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Access to Drinking Water, Sanitation, and Hand Hygiene Facilities in the Peri-Urban and Informal Settlements of Hosanna Town, Southern Ethiopia

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ABSTRACT: Access to water, sanitation, and hygiene (WASH) facilities and practices have been extensively studied in urban and rural areas. However, there is a paucity of information on the coverage of water, sanitation, and hygiene facilities in the peri-urban and informal settlement areas, which could potentially exacerbate the spread of water, sanitation, and hygiene-related diseases. Therefore, this study was designed to examine access to drinking water, sanitation, and hand hygiene facilities and their determinant factors in the peri-urban and informal settlements of Hosanna town. A community-based cross-sectional study involving 292 households was conducted in 3 kebeles of Hosanna town. The primary data was collected using a pretested structured questionnaire and an observational checklist. Bivariate and multivariable logistic regressions were used to analyze the data. All the households (100%) had access to piped water on and off-premises, but the reliability of the water sources was a big challenge. Findings revealed that only 35.1% and 16.8% of the households had basic sanitation and basic handwashing facilities, respectively. Households with a middle income were identified as a determinant factor for the presence of piped water on premises (AOR = 2.23; 95% CI = 1.24-4.00), improved sanitation (AOR = 2.17; 95% CI = 1.17-4.03) and handwashing facilities (AOR = 4.36; 95% CI = 1.98-9.62). Piped water on premises was also another strong predictor of the availability of improved sanitation (AOR = 3.34; 95% CI = 1.99-5.62) and handwashing facilities (AOR = 8.18; 95% CI = 4.08-16.42). The majority of the studied households living in the selected peri-urban and informal settlements had access to unreliable drinking water sources. The study also revealed that households had poor access to basic sanitation and basic handwashing facilities. Hence, the findings call for solid government interventions to improve the reliability of the drinking water sources, basic sanitation coverage, and availability of basic handwashing facilities.

KEYWORDS: Drinking water, hand hygiene, Hosanna town, informal settlements, peri-urban, sanitation

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Background

Access to safe drinking water, sanitation, and good hygiene (WASH) are fundamental in promoting good health and development.[1] However, globally, around 2 billion, and 3.6 billion people are without safely managed drinking water supply, and sanitation services, respectively.[2] A significant improvement has been achieved from 2000 to 2017, where the population using safely managed drinking water services increased from 61% to 71%, and safely managed sanitation services increased from 28% to 45%.[3] A recent report also indicated that 74% and 54% of the population had access to safely managed drinking water services and sanitation services in 2020 worldwide, respectively.[2] This coverage is much lower in sub-Saharan Africa, where only 30% of the population in the region had access to safely managed drinking water services, and 21% had access to sanitation services in 2020. Achieving sustainable development goals (SDGs) targets 6.1 and 6.2, which include ensuring access to safely managed drinking water, sanitation, and basic hygiene services for all, is a big hurdle, particularly in the peri-urban and informal settlements due to inadequate progress in water, sanitation, and hygiene services.[4]

Urban growth in sub-Saharan African cities occurs mainly in informal settlements, where access to water is often inadequate.[5] This informal growth is due to rapid population growth and rapid urbanization in the region. Despite an increase in access to improved drinking water facilities, the coverage of improved water sources accessible on premises was the lowest in sub-Saharan Africa compared with other regions in 2020. A recent report by WHO/UNICEF indicated that only 31% of the population, which includes urban, and rural areas of sub-Saharan Africa, use improved water sources accessible on-premises. Furthermore, the report showed that only 59% and 36% of them use supplies that are available when needed and free from contamination, respectively.[2] In general, urban places have better water access than rural areas in sub-Saharan Africa.[5] However, the intra-urban disparity in water access is a common problem in the region. This is because people living in low-income, informal, or illegal settlement areas had lower access to an improved water supply than other urban areas.[6]

Sub-Saharan Africa (SSA), including Ethiopia, is one of the regions with low levels of improved sanitation coverage. In the region, only 52% of the population had access to improved

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sanitation facilities in 2020.[2] A 2019 Ethiopian mini-demographic survey also indicated that 41.6% and 9.7% of households in urban and rural areas of Ethiopia had improved sanitation facilities, respectively. However, the report includes only the non-shared improved sanitation facilities, excluding shared facilities. The report also showed that 87% of households in urban areas and 61% of households in rural areas of Ethiopia had access to improved water sources.[7] A recent finding from Ethiopia indicated the existence of inequalities in access to improved drinking water and sanitation in Ethiopia.[8] Improving access to safe drinking water and sanitation facilities is a long-standing development goal that Ethiopia has adopted, and much improvement has been observed in both urban and rural settings.[9] Despite progress in recent times, there is still a significant problem in urban areas of the country, particularly in urban slums, and informal settlements. A study conducted in Uganda indicated that ensuring access to improved sanitation has become a big problem in the majority of low-income countries, particularly in poor urban informal settlements.[4]

Likewise, ensuring access to water and sanitation was a critical problem in Hosanna town, particularly in the peri-urban, and informal settlements.[10] The rapid urbanization along with rural people migration and lack of capacity for the local government to control informal settlements in Hosanna town has created massive peri-urban and informal settlements. The peri-urban areas refer to places located in the peripheral areas of the town, which contain predominantly legal settlements, and in a few cases, settlements that emerge illegally on private land, which lack access to adequate water, sanitation, and other infrastructure. On the other hand, informal settlements refer to places that lack land tenure rights, which are located in the transition zone between urban peripheral and rural areas, which include predominantly settlements that emerge illegally where there is inadequate infrastructure like roads, electricity, water, and other infrastructure. Informal settlements are not part of the urban development planning process as no land information is officially collected, and thus leads to low security of land tenure and poor living conditions due to lack of basic urban infrastructure and services.[11]

