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Research Paper

Access to basic water, sanitation, and hygiene (WASH) facilities and associated factors in Ethiopia: evidence from demographics and health surveys

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ABSTRACT

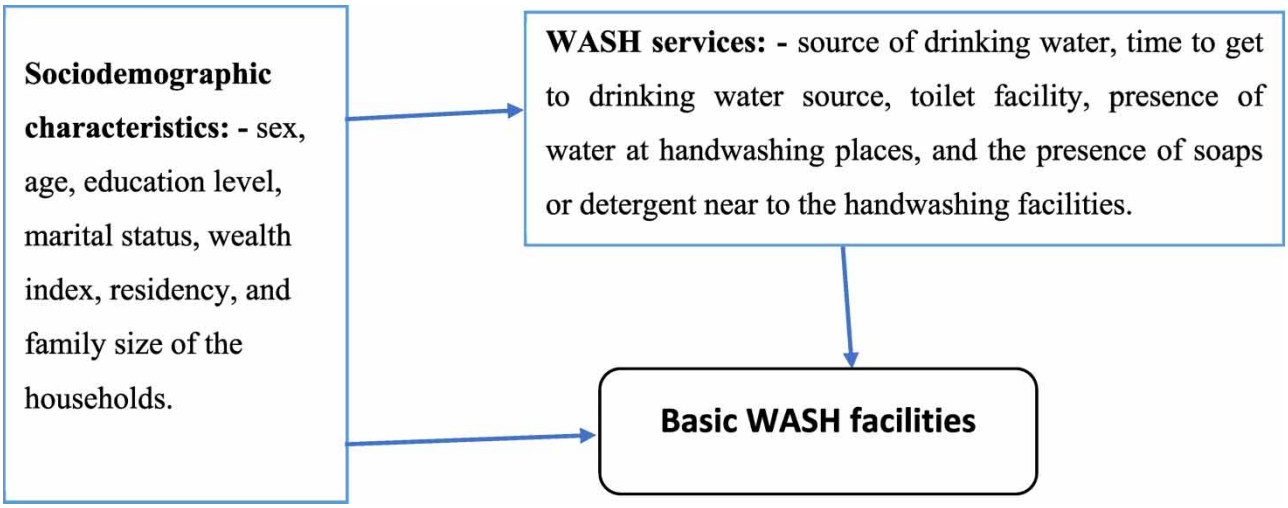
In low- and middle-income countries, ensuring water, sanitation, and hygiene (WASH) facilities for households remains a major public health concern. Therefore, this study aimed to assess households' access to WASH services and associated factors in Ethiopia. A cross-sectional study was conducted among 16,650 and 8,663 households in the 2016 Ethiopian Demographic Health Survey (EDHS) and 2019 Mini-EDHS, respectively. The households were selected using a stratified two-stage cluster sampling technique. Multivariable logistic regression analysis was performed to identify factors associated with basic WASH services. Households' access to basic water services was 65.2% (95% CI: 64.5–65.9%) and 68.7% (95% CI: 68.01–69.4%) in the 2016 EDHS and 2019 Mini-EDHS, respectively. Only 25.9% (95% CI: 25.2–26.62%) in the 2016 EDHS and 27.5% (95% CI: 26.34–28.3%) in the 2019 Mini-EDHS households had access to basic sanitation services. Moreover, only 38% (95% CI: 37.25–38.8%) of households had access to basic hygiene services in the 2016 EDHS. Female-headed households, urban residents, having education, family members $\geq$7, presence of soaps or detergents, and having a better wealth index were the most likely to have access to basic WASH services. The findings in general suggest the need for effective WASH interventions.

Key words: Ethiopia, households, hygiene, sanitation, water

HIGHLIGHTS

- This study will help track the progress toward achieving the SDGs.
- The study was conducted using nationally representative data.
- Households' access to basic WASH services was relatively low in Ethiopia.
- The findings suggested that compressive WASH interventions should be designed.

GRAPHICAL ABSTRACT



INTRODUCTION

Access to water, sanitation, and hygiene (WASH) services is a fundamental human right that is critical to improving health, human growth, and development (United Nation 2010; Agbadi *et al.* 2019; Prüss-Ustün *et al.* 2019). Access to WASH services is directly linked to the health of individuals and communities. Universal access to safe drinking water, adequate sanitation, and good hygiene practices has the potential to reduce the global disease burden (WHO/UNICEF 2021). Adequate WASH services are also necessary to prevent and control the spread of COVID-19 (Desye 2021).

