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A multilevel analysis of basic water availability in Ethiopia using 2016 demographic health survey

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Drinking water is one of life's most basic need, and people all around the developing world confront irregular water supplies. Still, more than one billion people globally do not have secure water supply and these leads to increasing the risk of death and incurring large costs in the prevention of water-borne diseases. There are limited knowledge on actual water availability in Ethiopia. Therefore, this study was aimed determining basic water availability and its associated factors in Ethiopia. This research used 2016 Ethiopian demographic health survey data. Because of the hierarchical and clustering nature of the data, a mixed effect multilevel logistic regression model was used. In this study, the prevalence of basic drinking water availability in Ethiopia is 51.16% (95% CI 50.04–52.27%). Based on the analysis result, the household head age between 46 and 65 [AOR = 4.08, 95% CI 1.64–10.17], household heads having middle-income level (AOR = 1.22, 95% CI 1.00–1.50), being rural communities [AOR = 4.32, 95% CI 3.07–9.57] and large central regions (AOR = 2.08, 95% CI 1.17–3.68) were significant factors. The magnitude of basic drinking water availability among households in Ethiopia is low. Exploring alternative water sources is important to reduce water interruptions.

Keywords Drinking water, Availability, Interruption, Ethiopia

Drinking water is one of life's most basic need, and people all around the developing world confront irregular water supplies. Access to water in an intermittent system can range from predictable to unreliable, and this distinction can have major consequences for users[1]. Still, more than one billion people globally do not have ready access to an adequate and secure water supply, with more than 800 million of them living in rural areas[2]. Intermittent water supply refers to a piped water supply that delivers water intermittently due to operational constraints like inadequate access, energy, or poor governance[1]. Water supply is crucial for public health, as millions worldwide lack sufficient water for survival and are interrupted for at least a month of the year[3]. At least one billion people globally are experiencing a 24-hour supply outage[4]. The 2015 report revealed that 11.4% of the world lacks safe drinking water, either due to exposure to harmful pathogens or long distances to access it[5]. In 2017, 82% of the world's population (6.2 billion people) used better water sources when they were needed, compared to 74% in 2000, which accounted for 4.6 billion people[6]. In developing countries, 75% of the population does not have access to clean water, leading to increasing the risk of death and incurring large costs in the prevention of water-borne diseases[2]. Many low and middle-income countries experience intermittent water system[7].

Water suppliers and utilities across Africa demonstrate that water availability in five out of thirteen nations falls below the WHO standard (50 L Per Capita Per Day)[8,9]. In Sub-Saharan Africa (SSA), only 57% of the population reports having an upgraded water supply that is completely operational, available when required, conveniently accessible, and delivers excellent quality and safe water[6]. In Sub-Saharan Africa, the number of people consuming surface water decreased by one-third, but the number of people using limited services with a round trip for water collection longer than 30 min more than doubled[10]. In Africa, over 2670 people die every day from diseases related by drinking unclean water, as well as poor sanitation and hygiene[11]. Access to improved drinking water supply in Ethiopia increased from 13 to 52% between 1990 and 2012[12]. However,

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other research in Ethiopia indicated that the proportion of the population consuming untreated surface water climbed to 22.5 and 14.7% in 2005 and 2011, respectively, due to interruption and scarcity[13]. In Ethiopia, 50.3% of households lack an improved water supply[14]. In actuality, Ethiopia alone accounts for 7.5% of the global water crisis[15]. United Nations Children's Fund (UNICEF) report showed that limited access to potable water causes 60–80% of communicable illnesses in Ethiopia, with diarrhea being the primary cause of 23% of under-five fatalities[16]. Ethiopians face water scarcity, requiring up to six hours of walking to collect water, often found to be contaminated[17].