Inadequate access to safe water, sanitation, and poor hygiene are responsible for 62% of diarrheal deaths in low- and middle-income countries.[12] Various studies in Ethiopia also verified that poor access to water and sanitation was associated with diarrhea.[13-15] A study conducted in semi-urban areas of north-eastern Ethiopia showed that 78.3% of the studied households used pit latrines without slabs, indicating that unimproved sanitation was the most commonly used sanitation facility in the area.[16] Likewise, access to water and sanitation is inadequate in Hosanna town, particularly in the peri-urban and informal settlements.[10] This has increased the risk of various water-related diseases, including diarrhea in the study area. The risk of various water-related diseases can be minimized through better water, sanitation, and hygiene services.[17] Evidence obtained from a systematic review also shows that improvements in drinking water, sanitation facilities, and hygiene practices have significantly reduced the risk of diarrhea in less developed countries.[18,19]

Access to water, sanitation, and hygiene facilities, and practices has been extensively studied in urban, and rural areas of developing countries, including Ethiopia. However, there is little information on access to water, sanitation coverage, and hygiene facilities, particularly in the peri-urban, and informal settlement areas in the study area. Therefore, a baseline survey was conducted to examine access to water, sanitation, and hand hygiene facilities and their determinant factors in the peri-urban and informal settlement settings of Hosanna town. It is hoped that the findings obtained from this study provide the basis for local leaders as well as policymakers to make informed decisions on which water, sanitation, and hygiene systems fit for peri-urban and informal settlement settings of Hosanna town and other major towns of the country.

Method

Study area

Hosanna town is the capital city of Hadiya zone, which is located 232 km from Addis Ababa, the capital of Ethiopia.[20] The town was established in 1904 and had 8 administrative kebeles and 3 sub-cities before 2018. However, following a new reform in 2018, the town was divided into 6 administrative urban kebeles, namely, Bobicho, Arada, Sech-Duna, Lich-Amba, Jelo-Naremo, and Heto. Kebele is the lowest administrative structure in Ethiopia. The population size of Hosanna town was estimated to be 145 399 in 2021 to 2022, of which 50.8% were males and 49.2% were females.[21] Geographically, the town is located at 7°30′00″-7°35′00″ North latitude and 37°49′ 00″-37°53′00″ East longitude (Figure 1).

Study design

A community-based cross-sectional study was conducted from December 1/2021 to January 1/2022.

Sample size determination

Since this study was a baseline survey for a prospective cohort study, the sample size was calculated based on the cohort-study sample size calculation formula using Epi-info version 7.2.3.1 software. The sample size calculation was based on the detection of a risk ratio of 1.56 among children lacking on-premises water access compared to children with on-premises water access from a cohort study in Papua New Guinea.[22] The percentage outcome in an unexposed group was 37.5%, obtained from a study in Nicaragua conducted to determine changes in childhood diarrhea incidence.[23] The ratio between unexposed and exposed groups was assumed 1:1; $\alpha = 0.05\%$ (95% CI), and the power of the study was assumed 90%. Then, the sample size was calculated, which was 254. After considering a 15%

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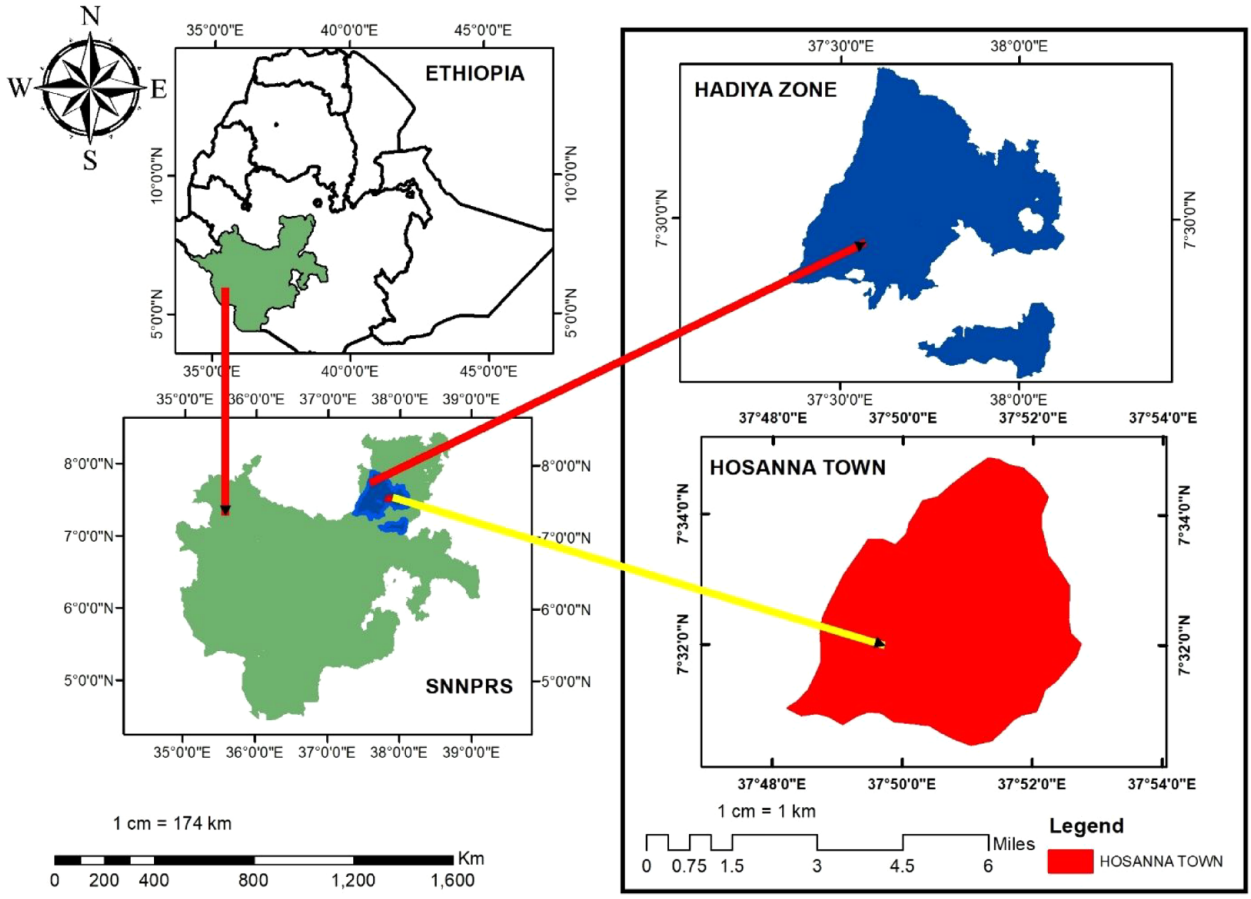