According to the World Health Organization (WHO), the main preventive measures against infectious diseases like diarrheal disease are ensuring access to safe drinking water, improving sanitation facilities, and promoting good hygienic practices (WHO/UNICEF 2021). In 2015, the Member States of the United Nations adopted the 2030 Agenda for Sustainable Development Goals (SDGs) 6, which aims to 'ensure the availability and sustainable management of water and sanitation for all' (Brookes & Carey 2015). SDG #6 Target 6.1 also aims to achieve universal and equitable access to safe and affordable drinking water for all. However, recent estimates show that the progress in access to improved WASH facilities has been disappointing in the least developed countries, including Ethiopia (WHO/UNICEF 2019).

Inadequate access to WASH services has many health consequences; it is the main contributor to the burden of diarrheal diseases and the COVID-19 pandemic. In addition, poor access to WASH is associated with the transmission of many Neglected Tropical Diseases (NTDs) such as guinea worm, trachoma, buruli ulcer, and schistosomiasis, and parasitic worms found in contaminated soil, such as *Ascaris lumbricoides*, whipworm, and hookworm (WHO/UNICEF 2021). It is also known that inadequate WASH has significant economic, environmental, and social impacts (Roche *et al.* 2017).

Globally, 2 billion people lack access to safely managed drinking water, 3.6 billion people do not have access to safely managed sanitation, and 2.3 billion people lack basic hygiene services (WHO/UNICEF 2021). About 446,000 deaths are attributed to inadequate WASH each year in children due to diarrhea (GBD 2016 Diarrhoeal Disease Collaborators 2018). The problem is mostly worsening in Sub-Saharan Africa (SSA) (WHO 2019). In SSA, WASH services remain one of the major public health problems. According to Zerbo *et al.* (2021), 7.75% of the total deaths due to diarrheal disease across SSA are attributed to unsafe WASH services. In Ethiopia, the 2019 Mini-EDHS report indicated that only 61% of the households in rural areas obtain drinking water from improved sources, and more than half (56%) of rural households use unimproved toilet facilities (EPHI *et al.* 2021).

While substantial progress has been made in increasing access to WASH services, billions of people, mostly in rural areas, still lack access to these basic services (Hassfurter 2017; World Bank Group 2017). Progress in WASH conditions may be affected by socioeconomic status, geographic location, and political commitment (Mason & Sarwar 2017). Factors found to be contributing to WASH services in households (Geremew *et al.* 2018; Dagne *et al.* 2019), healthcare facilities (Alene *et al.* 2022; Berihun *et al.* 2022), and schools (Besha & Guche 2016; Shehmolo *et al.* 2021) have been explored in several studies. Although some studies have been conducted on WASH services in Ethiopia, they cannot reflect households'

access to basic WASH services and associated factors at the national level. This indicates that households' access to basic WASH services and their determinant factors in Ethiopia are relatively unexplored.

The COVID-19 pandemic has demonstrated the critical importance of WASH services. Exploring access to WASH services will help track the progress toward achieving SDGs. Consequently, efforts to improve access to appropriate WASH services are required. Hence, this study aimed to assess households' access to WASH services and associated factors in Ethiopia. The findings of this study are helpful for policymakers and health authorities to implement targeted strategies to minimize infectious diseases caused by inadequate WASH services, including the pandemic COVID-19.

MATERIALS AND METHODS

Study setting

This study was conducted in Ethiopia, which has a total population of 123,415,729 (Ethiopia Population Projection 2022). Ethiopia is located in the northeastern part of Africa, also known as the Horn of Africa, lying between 3° and 15° North latitude and 33° and 48° East longitude. It is bordered by Sudan in the West, Somalia and Djibouti in the East, Eritrea in the North, and Kenya in the South, with a total border length of 5,311 km. Administratively, in Ethiopia, there are 11 regional states and 2 city administrations. Furthermore, each state and administration are subdivided into zones, districts, and kebeles (the lowest local administrative units in the country) (EDHS 2016; EPHI *et al.* 2021).

Data source

This study is based on a secondary data analysis using the 2016 EDHS and 2019 Mini-EDHS datasets. The EDHS was conducted by the Central Statistical Agency (CSA) in collaboration with the Federal Ministry of Health (FMoH) and the Ethiopian Public Health Institute (EPHI), with technical assistance from ICF International. The 2016 EDHS and 2019 Mini-EDHS surveys were conducted from January 18, 2016 to June 27, 2016, and March 21, 2019 to June 28, 2019, respectively. This study considered all households in the country in each survey as a targeted population, as it was intended to generalize the basic WASH services at the national level. Data collection was conducted by interviewing respondents from the selected households (EDHS 2016; EPHI *et al.* 2021).

