Assessing the challenges of utilizing fluoride filtered water and its factors, in Ethiopian central rift valley, Dugda district, Oromia region, south west Ethiopia,2019: A cross sectional study.

Awash Almebo Tsebe (tsebeawash@gmail.com)
Dilla university https://orcid.org/0000-0002-3552-4483

Hunachaw Beyene
Hawasa universtiy

Adane Erimias
Hawasa universtiy

Alem Eskeziya Ayenalem
Dilla universtiy

Research article

Keywords: Utilization, Community fluoride filter (CF), bone char Filter, Nalgonda Filter, Hydroxyl Appetite Filter (HAP)

Posted Date: January 22nd, 2020

DOI: https://doi.org/10.21203/rs.2.21560/v1

Abstract

Background: The high level of fluoride in the Rift Valley water is due to naturally occurring fluoride that dissolves out of certain acidic volcanic rock formations. However, the utilization of drinking fluoride filtered water with appropriate level of fluoride provides more than 60% of fluoride required by the body. Dugda district is one of the parts of Ethiopian central rift valley(ECRV) that have high fluoride up to 14mg/l in their groundwater source. There are 11 village sized de-fluoridation schemes in Dugda district. Sothe aim of this study was to assess the challenges of utilizing fluoride filtered water, and associated factors, in Ethiopian rift valley, Oromia region, North East Shaw Zone, Dugdadistrict.

Methods: A community-based cross-sectional study design complemented with the qualitative study was conducted from April 11-30, 2018Girigorian Colander. A total of 417 head of households were selected randomly for survey questioner interview,and six in-depth interviews were done with different water and sanitation experts at office level and 12 community key informant interview had done.

Result:In this study, 56.3% of the studded participants utilized fluoride filtered water for drinking and cooking foods.Household with a family history of no fluorosis problem had a statically significant association with utilizing fluoride filtered water 44.4 times (AOR 44.42, CI, (18.83, 24.74) more likely utilized fluoride filter water as compared to their counterpart. More than three forth 321(79.3%) households prefer to utilize filtered water from the newly established filtering techniques so-called HAP (Hydroxyl Appetite Filter), but in practice only181(44.7%), 47(11.6%) utilizetheir water from HAP and bonechar fluoride filteringtechniques respectively.

Conclusion: The results of this study revealed that those H/H utilized community level florid filterwater regularly were less likely affected by fluorosis problem than those H/H not utilized there drinking water from community level florid filter. Accessibility and type of fluoride filtering options were most challenging factors to utilize fluoride filtered water by households.

1. Introduction

The purity of water is scared and gets always contaminated by several pollutants. Fluorine is one of such contaminants that contaminate water all place around the universes. Fluoride is beneficial for the development of enamel when found in small concentration about 0.7 mg/l and causes severe health problems when finding above 1.5 mg/l in groundwater. The fluorosis was pervasive among the 200 million people groups from more than 30 nations over the globe (1). Fluorine (F_2) is a pale, yellow-green, corrosive gas which almost cannot be found in the natural environment in elemental form due to its high electronegativity and reactivity. Fluoride (F^-) is a fluorine anion characterized by small radius, great tendency to behave as ligand and easiness to form a great number of different organic and inorganic compounds in soil, rocks, air, plants, and animals. Some of those compounds are quite soluble in water, so fluoride is present in surface and groundwater as an almost completely dissociated fluoride ion (2). In most Ethiopian central refit valley (ECRV), the source of drinking water supply commonly comes from a groundwater source. The borehole water supply has several constraints in that it is limited in supply, often very brackish and hard and many times very high in mineral contents like fluoride (3).

The ECRV is part of a larger basin that extends from Syria and Jordan to Malawi and Mozambique. Due to its geological and climatic characteristics, the ECRV has some of the world's highest concentrations of Fluoride, found mainly in deep wells in the semi-arid parts of the region. The main source of F is the acid volcanic rocks found in the ECRV, which have both high F and low soluble calcium concentrations. Over 40% of deep and shallow wells are contaminated with concentrations up to 26 mg Fluoride per litre, However, the distribution of Fluoride in the deep wells is variable, even among wells that are closely spaced (4). Multiple factors need to be considered when choosing the appropriate fluoride removal technology: Cost and availability of material, capital investment and running cost, simplicity in design and operation, by-products during the course of the treatment, removal capacity, acceptance by the community and willingness to pay(5). Fluoride in groundwater is influenced by surface water/groundwater interactions, geothermal inputs, and aquifer geology. Mitigation options include

safe sourcing (locating primary low fluoride sources); alternatives are de fluoridation and multi-village piped water schemes the former dependent on NGO capacity and subsidy andcommunity involvement, the latter on investment, infrastructure, and professional management. Of the options, de-fluoridation is the least sustainable(6).