Households with inadequate water access are forced to use unprotected sources, which are exposed to contamination from animal and human waste[18]. Evidence suggests that there is significant variability in the prevalence of fecal contamination in intermittent water supply networks, which has been linked to epidemic spread of waterborne diseases including cholera and typhoid[19]. Furthermore, unprotected sources of drinking water increase bacterial and chemical contamination, endangering health with diarrhea and gastrointestinal infections. Pathogens that cause diarrheal diseases have been connected to dirty water consumption; these pathogens caused 502, 000 diarrhoea fatalities were recorded due to inadequate drinking water, while inadequate hand hygiene amounts to 297 000 deaths[3] Water-washed disease is one of the public health risks associated with a lack of personal hygiene caused by a water scarcity[17]. In addition, lack of sufficient drinking water and sanitation services is a fundamental barrier to tackling the continuing issue of poverty[20]. A shortage of water may hinder individuals from maintaining basic hygiene behaviors at critical times, such as washing their hands before eating or after using the restroom[1] and adequate water is a critical strategy for preventing a CVD-19 epidemic by exercising hand hygiene every 15–20 min[21]. Water scarcity also causes women to bear a disproportionate labor burden, particularly in collecting water from long distances, queuing long periods, and often waking early or late at night[22].

Previous studies have shown that various factors significantly influence the availability of household drinking water[13,23–26]. The rapid development of piped water supplies in Low middle income countries (LMICs), particularly in rural and peri-urban areas[6], combined with climate change[27], places increasing strain on the resources required to maintain water supply functionality, implying that the population served by intermittent water supplies may grow significantly in the coming years. Furthermore, access inequality and willingness to pay for water[28], water losses/less water in system[29], government corruption/power structures[29], demand-supply gap widens[29], increased population and urbanization[30] were some of the most prominent causes of water interruption in developing countries. Historically, few household studies have investigated water continuity and availability in African domestic water systems[8]. Some related systematic studies investigate the consequences of inadequate water availability and its health effects[31,32], while others analyze population coping methods in response to limited supply[33]. Furthermore, some studies' scope is either worldwide or predominantly focuses on other low and middle-income countries (LMICs), rather than Ethiopia[8,32,33]. Other relevant studies focused on quantifying and evaluating water availability, which differed from the current study strategy[8,32,34]. Studies on water availability in underdeveloped countries generally do not exactly identify supplies in a consistent, standardized manner, making the lessons of a particular case study or cultural analysis difficult to apply elsewhere[1] and causes and consequences of water scarcity abound exist. To the best of our knowledge, no previous researches has been conducted in Ethiopia on basic drinking water continuity. Therefore, the study aims to assess the magnitude and its factors influencing basic drinking water availability using a highly efficient model. The study's findings will aid public health policymakers in establishing basic drinking water for the community, thereby reducing the spread of infectious diseases. The findings are also utilized as baseline information for future researchers to anticipate infectious illnesses in Ethiopia.

Methods

Study design

We used data from the Ethiopian Demographic Health Survey 2016. The 2016 Ethiopian demographic and health survey (EDHS) is the fourth survey conducted by the central statistical agency (CSA) between January 18 and June 27, 2016[35]. The CSA conducted the survey in partnership with the Federal Ministry of Health (FMoH) and the Ethiopian public health institute (EPHI), with technical help from ICF International, and financial and technical support from development partners. The data is derived from a nationally representative sample, providing estimates at both national and regional levels, as well as urban and rural areas[35]. This research presents comprehensive, detailed, final outcomes of the survey at the national level, for the nine regional states and two city administrations of Ethiopia. Data was collected by interviewing respondents from the selected households.

Sample size and sampling technique

Each EDHS sample was designed to provide demographic and health indicators at the national and regional levels. The sample design allowed for specific indicators to be calculated for each of Ethiopia's 11 administrative regions: 9 regional states (Tigray, Afar, Amhara, Oromiya, Somali, Benishangul-Gumuz, Southern Nations Nationalities and Peoples (SNNP), Gambela, and Harari) and two city administrations (Addis Ababa and Dire Dawa). The 2016 EDHS surveys included 16,650 homes in 645 clusters. In each survey, each region was divided into urban and rural areas, and samples of enumeration areas (EAs) were picked individually in each stratum. The samples were chosen using a stratified two-stage cluster method. First, clusters were chosen from a list of enumeration area from the population and housing surveys. Second, households were chosen from a list of households in all of the EAs that were chosen for the sample frame. The EDHS dataset and sampling technique were obtained from the DHS website (http://www.measuredhs.com).

Study variables

The dependent variable is basic drinking water availability. In EDHS, households were asked as "Was water from piped water or water from a tube well or borehole was available in the 2 weeks preceding the survey?" Based on the response of households to this questions, those households who had water without interruption for at least one day in the two weeks preceding the survey were considered to having basic water (coded as "1"), and those households who did not have water for at least one day in the two weeks preceding the survey were considered to not having basic water (coded as "0"). The classification was based on EDHS guidelines[36].

