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Associations Between Improved Water Supply and Sanitation Usage and Childhood Diarrhea in Ethiopia: An Analysis of the 2016 Demographic and Health Survey

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ABSTRACT

BACKGROUND: Diarrheal disease is one of the leading causes of death in children under the age of 5. Access to and use of improved water and sanitation services is associated with this, but there is little country-level evidence for this relationship in Ethiopia. Therefore, associations between improved water supply and sanitation usage and childhood diarrhea in Ethiopia have been identified as the objective of this study.

METHODS: This study was a cross-sectional study using data from Ethiopia's 2016 Demographic and Health Survey. Through interviews with mothers/caregivers who had children under the age of 5 years, data was collected. The outcome of this study was the response of the mothers/caregivers interviewed to the 2-week occurrence of diarrhea. Logistic regression analysis was used to examine the relationship between dependent and independent variables.

RESULTS: The survey results found that the use of improved drinking water and latrine facilities was 59.3% (95% CI: 58.36-60.31) and 17.3% (95% CI: 16.59-18.09), respectively. With respect to the handling practices of child feces, 24.8% (95% CI: 23.8-25.70) of the child feces of the interviewed mothers/caregivers were disposed of safely. The prevalence of childhood diarrhea in the preceding 2 weeks was 11% (95% CI: 10.36-11.61). Residence of Somali Region (AOR = 1.81, 95% CI: 1.25-2.61), having more than 2 under-5 children (AOR = 1.21, 95% CI: 1.01-1.46), having more than 5 family members (AOR = 1.18, 95% CI: 1.03-1.36), sex of the indexed child (AOR = 0.88, 95% CI: 0.77-0.99) and unsafe child feces disposal practices (AOR: 1.32; 95% CI: 1.14-1.54) were significantly associated with childhood diarrhea.

CONCLUSION: Residing in the Somali region, having more than 2 children under the age of 5 and having more than 5 household members, indexed child sex, and safe disposal of child feces were significantly associated with diarrhea. Therefore, in Ethiopia, the prevention of childhood diarrhea should concentrate on eliminating household crowding and encouraging the safe disposal of child feces.

KEYWORDS: Drinking water, sanitation, child, diarrhea, Ethiopia

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Introduction

Diarrheal disease is one of the leading causes of death in children under the age of 5.[1,2] Around 525 000 children under 5 are killed by diarrhea each year.[1] Diarrhea caused by infection is common in developing countries. More than half of these incidents occur in Africa and South Asia, where attacks are more likely to lead to death or other severe outcomes.[1] In low-income countries, children under 3 years of age experience an average of 3 episodes of diarrhea a year.[1,3] The youngest children are the most vulnerable; the incidence is highest in the first 2 years of life and declines as the child grows older.[3]

Inadequate availability of water, shortage of sanitation, and poor hygiene habits lead millions of the world's poorest people to die each year from preventable diseases such as diarrhea.[4] A previous study found that the lack of adequate water supply and open defecation had adversely affected around 2 billion people living in rural areas.[5] Systematic reviews and meta-analysis results suggested that a decline in diarrheal disease was associated with adequate drinking, proper sanitation, and hygiene measures. Point-of-use water treatment with chlorine, for example, decreases the risk of diarrhea by 25% to 58%,[6-9] improved sanitation can reduce the rate of diarrheal diseases by 32% to 37%[10-12] and handwashing promotion reduces the incidence of diarrhea by 30%.[13] A study in Malawi has revealed that children living in households with sufficient quality water sources and latrines are at 20% reduced risk of diarrhea.[14] A study reported in Indonesia found that the risk of diarrhea is substantially higher in households participating in unsafe disposal of child feces than in those participating in safe disposal.[15] Similarly, another research result indicated that the unsafe disposal of feces raised the risk of diarrhea by 23%.[16] It is also a risk factor for soil-borne infections of helminths, for example, hookworm, ascariasis, and trichuriasis, which cause environmental diseases marked by inadequate absorption of nutrients in the intestines.[17,18]

Globally, nearly 2.4 million deaths (4.2% of all deaths) could be avoided annually if all exercised basic hygiene and provided decent, safe sanitation and drinking water.[19] An approximate 88% of all child deaths as a result of diarrheal

disease will be stopped through WASH improvement.[20] Around 2.0 billion people, however, still do not have adequate sanitation services worldwide, such as toilets or latrines. Among those, 673 million still defecate outdoors, for instance, in street gutters, behind trees, or in open bodies of water.[21] Ethiopia is a vast country where there is still very restricted access to better water supply and sanitation services in rural areas where the majority of households defecate in bushlands or open fields. The nation has the highest infant deaths associated with diarrhea[17,22] and previous studies in Ethiopia have shown that water quality and latrine use are a risk factor for childhood diarrhea.[23,24] However, the status of improved access to drinking water, the use of latrine facilities, and their association with reported childhood diarrhea have been examined in a limited national or regional representative study. It is therefore important to examine country-level data to provide an exhaustive review of the proof. The objective of this study was to determine the status of improved drinking water and latrine services utilization, child feces disposal practices in Ethiopia and their associations with reported childhood diarrhea. The findings of this study could enable the government, nongovernmental organizations, and other stakeholders to establish and enforce effective strategies to prevent/mitigate childhood diarrhea.