Many de-fluoridation techniques already exist, but there is still no one method that has been found effective, safe and cheap enough to implement widely; Tare is gap in choosing the locally acceptable, affordable and sound community de fluoridation technologies that implemented for local community in the study area.(7).Groundwater de-fluoridation options vary in scale (from household to community level), efficacy, sustainability, and user acceptance. Acceptance depends significantly on social problems experienced from fluorosis and on local beliefs, and experience has shown that awareness campaigns can play a significant role in determining acceptance(4).

A cross-sectional study done on preference of utilizing water from Community fluoride filter in ECRV revealed that out of 211H/H interviewed 45% state they use only filtered water for both drinking and cooking, 25.5% use filtered water between 50 to 75%, 20.9% use variable means that they use fluoride filtered water less than 50% of their total water consumption; 8.1% use at least 75% of the water from community level fluoride filter and 1.3% reported not yet consuming filtered water. Moreover, on average 89.9% of the respondents reported thatthe source of their drinking water is from community filter water schemes, but only 62.8% use filtered water for cooking. On average one household buy 4.9 jerry can of filtered water per week this implies one person use 2.9 litter per day, but in practice, one person consumes 4.4liter per day in this village this indicate that almost 50% of water utilized by each household comes from high fluoride contaminated water sources (8). Identifying and assessing the utilization challenge of implemented technology options for community benefit is significant to sustain the implemented fluoride mitigation technology for community benefit. Few data is available regarding the current status of Fluoride mitigation programs implemented in the ECRV, Particularly in Dugdadistricts Assessing the challenges of utilizing fluoride filtered water from nalgonda, HAP, and bone char CF. and its factors, of these implemented mitigation technology help to identify its present history of community fluoride filter water supply schemes and used to explain how many people remain dependent on non-fluoride filtered water sources options. So the aim of this study is to assess the challenges of utilizing fluoride filtered water, and its factors, In Ethiopian central rift valley, Dugdadistricts, Oromia reign, April 2018.

2. Methods

2.1 Study design and setting

A community-based cross-sectional study complemented with the qualitative studywas conducted from April 11-30, 2018G.C. in Dugdadistrict; part of ECRV area found in Oromia reign, North East Shaw Zone. This district has a total population of 115504. The district divided into 1 Town and 34 rural district administrations. Among those34 rural districts, only 8 districts have implemented Community fluoride filter water Schemes. Starting from 2005 there were 9 Nalgonda filter and 8 bone char filter schemes so-far piloted in that 8districts by OSHO and Ethiopian, Catholic Church. For this study the following 3 districts who have Nalgonda and bone char filter water schemes were included namely; TuchiGragonavillage (820H/H), DodotaDenbel village (843H/H) and JwwaBofoo village(582 H/H). Those selected villages were one of the florid mitigation intervention project areas in ECRV that respectively found at a distance around 5km, 6.5km, and 8km from Maki Town.

2.2 Sampling procedure

A total of 417H/H were selected by using malty stage sampling followed by simple randomsampling procedure. From a total of 23101 H/H in 34 clusters of Dugdadistrict 8 clusters ware purposively selected that have a fluoride mitigation implementation schemes; then from out of 8 clusters; 3clusters were selected randomly and finally a total of 417 sample size ware proportionally allocated for those selected 3 clusters, and each household were sampled by a simple random sampling method.

2.3 Data collection procedure

Data was collected using structured interviewer-administered questionnaire. The questionnaire was adapted from the different relevant literature on community fluoride filter water utilization with required modifications based on the research objectives. The questionnaire was prepared in English and translated to Amharic and Afaan Oromo language then translated back to English to check uniformities. For the community survey, from a total of 23101 H/H in 34clusters of Dugda district 8 clusters werepurposively selected that have a fluoride mitigation implementation schemes; then from out of 8 clusters3 clusterswere selected randomly and finally the 417 total sample size were proportionally allocated for those selected 3 clusters and each household were sampled by a simple random sampling method.

2.4 Data quality control

The quality of the data was maintained before, during and after the data collection. To maintain the quality of data to be collected, interviewers and supervisors were trained on the significance of the research, independent factors, interviewing techniques, how to control the quality of data and effectiveness of data collectors, the importance of privacy, confidentiality, discipline and other relevant information on the questioner one day training was given for interviewers and supervisors about the data collection tools and the approach that they were to follow. Pre-test was done by taking 5% of sample questioners in one cluster out of the actual data collection area of Dugdadistrict and modification was made accordingly. Furthermore, supervisors and the principal investigator checked the collected data carefully on daily basis for their completeness, accuracy, and clarity. Pre-test of the questionnaire was carried out on 5% of respondents whose socio-demographic factors are the same with those actual study participants at Abono Gabriel clusters of Dugdadistrict (out of actual data collection site). During pre-test, the interviewers & supervisors were assessed the clarity and understand ability of the questionnaire and some correction & changes were made on questionnaire be for it was duplicated for actual data collection.