The independent variables retrieved for basic drinking water availability include age of household head, sex of household head, educational level of household head, household size, and household wealth index, presence of electricity, household media exposure and time to obtain water. Community-level factors that may influence the availability of basic drinking water include location of residence, region, community-level education, and community media exposure. Some of the individual characteristics were obtained directly from DHS, such as the gender of the household head. Other variables were computed and categorized further. The operational definition and coding of variables are given below. The table (Table 1) contains a summary of the variables extracted at the individual and community level.

Data analysis

EDHS data were coded and further classified. The data was analyzed using STATA version 14.0 software. Before running any analysis, the samples were weighted, followed by descriptive and analytical statistics were performed. EDHS data is hierarchical in character; hence a mixed effect multilevel logistic model was applied. The difference in basic drinking water availability between clusters was calculated using a cluster-level random intercept.

Four models were fitted in the multilevel analysis: the null model (Model 1), Models 2, 3, and 4. The null model (Model 1) simply comprised the outcome variable and was used to examine the variability in basic drinking water supply. Model 2 included individual factors with the outcome variable, whereas Model 3 contained community-level variables with the outcome variable. The fourth model (Model 4) incorporated community and individual variables, as well as an outcome variable. The deviation test was used to assess model fitness.

Variable	Definition	Categories
Age	Age of household head	13–17
		18–30
		31–45
		46–65
		> 65
Sex	The sex of the household head	1 Male
		2 Female
Household head Education	The highest educational level the household head attained at the time of survey	0. No formal education
		1. Primary
		2. Secondary
		3. Higher
Wealth index	Categories were given based on the number and kinds of consumer goods the households owned	0. Poor
		1. Middle
		2. Rich
Household size	The number of household members with which the household head was living.	0. ≤ 3
		1. 4–7
		2. 7^+
Time to get water	Water available on premises plus accessed in less than 30 min in round trip vs. requires greater than 30 min to access	0. ≤ 30 min
		1. > 30 min
Community level variables extracted from EDHS data set		
Place of residence	The place where the household head residing at a time of survey	0. Urban
		1. Rural
Mass media exposure	Defined as the proportion of household heads whohad mass media exposure within the cluster. The aggregate of individual household heads with mass media exposure can show overall mass media exposure of the cluster. It was categorized as high if cluster has more than 50% of household heads with mass media exposure or low otherwise	0. Low
		1. High
Community educational status	Defined as the proportion of household head who attended primary/secondary/higher education within the cluster. The aggregate of individual household head's primary/secondary/higher educational level can show overall educational attainment of the household head in the cluster. It was categorized as high if clusters with more than 50% of primary/secondary/higher education or low otherwise.	0. Low
		1. High
Region	The geographical region of Ethiopia where household heads live. Tigray, Amhara, Oromia, and Sothern nations nationalities and peoples region (SNNPRs) were categorized under larger central regions; Afar, Somali, Benishangul, and Gambella were under Small peripherals, while Metropolis include Harari, Dire Dawa, and Addis Ababa regions.	0 "Metropolis"
		1 "Large central
		2 "Small peripherals

Table 1. Individual and community level variables extracted for assessing basic water availability in Ethiopia.

A random effect (a measure of variation) was estimated by the median odds ratio (MOR), the intra-cluster correlation coefficient (ICC), and the proportional change in variance (PCV). MOR is defined as the central value of the odds ratio between the highest and the lowest basic water availability when randomly selecting two clusters. The PCV reveals the variation in basic water availability in communities that is explained by factors at the individual and community level factors; it was determined using the formula[37]. The ICC indicates the variation in the basic water availability between clusters, which was calculated both manually and using the STATA command[37].

Model Assumptions

The skewness of the data was examined using a histogram, which revealed that it was normally distributed. The relationship between each independent variable was cheked using the multicollinearity test. According to the multicollinearity test results, the variance inflation factor (VIF) of individual-level variables (Model 1) was 1.6, followed by community-level variables (VIF = 1.95) and the final model (VIF = 1.98). Furthermore, the model's fitness was tested using random effect assumptions.

