eating vegetables	7	18	1.56	0.33-7.24	0.43
Cooked vegetables	**1**	**15**	**0.07**	**0.01-0.77**	**0.03**
Types of vegetables/food used					
▪ Cabbage ▪ Carrot ▪ Potato ▪ Tomato ▪ Enjera wat ▪ Mango ▪ Banana ▪ Orange ▪ Cactus ▪ Keyisir ▪ Selata	1 4 2 2 4. 1 1 1 1 1 1	7 9 14 6 14 3 6 5 6 5 6	0.37 1.56 0.29 1.00 0.76 1.00 0.44 0.56 0.44 0.56 0.44	0.04-3.04 0.35-6.88 0.05-1.58 0.1-5.98 0.18-3.26 0.09-10.87 0.05-4.22 0.06-5.42 0.05-4.22 0.06-5.42 0.05-4.22	0.34 0.41 0.34 0.66 0.50 0.70 0.48 0.53 0.43 0.53 0.43
Eating outside home within last 5 days	2	3	2.25	0.32-15.90	0.37
▪ Eating from hotel ▪ Eating from neighbour ▪ Eating vendered food at road side ▪ Eating at party/wedding	1 2 1 1	3 2 4 2	1.00 3.5 0.72 1.56	0.09-10.86 0.42-28.92 0.07-7.34 0.12-19.24	0.70 0.25 0.63 0.59
Presence of floods to drinking water	2	6	1.00	0.17-5.98	0.66
Sharing latrine with other families	5	18	0.67	0.16-2.81	0.42
Sharing latrine with diarrheal case	1	7	0.37	0.04-3.40	0.34
Latrine correctly constructed	**2**	**18**	**0.17**	**0.03-0.92**	**0.032**
Presence of facilities for hand washing	2	6	1.00	0.17-5.98	0.66
Cleanliness around the home	**1**	**16**	**0.10**	**0.01-0.86**	**0.01**
Observed dirty latrine	7	7	7.77	1.55-37.78	0.011

Using soap for hand washing	**1**	**8**	**0.31**	**0.03-0.81**	**0.04**
Washing hands before eating anything	7	24	0.58	0.12-2.95	0.40
Seek medical attention early	3	17	0.33	0.07-1.52	0.14

Multivariate analyses showed that observed dirty latrine [Adjusted odds ratio (AOR) 8.34, 95% confidence interval (CI) 1.36-51.04, P=0.021] and contact of patient with diarrhoea and vomiting in the house [OR = 37.18, 95% CI (1.34- 72.19), P=0.0179] were independently and significantly associated with risk for AWD (Table 4).

Table 4: Multivariate analysis (unconditional logistic regression) of risk factors associated with AWD cases in Raya Kobbo district, Northern Wollo Zone, Amahara region, Ethiopia, 2016

Factors	Adjusted Odds Ratio (AOR)	95% CI	P-Value
Observed dirty latrine	8.34	1.36-51.04	0.021
Contact of patient with diarrhoea and vomiting at home	9.92	1.34-72.19	0.023

4. DISCUSSION

The reported cases of severe and acute watery diarrhoea in the Raya Kobbo district predominantly affecting adults and the isolation of pathogenic strain of cholera organisms in 70% (7/10) of the collected stool samples from patients admitted in the hospital confirmed to be the outbreak was caused by *Vibrio cholerae* specifically serogroups o1 and o139. This study showed that, the AWD outbreak affected all age groups in the district and more especially among young adult males. However, people in age 21-25 years in both sexes were most affected. The number of males affected were higher than female which might be more males exposed to dirty latrines and contact AWD cases than females. This finding consistent with the study in Greater Accra Region in which males more affected than females [19].

In this study, there was no death and the lowest AR (in the district town AR of 15 per 100,000 populations). Different stakeholders' such as UNICEF participated in the control of AWD by establishing ATC and supplying other logistics in line with zonal and district health departments. The water supply system in these areas also had visible leakages in the pipes supplying water to the kebeles affected suggesting possible water contamination, since there was evidence of visible broken tubes. Because of the support and coordination of sectors in the district such as water resource office, broken water supply tubes in the district was assessed and maintained quickly. On the other hand, the study in Ghana (greater Accra Region) indicated that the outbreak of cholera caused several deaths and highest CFR in the region due to delay in controlling the outbreak that were attributed to most health facilities were not well prepared before onset of outbreak [19].

According to this case-control study, the risk factors for AWD outbreak were dirty latrine and contacts of diarrhoea cases in the home in the previous five days. These results were consistent with those that have been reported by other studies in India [20] and study in the southwest community of Nigeria [21], which indicated that the odds of having AWD were increased in those who had contact with a case of diarrhoea.

No relationship was found between AWD infection and source of drinking water such as river water and tap water, sharing food in common plate, travel to other places in the last five days, eating outside home within the last five days, presence of floods to drinking water source and sharing latrine with other families. Although some studies have found that, the drinking of river water, sharing food in common plate, eating outside home, presence of floods to drinking water source and sharing latrine with other families [22] were associated with cholera. A previous study found that uncooked vegetables and fruits such as vegetables, carrots, potatoes and Selata had a significant association with cholera infection [23]. A case-control study of a cholera outbreak in Zambia showed that the consumption of raw vegetables was significantly associated with cholera [24].

The overall response to this AWD outbreak was most impressive at the community, district and zonal levels. Once the AWD outbreak had been identified in rural and town kebele of Raya Kobbo district, health care providers and health bureau staff in Raya Kobbo Primary hospital, rural district health office, and town district health office seized the opportunity to prepare for such an epidemic in their own respective area. Multiple governmental and non-governmental organizations responded to the outbreak by supplying tents, providing medical supplies, and performing community outreach services.

Limitation

This study might have some limitations. No extensive microbiological assessments of the environment conducted, no water and food samples were collected for laboratory investigation. Hence, we investigated factors related to behaviours and practices of community due to resource limited.

5. CONCLUSION AND RECOMMENDATION

Environmental and latrine related sanitation problem caused the outbreak of diarrhoea. The odds of having AWD were increased in those who had contact with a case of diarrhoea.

We recommend that he districts continue with health education and social mobilization on personal, community hygiene and sanitation particularly maintaining latrine sanitation at home. Focused health education on precautions during caring and supporting of AWD case both at home and at health facilities should be strengthened.

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