2.5 Data process and analysis

The collected data were entered, cleaned, coded, and analyzed by using SPSS version 20.0 windows program. Frequencies, data validation, and cross tabulations were used to check for completeness and consistency whereas selecting cases and sorting was used to identify outliers. Descriptive statistics (Frequencies, proportions, and measure of central tendency and measure of variation) were used to describe the study subjects. Bivariate analysis was used primarily to check which variable is associated with dependent variable individually. To limit the number of variable and unstable estimates in the subsequent models, only variables with p value < 0.25 in the bivariate analysis were further entered into the multivariate logistic regression model. In order to assess the goodness of fit of the final model Hosmer and Lemeshow goodness of fit test and log likelihood was applied. The result was presented using the crude odds ratio (COR), Adjusted Odds Ratio (AOR) and Confidence level (95% CI). Finally in all analyses, P value<0.05 was considered as significant and presented by adjusted odds ratio (AOR) with 95%C.I. Odds ratio was used to measure strengthen and identify factors associated with utilization of fluoride filtered water by the community from implemented functional mitigation intervention water schemes. Multivariate analysis was used to evaluate independent effects of selected variables controlling the effects of others. Finally, the result of this study was presented using the adjusted odds ratio (AOR) and confidence level (95% CI). In all analyses, P value <0.05 was considered as a level of significance. For the qualitative data, the thematic content analysis was applied, through identifying and categorizing patterns in the data by exploring factor. After having transcribed the whole data set, an in-depth analysis was carried out, through careful reading of the data and finally, conclusions were made by triangulating both quantitative and qualitative results.

3. Result

3.1 Socio-demographic characteristics of respondents

A total of four hundred five (405) head of households were interviewed with a response rate of 97.2% for questioner interview. Twelve (12) community members and six (6) water sanitation and quality experts for key informant interview with 100% response rate were participated in the study. The mean age of the respondents were 38.58 (SD) (7.98) years, with 26 and 62 years minimum and maximum age respectively. More than halves of the respondents, 275 (67.5%) were married and 305(94.1%) live in rural area. One hundred eighty-three, (45.2 %) of the respondents were illiterate and 211 (52.1%) were orthodox religion followers (*Table 1).*

3.2 Fluoride filtered water Utilization Challenges

Two hundred twenty-eight (56.3%) of the interviewed households were used fluoride filtered water from community fluoride filter water schemes for drinking and cooking foods. The reaming 177 (43.7%) utilized water from non-fluoride filter water schemes. Three hundred twenty-five (80.2%) of interviewed households were traveled a distance less than 1.5km and only 80 (19.8%) traveled greater than 1.5km for collecting water for drinking. Two hundred eleven (52.1%) were regularly getting filtered water, 17(4.2%) get irregularly and 177(43.7%) not get filtered water at all. were as the minimum and maximum water tariff 258(63.7%) pay 0.50 birr and 80 (19.8) pay 0.75 birrs for 20 liter respectively. However, 89(22%) of the interviewed households did not afford to pay for water tariff. Three hundred sixty- one (89.1%) of the interviewed households used “Jerri cans” for water storage and 44(10.9%) used a clay pot to store drinking water in their home. Three hundred forty-eight (85.9%) of the interviewed households had good knowledge about community fluoride filter water schemes. Moreover more than three forth 321(79.3%) prefer to utilize filtered water from the newly established filtering techniques so-called (HAP), only 70(17, 3%), and 14(3.5%) prefer to utilize from bone char and Nalgonda filter techniques respectively. In practice only 181(44.7%), 47(11.6%) utilize their water from HAP and bone char filter techniques respectively. (*Table2).*

3.3 Factors associated with community fluoride filtered water utilization

3.3.1 Bivariate analysis

Socio-demographic factors: As it is presented in table 3 below; the bivariate logistic analysis of socio demographic characteristics with fluoride flirted water utilization revealed that age groups >45 [(COR) = 0.31; 95% (CI) (0.19,0.53)],religion, [(COR) = 4.82; 95%(CI) (2.35,9.89)] level of education Illiterate [(COR) = 0.62; 95% (CI) (0.39,0.98)] and family income [(COR) = 5.3; 95%(CI) (2.5, 11.3)] categories were significantly associated, while sex [COR = 0.815, 95% CI: (0.545, 1.22)], marital status, [(COR) = 1.056; 95%(CI) (0.69, 1.60)] another occupation [COR = 0.679, 95%CI: (0.363 1.272)] and place of residence [COR = 1.564, 95% CI: (0.683, 3.58)] did not show significant association with community fluoride filtered water utilization.