Figure 1. Map of the study area.

follow-up loss, the total sample size of the study was 292 (146 households for each exposed and non-exposed group). Then, the total sample size (292 HHs) was shared into the selected 3 kebeles based on the proportional sizes of each kebele. The sample size calculation formula is presented below in equation one.[24]

$$n = \frac{[Z_{1-\alpha}\sqrt{\{1+1/m)P^*(1-p)\}} + Z_{1-\beta}\sqrt{\{P_0^*(1-P_0/m)P_1(1-P_1)\}}]^2}{(P_0-P_1)^2} \quad (1)$$

Where, n = total sample size, Z1 − β = desired power (0.84 for 80% power and 1.28 for 90% power), Z1 $-\alpha_{/2}$ = critical value and a standard value for the corresponding level of confidence (At 95% CI = 1.96 and at 99% CI = 2.58), m = number of control subjects per experimental subjects, P_0 = possibility of events in non-exposed group, P_1 = possibility of events in exposed group, and $P = P_1 + P_0 m/m + 1$.

Sampling techniques and selection of study households

The study was conducted in 3 kebeles of Hosanna town, namely Bobicho, Sech-Duna, and Jelo-Naremo, and the kebeles were purposely selected due to the existence of vast peri-urban and informal settlements in those 3 kebeles. The study households were selected using a simple random sampling technique from the selected kebeles, which includes households connected with piped water on premises and off premises. To ensure randomization, a number was assigned to each household in the study population. Then, households were randomly selected from a list of households living in the peri-urban and informal settlement areas. Based on the proportional sizes of each kebele, 100, 90, and 102 households were selected randomly from Bobicho, Sech-Duna, and Jelo-Naremo kebeles, respectively. Then, the data collectors team conducted transect walks in each kebele, which involved house-to-house visits to check whether the selected households fulfilled the inclusion criteria. This was done to ensure a 1 to 1 ratio of households connected with piped water on premises and off premises was accurate and complete.

Inclusion and exclusion criteria for study households

Households living in the peri-urban and informal settlements of the selected kebeles that lacked water on pre-premises and received water services from piped and other un-piped improved water sources were considered as an exposed group, whereas households living in the same or nearby areas that had access to improved water sources located on-premises, which include house and yard connection, were considered as

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unexposed. On the other hand, households with less than 6 months of stay in the area were excluded from the study.

Data collection strategy and quality assurance

The data was collected using a pretested structured questionnaire and an observational checklist. The questionnaire for the study participants was prepared in English and translated into Amharic and back to English to ensure its consistency. The data was collected by experienced trained health professionals. Before commencing data collection, pre-testing was conducted on 8% of the study participants so as to ensure that the questions were complete and comprehensive. The feedback obtained during pre-testing was incorporated into research questions before being directly administered to study participants. To minimize bias in the study, the study participants and data collectors were blinded to the research objectives and hypothesis during the data collection process. The data collection process was also subjected to continuous follow-up and all the data collected was checked for consistency and lack of any errors.

Study variables and measurement

Dependent variables. The dependent or outcome variables of the study were piped water on premises, improved sanitation facilities, and the presence of a handwashing facility. Water sources located inside the user's dwelling, plot, or yard, which include improved water sources located on premises such as house and yard piped water connections, were categorized as piped water on premises (Table 1). Whereas improved water sources located off premises, which include piped and unpiped improved water sources, were categorized as water sources out of premises. Sanitation facilities were also classified as either improved or unimproved facilities. Improved facilities include facilities that are not shared with other households as well as facilities that are shared between 2 or more households. The improved sanitation facilities include flush or pour-flush, pit latrine with slab, and twin pit with slab. Whereas households that had a pit latrine without slab/open pit and twin pit without slab were categorized as unimproved facilities. Regarding handwashing facilities, households that lack any fixed, or mobile handwashing facilities in their compound were considered as not having handwashing facilities. On the other hand, households that had a fixed, or mobile place for handwashing were categorized as having a handwashing facility.

Then, binary variable codes were created for dependent variables Yes (1) and No (0). Yes (1) to indicate the presence of piped water on premises, an improved sanitation facility, and a handwashing facility. No (0) to indicate the absence of piped water on-premises (presence of piped water off-premises), unimproved sanitation facility, and absence of a handwashing facility. Water sources and sanitation facilities were categorized as improved and unimproved facilities according to the WHO and UNICEF Joint Monitoring Program (JMP) for water supply and sanitation.[25]

Independent variables. The explanatory variables of the study were socio-demographic factors (ie, sex of the head of household, educational status of the head of household, mother's education level, house ownership, family size, income of the household, marital status mothers/caregivers, occupation of mothers/caregivers, religion, number of under-five children). Besides, the location of water sources was also identified as an explanatory variable for predicting improved sanitation and hand washing facilities.

Data analysis. Descriptive statistics such as frequency and percentages were used to summarize and present the data obtained from the participating households. Both bivariate and multivariable logistic regression at 95% CI were used to analyze the data. Bivariate logistic regression was used to examine the associations of independent variables with the outcome variable without controlling confounding factors, whereas a multivariable logistic regression model was used to examine the associations of outcome variables with different independent variables by controlling for potential confounding factors. Any independent variables scoring a *P*-value less than .25 in bivariate logistic regression analysis were included in the multivariable model. Assumptions of logistic regressions were tested using different methods. Multicollinearity among independent variables was checked by calculating the variance inflation factor (VIF). The goodness of fit of the model was also tested by Hosmer-Lemeshow statistics. A *P*-value associated with the log-likelihood ratio was also calculated to evaluate the goodness of fit of the multivariable model for the data. In all data analysis, a *P*-value less than .05 was considered statistically significant. Generally, all quantitative data was entered into Excel and exported to STATA 14 software for analysis.