Results

Socio-demographic characteristics of participants

This research includes 7710 weighted household heads. From this, 3944 (51.16%) of household heads had basic water availability. The average age of household heads was 43.8 years. The majority of household heads (34.8%) were between the ages of thirty-one and forty-five. Approximately 5375 (69.72%) were male household heads. According to this study, the majority of survey respondents, 4621 (59.94%), were from rural areas. Household heads with no education accounted for 3473 (45.04%), while those with higher education accounted for 995 (12.91%). The results are summarized in the table below (Tables 2 and 3).

Random-effects and model comparisons

As indicated in Table 3, the ICC in the null model was 0.51, indicating that about 51% of the variations in basic water avalaibltiy between households were attributed to the difference at the cluster level, but the rest 49% were attributed to individual household factors. The MOR value was 4.74, in the null model, which showed the median odds between the lowest and the highest basic water availablity in the clusters. Furthermore, PCV in the final model was 35.42%, indicating that the variation in avalaiblity of water among study households was explained by factors at both the individual and community levels simultaneously. The fourth model has the lowest deviation (7906) and was taken as the best-fitted model (Table 4).

Characterstices	Catagories	Basic water availability, n (%)		Total weigheted frequency (%)	Pearson chi-square (χ2) test
		Yes, *n* = 3944 (51.16%)	No, *n* = 3766 (48.84%)		
Age of HH head	13–17	11(19.54)	42 (80.46)	53 (0.68)	Pr = 0.000
	18–30	883 (45.81)	1044 (54.19)	1927 (24.99)	
	31–45	1362 (50.77)	1321(49.23)	2683 (34.80)	
	46–65	1224 (55.56)	979 (44.44)	2204 (28.58)	
	> 65	465 (55.09)	379 (44.91)	844 (10.95)	
Sex of HH head	Male	2834 (52.73)	2,541 (47.27)	5,375 (69.72)	Pr = 0.000
	Female	1110 (52.45)	1,225 (47.55)	2,335 (30.28)	
Educational level of HH	No education	2097 (60.37)	1,376 (39.63)	3,473 (45.04)	Pr = 0.000
	Pramary	1116 (49.48)	1,139 (50.52)	2,255 (29.24)	
	Secondary	404 (40.92)	583 (59.08)	987 (12.81)	
	Higher	328 (32.98)	667 (67.02)	995 (12.91)	
Wealth index	Poor	1070 (65.53)	563 (34.47)	1,633 (21.18)	Pr = 0.000
	Middle	818 (67.23)	399 (32.77)	1,217 (15.79)	
	Rich	2056 (42.30)	2,804 (57.70)	4,860 (63.03)	
Household size	1–3	1498 (47.42)	1,662 (52.58)	3,160 (40.99)	Pr = 0.000
	4–7	2037 (52.67)	1,831 (47.33)	3,868 (50.18)	
	Above 7	409 (40.05)	273 (59.95)	682 (8.84)	
Having electricity	Yes	1,253 (34.10)	2,423 (65.90)	3,676 (47.68)	Pr = 0.000
	No	2,691(66.71)	1343 (33.2)	4,034 (52.32)	
Time to get water	< 30	2,317 (44.40)	2,901 (55.60)	5,218 (67.68)	Pr = 0.000
	> 30	1,628 (65.32)	864 (34.68)	2,492 (32.32)	
HH media exposure	Yes	1,576 (42.70)	2,114 (57.30)	3,690 (47.86)	Pr = 0.000
	No	2,369 (58.92)	1,651 (41.08)	4,020 (52.14)	

Table 2. Individual characteristics of the household heads. *HH* household.

Characterstices	Catagories	Basic water availability, n (%)		Total weighetd frequency (%)	Pearson chi-square (χ2) test
		Yes, *n* = 3,944 (51.16%)	No, *n* = 3,766 (48.84%)		
Place of residence	Urban	937 (30.34)	2,152 (69.66)	3,089 (40.06)	Pr = 0.000
	Rural	1614 (34.92)	3,007 (65.08)	4,621 (59.94)	
Community level mass media exposure	Low	2892(37.47)	1,733 (62.53)	4,625 (59.99)	Pr = 0.000
	High	1053 (34.12)	2,032 (65.88)	3,085 (40.01)	
Community Educational status	Low	690(66.35)	350 (33.65)	1,040(13.49)	Pr = 0.082
	High	3254 (48.79)	3,416 (51.21)	6,670 (86.51)	
Region	Metropolis	299 (36.13)	529 (63.87)	828 (10.74)	Pr = 0.000
	Large central	3495 (53.38)	3,052(46.62)	6,547 (84.92)	
	Small peripherals	150 (44.90)	184 (55.10)	335 (4.34)	

Table 3. Community-level determinants of basic water availability in Ethiopia.