utilization challenge factors: The bivariate logistic analysis of socio demographic characteristics with fluoride flirted water utilization revealed that fluoride filtered water tariff [COR = 0.23 95%, CI 0.11. 0.45), H/H getting filtered water regularly [COR = 7.46, 95% CI: (4.46, 11.63], affordability [COR = 6.15, 95% CI: (3.58, 10.57)], distance travelled for water collection [COR = 1.88, 95% CI: (1.15, 3.10)].H/H who have family affected history[COR = 32.44, 95% CI: (18.58,56.66)], NO.times supply brace per week[COR = 6.66, 95% CI: (2.48, 17.90],were all significantly associated with community fluoride filtered water utilization.

Behavioural Factors: This study showed that behavioural factors such as H/H who have poor knowledge about fluorosis problem and CF. water schemes COR = 0.397, 95% CI: (0.22, 0.71], were significantly associated. No significant association showed for preference of community filtering schemes COR = 1.02, 95% CI: (0.63, 1.65] with community fluoride filtered water utilization in the bivariate analysis *(Table 3).*

3.3.2 Multivariable Analysis

As it is indicated in the above bivariate logistic regression table age, greater or equal to 45, illiteracy, family income, H/H get filtered water regularly, filtered water affordability, distance travelled less than 1.5km, water tariff less or equal to 0.50birr, H/H have history of affected family by fluorosis, H/H knowledge of CF, and number of times water supply break per week were variables with P- value less than 0.05, has taken as a candidate for multivariate analysis. In multivariate analysis,

household who had no a history of the affected family in the last 10 years were 44.4 times [AOR = 44.4, 95% CI: (18.8, 104.74)] more likely utilize community fluoride filtered water compared to their counterparts of non-fluoride filtered water users. The fluoride filtered water utilization among those households who had family income less than 1000birr0.03 times [AOR = 0.03, 95% CI: (0.004, 0.226)], household who had not afford to pay for water tariff 0.28 times [AOR = 0.28, 95% CI: (0.004, 0.226)], and household who collect a 20 litter filtered water with great or equal to 0.50 birr 0.385 times [AOR = 0.385, 95% CI: (0.16, 0.91)].had all less likely utilize filtered water compared to their counterparts respectively.

Behavioural factors, the odds of utilized community fluoride filtered water among household had good knowledge about community fluoride filter schemes was 5.93 times [AOR = 5.93, 95%CI: (1.30, 26.95)] higher compared to their counterparts.

The likelihood of utilizing community fluoride filtered water was found to be significantly higher among household who had no a history of the affected family in the last 10 years 44.4times [AOR = 44.4, 95% CI: (18.8, 104.74)] more likely, as compared to their counterpart *(Table 4).*

4. Discussion

A Community survey study through one-time face-to-face interviews to assess the utilization and characterize existing fluoride filter water scheme systems and obtain public opinion for utilizing filtered water from different filtering methods and community acceptance to sustain the CF. methods were conducted in Dugda district, Oromia reign. This study revealed the coverage of community fluoride filtered water utilization at the time of this study was 56.3% this utilization was comparable or nearly similar with studies done at the northern part of the Ethiopian Rift Valley that revealed the consumption of fluoride-free water dropped to less than 60% (9). But, lower as compared to studies done at Weyo Gabriel, An average of 65 % (SD 33.8 %) of the total water consumption was fluoridefiltered water. One hundred eight-one (44.5% of H/H utilize fluoridefiltered water from the newly established filtering techniques so-called (HAP), only 70(17.3%) and 14(3.5%) of H/H utilize fluoride filtered water from bone char and Nalgonda techniques respectively. This result was higher than study done anther clusters in Oromia; Weyo Gabriel village that 18% of the study community preferring the new alternate and 55.8% prefer the existing Community filter respectively(10). In this study; family income, affordability, water tariff, H/H have a history of affected family and H/H knowledge about fluoride filter options are factorsthat associated with community filtered water utilization.

As it is obtained from key informant interview result and community survey result 211(52%) of the interviewed H/H had orthodox religion followers in the area and they believe that bone char filters were interrupting the pasting day of their religion so that it is not acceptable by most of the local community in the area due to religious reason. However, those Protestants were not opposing the bone char filter methods; this is the reason that way those protestant religion followers were more likely to use filtered water than compared to their counterparts of orthodox. This result was comparable with a study done in one rural clusters in India the Taboo limitations especially the bone char method is culturally not acceptable to Hindus. The bone char origin from pigs may be questioned by Muslims. Even the charring of bones has been reported to be repulsive(11).