Results

Socio-demographic characteristics of study households

A total of 292 households participated in the study with a 100% response rate. The majority of the study households (92.1%) were male-headed households, and most of them completed primary school (35.6%). More than one-fourth of them (25.7%) have completed secondary school, and only 2.4% of households had no formal education. Nearly one-fourth of the study households (25%) had completed a first degree and above. Regarding a mother's education status, most of them have completed primary school (38.4%), and only 6.8% of mothers had no formal education. Among the total study households, the majority (77.7%) were Protestants, followed by

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Table 1. Operational definition of terms.

VARIABLES	DEFINITION
Proper waste disposal practices	It refers to waste collected by a formal service provider, incinerated or buried, stored in a storage container, or disposed of in a designed site in a way that cannot affect the environment and public health.
Improper waste disposal practices	If waste is discarded elsewhere in an open space, collected by an informal service provider, or discarded within a household yard or plot in a way that affects the public health and environment, it is considered improper waste disposal practice.
Proper liquid waste disposal practices	If liquid waste is connected to a sewer, septic tank, or pit, then it is considered proper liquid waste disposal practices.
Improper liquid waste disposal practices	If liquid waste is disposed of directly on open ground or water body, or if a sink/drain is connected to an open drain or open ground, then it is considered improper liquid waste disposal practices.
Piped water off premises	It is located outside the living areas. It includes improved water sources located off premises, and households collect their water from piped improved water sources located off premises.
Piped water on premises	It is located inside the user's dwelling, plot, or yard. It includes households that do have access to improved water sources located on-premises, which include house and yard piped water connections.
Open defecation	A self-reported behavior, which includes defecating in open spaces, fields, forests, bushes or open bodies of water.
Basic sanitation facility	It includes improved facilities that are not shared with other households.
Basic handwashing facility	Availability of a handwashing facility with soap and water at home

Orthodox Christians (15.1%). Religions such as Apostolic, Muslim, and Adventist constituted 7.2% of the study households. Other socio-demographic characteristics of study households are summarized in Table 2.

Characteristics of drinking water sources

The result revealed that 50% of the households had access to piped water on premises, and the remaining had access to piped water off premises. This shows that all households (100%) were using piped water on and off premises as their main dry and rainy season drinking water sources. On the other hand, 68.8% of the study households used rain water for other domestic purposes, such as cooking and handwashing during the rainy season. Households who accounted for 40.8% spent more than 30 minutes collecting water from their main water sources. Besides, the reliability of the water supply was questioned by the majority of the study households. Only 8.9% of the studied households had access to reliable water services that received water services regularly or with a known schedule from their main water sources. The reliability of the water sources was assessed in terms of accessibility of the water sources and availability of water from the main water sources when water is needed (Table 3).

Sanitation and hygiene

The majority of the study households (97.6%) had access to toilet facilities, and the common types of sanitation facilities (50.4%) were pit latrines with slabs. Only 2.4% of the studied households had no access to sanitation facilities. More than half of the study households (55%) had improved sanitation facilities, and the remaining 45% had access to unimproved

Table 2. Weighted descriptive statistics of socio-demographic characteristics.

VARIABLES	FREQUENCY (%)
Sex of the head of Household	
Female	23 (7.9)
Male	269 (92.1)
Educational status of the head of household	
No formal education	7 (2.4)
1-8 grades complete	104 (35.6)
9-12 grades complete	75 (25.7)
Certificate and Diploma	33 (11.3)
First degree and above	73 (25)
Mother's education level	
No formal education	20 (6.8)
1-8 grades complete	112 (38.4)
9-12 grades complete	76 (26)
Certificate and Diploma	44 (15.1)
First degree and above	40 (13.7)
Marital status of mothers/caregivers	
Married	268 (91.8)
Single	7 (2.4)
Divorced	9 (3.1)
Widowed	8 (2.7)

(Continued)

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Table 2. (Continued)

VARIABLES	FREQUENCY (%)
Occupation of mothers/caregivers	
House wife	152 (52.1)
Government employee	67 (22.9)
Self-employed	72 (24.7)
NGO employee	1 (0.3)
House ownership	
Private house	186 (63.7)
Private rental house	106 (36.3)
Family size	
2-4	97 (33.2)
5-6	135 (46.2)
⩾7	60 (20.6)
Religion	
Protestant	227 (77.7)
Orthodox Christian	44 (15.1)
Muslim	8 (2.7)
Apostolic	11 (3.8)
Adventist	2 (0.7)
No. of under-five children	
1	141 (48.3)
⩾2	151 (51.7)
Average monthly HH income	
<3201 Ethiopian Birr	140 (47.9)
3201-7800 Ethiopian Birr	120 (41.1)
>7800 Ethiopian Birr	32 (11)

sanitation. The improved sanitation facilities shared by 2 or more households were categorized under improved sanitation facilities. The result also revealed that two-thirds of the households (65%) had access to a fixed or mobile place for handwashing. Of these households, as confirmed by observation, only 25.8% had water and soap near the handwashing facility. On the other hand, more than one-third of the households (35%) didn't have any handwashing place in their living compound. Both solid and liquid waste management practices were poor in the study area, indicating that wastes were indiscriminately dumped into an open space. The majority of households (51.4%) had improper solid waste disposal practices, which dispose their solid waste improperly in an open space in a way that affects public health and the surrounding environment. Likewise, more than 84% of households managed their liquid waste inappropriately by discarding their liquid waste in an open ground, water body, and open drain (Table 4).

Table 3. Weighted descriptive statistics of characteristics of drinking water sources.

