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Faecal Contamination of Drinking Water in Arba Minch Town, Gamo Gofa Zone, South Ethiopia.

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Abstract
Background: Water is one of the most important elements for all forms of life. It is indispensable in the maintenance of life of the earth. Microbiological quality of drinking water has attracted great attention worldwide because public health impacts. Frequent examination of faecal indicator organisms remain the most sensitive way of assessing the hygienic condition of water. Therefore, the main aim of the study was to assess the quality of drinking water and factors which contribute for the contamination of drinking water, in Arab Minch town.
Methods: A cross-sectional study was conducted from February to April 2012 at Arbaminch town south Ethiopia. Materials and methods used to assess faecal contamination of drinking water were autoclave, incubator, balance test tube, test tube rack, cleaning and maintenance equipment, refrigerator and others materials used for multiple tube test technique. In house hold the community were visited at time most resident were less busy from Monday to Friday.
Result: the study included 169 households to analyse the microbiological quality of drinking water. Latrine availability and utilization is 88%. From the participants majority heard about fecal contamination of drinking water, had home water treatment options. Nearly half of the study participants perceived that the contamination comes from using unclean equipments
Conclusion and recommendations: there is unacceptable faecal coli form count. This indicates that the water used was contaminated. Therefore, water treatment and its utilization is highly recommended to prevent water borne diseases.
Keywords: Faecal contamination, Water quality Indicator, Gamo Gofa, Ethiopia

1. INTRODUCTION

The quality of drinking water directly affects the well-being of individuals with cumulative effects at every social level. Diseases caused by contaminated water consumption and poor hygiene practices are the leading causes of death among children worldwide. Absence of basic sanitation and hygienic practice are associated with morbidity and mortality from excreta related disease. Water may be contaminated with pathogens at the source but contamination may also occur during distribution, transportation and handling in house hold water related illness (1, 2).

Microbiological quality of drinking water attracted great attention worldwide because of implied public health impacts (3).

Total and faecal coli form has been used extensively for many years as indicator for determining the sanitary quality of water source. Water borne outbreaks are the most obvious manifestation of water borne diseases. Microbiological examination has several roles in the investigation of water borne outbreak (4).

Approximately three out of five person in developing countries do not have access to safe drinking water and only about one in four has any kind of sanitary facilities (5, 6) In Ethiopia over 60% of the communicable diseases are due to poor environmental health conditions arising from unsafe and in adequate water supply. In Arba Minch the water source for the most part of the town is “forty spring” which is natural and suitable for health and the reaming may get from other water sources. In most kebeles households have their own pipe connection. The purity of the source does not confirm the cleanness OF THE WATER BECAUSE IT MAY BE CONTAMINATED AT SOME POINT OF ITS WAY FROM SOURCES TO THE HOUSEHOLD PIPE CONNECTION. MOST PROBABLE NUMBER (MPN) IS A UNIT TYPICAL FOR FAECAL COLI FORMS TO DETERMINE THE EXTENT AND RISK FACTOR FOR FAECAL CONTAMINATION (7)

More than 88% of the global diarrheal diseases are water borne infections. It is also estimated that one billion people in developing countries have no access to clean water. More than two billion People have no any form of sanitation services. Consequently, 250 million people are exposed to water borne diseases resulting in 10 – 20 million deaths (8).

The world health organization (WHO) estimates that 2.2 million people die annually from diarrhoea diseases. Ten present of the population of the developing world are severely infected with Intestinal; worms

related with improper waste management (9).

In Kenya diarrheal; diseases are among the major illness affecting children of the slam resident. According to the report by African population and heath research centres (APHRC) in 2002, prevalence of diarrhoea was 32% among children below 3 years of age in the slams, which is double the rate for Nairobi and national average (10).

Forty six present of less than five years mortality is due to diarrhoea with water related diseases. According to the ministry of health, estimation 6,000 children dies each day from diarrheal and dehydration (11).