Household who had afford to pay for filtered water [AOR = 0.28, 95% CI, (0.004, 0.226)], family income [AOR = 0.03, 95% CI, (0.004, 0.226)] and water tariff [AOR =, 0.385 95% CI, (0.46, 0.91)] had less likely associated with community filtered water utilization compared to their counterparts respectively. This result was due to that as it is indicated in result part more than 80% of the respondents reported that they were not able to pay for fluoride filtered water; as it obtained interview the maximum water tariff in Dugda district was 18 birr per 1m3 means 0.36 birr per 20 litre filtered water in Oromia and 0.2 to 0.3 Ethiopian birr per 20litter in SNNPR district and clusters, in practice this tariff ranges up to 0.50 birr per 20 litter or 25birr per 1m^3 in Dugedadistrict at 3 clusters. However only 89(22%) of the interviewed households were not afford to pay for water tariff. Water tariffs have been also raised to increase the high Operational costs this was higher than a study done in ArsiNegelledistrict; that the water tariff was up to 14 Ethiopian Birr/m^3 is in place(6). Operational costs ranges typically between 0.63 and 28.44 Ethiopian Birr/m3 this becomes higher in case of power cuts because of the use of generators.

Household with a family history of fluorosis problem had statically significant association with utilizing floured filtered water (AOR 44.42, CI, (18.83, 24.74) as is indicated in part four result section; The likelihood of utilizing community fluoride filtered water was found to be significantly higher among household who had no a history of affected family in the last 10 years [AOR = 44.4, 95% CI: (18.8, 104.74)] as compared to their counterpart. In this study, the prevalence of fluorosis case among interviewed 3 clusters at Dugdadistrict was 10% that was 5.1% among age less or equal to 14 years and 4.9% among age greater than 14 years respectively. This study was lower than study done at the Main Ethiopian Rift valley on dental Fluorosis prevalence and severity among 491 children (10 to 15 years was reviled a prevalence of mild, moderate, and severe DF in children's teeth was 17%, 29%, and 45%, (12), and in villages with very high fluoride levels (10–14 mg/L) like as some villages in Dugdadistrict fluoride levels up to (9–14.2mg/L) the percentage of lightly and severely affected children age less than 10 to 15 year in Metahara district were respectively 40% and 60 % that is to Mach higher than this study result that 5.1% prevalence among children age less than 14 years. Another case study concerns the area around Lake Lamentation in Kenya fluoride levels ranged between 2.1 and 20.1 mg/l, and fluorosis among children up to age 14 years was 96 %; as 90 % higher than in Dugda district respectively (13, 14).

This study also reviled that among behavioural factors, households who had good knowledge about community fluoride filtering schemes that the odds of utilizing community fluoride filtered water had 5.93 times more likely (95%CI: (1.30, 26.95)] higher among them compared to their counterparts. This indicates that H/H who had good knowledge about community fluoride filter was almost 6 times more utilize fluoride filtered water than those who have poor knowledge's. This study result revealed as a community have better knowledge compared to the study done at Funtale, Adametulu, and Alabadistricts on the knowledge and perception of the community on fluoride mitigation is poor (13, 15). Health extension workers (HEWs) did not teach about fluoride and related health consequences. Dental fluorosis was reported to start at early ages and not commonly perceived as a major problem. However, adolescents worried and felt that they might be singled out when going to other areas. Older people had a skeletal fluorosis, which interferes with their day to day activities (15) In some places in Ethiopian rift valley, most households perceives that whatever the chemical content is, the presence of water is considered as a blessing (15) However, in practise as this study revealed that prevalence of fluorosis among households who used filtered water for the last 10years had only 1.9% that compared to those households not utilized their drinking water from fluoride flittered source had a 7.7% prevalence of fluoride history; this implies these households who utilized their water from filtered source had nearly protected than those not utilized from community filters; even if the Daly fluoride intake is not only from drinking water only all foodstuffs and beverages including water contain at least trace amounts of fluoride. Food seems to be the source of 80–85% of fluoride intake; intake from drinking water is 0.03–0.68 mg d^{-1} and from toothpaste 0.2–0.3 mg d^{-1}(14, 16) Questions regarding water quality showed that people were aware that their water may need to be treated and was intended to do so to minimize health impacts and waterborne diseases. They were also aware of the causes and effects of non-fluoride filtered water quality; however, the some of the community usually has no choice but to use the household level florid filter water they own or the one easily accessible community filter or deemed convenient. This study revile also religious reason had the main challenge for the acceptance of bone char filter in those rural villages; this result was similarly comparable with the community survey result of this study that more than 50% of the study H/Hs were orthodox religion followers and were completely oppose using filtered water by bone char filter in those clusters, In General: according to the interview result obtained from the key informant interview; the Nalgonda filters techniques was almost non-functional except one scheme in the vicinity of Dugda district, catholic church. Even if it was not acceptable by the majority in the area there were 7 functional bone char filter schemes in those 3 clusters. However, from interviewed 405 head of households only 47 (11.6%) of H/H were prefer to utilize filtered water from bone char schemes. This indicates that haw Mach the religious reason influence the acceptance of bone char filter in this local community. Similarly, the result obtained during key informant interview were realize the survey result that during key informant interview most of the participants were complaints against the use of bone char filter techniques. During key informant interview the community report even if they buy a 1kg HAP filter by 120 Ethiopian birrs and 1kg of bone char by 8 Ethiopia birrs and regenerate it for two times per year without knowing why and when they regenerate the filter material; but more than 325(80%) of the local community accept to use filtered water from the newly constructed HAP filtering schemes without considering the variation of cost