VARIABLES	FREQUENCY (%)
Main sources of drinking water during dry and rainy seasons (n = 292)	
Piped water to compound, yard or plot	146 (50)
Piped to neighbor	27 (9.3)
Public tap/standpipe	90 (30.8)
Water vendors	29 (9.9)
Main source of water for other domestic purposes, such as cooking and handwashing in the dry season	
Piped water to compound, yard or plot	146 (50)
Piped to neighbor	27 (9.3)
Public tap/standpipe	90 (30.8)
Water vendors	29 (9.9)
Main source of water for other domestic purposes, such as cooking and handwashing in the rainy season	
Rainwater collection	201 (68.8)
Piped water on or off premises	91 (31.2)
Location of water sources	
Piped water off premises	146 (50)
Piped water on premises	146 (50)
Time taken to fetch water for return trip	
Water on-premises	146 (50)
Less than 15 min	6 (2)
15-30 min	21 (7.2)
30-60 min	72 (24.7)
Greater than 60 min	47 (16.1)
Is water always available from your main water source? (Availability of water from water sources with a known schedule)	
Yes, water is always available	26 (8.9)
No, water is available most of the time	59 (20.2)
No, water is available some of the time	122 (41.8)
No, water is rarely available	85 (29.1)
The main reason for not always getting water from your water source?	
Source is not accessible	108 (37)
Water is not available from source	158 (54.1)
None respondent (Water is always available)	26 (8.9)

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Table 4. Weighted descriptive statistics of sanitation and hygiene facilities.

VARIABLES	CATEGORY	FREQUENCY (%)
Access to latrine facility	Yes	285 (97.6)
	No	7 (2.4)
Type of toilet facility	Flush or pour flush	8 (2.7)
	Pit latrine with slab	147 (50.4)
	Twin pit with slab	2 (0.7)
	Pit latrine without slab/open pit	123 (42.1)
	Twin pit without slab	5 (1.7)
	Share with neighborhood	4 (1.4)
	Open defecation	3 (1)
Sharing status of toilet facility	Yes	95 (33.3)
	No	190 (66.7)
Sanitation Status	Improved	157 (55.1)
	Unimproved	128 (44.9)
Household solid waste disposal method	Proper disposal practices	142 (48.6)
	Improper disposal practices	150 (51.4)
Household liquid waste disposal method	Proper disposal practices	45 (15.4)
	Improper disposal practices	247 (84.6)
Do you have a HW facility?	Fixed or mobile place for HW	190 (65.1)
	No HW place in dwelling/yard/plot	102 (34.9)
Availability of both water and soap at the place for HW	Yes, it is available	49 (16.8)
	No, it is not available	141 (48.3)
	No HW place in dwelling/yard/plot	102 (34.9)
Is HWF available near the toilet?	Yes	57 (19.5)
	No	235 (80.5)

Factors associated with piped water on premises in the binary and multivariable logistic regression analysis

The educational status of the head of household, the education level of mothers, and the income of the household were significantly associated with the presence of piped water on-premises in the binary logistic regression analysis. A first-degree and above education level of mothers (OR = 3.89; 95% CI = 1.23-12.29) and the head of households (OR = 2.19; 95% CI = 1.2-4.00) was significantly associated with increased access to piped water on premises. Households with a middle and high income were also associated significantly with increased access to piped water on premises (Table 5). Before conducting the multivariable logistic regression analysis, a *P*-value associated with the log-likelihood ratio (LLR) was calculated to evaluate the goodness of fit of the model for the data. The calculated *P*-value associated with the log-likelihood ratio was very small, which was .0046 (less than .05), indicating that the model was a good fit for the data.

Seven variables with a *P*-value $<.25$ in bivariate analysis, which includes the educational status of the head of household, mother's education level, marital status of mothers, house ownership, income of the household, religion, and number of under-five children were included in the multivariable logistic regression analysis. However, only the income of households was significantly associated with piped water on premises in the multivariable logistic regression analysis (Table 8). Households with a middle income were 2.2 times more likely to have piped water on premises compared to low-income households at *P* value $<.01$ (AOR = 2.23; 95% CI = 1.24-4.00).

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Table 5. Bivariate analysis of socio-demographic factors with piped water on premises.

VARIABLES	FREQUENCY (%)	PIPED WATER ON PREMISES (YES)	OR (95% CI), *P*-VALUE
Educational status of the head of household			
⩽Primary education	111 (38.0)	47	RC
Secondary education	75 (25.7)	39	1.48 (0.82-2.65), .196
Certificate and diploma	33 (11.3)	15	1.13 (0.52-2.48), .751
First degree and above	73 (25.0)	45	2.19 (1.2-4.00), .011*
Mother's education level			
No formal education	20 (6.8)	6	RC
1-8 grades complete	112 (38.4)	54	2.17 (0.78-6.06), .138
9-12 grades complete	76 (26.0)	39	2.46 (0.85-7.08), .095
Certificate and Diploma	44 (15.1)	22	2.33 (0.76-7.18), .140
First degree and above	40 (13.7)	25	3.89 (1.23-12.29), .021*
Marital status of mothers/caregivers			
Married	268 (91.8)	137	RC
Other marital status	24 (8.2)	9	0.57 (0.24-1.36), .206
House ownership			
Private rental house	186 (63.7)	48	RC
Private house	106 (36.3)	98	1.35 (0.83-2.17), .224
Monthly HH income			
Low income	140 (47.9)	53	RC
Middle income	120 (41.1)	72	2.46 (1.49-4.06), .000*
High income	32 (11.0)	21	3.13 (1.40-7.01), .005*
Religion			
Protestant	227 (77.7)	108	RC
Other religions	65 (22.3)	38	1.55 (0.89-2.71), .123
No. of under-five children			
1	141 (48.3)	65	RC
⩾2	151 (51.7)	81	1.35 (0.85-2.14), .198

Abbreviations: OR, crude odds ratio; RC, reference category.
All variables with a *P*-value < .25 in the bivariate logistic regression analysis are presented in this regression table and included in the multivariable logistic regression analysis.
*Variables significant at *P*-value < .05.

Factors associated with improve sanitation in the binary and multivariable logistic regression analysis

The binary logistic regression analysis indicated that the sex and educational status of the head of the household, marital status of mothers/caregivers, income of the household, and location of water sources were significantly associated with improved sanitation (Table 6). Male-headed households were 3 times more likely to have improved sanitation compared to female-headed households at *P*-value < .05 (OR = 3.06; 95% CI = 1.22-7.69). Households with piped water on premises were also 3.6 times more likely to have improved sanitation compared to households lacking piped water on premises at *P*-value < .01 (OR = 3.57; 95% CI = 2.18-5.83). A *P*-value associated with the log-likelihood ratio was calculated to evaluate the goodness of fit of the model for the data before starting the regression analysis. The calculated *P*-value associated with the log-likelihood ratio was very small, which was

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Table 6. Bivariate analysis of socio-demographic factors and location of water sources with improved sanitation facilities.