Characterstices	Catagories	Null model	Model 1	Model 2	Model 3
			AOR [95% CI]	AOR [95% CI]	AOR [95% CI]
Age of HH head	13–17		Ref		Ref
	18–30		3.70 (1.50–9.15)**		3.60(1.45–8.97)**
	31–45		3.66 (1.48–9.04)**		3.62(1.45–9.01)**
	46–65		4.14 (1.67–10.25)**		4.08(1.64–10.17)**
	> 65		3.66 (1.46–9.17)**		3.60(1.42–9.03)**
Sex of HH head	Male		Ref		Ref
	Female		1.00 (0.88–1.14)		1.06 (0.93–1.20)
Welth index	Poor		Ref		Ref
	Middle		1.10 (0.98–1.47)		1.22 (1.00–1.50)*
	Rich		1.03 (0.84–1.26)		1.17 (0.95–1.43)
Having electricity	Yes		Ref		Ref
	No		2.20(1.74–2.78)***		1.27(0.99–1.64)
Residence	Urban			Ref	Ref
	Rural			6.13(3.54–10.59)***	5.42 (3.07–9.57)***
Commintiy level education	Low			Ref	Ref
	High			0.71(0.46–1.09)	0.71(0.47–1.09)
Commintiy level media exposure	Low			Ref	Ref
	High			0.59(0.35–0.99)	0.59 (0.35– 1.00)
Region	Metropolis			1.90(0.99–3.63)	1.89 (0.99–3.60)
	Large central			2.14(1.21–3.81)**	2.08(1.17–3.68)*
	Small peripherals			Ref	
Random effect					
VA		3.36	2.54	2.21	2.17
ICC		0.51	0.44	0.41	0.40
MOR		4.74	4.12	3.84	3.81
PCV		Ref	24.40	34.22	35.42
Model compartion					
Diviance		8090	8024	7926	7906

Table 4. Factors associated with basic water avaliablitiy in Ethiopia, 2021: data from 2016 EDHS. In the table ICC means intraclass correlation coefficient, *MOR* median odds ratio, *PCV* proportional change in variance, *Com. Media* community media use, *Com. Education* community education, *HH* Houshold. *means P-value < 0.05, **Pvalue < 0.01 and ***Pvalue < 0.001.

Mixed-effect analysis of factors associated with basic water availability in Ethiopia

Variables with a P-value less than 0.25 in the bivariate analysis were selected for multivariate analysis. Individual-level variables (Model 1) such as age of the household head and having electricity at the household, wealth index as well as community-level factors (Model 2) such as residence and region were significantly associated with basic water availability. Based on the final model (Model 3), variables such as the age of the head of household, wealth index, residence and region were significantly associated with basic water availability.

The household head age between 18 and 30, between 31 and 45, between 46 and 65 and greater than 65 were significantly associated with basic water availability at the household with [AOR = 3.60, 95% CI 1.45–8.97], [AOR = 3.62, 95% CI 1.45–9.01], [AOR = 4.08, 95% CI 1.64–10.17] and [AOR = 3.60, 95% CI 1.42–9.03] respectively. The household head whose age between18 and 30, between 31 and 45 were 3 times having basic available water when compared with age groups between 13 and 17. The odds of having household water among household head whose age between 46 and 65 was 4 times greater when compared with between 13 and 17. The likely hood of having basic available water at household head ages greater than 65 were 3.60 times higher when compared with household heads with lower ages groups.

The household heads having middle wealth index (income level) 22% (AOR = 1.22, 95% CI 1.00–1.50) times higher odds of having basic available water compared to household heads with poor income level. The likely hood of having basic available water was 5.42 [AOR = 4.32, 95% CI 3.07–9.57] times higher in rural communities than in their counterparts. Communities who live in the large central region were 2.08 times higher in having basic available water than communities living in small peripheral regions of Ethiopia (Table 4).