Study design

An analytical cross-sectional study design using secondary data from the 2016 EDHS and 2019 Mini-EDHS was conducted.

Source population

All households in Ethiopia during the study periods in the 2016 EDHS and 2019 Mini-EDHS.

Study population

The study included all households in 645 Enumeration Areas (EAs) in the 2016 EDHS and 305 EAs in the 2019 Mini-EDHS.

Sample size and sampling technique

The sample in each EDHS was designed to provide population and health indicators at the national and regional levels. The sample design allowed specific indicators to be calculated for each of Ethiopia's 11 administrative regions: 9 regional states (Tigray, Afar, Amhara, Oromia, Somali, Benishangul-Gumuz, Southern Nations Nationalities and Peoples (SNNP), Gambela, and Harari) and 2 city administrations (Addis Ababa and Dire Dawa). The 2016 EDHS and 2019 Mini-EDHS samples were stratified and selected in two stages. Each region was stratified into urban and rural areas. Samples of EAs were selected independently in each stratum in two stages. Implicit stratification and proportional allocation were achieved at each of the lower administrative levels by sorting the sampling frame within each sampling stratum before sample selection, according to administrative units at different levels.

In the first stage, a total of 645 EAs (202 in urban areas and 443 in rural areas) in the 2016 EDHS and a total of 305 EAs (93 in urban areas and 212 in rural areas) in the 2019 Mini-EDHS were selected with a probability proportional to EAs size and with independent selection in each sampling stratum. In the second stage of selection, a fixed number of 30 households per cluster was selected with an equal probability of systematic selection from the newly created household listing. Accordingly, 16,650 households in the 2016 EDHS and 8,663 households in the 2019 Mini-EDHS were selected for the survey (EDHS 2016; EPHI *et al.* 2021).

Study variable

Dependent variables

The dependent variables were households' access to basic WASH services. Access to basic WASH services was dichotomized as 'Yes' or 'No.' Coded as Yes = 1 if the household had access to basic WASH service, and coded as No = 0 if they did not have access to basic WASH service.

Explanatory variable

The explanatory variables for this study were as follows: sociodemographic characteristics (sex, age, education level, marital status, wealth index, residency, and family size of the households) and WASH services (source of drinking water, time to get to the drinking water source, toilet facility, presence of water at handwashing places, and presence of soaps or detergents near the handwashing facilities), as depicted in Tables 1 and 2. The variables were selected based on the literature review of factors affecting access to basic WASH services (Agbadi *et al.* 2019; Ahmed *et al.* 2021; Andualem *et al.* 2021; Gaffan *et al.* 2022).

Table 1 | WHO/UNICEF Joint Monitoring Program (JMP) ladder for WASH services

Service level	Water	Sanitation	Hygiene
Basic	Drinking water from an improved source, provided collection time is not more than 30 min for a round trip, including queuing	Use of improved facilities that are not shared with other households	Availability of a handwashing facility with soap and water at home
Limited	Drinking water from an improved source, for which collection time exceeds 30 min for a round trip, including queuing	Use of improved facilities that are shared with other households	Availability of a handwashing facility lacking soap and/or water at home
Unimproved	Drinking water from an unprotected dug well or unprotected spring	Use of pit latrines without a slab or platform, hanging latrines or bucket latrines	Not applicable
No service	Surface water	Open defecation	No handwashing facility at home

Source: Adapted from WHO/UNICEF Progress on Household Drinking Water, Sanitation and Hygiene (2000–2020) (WHO/UNICEF 2021).