VARIABLES	FREQUENCY (%)	IMPROVED SANITATION (YES)	OR (95% CI), *P*-VALUE
Sex of head of the HH			
Female	23 (8.1)	7	RC
Male	262 (91.9)	150	3.06 (1.22-7.69), .017*
Educational status of head of the household			
⩽Primary education	108 (37.9)	54	RC
Secondary education	74 (26.0)	40	1.18 (0.65-2.13), .591
Certificate and diploma	32 (11.2)	14	0.78 (0.35-1.72), .535
First degree and above	71 (24.9)	49	2.23 (1.19-4.18), 0.013*
Mother's Education level			
No formal education	20 (7.0)	6	RC
1-8 grades complete	108 (37.9)	60	2.92 (1.04-8.16), .041*
9-12 grades complete	76 (26.7)	45	3.39 (1.17-9.78), .024*
Certificate and Diploma	41 (14.4)	20	2.22 (0.71-6.92), .168
First degree and above	40 (14.0)	26	4.33 (1.36-13.77), .013*
Marital status of mothers/caregivers			
Married	261 (91.6)	150	RC
Other marital status	24 (8.4)	7	0. 30 (0.12-0. 75), .011*
Occupation of mothers/Caregivers			
House wife	149 (52.3)	86	RC
Government employee	64 (22.4)	37	1.00 (0.55-1.82), .99
Other occupation	72 (25.3)	34	0. 66 (0.37-1.15), .143
Monthly HH income			
Low income	137 (48.1)	60	RC
Middle income	116(40.7)	76	2.44 (1.46-4.06), .001*
High income	32 (11.2)	21	2.45 (1.10-5.47), .029*
Religion			
Protestant	223 (78.2)	128	1.53 (0. 87-2.70), .138
Other religions	62 (21.8)	29	RC
Location of water sources			
Piped water off premises	141 (49.5)	56	RC
Piped water on premises	144 (50.5)	101	3.57 (2.18-5.83), .000*

Abbreviations: OR, crude odds ratio; RC, reference Category.
Households who lacked sanitation facilities were excluded from the bivariate analysis.
All variables with a *P*-value < .25 in the bivariate logistic regression analysis are presented in this regression table and included in the multivariable logistic regression analysis.
*Variables significant at *P*-value < .05.

.0000 (less than .05), indicating that the model was a good fit for the data. Seven variables with a *P*-value < .25 in the bivariate logistic regression analysis were included in the multivariable logistic regression analysis. These variables include the sex of the head of household, educational status of the head of household, mother's education level, occupation

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of mothers/caregivers, income of the household, religion, and location of water sources. The variable marital status of mothers/caregivers was excluded from the multivariable logistic regression analysis due to a multicollinearity effect on the sex of the head of household.

The multivariable logistic regression analysis verified that the income of the household, religion, and the location of water sources were significantly associated with improved sanitation (Table 8). Households with a middle income were 2.2 times more likely to have improved sanitation compared to low-income households (AOR = 2.17; 95% CI = 1.17-4.03). Likewise, households with a Protestant religion were 2 times more likely to have improved sanitation compared to other religions (AOR = 2.05; 95% CI = 1.09-3.86). Households having piped water on premises were also 3.3 times more likely to have improved sanitation than households lacking piped water on premises at *P*-value < .001 (AOR = 3.34; 95% CI = 1.99-5.62).

Factors associated with the presence of handwashing facilities in the binary and multivariable logistic regression analysis

The binary logistic regression analysis indicated that the sex of the head of household, educational status of the head of household, mother's education level, marital status of mothers/caregivers, occupation of mothers/caregivers, income of the household, and location of water sources were significantly associated with the presence of handwashing facilities (Table 7). Households with a high income (OR = 12.52; 95% CI = 3.61-11.62) and piped water on premises (OR = 6.83; 95% CI = 3.91-11.94) were 12.5 and 6.8 times more likely to have handwashing facilities, respectively. The fitness of the model was checked using a *P*-value associated with the log-likelihood ratio. The calculated P-value associated with the log-likelihood ratio was very small, which was .0000 (less than .05), indicating that the model was a good fit for the data. Eight variables with a *P*-value < .25 in the bivariate analysis, which includes sex of the head of household, educational status of the head of household, mother's education level, occupation of mothers, house ownership, family size, income of the household, and location of water sources were included in the multivariable logistic regression analysis.

The multivariable logistic regression analysis indicated that variables such as male-headed households (AOR = 5.07 95% CI = 1.36-18.90), mothers with a first degree and above education level (AOR = 29.37 95% CI = 2.54-339.62), households with middle income (AOR = 4.36; 95% CI = 1.98-9.62), and piped water on premises (AOR = 8.18; 95% CI = 4.08-16.42) were significantly associated with the presence of handwashing facilities. Besides, household heads with a certificate and diploma education level (AOR = 3.69; 95% CI = 1.09-12.51) and with a first degree and above education level (AOR = 11.77; 95% CI = 2.74-50.52) were significantly associated with the presence of handwashing facilities (Table 8). Male-headed households and households with a middle income were 5 and 4.4 times more likely to have access to handwashing facilities, respectively. Households having piped water on-premises were also 8.2 times more likely to have access to handwashing facilities compared to households lacking piped water on-premises.