Methods and Materials

Data source

We used data from 2016 Ethiopian Demographic and Health Studies (EDHS). It is a nationally representative cross-sectional survey conducted in 9 regions and 2 city administrations. The EDHS was designed to provide representative data at the national and regional level disaggregated by urban and rural locations. It is the fourth Demographic and Health Survey conducted in Ethiopia and implemented by the Central Statistical Agency (CSA). The 2016 EDHS sample was stratified into urban and rural areas and selected in 2 stages. In the first stage, a total of 645 enumeration areas (202 in urban areas and 443 in rural areas) were selected with probability proportional to the enumeration area size and with independent selection in each sampling stratum. In the second stage, a fixed number of 28 households per cluster were selected with an equal probability of systematic selection. Data collection took place from January 18, 2016, to June 27, 2016.[25] All interviewed mothers/caregivers who owned under-5 children from the sampled households were included in the interview. Of the 10 641 eligible children, 9916 children interviewed mothers/caregivers gave a complete response about the 2-week occurrence of diarrhea among their under-5 children. After excluding those under-5 children whose mother/caregivers did not respond to the diarrhea case, 9754 under-5 children with complete information were used as the data for this study.

Study variables

Outcome variable. The outcome of this study was the interviewed mothers /caregivers' response to the 2-week occurrence of diarrhea among their under-5 children. Diarrhea is defined as 3 or more loose or watery stools in 24 hours or more frequently than normal for an individual.[3] In the 2016 EDHS, mothers/caregivers were asked about a 2-week occurrence of diarrhea among their under-5 children using the statement "Has (NAME) had diarrhea in the last 2 weeks?" Those interviewed mothers/caregivers reportedly either YES, NO, or DO NOT KNOW. In this study, only data of mothers/caregivers responded by saying YES/NO were included in the analysis.

Explanatory variables. To examine the factors associated with reported childhood diarrhea, region, place of residence, exposure to media, wealth status, drinking water sources, latrine type, place where household members wash their hands and share toilets with other households and persons fetching water were included in the study. Most of the data of the associated factors were taken directly as they were in the DHS dataset. However, variables like wealth index, source of water supply, latrine facilities, and child feces disposal practices were categorized. A new wealth index was generated following the procedure of the 2016 EDHS using principal component analysis (PCA). The new wealth index was further categorized into poor, middle, and rich. Similarly, sources of water supply, latrine facilities, and child feces disposal practices were categorized based on the WHO/UNICEF JMP for water supply and Sanitation definition.[26] According to the definition, of water collected from water piped into the residence, a public tab, water from a borehole, water from a protected spring or well, rainwater, and bottled water were categorized as "improved" whereas, water from unprotected dug wells or springs, water from a vendor or tanker-truck and surface water (including rivers, dams, lakes, ponds, streams, canals, and irrigation channels) was categorized as "unimproved." Similarly, improved latrine facilities were defined as using latrines like any nonshared toilets of the following types: flush/pour flush toilets with pipe sewer systems, septic tanks, pit latrines, ventilated improved pit (VIP) latrine, pit latrine with slabs, and composting toilets. On the other hand, using a public or shared latrine, open-pit, latrine, bucket latrine, other types of the latrine, and if no facility at all or using bush/field is defined as "unimproved" in this analysis. Child feces disposal practices were defined as "safe disposal" if the interviewed mother/caregivers disposed of child stools by putting or rinsing in a toilet or latrine, or burying them, or in a situation where the child used a toilet or latrine. Otherwise, feces disposal was regarded as unsafe.

Data analysis

Stata version 16.0 (Stata Corp, College Station, TX, USA) was used for data analysis. Since the DHS used a multistage

cluster design, sampling weights and clustered standard errors at the PSU level were taken into account using the svyset command in Stata version 16. The data were presented using frequency and percentage. Bivariate logistic regression was performed to investigate the crude association of availability and usage of improved water and sanitation facilities with childhood diarrhea. Finally, multiple logistic regressions were performed to identify independent predictors of childhood diarrhea. Variables with a *P*-value of less than .05 is found to be significantly associated with childhood diarrhea.