Table 2 | WHO/UNICEF JMP ladder for improved and unimproved for water and sanitation facilities

Facilities type	Drinking water	Sanitation
Improved facilities	*Piped supplies* • Tap water in the dwelling, yard or plot, including piped to a neighbor, and public taps or standpipes *Non-piped supplies* • Boreholes/tube wells, protected wells and springs, rainwater, packaged water, including bottled water and sachet water, delivered water, including tanker trucks and small carts/tanks/drums, and water kiosks	*Networked sanitation* • Flush and pour-flush toilets connected to sewers *On-site sanitation* • Flush and pour-flush toilets or latrines connected to septic tanks or pits, Ventilated Improved Pit (VIP) latrines, pit latrines with slabs (constructed from materials that are durable and easy to clean), and composting toilets, including twin pit latrines with slabs and container-based systems
Unimproved facilities	*Non-piped supplies* • Unprotected wells and springs	*Networked sanitation* • Flush and pour-flush toilets flushed to an open drain or elsewhere *On-site sanitation* • Pit latrines without slabs, open pits, hanging toilets/ latrines, bucket latrines, including pans, trays or other unsealed containers

Source. Adapted from WHO/UNICEF Progress on Household Drinking Water, Sanitation and Hygiene (2000–2020) (WHO/UNICEF 2021).

Data processing and analysis

Statistical analysis was performed using SPSS version 25 software. Descriptive statistics were used to be computed like frequencies and percentages. Bivariate and multivariate regression analyses were used to analyze the weighted data. Bivariate regression was applied to determine the unadjusted effects of each of the variables. The variables with a *p*-value of 0.20 were then moved to multivariable regression to assess the independent effect after other variables were controlled. The variables with a *p*-value <0.05 were considered statistically significant. Multi-collinearity diagnostics were conducted to exclude variables with a Variance Inflation Factor (VIF) of greater than 10 from multivariable regression.

Data quality assurance

To maintain the data quality, the data collection tools were pretested, and the data collectors were trained. Following the fieldwork, a debriefing session was held, and modifications to the data collection tools were made based on lessons drawn from the exercise (EDHS 2016; EPHI *et al.* 2021).

Ethical consideration

Since the study used secondary data analysis of the publicly available datasets, ethical approval was not required. However, at the start of each household interview, EDHS surveyors obtained informed consent, and data were obtained from DHS after being registered and requested from https://dhsprogram.com/data/.

RESULTS

Household characteristics

About 68.5% in the 2016 EDHS and 72.6% in the 2019 Mini-EDHS of households were male-headed. Regarding household head age, the age categories of 30–44 years covered the highest, 35.5 and 37.6%, respectively, for the 2016 EDHS and 2019 Mini-EDHS. About 68.6% in the 2016 EDHS and 69.5% in the 2019 Mini-EDHS of people lived in rural areas. Of the total household heads, about 52.4% in the 2016 EDHS and 47.7% in the 2019 Mini-EDHS had no formal education, as shown in Table 3.

Households reported access to WASH services

Household access to improved sources of drinking water was 65.2 and 68.7%, respectively, in the 2016 EDHS and 2019 Mini-EDHS, and only 25.9% in the 2016 EDHS and 27.5% in the 2019 Mini-EDHS of the households had access to improved sources of toilet facilities. Of the total households, only about 38% of them in the 2016 EDHS had water at their handwashing place. A majority of households (75.7%) had no soaps or detergents near handwashing facilities, as reported in the 2016 EDHS, as shown in Table 4.

Factors associated with households' access to basic WASH services

Water

Households' access to basic drinking water service was 65.2% (95% CI: 64.5–65.9%) in the 2016 EDHS and 68.7% (95% CI: 68.01–69.4%) in the 2019 Mini-EDHS. Factors associated with household access to basic drinking water services were sex, age, residency, education level, wealth index, and the time taken to fetch water, as depicted in Table 5.

In the 2019 Mini-EDHS, female-headed households were 1.5 (95% CI: 1.3–1.7) times more likely than male-headed households to have access to basic drinking water services. Household heads aged 45–59 years had 1.24 (95% CI: 1.1–1.15) and $\geq$60 years had 1.8 (95% CI: 1.2–2.5) times as much access to basic drinking water services in the 2016 EDHS, and household heads aged 45–59 years had 1.2 (95% CI: 1.02–1.5) and $\geq$60 years had 1.2 (95% CI: 1.1–1.5) times as much access to basic drinking water services in the 2019 Mini-EDHS, compared to those household heads who were under 30 years old. Households living in urban areas were 2.4 (95% CI: 1.01–1.5) times more likely to access basic drinking water services than rural households in the 2019 Mini-EDHS.