Contaminated drinking water is a principal case of the diarrheal disease results in 2.5 million child hood death yearly. Microbiological water quality test can identify were the contamination occurs in the course of collection, transport & home storage. Thus access to safe source alone doesn't ensure the quality of water that is consumed. Further, a better water source doesn't lead to full health benefit in the absences of improved water storage and sanitation (12, 13).

The aim of the present study is to assess the faecal contamination of drinking water in Arba Minch town. Also we tried to examine drinking water quality from the source to the tap water which is ready for use in Arba Minch town including their water storage and cups used for drinking.

According to cross-sectional study conducted on Peru urban households, tima, peru 68% owned their houses and 24% were living on property without a land title. All water was bought from nearby households with water connection 82% or collected from shared standpipe 18%. Both of these out lets provided water from the same high quality source. Two samples taken 1 month apart from the standpipe had chlorine residuals of 0.7 and 0.5mil gram per dices litter, and samples from each of the 2 houses where other participants reported buying water residuals of 0.6 and 0.5 mil gram per dice litters. All sources water samples were negative for faecal contamination. All family without connection used house channel water from the source outlets directly to storage containers in their homes (14).

Study conducted North Gondar seventy water samples were taken from the five types of water sources. 64.29% were constructed with collection both box and the rest, 35.7%, were without collection box, maintenance and disinfection was carried out by 64.29% of the protected springs and wells, but this was not performed regularly. Analysis of protected springs demonstrated that 71.4%, of the samples had all kind of indicator bacteria. Fifty percent of positive samples had faecal coli forms, of these 35.7%, had E. coli. Fifty percent of protected wells had all kinds of indicator bacteria .However 50% of the samples are free from any kind of bacteria. On the other hand analysis of water line demonstrated that 57% of the samples had indicator bacteria. 50% faecal coli form and E. coli only 43% of the water line samples had no coliform (15).

Based on the study conducted in Bahir Dar city the sanitation and hygiene practice was 65.7% collect water without contact with their hand. 51.4% collect water with covered container and 88.5% have no latrine in their house 25.7% replied that they wash their hands with soap after visiting toilet. Then their conclusion was that water supplies at tap and household water container were contaminated. With bacterial poor sanitation low level of hygiene uncontrolled treatment parameters are the result for contamination (16).

A bacteriological analysis of drinking water quality in serbo town. 100ml of water samples were collected from each water sources. The samples were tested by using multiple test tube technique for presumptive coliform count formed by E.coli confirmation. They got total of 87.5% have bacterial count above the pre visible limits for drinking water. They conclude that the majority of water sources had unacceptable total coliform count (17).

On the study conducted on department of Microbiology, Hindustan college of Arts and science, A total of 15 of 20 samples were collected randomly from municipal water supply in sterilized screw capped bottles transported to the laboratory in cold condition and processed within 6-houres of their collection. The bacteriological examination according to American public health association (APHA) included indicator of faecal pollution such as Total coli forms (TC), Faecal coli forms (FC)and faecal (FS). Tc and Fc were estimated by MTF method using lactose broth. Fs were also estimated by MTF method using azide dextrose broth. And Fc test at the tube were both incubated at 370c. Suspension from positive Tc tubes (gas production in the 44.5 inverted Durham's tube) were streaked on Eosin Methylene- blue (EMB) for 24-48 hours. Colonies agar and McCaskey agar incubated at 37oc showing typical characteristics of E.coli, klebsiella, Enterobacter and Citrobacter (lactose fermenting) were isolated, purified and maintained on nutrient agar (17, 18).