Discussion

The findings of this study showed that almost all households (100%) had access to improved water sources. Although all the households had access to piped water supply, the reliability of the water sources was a big challenge. The findings indicated that only 8.9% of the study households had access to reliable water services that received water regularly from their main water sources during the dry and rainy seasons. The remaining households (91.1%) had access to unreliable water sources. Households who accounted for 37% and 54.1% responded that the main reason for irregular water provision was due to the inaccessibility of the water source at a given time and unavailability of water from the source when water is needed, respectively. They adopted different coping strategies for unreliable water supply to fulfill their water needs, including storing water at home and using alternative water sources such as springs and water vendors. The result is in line with the findings obtained from 4 regions in Ethiopia, which indicated that the main limiting factor associated with the water supply was the reliability of the water supply.[26] As indicated by the study, of those households who had access to piped water supply, only 32% of them got reliable services from their main source of water supply during the dry season. Various other studies also confirmed that piped water supply lacks consistency and is associated with frequent interruptions in low- and middle-income countries.[27-29] Evidence indicates that the reliability of the water services can be expressed in terms of adequacy of water quantity, quality, availability of water from water sources with a known schedule, and punctuality of water service, even if it is not continuous. Water services are considered as problematic if there is down time, significant breakdown, and slow repair.[30] Regarding factors determining the presence of piped water on-premises, only the income of the households was significantly associated with water piped on premises at a *P*-value of <.01.

The result revealed that 97.6% of the study households had access to sanitation facilities, and pit-latrine with slab (50.4%) was the most commonly used sanitation facility in the study area. The result is in line with the study conducted in Jimma town and in a slum community in Kampala, Uganda, where 94.5%, and 66.9% of the households were using pit-latrine with slab, respectively.[31,32] Open defecation practice (1%) was very low in the study area. This result is consistent with a study conducted in Benin city, Nigeria, in which 1.5 of the households practiced open defecation.[33] In contrast to this finding, a study conducted in Addis Ababa slums (5.2%), eastern Ethiopia (11%), Jimma town (5.5%), Ethiopian urban areas (6.9%), in peri-urban areas in Northwest Ethiopia (11.3%), and small

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Table 7. Bivariate analysis of socio-demographic factors and location of water sources with the presence of handwashing facilities.

VARIABLES	FREQUENCY (%)	HANDWASHING FACILITY (YES)	OR (95% CI), *P*-VALUE
Sex of the head of HH			
Female	23 (8.1)	6	RC
Male	262 (91.9)	184	6.13 (2.34-16.11), .000*
Educational status of the head of household			
⩽ Primary education	111 (38.0)	49	RC
Secondary education	75 (25.7)	47	2.12 (1.17-3.87), .014*
Certificate and diploma	33 (11.3)	25	3.95 (1.64-9.53), .002*
First degree and above	73 (25.0)	69	21.83(7.45-63.97), .000*
Mother's education level			
No formal education	20 (6.8)	6	RC
1-8 grades complete	112 (38.4)	61	2.79 (1.00-7.79), .050
9-12 grades complete	76 (26.0)	50	4.49 (1.54-13.05), .006*
Certificate and Diploma	44 (15.1)	35	9.07 (2.72-30.27), .000*
First degree and above	40 (13.7)	38	44.33 (7.99-246.00), .000*
Marital status of mothers			
Married	268 (91.8)	184	RC
Other marital status	24 (8.2)	6	0.15 (0.06-0.40), .000*
Occupation of mothers/caregivers			
House wife	152 (52.1)	98	RC
Government employee	67 (22.9)	59	4.06 (1.81-9.13), .001*
Other occupation	73 (25.0)	33	0.45 (0.26-0.80), .007*
House ownership			
Private rental house	106 (36.3)	62	RC
Private house	186 (63.7)	128	1.57 (0.95-2.57), .076
Family size			
2-4	97 (33.2)	53	RC
5-6	135 (46.2)	98	2.20 (1.27-3.81), .005*
⩾7	60 (20.6)	39	1.54 (0.79-2.99), .201
Monthly HH income			
Low income	140 (47.9)	61	RC
Middle income	120 (41.1)	100	6.48 (3.61-11.62), .000*
High income	32 (11.0)	29	12.52 (3.64-43.03), .000*
Location of water sources			
Piped water off premises	146 (50.0)	66	RC
Piped water on premises	146 (50.0)	124	6.83 (3.91-11.94), .000*

Abbreviations: OR, crude odds ratio; RC, reference category.
All variables with a *P*-value < .25 in the bivariate logistic regression analysis are presented in this regression table and included in the multivariable logistic regression analysis.
*Variables significant at *P*-value < .05.

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Table 8. Multivariable logistic regression analysis for piped water on premises, improved sanitation, and the presence of handwashing facilities (*P*-value < .05).

MULTIVARIABLE LOGISTIC REGRESSION ANALYSIS OF SOCIO-DEMOGRAPHIC FACTORS WITH PIPED WATER ON PREMISES		
VARIABLES	AOR (95% CI)	*P*-VALUE
Monthly HH income		
Middle income	2.23 (1.24-4.00)	.007**
High income	2.65 (1.02-6.89)	.046*
Multivariable logistic regression analysis of socio-demographic factors and location of water sources with improved sanitation		
Monthly HH income		
Middle income	2.17 (1.17-4.03)	.014*
Religion		
Protestant	2.05 (1.09-3.86)	.025 *
Location of water sources		
Piped water on premises	3.34 (1.99-5.62)	.000**
Multivariable logistic regression analysis of socio-demographic factors and location of water sources with the presence of handwashing facilities		
Sex of the head of household		
Male	5.07 (1.36-18.90)	.015*
Educational level of the HH head		
Certificate and diploma	3.69 (1.09-12.51)	.036*
First degree and above	11.77 (2.74-50.52)	.001**
Mother's education level		
First degree and above	29.37 (2.54-339.62)	.007 **
Monthly HH income		
Middle	4.36 (1.98-9.62)	.000 **
Location of water sources		
Piped water on premises	8.18 (4.08-16.42)	.000**

Abbreviation: AOR, adjusted odds ratio.
All variables with a *P*-value < .25 in the bivariate logistic regression analysis were included in the multivariable logistic regression analysis.
Only those variables with a *P*-value < .01 and < .05 in the multivariable logistic regression analysis are included in this regression table.
The variable marital status of mothers/caregivers was excluded from the multivariable logistic regression analysis due to a multicollinearity effect on the sex of the head of household.
*Variables significant at *P*-value < .05.
**Variables significant at *P*-value < .01.

towns in 4 regions of Ethiopia (13%) reported high rate of open defecation.[9,26,31,34-36] A self-reported data was used to assess open defecation practices that might increase the likelihood of underreporting. Evidence also indicates that open defecation was underreported,[37] and self-reported data on open defecation practices generate less reliable data.[34] Hence, a lower open defecation practice in the study area might be due to underreporting.