Moreover, in the 2019 Mini-EDHS, the odds of having access to basic drinking water services were significantly higher in households having primary education 1.2 (95% CI: 1.04–1.4), secondary education 1.3 (95% CI: 1.01–1.7), and higher education 1.3 (95% CI: 1.02–1.7) compared to households having no formal education. Poorer households 2.2 (95% CI: 1.9–2.6), middle households 3.1 (95% CI: 2.6–3.6), richer households 5.4 (95% CI: 4.4–6.5), and richest households 28 (95% CI: 20–48) were more likely to have access to basic water services than poorest households reported in the 2019

Table 3 | Household characteristics in the 2016 EDHS and 2019 mini-EDHS

Variables	Categories	2016 EDHS, *n* (%)	2019 Mini-EDHS, *n* (%)
Sex of household head	Male	11,413 (68.5)	6,291 (72.6)
	Female	5,237 (31.5)	2,372 (27.4)
Age of household head (years)	15–29	3,359 (20.2)	1,854 (21.4)
	30–44	5,917 (35.5)	3,257 (37.6)
	45–59	3,707 (22.3)	1,919 (22.2)
	≥60	3,667 (22)	1,633 (18.9)
Residency	Urban	5,232 (31.4)	2,645 (30.5)
	Rural	11,418 (68.6)	6,018 (69.5)
Marital status	Never married	1,046 (6.3)	2,252 (26)
	Married	12,070 (72.5)	5,718 (66)
	Windowed	2,111 (12.7)	173 (2)
	Divorced	1,423 (8.5)	520 (6)
Family size	1–3	6,258 (37.6)	3,051 (35.2)
	4–6	7,031 (42.2)	3,668 (42.3)
	≥7	3,361 (20.2)	1,944 (22.4)
Educational level	No education	8,726 (52.4)	4,128 (47.7)
	Primary	4,658 (28)	2,715 (31.3)
	Secondary	1,686 (10.1)	963 (11.1)
	Higher	1,580 (9.5)	857 (9.9)
Wealth index	Poorest	4,676 (28.1)	2,093 (24.2)
	Poorer	2,348 (14.1)	1,405 (16.2)
	Middle	2,057 (12.4)	1,285 (14.8)
	Richer	2,020 (12.1)	1,274 (14.7)
	Richest	5,549 (33.3)	2,606 (30.1)

Note: EDHS = Ethiopian Demographic Health Survey; *n* = frequency.

Table 4 | WASH services used by households in the 2016 EDHS and 2019 mini-EDHS

Variables	Categories	2016 EDHS, *n* (%)	2019 Mini-EDHS, *n* (%)
Source of drinking water	Improved source	10,861 (65.2)	5,952 (68.7)
	Unimproved source	5,789 (34.8)	2,711 (31.3)
Time taken to fetch water (min)	<30	7,170 (43.1)	4,269 (49.3)
	≥30	9,480 (56.9)	4,394 (50.7)
Toilet facility	Improved facility	4,306 (25.9)	2,378 (27.5)
	Unimproved facility	12,344 (74.1)	6,285 (72.5)
Presence of water at handwashing place	Water is available	3,429 (38)	–
	Water not available	5,607 (62)	–
Presence of soaps or detergents near to handwashing facilities	Yes	2,199 (24.3)	–
	No	6,837 (75.7)	–

Note: EDHS = Ethiopian Demographic Health Survey; *n* = frequency; – indicates no data available.

Mini-EDHS. On the contrary, in the 2019 Mini-EDHS, people who traveled ≥30 min to fetch water were 45% less likely 0.55 (95% CI: 0.5–0.6) to have access to basic drinking water services than those who traveled <30 min.

Sanitation

Households' access to basic sanitation facilities was only 25.9% (95% CI: 25.2–26.62%) in the 2016 EDHS and only 27.5% (95% CI: 26.34–28.3%) in the 2019 Mini-EDHS. Factors associated with household access to basic sanitation facilities were sex, age, residency, family size, education level, wealth index, and time taken to fetch water, as depicted in Table 5.

Table 5 | Multivariable regression results from the 2016 EDHS and 2019 mini-EDHS on factors associated with household access to basic WASH services