According to study conducted on jmma university 24 water samples were collected from the study area. Six above the permissible limits for drinking water. Out of 24 analysed wells, 17 of them were located were from protected wells and eighteen were from unprotected wells. From six protected wells, four of them were public owned and the rest two of them were owned but private. All the water sources had no regular treatment. From these water sours 87.5 %(71/24) have presumptive bacteria count MPN downhill and the rest of the water sources were located above hill. All well located below hill had total coli form count of more than 10per 100ml of water. Of the analysed samples analyse had acceptable faecal coli form count (less than 10 MPN Per 100ml water) from these one source was in an excellent range two of them were within an acceptable range. 75%of

water source were found at ion for minimum distance should be exist between latrine and water source (18, 19). The study could provide data on faecal contamination of water- source and contamination occurs in course of collection, transport and home storage. The information can give bacteriological data essential for every aspect of improvement of public health and control of water quality programs. Therefore, the study aimed to assess the fecal contamination of drinking water and factors which contribute for the contamination of drinking water in Arab Minch town 2012.

2. METHODS AND MATERIALS

2.1 Study setting

Across sectional study was conducted from February to March 2012 in Arab Minch town south Ethiopia.
Arbaminch town is located 500km south of Addis Abeba in southern Ethiopia situated in the great African rift valley in elevations of about 1285 meter above sea level. Total area of the town is estimated about 1095 hectare and its temperature is about 29c and the average rain fall is 900mm. Arba Minch is structured in 4 main sub-cities and 11 Keble's. From the four main sub-cities Nechsar sub-city was selected randomly. Which include three kebeles we selected three "ketenas" by lottery method The present water supply source from fourthy spring the existing water distribution of the town consists three reservoirs in addition to this number of organization have their Owen reservoirs' and this number of town majority of the People use public tapes.

2.2. Study variable

Dependant variable

Faecal contamination of drinking water.

Independent variable

The independent variables include; Hand washing after using toilet, Reservoir washing frequency, Distance of Latrine from drinking water, Storage condition

2.3. Sample size estimation and sampling technique

The sample size was calculated assuming (p), Population proportion for faecal contaminations is 87.5%, 5% marginal error (d) and confidence interval of 95% and by assuming 10% non-response rate the sample was 178. Multi stage sampling technique had been used to select the study population

2.4. Study Population

All house hold in Arba Minch town were the source population and households in Arab Minch town Nechsar sub- city in three kebeles of "wuha minch" "mehal ketema" and "edget ber" were study population.

2.5. Inclusion and exclusion critera

The households using water from:-pipe, reservoir sources, sources used by the town were included to the study while households without residents and households which uses kulifo river water were excluded from the study.

2.6. Material and equipment

Material and equipment used to process faecal contamination of drinking water were autoclave, incubator, balance test tube, test tube rack, cleaning and maintenance equipment refrigerator and others. In house hold selections in the community were visited at time most resident were less busy from Monday to Friday.

Their resident was first asked to rinse each hand for 30 second in a plastic bag containing 100ml of distilled water three water samples were collected in 250ml sterile glass bottles. First sample from drinking water storage container as normally collected by residents. Drinking water as served in a cup then the resident will asked to wash cup as they normally would. Then additional samples were collected from pipe connected separately. Remove any external tilting from the tap. Clean carefully the outside nuzzle of the tap. Turn the tap and allow water run for 1 minute. Sterilize the tap using the flame by igniting peace of cotton wool soak in alcohol holding with a paired of tongs. Allow taps to cool by running the water for few seconds feel the sample bottle from gentle flow of water and replace the bottle cups. Samples from sources Sterile sample bottle on to washed length of robes attached ½ kg weighting stone as weighted below the bottle and we removed the cap from the bottle aseptically and lowered the bottle in to the well to a depth of 1 meter. Rise the bottle out of when no more bubbles raised to the surface replace the bottle cap and labile the bottle and transported to regional laboratory by ice cold within three hours of collection. The water sample would be tested by multiple tubes by using axoid Mac Conckey broth.

2.7. Data collection

Data was collected by structured questionnaire through face to face interview. Households were included if resident were present. Participants provided informed verbal consent for their participation. In the study of 106 households meet our inclusion criteria .The questions were related to water extraction patterns, type of water transport, water treatment method and cleaning habits and sanitation facility.

2.8. Data processing and analysis

The data entry and analysis was done by SPSS software version 16. The frequency distribution of variables had been examined to check for data enter error, means recognized missing codes and out of range values analysis

was performed for some variables. The data were presented by table and graphs.