The finding indicated that 55.1% of the study households had improved sanitation, and more than one-third (44.9%) had unimproved sanitation facilities. Of those improved sanitation facilities, 35.1% were categorized as basic sanitation facilities, and the remaining 20% as limited sanitation facilities. The result is lower than other studies conducted in Northeast Amhara, Kandahar city in Afghanistan, and small towns in 4 regions of Ethiopia, where 59.8%, 85.7%, and 57% of the households had access to improved latrines, respectively.[26,38,39] This variation could be associated with poor urban service provisions, socioeconomic factors, and unplanned settlement in the peri-urban, and informal settlement settings in the study area. This finding is higher than the findings from Ethiopia (25.4%) and Ghana (12%).[40,41] This could be associated with national progress on access to improved sanitation facilities in recent years as well as with the study's finding being recent. However, the progress was not as expected because there were still a large proportion of households without improved sanitation facilities in the study area. Regarding the predictors of the availability of improved sanitation, the findings identified the income of the household, religion, and location of water sources as determinant factors of improved sanitation.

Almost two-thirds of the households (65%) had access to handwashing facilities in the study area. This result is lower than a report obtained from the 2016 Ethiopian Demographic and Health Survey (EDHS), where 81% of the households in urban areas had a place for handwashing.[9] This could be associated with low handwashing promotion, socio-economic factors, and inadequate coverage of piped water on premises, which might affect the availability of water at home. Besides, of the total study households, only 16.8% had basic handwashing facilities. This result is slightly higher than the studies done in Ethiopia (8%) and Benin (10.1%).[42,43] However, the result is too far from the SDG's ambitious objective, which focused on ensuring access to adequate and equitable sanitation and hygiene services for all by 2030. With this limited effort, households in the study area will remain at great risk of water-related infectious diseases, including diarrhea.

Various studies claimed that the availability of handwashing facilities was positively associated with effective handwashing practices.[44,45] Hence, determining the availability of handwashing facilities and factors affecting their presence would support the installation of handwashing facilities, thereby playing a role in reducing the spread of infectious diseases that could be prevented through effective handwashing practices.[42] Findings obtained from this study also indicated that various factors were associated with the presence of handwashing facilities. Results from the multivariable logistic regression analysis showed that sex of the household head and his/her, educational status, mother's education level, income of the household, and location of water sources were significantly

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associated with the presence of handwashing facilities. This is consistent with findings obtained from a study conducted in Ethiopia, which indicated that the educational status of the head of household and household wealth rank was positively associated with the presence of basic handwashing facilities.[42] Likewise, a result from the pooled logistic regression model verified that sex of the household head, education of the household head, and household wealth were determinant factors for the presence of handwashing facilities in 4 East African countries.[46]

Limitation of the Study

The study was associated with a few limitations. One of the limitations was the cross-sectional nature of the study. Due to this nature of the study, it evaluates water, sanitation, and hygiene facilities, which reflects water, sanitation, and hygiene facilities, and practices existing only at the time of the baseline survey. The study determined factors associated with access to piped water on premises, improved sanitation, and the presence of handwashing facilities. Although the study measured different variables associated with the availability of water, sanitation, and hygiene facilities using an adjusted multivariable logistic regression model, there could be other unmeasured confounding factors that could affect the current association. Since this study was conducted in one specific urban area of southern Ethiopia, evidence obtained from this study can't be generalized across all peri-urban and informal settlement areas in Ethiopia and other developing countries. This was another limitation of the study. Therefore, more studies should be carried out nationally and internationally across the world, particularly in the peri-urban, and informal settlement areas of developing countries to have in-depth evidence on water, sanitation, and hygiene facilities, and practices in peri-urban and informal settlement areas.

Conclusion

The study revealed that the majority of households living in the selected peri-urban and informal settlements had access to unreliable drinking water sources. The unreliability of the water sources was mainly associated with the unavailability of water from water sources when water is needed and the inaccessibility of the water sources. The study also revealed that households had poor access to basic sanitation and basic handwashing facilities. Although the findings indicated that open defecation was low, the existence of a large proportion of households with unimproved sanitation facilities would make people highly vulnerable to infectious diseases in the study area. The availability of handwashing facilities at home is vital as it encourages handwashing practices. However, the findings showed the existence of inadequate handwashing facilities and specifically low basic handwashing facilities. This inadequate availability of handwashing facilities might reduce the potential to control the spread of infectious diseases that could be prevented through effective handwashing practices.

The study also identified predictors of the availability of piped water on premises, improved sanitation, and handwashing facilities. Monthly household income was identified as a strong predictor of the availability of piped water on premises, improved sanitation, and handwashing facilities. Piped water on premises was also another strong predictor of the availability of improved sanitation and handwashing facilities. A better education level of the household was positively associated with the presence of handwashing facilities. Hence, the findings call for solid government interventions to improve the reliability of the main water sources, basic sanitation facilities coverage, and availability of basic handwashing facilities in the study area. This could be achieved by improving various urban services, awareness creation, and through engaging households in various poverty reduction activities, particularly in the peri-urban, and informal settlement settings of the town.

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Author Contributions

All authors (AAA, SRG and STM) contributed to conceptualization, methodology, data curation, investigation, formal analysis, validation, visualization, writing review, and editing. AAA is the project owner and contributed to writing the original draft.

Data Availability Statement

Data are available from a corresponding author on reasonable request.

Ethical Consideration

The ethical clearance of the study was obtained from the National Research Ethics Review Committee, Ministry of Science and Higher Education (Ref.No.7/2-150/ M 259/35). The letter of permission was also taken from the Hosanna town administration office and the selected kebeles to visit the study area and select participating households.

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