		2016 EDHS			2019 Mini-EDHS	
Variables		**Water AOR (95%CI)**	**Sanitation AOR (95%CI)**	**Hygiene AOR (95%CI)**	**Water AOR (95%CI)**	**Sanitation AOR (95%CI)**
Sex	Male	1	1	1	1	1
	Female	0.99 (0.9–1.2)	1.03 (0.9–1.2)	1.2 (0.99–1.3)	**1.5 (1.3–1.7)*****	**1.34 (1.2–1.6)*****
Age	15–29	1	1	1	1	1
	30–44	**0.7 (0.6–0.8)*****	**0.65 (0.6–0.8)*****	1.1 (0.97–1.3)	1.1 (0.9–1.3)	1.1 (0.9–1.3)
	45–59	**1.24 (1.1–1.5)***	**0.7 (0.6–0.83)*****	1.12 (0.97–1.3)	**1.2 (1.02–1.5)***	**0.3 (0.02–0.6)***
	≥60	**1.8 (1.2–2.5)***	**0.8 (0.65–0.9)*****	**1.4 (1.1–1.6)***	**1.2 (1.1–1.5)***	**0.5 (0.2–0.9)****
Residency	Rural	1	1	1	1	1
	Urban	0.97 (0.8–1.2)	0.9 (0.73–1.07)	**1.38 (1.12–1.7)***	**2.4 (1.01–1.5)*****	**2.7 (2.2–3.2)*****
Family size	1–3	1	1	1	1	1
	4–6	1.1 (0.95–1.2)	0.9 (0.8–1.04)	1.1 (0.96–1.2)	1.1 (0.9–1.3)	1.04 (0.9–1.2)
	≥7	1.1 (0.95–1.3)	0.9 (0.7–1.02)	1.1 (0.93–1.2)	1.1 (0.9–1.3)	**1.3 (1.06–1.6)****
Education	No education	1	1	1	1	1
	Primary	0.9 (0.8–1.04)	0.93 (0.8–1.09)	1.03 (0.9–1.7)	**1.2 (1.04–1.4)****	0.9 (0.8–1.1)
	Secondary	0.97 (0.8–1.2)	0.93 (0.76–1.1)	1.2 (0.99–1.4)	**1.3 (1.01–1.7)***	**1.3 (1.1–1.7)***
	Higher	1.14 (0.9–1.4)	1.08 (0.9–1.34)	**1.4 (1.2–1.7)*****	**1.3 (1.02–1.7)***	**2.5 (1.9–3.2)*****
Wealth Index	Poorest	1	1	1	1	1
	Poorer	0.98 (0.8–1.2)	1.2 (0.94–1.5)	0.9 (0.7–1.1)	**2.2 (1.9–2.6)*****	0.9 (0.7–1.2)
	Middle	1.04 (0.8–1.3)	**1.25 (1.01–1.6)***	0.99 (0.8–1.2)	**3.1 (2.6–3.6)*****	**0.7 (0.5–0.98)***
	Richer	0.9 (0.7–1.1)	**1.5 (1.2–1.8)*****	1.12 (0.9–1.4)	**5.4 (4.4–6.5)*****	**2.1 (1.3–4.2)*****
	Richest	0.99 (0.8–1.3)	**1.3 (1.01–1.8)***	1.02 (0.8–1.3)	**28 (20–40)*****	**3.7 (2.6–5)*****
Time taken to fetch water	<30 min	1	1	1	1	1
	≥30 min	1.06 (0.9–1.2)	1.01 (0.9–1.2)	0.85 (0.65–1.1)	**0.55 (0.5–0.6)*****	**2.4 (2.06–2.8)*****
Presence of soap or detergent	No	1	1	1	1	1
	Yes	0.9 (0.8–1.05)	1.04 (0.9–1.2)	**5.6 (5–6.4)*****	0.7 (0.6–1.1)	1.1 (0.9–1.3)

Note: EDHS = Ethiopian Demographic Health Survey, AOR = adjusted odds ratio, 1 indicates the reference category.
*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

Compared to households with male heads, female-headed households were 1.34 (95% CI: 1.2–1.6) more likely to have access to basic sanitation facilities in the 2019 Mini-EDHS. In the 2019 Mini-EDHS, urban residents were 2.7 (95% CI: 2.2–3.2) times more likely to access basic sanitation facilities than rural residents. Household heads with a secondary education level were 1.3 (95% CI: 1.1–1.7) and a higher education level were 2.5 (95% CI: 1.9–3.2) in the 2019 Mini-EDHS were more likely to have access to basic sanitation facilities compared to household heads who had no formal education.