2.9. Quality control

Faecal contaminated drinking water was processed according to standards operating procedure and laboratory safety rule had been followed. Contaminations by microorganism capable of overnight growth showed by turbidity of in fluid media. The simplest way to test contamination is to incubate the prepared sample media and check microbial growth in the media.

2.10. Ethical consideration

Permission letter was written from Arbaminch University, college of Medicine and Health science, Department of Medical Laboratory to the official bodies who are responsible in relation to water and the aim of the study explained to them; at last we got verbal consent from the responsible bodies to conduct the study.

3. RESULTS

3.1 DEMOGRAPHIC DATA

In almost 169 (95%) of the families visited from them 127 (75%) comprised 1-5 members with in the households and 5(2.9%) houses found with members above ten. The educational level decreased from lower to higher level of education (Table 1).

Table 1, Level of education and Number of family in the houses.

No	Variable	Frequency	Percept
1	Level of education		
	Elementary	25	14.8
	High school	72	42.6
	Diploma	58	34.3
	Higher	14	8.2
2	Number of family		
	1-5	127	75.5
	5-10	37	21.6
	>10	5	2.9

3.2 House hold characteristics

One hundred forty households (88%) had their own latrine the remaining 29 (12.%) haveno latrine. From 169 households 140 of them had their pipe line. One hundred forty samples were taken from the pipe and 108 of 140 indicate the presumptive growth of faecal coli form bacteria. Out of 29 samples taken from the public pipe 10 of them indicate the growth of coli form bacteria.

3.3 Knowledge related to contamination treatment of water in house holds

From the participants majority heard about fecal contamination of drinking water, had home water treatment options. Nearly half of the study participants perceived that the contamination comes from using unclean equipment (Table 3)

Table 3; Knowlage related to contamination and treatment drinking water in household in Arbaminch town 2012.

No	Variables	Frequency	Percentage
1	Heard about contamination		
	Yes	151	89.6
	No	18	10.4
2	How water contaminated		
	Exposure of fly	40	23.6
	Using unclean equipment	75	44.3
	Using open storage	21	12.3
	Contaminated with faeces	33	19.8
3	Household water treatment		
	Yes	132	78.3
	No	37	21.7
4	How you treat water		
	Filtration	13	7.5
	Boiing	21	12.3
	Water agar	65	38.5
	Others	70	41.7

From 169 households 95(89.6%) of the participants heard about water contamination and 11 (10.4%) of them didn't heard about water contamination. From 95 respondents who heard about water contamination 25 (23.6%) had knowledge about contamination of drinking water due to exposure to flies, 47 (44.3%) of them thought using unclean drinking water equipment's may cause water contamination, 13 (7.5%) of them believe using open storage vessels may expose drinking water to contamination, 21(12.3%) of them thought drinking water may be contaminated with faces.

3.4 Water storage and Transport vessel

Transport vessel 9.5% used bucket, 13.2% used canister and almost more than half 77.4% used other material to transport the water as principal water storage 7.5% used tanker 88.7% used jerry can and the rest used high land for storage. From all study house hold 60% clean their storage vessels and 5% did not clean their storage vessel. From house hold 17% wash their vessel of at least daily, 50% was half weakly, 26.4% wash weakly. As drinking water storage 4.7% used bowl, 1.9% used safe cup and the rest 70% used other material for drinking water storage. The above storage materials was made from different material 75.5% was from plastic material, 13.2% from glass and 2.8% from vat. Total of 80 samples were taken from jeer can 65of 80 indicate the growth of E.coli bacteria, out of 16 samples from high land 11 showed the growth of coli form bacteria. From 10 samples taken from bucket 70 percent shows the presumptive growth of E.coli bacteria.

Drinking cups and water conception

The material used for drinking purpose 37.7% used cups made of tin, 57.5% used caps made of glass and1.9% used caps other materials 85.8% put their drinking cups in closed way and 14.2% in open way. The daily conception of the study households is that 45.3% used 10litrs daily 14.2% and 39.6 % was>20 litre.