among the two filtering alternatives that they expend 120 birrs for 1kg HAP and 0.75 birrs for 20 litter filtered water by HAP most of the local household prefer to use filtered water from HAP filter schemes. This is mainly due to that most of orthodox religion followers believe that drinking the water filtered by bone char filter was interrupt the fasting day so none of the orthodox religion followers can use water from bone char filter schemes and those Protestants and Muslims also complain change of test problem present in bone char filters that practiced as one mien of fluoride mitigation intervention in Dugda district.

5. Conclusion

The overall utilization of households used fluoride filtered water from community fluoride filter water schemes was 56.3%. Moreover more than three forth 321(79.3%) prefer to utilize filtered water from the newly established filtering techniques so-called (HAP), only 70(17.3%) preferred and bone char filter, however, none of the orthodox religion followers had used their water from bone char filter schemes; and only 14(3.5%) prefer Nalgonda techniques respectively. In the study area the implemented floured mitigation techniques of Nalgonda filter was almost 100% nonfunctional and the bone char filter was also faced a great opposition from the local community due to religious reason and currently the community shift to use filtered water by HAP even if its raw material is costly available. The main reason for this faller was that simply implementing hardwires without assessing the felt need of the local community was the entire time end up by zero achievements.

In this study after adjusting for other variable religion, family income, affordability, H/H have history affected family and H/H knowledge about community fluoride filter schemes were factors significantly associated with utilization of community fluoride filtered water.

List Of Abbreviations And Acronyms

CF: Community Level Fluoride Filter, HAP: Hydroxyapatite, ECRV: Ethiopian Central Rift Valley,MWSS: Multiple-village Water Supply Scheme,NFMP: The National Fluorosis Mitigation Project,NCF: Nakaru Catholic Foundation

Declarations

Ethics approval and consent to participate

Ethical clearance was obtained from Institutional Review Board (IRB) of Hawassa University, Medicine and Health Science College and legal written letter for the study area was obtained from Department of Environmental health and final Permission for conducting the study was also obtained from Dugda district, Water ,mining , and Energy Office. All the study respondents were informed about the objective and the purpose of the study, and their verbal consent was obtained before conducting data collection. Confidentiality of the information was assured and collected anonymously.

Consent for publication:“Not applicable”

Availability of data and materials: “The data that support the findings of this studyhas a sort of identifier of individual participants and researcher reserved to send it”

Competing of interest: The author declaresthere is no any competing interest

Funding: “Not applicable”

Author contributions: AAT: was the only author involved in proposal development and conducting the analysis. **AE**&**HB** contributed in supervision and fieldwork activities.**AEA** contributed in writing manuscript .All authors read and approved the final manuscript

Acknowledgment: The author would like to thank Hawassa University Instructors who were advisors of the primary author.