Moreover, compared to the poorest households, middle households were 1.25 (95% CI: 1.01–1.6), richer households were 1.5 (95% CI: 1.2–1.8), and the richest households were 1.3 (95% CI: 1.01–1.8) in the 2016 EDHS, and richer households were 2.1 (95% CI: 1.3–4.2) and 3.7 (95% CI: 2.6–5) in the 2019 Mini-EDHS, more likely to access basic sanitation facilities. As reported in the 2019 Mini-EDHS, households traveling to fetch water ≥30 min are more likely to access basic sanitation facilities by 2.4 (95% CI: 2.06–2.8) times more than households traveling to fetch water for <30 min. In the 2019 Mini-EDHS, the odds of reported access to basic sanitation facilities were 1.3 (95% CI: 1.06–1.6) times higher in households with seven or more family members than in households with fewer family members. The odds of access to basic sanitation facilities among household heads aged 30–44 years were 35% less likely 0.65 (95% CI: 0.6–0.8), household heads aged 45–59 years

were 30% less likely 0.7 (95% CI: 0.6–0.83), and household heads aged ≥60 years were 20% less likely 0.8 (95% CI: 0.65–0.9) in 2016 EDHS, and household heads aged 45–59 years were 70% less likely 0.3 (95% CI: 0.02–0.6) and household heads aged ≥60 years were 50% less likely 0.5 (95% CI: 0.2–0.9) in the 2019 Mini-EDHS, than household heads aged below 30 years old.

Hygiene

Only 38% (95% CI: 37.25–38.8%) of households had access to basic hygiene services in the 2016 EDHS. The factors associated with households obtaining basic hygienic services were age, residency, education, and the presence of soaps or detergents near handwashing facilities, as depicted in Table 5.

Household heads aged ≥60 years were 1.4 (95% CI: 1.1–1.6) times more likely to access basic hygiene services. People who lived in urban areas were more likely to access basic hygiene services by 1.38 (95% CI: 1.12–1.7) times more than those who lived in rural areas. Compared to household heads who have no formal education, household heads educated at a higher level have 1.4 (95% CI: 1.2–1.7) more odds of accessing basic hygiene services. Moreover, households having access to soaps or detergents near handwashing facilities were 5.6 (95% CI: 5–6.4) times more likely to access basic hygiene services than households having no access to soaps or detergents near handwashing facilities.

DISCUSSION

According to the findings of this study, 65.2% (95% CI: 64.5–65.9%) and 68.7% (95% CI: 68.01–69.4%) of households have access to obtain basic drinking water services, respectively, for the 2016 EDHS and 2019 Mini-EDHS. By comparison, the proportion of households with access to basic drinking water services was found to be higher in a study conducted in Benin, West Africa (63.98%) (Gaffan *et al.* 2022) and SSA (53.6%) (Belay *et al.* 2022). However, the proportion in this study is found to be lower than in a study conducted in Ghana (88%) (Agbadi *et al.* 2019). Household access to basic sanitation facilities in this study was 25.9% (95% CI: 25.2–26.62%) in the 2016 EDHS and 27.5% (95% CI: 26.34–28.3%) in the 2019 Mini-EDHS. The findings were higher than a study conducted in Benin, West Africa (13.28%) (Gaffan *et al.* 2022), and Ghana (12%) (Agbadi *et al.* 2019). Only 38% (95% CI: 37.25–38.8%) of households had access to basic hygiene services in the 2016 EDHS. This finding is higher than a study conducted in Benin, West Africa (10.11%) (Gaffan *et al.* 2022), but lower than a study reported in Bangladesh, which found 56.3% (Ahmed *et al.* 2021). The variations in WASH services could be due to the study period and setting, the education level among countries, disparities in Gross Domestic Product (GDP) status.

According to the findings in the 2019 Mini-EDHS, female-headed households were 1.5 times more likely to access basic drinking water sources and 1.34 times more likely to access basic sanitation facilities than male-headed households. Similar findings were reported from Ethiopia, Ghana, and Nigeria (Morakinyo *et al.* 2015; Agbadi *et al.* 2019; Andualem *et al.* 2021). Most women in developing countries have more household responsibilities (such as fetching water, children's care, cleaning compounds, and food preparation) (Agbadi *et al.* 2019). Hence, this might be directly associated with water and sanitation in the sense that women may be more preoccupied than men.

The results of this study suggested that the older the household head, the more likely he or she is to have access to basic water and hygiene services. One possible explanation is that individuals with older household heads are in the active economic group and are more likely to install and afford basic water and hygiene facilities, especially when they own their homes (Akpakli *et al.* 2018). In addition, as people's age increases, they can adopt behaviors that improve their quality of life (Agbadi *et al.* 2019). These findings are supported by other findings (Akpakli *et al.* 2018; Agbadi *et al.* 2019; Gaffan *et al.* 2022).