Discussion

Inadequate or unavailable domestic drinking water has major consequences for health, the economy, society, and the environment. Access to safe and reliable water is essential for human well-being and sustainable development. The Sustainable Development Goals (SDGs) strive to attain universal access to securely managed water, which needs an improved supply to be placed on premises, available when required, and free of pollution[6]. Several additional researches demonstrated that inconsistent water supply contribute to water quality degradation at the home level[38]. Interruptions in piped water supply are likely to increase cholera incidence in an endemic situation through many mechanisms[39]. Evidence suggests that the frequency of interruptions in a water supply is not reliant on whether the supply is improved or unimproved, but rather that each supply type is prone to discontinuities[31]. In this study, the prevalence of basic drinking water availability among households in Ethiopia is 51.16% (95% CI 50.04–52.27%), indicating that water is provided without interruption for at least one day in the two weeks before to the survey. This result is lower than a research performed in Addis Abeba slums, Ethiopia, where 87.9% of households had an intermittent piped water supply for an average of 4.3 days during the two weeks before to the survey[40]. In addtion the current study less than study in Africa[8], in which the majority (89%) reported water availability, but the measurement was either litter per capita per day (LPCD). However, the current finding greater than study conducted in Cameroon[41], which indicated that between 25% and 30% of their study sample had water available water once every two weeks, and 64% of households had water available for only two hours a day. In another research conducted in Malawi, only 40% of households had water available seven days a week[42]. The discrepancy in magnitude may be due to definition of water availability it may be hours per day or per week that water is available at least 12 h per day or 4 days per week, as 'available when needed. In this survey, households' drinking water sources were public tap/standpipe (38.14%), piped to yard/plot (28.83%), tube well or borehole (23.91%), piped to neighbor (7.24%), and piped into dwelling (1.87%). According to reports, discontinuous supplies were either piped water supply or public standpipes[8].

In this finding, availability of basic drinking water is significantly associated with the age of the household heads, which indicated that household heads whose age was greater than 18 years of age had basic water availability when compared with household heads with age groups between 13 and 17. Evidence from studies suggested that households headed by persons aged 35–54 and 55 and above were less likely to have access to improved drinking water sources[43,44]. One possible explanation is that those households with older adults prioritize water availability because as individuals age, their bodies become less effective at controlling water balance, their thirst mechanism weakens, and they may not know they are dehydrated until it is too late. Furthermore, their kidneys may be less capable of concentrating urine, leading to dehydration and electrolyte imbalances.

In this finding, middle income households had basic water availability than those poor households. There is low evidence which indicate the real relation between wealth index and water continuity or basic water availability. However there are related researches which reported the association between wealth index and access to improved water. So, as understand from previous evidences, a better-off households are more likely to consume safe and reliable water[45]. People who have better incomes would intend to fulfill the necessities of life. In addition, the rich can afford the initial high cost of improved water facilities and the poor may be disproportionately underserved in the distribution of public utility[23,46]. Households with poor wealth index and interrupted water supply are more likely to consume contaminated water, increasing their risk of waterborne diseases such as diarrhea, cholera, and typhoid fever. These diseases can cause dehydration, malnutrition, and even death, particularly among vulnerable populations such as children and the elderly. Evidence also supported this results that not all poor people lack adequate water resources[47].

According to the current research findings, rural populations have more basic water availability than urban communities. Other research revealed that in Ethiopia, availability of water is higher in rural (95%) than in urban regions (65%), whereas the contrary is true in South Africa, with 87% reporting having available water when required in urban compared to just 67% in rural[6]. Furthermore, the present findings contradict with prior studies done in Africa[8], there is less domestic water accessible in rural areas than in cities. The current study also finds that this difference between residences is not what one could expect. Since one may predict that urban regions will have infrastructure, laws, investment, diversity, and awareness, which all contribute to better availability of water compared to rural areas[8,43,48]. Furthermore, evidence is supplied to show that having a piped supply can enhance water availability, but it is not definite, and the prevalence of interruptions in a water supply does not depend on whether the supply is improved or unimproved, but that each supply type is prone to discontinuities[8].