3.5 Domestic and personnel hygiene

When asked if they cleaned their drinking cup all of the respondents reported that they cleaned their drinking cups. Almost all cleaned daily, 21 (12.3%) cleaned half weekly and 5 of 169 was cleaned weekly. Frome 169 samples taken from cup 137 of them showed the growth of E. coli bacteria. This indicates unacceptable faecal coli form count. More than half of the respondents 88.7% used water with different detergent to clean the material, 5.7% used to clean only water and only 5.7% used boiled water. 72.6% stored their drinking water in closed container and 27.4% stored their drinking water in open container 87.7% of them closed the reservoir after water is fetched, 12.3% did not close the reservoir. As we observed distance of latrine from the drinking water 54.7% was far and 45.3% was near. Type of floor of latrine 41.5% had been made of concert cement and 57.5% had been made of wooden material when we see cleanness of latrine to 57.5% we observed fly infestation and 42.2% there was no fly infestation.

4. DISSCUTIONS

Education was great impact on sanitation. Most participant in our visit were elementary. Their educational level increase from highest grade to the lowest level. In our visit what we observed was in family members greater than five members had poor sanitation of their material. Some households have no later in and they might used open defecation, this leads them to fly infestation, fly infestation also caused by poor sanitation and nearest distance of latrine. The above all factors led's for the contamination of drinking water. The study investigated faecal contamination of drinking water from sources to the cup used for water storage and drinking material used to serve. In our study we found that 83% have their own pipe connection but the study done in Peru urban indicated that water was brought nearby households with water connection 82% of participants or collected from shared stand pipe which helped them to get the same high quality source. Twenty four water samples were collected from the study area. Six were from protected wells and eighteen were from unprotected wells Owned by private. All the water sources had no regular treatment. From these water sources 87.5% (21/24) have presumptive bacteria count MPN above the permissible limits (1, 2, 12).

Most of households in our study have knowledge about contamination. From them majority believed that contamination was by nu cleaned equipment's. More than half of the respondents have knowledge about treatment of drinking water. Much of them did not use any treatment at home. Even though they have knowledge about contamination, they did not the sources. Even if the water was treated at the sources contamination occurred at the transportation vessels and the storage (11).

Most hose holds used jerry cans for transportation and storage of water. But some households used bucket, canister, tanker and barrel. The majority house house holds cleaned their storage and transport vessels weekly, this leads to the contamination of drinking water and storage vessel. The contamination was in relation with storage material and transport vessels.In the study conducted in Lima, Peru urban instead of carrying water in bucket or other containers, all study households used long hoses to root water directly from stand pipe or neighbours spigot to house hold storage containers. Such practice was much easier way to collect water in the steep, rocky condition of the community (14). Contamination of drinking water no association to transport materials and storage materials, because they daily cleaned their storage materials and daily treat their home drink water.

More than half of the respondents used different detergents to clean their material. Few respondents cleaned their materials with boiled water. They daily cleaned their cup but they did not cleaned storage materials frequently. Even though, they cleaned their cup daily their longer stay from cleaning the storage exposed their drinking water to contamination. Hence, the daily cleanness of the cup do not guaranty for safe and pathogen-free drinking water at the point of concumption.In other study the respondents used clean water and most of them boiled water to cleaned their material, because of this reason the contamination was lower than our study.

5. Conclusion and Recommendations

In our conclusion, the water at the tap and the house hold were grossly contaminated with bacteria. The tap and house hold waters were within high health risk. Households who used poor cleaned cup, storage and house hold who did not wash their hands after defecation had high contamination of coli form bacteria.

Based on our study we forwarded the following recommendations. Awareness creation should be done about proper usage of water and keeping personal hygiene. Health education should be given on the contamination and prevention of faecal contamination of drinking water. The best solution remains a connection in home providing clean, chlorinated water.

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