References

1. Waghmare S, Arfin T. <Fluoride-Removal-by-Clays-Geomaterials-Minerals-Low-Cost-Materials-and-Zeolites-by-Adsorption-A-Review.pdf>.International Journal of Science, Engineering and Technology Research, November 2015; Volume 4(I, 11).
2. Habuda-Stanić M, Ravančić ME, Flanagan a. A Review on Adsorption of Fluoride from Aqueous Solution. Open access wwwmdpicom/journal/materials. 2014, ;7( ):6317-66.
3. MOOLA M. Fluoride in Drinking Water and its Effects on Human Health and Nutrition. WRC Report No 1094/1/08. 2008;1(WRC Report No 1094/1/08):1-78.
4. Datturia S, Steen Bergen Fv, Beusekom Mv, Kebede b S. Comparing defluoridation and safe sourcing for Fluorosis mitigation in the Ethiopian central rift valley.. October-December 201524.
5. Bjorvatn K, Bårdsen A, Tekle-Haimanot R. Defluoridation of drinking water by the use of Clay/soil. Department of dental research, university of bergen, Norway faculty of medicine, university of Addis Ababa, ethiopia. 11/9/2017:5.
6. Kofa GP, Gomdje VH, Telegang C, Koungou SN. Removal of Fluoride from Water by Adsorption on to Fired Clay Pots: Kinetics and Equilibrium Studies. Hindawi Journal of Applied Chemistry https: //doiorg/101155/2017/62546834, July 2017,Volume 2017(Article ID 6254683, 7 pages).
7. Kumsa DA, Kebede S, Steenbergen Fv, Beusekom Mv. The Right to Smile: Fluoride and Fluorosis in Central Rift Valley, Ethiopia. Ground water Magazine. January, 2017; 3.
8. Abaire B. Defluoridation: A Means to a Safe Drinking Water Supply in the Ethiopian Rift Valley..Global water initiative. Web. 13 Mar.2012.
9. Vithanage M, Bhattachary P. Fluoride in the environment: sources, distribution and de-fluoridation. Environ Chem, Lett Springer,2015.
10. LEMMA T, Norman Y. Low-cost chemically activated cow bone for fluoride removal from drinking water: batch, field-scale column and business model studies. 2017.
11. Tekle-Haimanot R, Fekadu A, Mekonnen Y. Fluoride levels in water and endemic Fluorosis in ethiopian rift valley. Faculty of Medicine, Addis Ababa University, POBox 4147, Addis Ababa, Ethiopia. 11/24/2017.
12. Resources EloW, University AA, P.O.Box 150461 AA, Ethiopia, 251-114341698 T, www.aau.edu.et, Wweo. Summary of Kori Water Supply and Fluorosis Mitigation Project, Afar Regional State, Ethiopia. Accssed 11/24/2017.
13. Improving the Quantity, Quality and Use of Africa's Water.
14. Huber AC, Mosler H-J. Determining the differential preferences of users of two fluoride-free water options in rural Ethiopia. J Public Health, 2013;21:9.
15. Huber AC, Mosler H-J. Determining behavioral factors for interventions to increase safe waterconsumption: a cross-sectional field study in rural Ethiopia. International Journal of Environmental Health Research, April 2013. 23 (2):12.
16. Ahiablame L, Engel B, Venort T. Improving Water Supply Systems for Domestic Uses in Urban Togo: The Case of a Suburb in Lomé. International Journal of Science, Engineering and Technology Research (IJSETR)Wwwmdpicom/journal/water. 1 February 2012;4(ISSN 2073-4441):12.
17. Ashagrie T. Total Dietary Fluoride Intake and Its Observed Health Effect in Young Children:Case of Bidara Fuka and Dibibisa Kebeles in SNNPR and Oromia Regions: Ethiopian Rift Valley. Desertation June, 2011, Addis Ababa.

Tables

Table 1; Socio demographic characteristics of the head of households in Dugedadistricts, Oromia, Ethiopia April,2018.

Variables(n=405)		frequency	Percentage
Gender	Male	156	38.5
	Female	249	61.5
Age	< 45	236	79.3
	≥45	175	20.7
Educational status	Illiterate	183	45.2
	Read and write	125	30.9
	Primary	97	23.9
Marital status	Married	275	67.9
	Single	28	6.9
	Divorsed	42	10.3
	Widowed	60	14.8
Religion	Orthodox	211	52.1
	Protestant	53	13.1
	Muslim	141	34.8
Average family Income/month	less than 1000birr	89	22
	1000 to 2000birr	280	69.1
	2001 to 3000birr	36	8.9
Family size	Less than 5	270	67.7
	Greater or equal to 5	135	33.3

Table 2: floured filtered water utilization and challenges among households in Dugeda districts, Oromia, Ethiopia April, 2018.