The findings in this study showed that urban households were 1.38 times more likely to access basic hygiene services in the 2016 EDHS, 2.4 times more likely to access basic water services, and 2.7 times more likely to access basic sanitation facilities in the 2019 Mini-EDHS than rural households. These findings were supported by a study conducted in South Africa, Ghana, and Ethiopia (Geremew *et al.* 2018; Agbadi *et al.* 2019; Simelane 2020). One of the possible explanations for this might be that people living in urban areas are more likely to obtain basic services, which increases the likelihood of adopting an improved source (Morakinyo *et al.* 2015). The disparity between urban and rural areas could be explained by the fact that most people in SSA live in rural areas and have low economic status. Hence, they do not have adequate financial resources to access basic WASH services.

The odds of having access to basic sanitation facilities within a household with a large family size (≥7) were 1.3 times higher in the 2019 Mini-EDHS than in households with fewer family members. Other studies also found support for this finding (Adams *et al.* 2016; Ahmed *et al.* 2021). This finding may imply that the more household members, the more resources they may have for building WASH facilities (Irianti *et al.* 2016; Ahmed *et al.* 2021). Another possible explanation could be

that households with larger family members may not share toilets with other neighbors, but rather they are triggered to construct their own. In contrast, a negative association was found between an increase in the number of household members with access to basic WASH services in previous studies (Donacho *et al.* 2022; Gaffan *et al.* 2022).

Household heads with higher levels of education have better access to basic WASH services. This indicates the likelihood of a given household adopting an improved WASH service increases with education level. This study finding is supported by other studies (Morakinyo *et al.* 2015; Andualem *et al.* 2021; Donacho *et al.* 2022; Gaffan *et al.* 2022). The level of education is an essential social determinant of health that influences the ability to make better decisions about the health of household members (Gaffan *et al.* 2022). In the current study, the more educated household head would have more access to basic WASH services and would utilize their resources to provide their household with these services. Because more educated households are likely to be more aware of the negative health effects of using unimproved WASH services.

Access to basic drinking water and sanitation services was more likely in households with better wealth indexes. This result is consistent with other findings (Akpakli *et al.* 2018; Geremew *et al.* 2018; Andualem *et al.* 2021; Gaffan *et al.* 2022). Wealthy households were in a better position to provide improved drinking and sanitation services for their members than the poorest households (Ayesu *et al.* 2015). People with a better income would intend to fulfill the basics of life. Wealthy households can afford the costs associated with the installation of basic water and sanitation facilities. These expenditures may seem high for the poorest households, which face other constraints and daily expenses (Gaffan *et al.* 2022).

In the 2019 Mini-EDHS, households traveling $\geq$30 min to fetch were negatively associated with households' access to basic water services. This finding is supported by other studies (Morakinyo *et al.* 2015; Andualem *et al.* 2021). The carrying of water over long distances is a health hazard, especially during the development and pregnancy periods. According to WHO/UNICEF JMP (2021), households' access to drinking water exceeding 30 min of collection time is a limited service. Water must be sufficient, safe, acceptable, accessible, and affordable for everyone (Desye *et al.* 2021).

In the 2016 EDHS, households that had soaps or detergents near handwashing facilities were 5.6 times more likely to have access to basic hygiene services than households that did not have soaps or detergents near handwashing facilities. This implies that the presence of designed handwashing facilities with soaps or detergents in the household promotes handwashing practices at critical times (Wolf *et al.* 2019). This finding is comparable to that of previous studies conducted in Ethiopia and Vietnam (To *et al.* 2016; Soboksa 2022).

Strengths and limitations of the study

The EDHS data were collected in a cross-sectional study, so causal relationships could not be established. In addition, an important variable in hygiene data was not available in the latest Mini-EDHS of 2019. Besides the limitations, the study's strength is the use of a large sample size and nationally representative data.

CONCLUSION

In conclusion, households' access to basic WASH services was relatively low. Sex, age, residency, family size, wealth index, education level, time to fetch water, and the presence of soaps or detergents near the hand washing facilities were factors affecting households' access to basic WASH services. The findings suggest the need to design effective interventions and implementation strategies like the One WASH national program, which should be implemented consistently and effectively with strong supervision at the national level to improve WASH services. In addition, to ensure basic WASH services, health extension workers, non-governmental organizations, and policymakers should design comprehensive WASH interventions.

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DATA AVAILABILITY STATEMENT

All relevant data are included in the paper or its Supplementary Information.

CONFLICT OF INTEREST

The authors declare there is no conflict.

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