On the other hand, the frequency of stoppages of the intermittent water supply may reduce during the rainy seasons because of the increased availability of surface water for the water treatment plant in the urban area[40].

One possible explanation for this research finding is that rural areas have a high availability of water due to a variety of characteristics specific to their environment. For starters, they frequently have access to natural water sources such as rivers, lakes, and groundwater, which provides a continuous and reliable water supply, particularly in areas with high rainfall. Furthermore, rural populations are more motivated to investigate new solutions tailored to their individual needs, such as rainwater harvesting, water storage, and traditional water management practices. Finally, government support and investment in rural water infrastructure, which might include the installation of wells, water treatment facilities, and irrigation systems, contributes to better water availability. These factors, combined with the often close relationship rural communities have with their natural surroundings, can contribute to good water availability. However, it's important to note that this is not conclusive, and many rural communities still face challenges related to water availability, especially in arid regions or areas with poor infrastructure.

Overall, supply interruptions and instability create a vicious loop that exposes the population exposure to unsafe water sources, encourages water storage in households, and restricts hygiene practices. These factors collectively contribute to increase cholera transmission, which is already expanding throughout Ethiopia. The daily fight for water is one of the most challenging aspects of poverty, especially for women and girls who must walk vast distances to get water.

This research also showed that communities found in the large central region of Ethiopia had a better basic availability of water than those in the smaller peripherals. This finding is supported by previous evidence that regions in small peripheral region, such as rural zones in the Somali region and border Afar regions, had limited access to drinking water[49]. The reason might be because large central regions receive a lot of rain throughout the rainy season, which helps replenish water supplies including rivers, lakes, and groundwater. The Blue Nile River and its tributaries flow through the Amhara region, while the Awash River and its tributaries pass through Oromia, forming SNNP with major lakes like Lake Tana and Lake Chamo.

This study has the following limitation: we were unable to compare availability in the context of improved vs. unimproved water supply. Furthermore, there are no equivalent previous researches in Ethiopia to compare with the current findings.

Conclusion

In this research, the prevalence of basic drinking water availability among households in Ethiopia is 51.16%, which is low even if there are no similar comparable standards in Ethiopia. This study demonstrates that deaths and injuries that may have been avoided by boosting hand hygiene and personal cleanliness were not prevented due to a lack of drinking water. Diarrhea is frequent in Ethiopia, and cholera is on the rise in some places; however, this can be avoided by practicing proper handwashing during critical periods. So, if households do not have adequate water, it becomes difficult to prevent waterborne diseases.

Households with interrupted water supply sources are exposed to greater health hazards because microbiological development during stagnant times and domestic storage in response to inconsistent supply. Household head age between 46 and 65, household heads having middle income level, being rural communities and large central regions were significantly associated with basic water availability. The availability of basic water is affected both directly and indirectly by household income level. This meant that the households in poor living conditions do not pay the water cost tariff established by the government, which leads to interruption of water in metropolitan areas, and as a result, people are forced to use unprotected water sources like rivers. Improving living conditions for both urban and rural residents may increase uninterrupted access to clean drinking water in developing countries, including Ethiopia. Furthermore, taking into account the climatic conditions in various geographical areas when designing water supplies is crucial to reducing interruptions in drinking water, particularly during the dry season.

Recommendation

The Ethiopian government should promote water infrastructure that ensuring access to safe and reliable water is crucial for the health and well-being of people, especially in small peripheral regions facing water scarcity or unreliable water supply. In urban area, the government should explore alternative water sources, such as groundwater, that can withstand natural disasters and other emergencies. Furthermore, conducting regular water supply audits and vulnerability assessments is critical for long-term water interruptions. Researchers should focus on the likely causes of interruption and other variables of basic water availability utilizing advanced research methods.

Data availability

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Author contributions
M.E conceptualizing the title and involved in study deign, data analysis and manuscript writing, J.A analyzed involved in data analysis and manuscript writing. "N.T" & "W.B" were a major contributor in editing the manuscript. M.A was involved in method design and analysis. D.K was contributing in study deign, data analysis and manuscript approval. All authors read and approved the final manuscript.

Declarations

Competing interests
The authors declare no competing interests.

Ethics approval and consent to participate
The authors followed DHS standards and procedures to obtain publicly available data from http://www.measuredhs.com. We obtained consent from CSA via its data manager by completing the online form.

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