Variables(n=405)		frequency	Percentage
Source of water utilization .	Community fluoride filter	228	56.3
	HAP	181	44.7
	Bone char	47	11.6
	Use non filter source	177	43.7
	Non community filter	177	43.7
	non bone char filter	23	5.6
	Non F/ Nalgonda	14	3.5
	other non-filtered source	140	34.6
Travelled distance	< 1.5km	325	80.2
	≥ 1.5km	80	19.8
Household get filtered water	Regularly	211	52.1
	Get irregularly	17	4.2
	Not get at all	177	43.7
water tariff/20 litter	0.50birr	258	63.7
	0.60birr	67	16.5
	0.75birr	80	19.8
Knowledge of CF. schemes	Good knowledge	348	85.9
	Poor knowledge	57	14.1
Water source regularly face a supply brake	Nalgonda filter schemes	46	11.4
	Bon char filter	40	9.9
Preference of utilizing CF. water schemes options	Nalgonda filter	14	3.5
	Bone char filter	70	17.3
	HAP filter	321	79.3

Table3: Bivariate logistic regression of community fluoride filtered water utilization with predictor variables among 3 villages of Dugeda districts, April,2018.

Variables	Fluoride filtered water utilization				
	Yes	No			
			COR	95% CI	PV
Age					
≥45	27	53	0.31	0.19, 0.53	<0.001**
<45	201	124	1	1	1
Level of Educational status					
Illiterate	91	92	0.62	0.39, 0.98	0.04
Read and write	60	37	1.01	0.59 , 1.74	0.969
Primary	77	48	1	1	1
Religion					
Protestant	40	12	4.82	2.35, 9.89	<0.001**
Muslim	123	71	2.50	1.63, 3.85	<0.001**
Orthodox	65	94	1	1	1
Family income					
< 1000 birr	21	68	0.70	0.29, 1.66	0.421
1000 to 2000birr	196	84	5.30	2.50, 11.30	<0.001**
> 2000birr	11	25	1	1	1
H/H get water regularly7					
Yes	165	46	7.46	4.46, 11.63	<0.001**
NO	63	131	1		
H/H afforded to pay for water tariff					
Yes	207	109	6.15	3.58, 10.57	<0.001**
No	21	68	1	1	
Distance traveled to water collection					
≤ 1.5km	193	132	1.88	1.15, 3.10	0.012
>1.5km	35	45	1	1	
Water tariff					
≤ 0.50 birr	158	100	1.74	1.15, 2.62	0.008
≥0.50 birr	70	77	1	1	
H/H have affected family					
Yes	189	23	1	1	
No	39	154	32.44	18.58, 56.66	<0.001**

H/H knowledge about CF.					
Poor	21	36	0.397	0.22, 0.71	0.002
Good	207	141	1	1	
H/H preference of filtering methods					
HAP	181	140	1.02	0.63, 1.65	0.943
Nalgonda and Bon char	47	37	1	1	
NO of times supply brace per week					
< 3 times	223	154	1	1	
≥ 3 times	5	23	6.66	2.48, 17.90	<0.001**

Table 4: Summary of multivariable logistic regression effects of associated factors and utilizing fluoride filtered water among 3 villages at Dugda district, April 2018.

	fluoride filtered water utilization				
	Yes	No			
Variables			COR with 95% CI	AOR with 95%CI	PV
Age					
≥45	27	53	0.31 (0.19, 0.53)	0.82 (0.29, 2.30)	0.699
<45	201	124	1	1	
Level of Educational status					
Illiterate	91	92	0.62 (0.39,0.98)	1.50(0.55, 4.07)	0.425
Read and write	60	37	1.01(0.59,1.74)	1.30(0.47, 3.58)	0.606
Primary	77	48	1	1	1
Family income					
< 1000 birr	21	68	0.70 (0.29, 1.66)	0.03(0.004,0.226)	0.001
1000 to2000birr	196	84	5.30 (2.50,11.30)	0.59(0.138, 2.52)	0.477
2001 to 3000birr	11	25	1	1	
H/H get water regularly					
Yes	165	46	7.46(4.46, 11.63)	2.73(0.93, 7.97)	0.067
NO	63	131	1	1	
H/H afforded to pay for water tariff					
Yes	207	109	6.15(3.58, 10.57)	0.28(0.004, 0.26)	0.001
No	21	68	1	1	
Distance travelled to water collection					
≤ 1.5km	193	132	1.88(1.15, 3.10)	1.32(0.57, 3.05)	0.519
>1.5km	35	45	1	1	
Water tariff					
≤ 0.50 birr	158	100	1.74(1.15, 2.62)	0.385(0.16, 0.91)	0.030
≥0.50birr	70	77	1	1	
H/H hove affected family					
Yes	189	23	1	1	
No	39	154	32.44(18.58,56.66)	44.42(18.83,24.74)	<0.001**
H/H knowledge about CF.					
Poor	21	36	0.397(0.22, 0.71)	5.93(1.30, 26.95)	0.021
Good	207	141	1	1	

NO of times supply brace per week					
< 3 times	223	154	1	1	
≥ 3 times	5	23	6.66(2.48, 17.90)	0.30(0.02, 4.05)	0.367