Ethics approval

The author followed the principles and procedures of DHS to get publicly available data from https://dhsprogram.com/data. He was granted permission from CSA through its data manager to use the CSA data online form.

Results

Study participant characteristics

The database contained information on recent diarrhea occurrence for a total of 9754 children under age 5. Of these, 15% lived in the Oromia region while 4.3% were living in the city of Addis Ababa. Table 1 reports selected socio-demographic and economic characteristics of the included participants. Where these statistics differ from those previously reported elsewhere, it is because only include those households in which the mothers/caregivers gave a usable yes/no answer to diarrhea question. Most of the households studied (81.4%) lived in rural parts of the country. The majority of households (80.0%) owned 2 or less children under 5 years of age, while more than half of households (50.8%) were Muslim religious followers. The findings showed that 56.2% lived in households with more than 5 members. With regards to educational status, 64.3% of the respondents and 49.1% of the husbands/partners of the respondents did not have formal education (Table 1).

As reported in Table 2, the prevalence of childhood diarrhea in the preceding 2 weeks was 11% (95% CI: 10.36-11.61). The findings revealed that 51% of the included children were male. More than 40% of the households of the study participants used unimproved drinking water sources. Regarding the time to get to the water source, 17.1% of the households had water sources on premises, and 46.9% walked for up to 30 minutes to collect water. Among the interviewed mothers/caregivers, 43.9% had no type of latrine facilities and 39.3% of them used unimproved latrine facilities. Of those who own latrines, 32.6% of the study participants reported that they shared the latrines with others. Concerning child feces disposal practices, 24.8% of the interviewed mothers/caregivers' child feces were disposed of safely. Around 76.4% of respondents did not frequently listen to the radio at all and 79.1% of respondents did not frequently watch television at all (Table 2).

Figure 1 shows the distribution of latrine types of study participants according to regional, state, and status at the country level. In the figure, the majority of the Afar (80.1%), Gambela (65.7%), and Somali (62.7%) regional state respondents did not have any latrine facility. Similarly, the improved latrine facility type was found to be the highest among the respondents of Addis Ababa (83.8%) and Dire Dawa (50.5%) City administrations, whereas it was the lowest among the Benishangul Gumuz (3.0%) and Amhara (3.6%) regional state respondents, respectively (Figure 1).

The prevalence of safe child feces disposal practices is presented in Figure 2. In the figure, the highest prevalence of safe child feces disposal was found in the South Nation, Nationalities and People Regional (SNNPR) state (37.4%) followed by Benishangul Gumuz (33.3%). The lowest prevalence of safe child feces disposal was found in the Gambella region (16.5%), followed by the Afar region (18.3%) (Figure 2).

In this study, based on the WHO/UNICEF JMP for water supply and sanitation category, 59.3% of households used drinking water from improved sources, whereas the remaining 40.7% of study participants used unimproved water sources in Ethiopia. The study showed that the highest improved water supply was detected in Addis Ababa (95.2%), Dire Dawa (77.0%), and Benishangul Gumuz (77.0%), whereas the least was observed in Somali (38.6%) and Afar (42.4%) regional states (Figure 3).

Factors associated with childhood diarrhea

The bivariate and multivariable logistic regression analyses were computed and are presented in Table 3. Bivariate analyses (unadjusted) indicated that the region of the respondent (Somali and Addis Ababa), number of household members and under-5 children, religion (Muslim), type of latrine (unimproved) and child feces disposal practices are significant factors associated with childhood diarrhea. On the other hand, the likelihood of childhood diarrhea occurrence was less among households collecting water from improved sources and within 30 minutes, even though the reduction was not significant. After computing the bivariate analysis, the selected variables were further examined using a multivariable logistic model to see their relative effects on childhood diarrhea. In the model (adjusted), the region of the respondent (Somali), the number of household members, the sex of a child, and the number of under-5 children in the household and child feces disposal practices are the only statistically significant variables associated with childhood diarrhea.

The odds of having childhood diarrhea were 1.81 (AOR = 1.81, 95% CI: 1.25-2.61) among Somali residents and 1.53 (AOR = 1.53, 95% CI: 0.93-2.51) among Addis Ababa residents as compared to Dire Dawa residents. The study also indicated that the odds of having diarrhea were 5% higher among urban residents as compared to rural residents (AOR = 1.05, 95% CI: 0.77-1.42). The odds of developing

Table 1. Socio-demographic and economic characteristics of the included participants, 2016 Ethiopia Demographic and Health Survey.

VARIABLES	CATEGORY	FREQUENCY	PROPORTION (%) AT 95% CI
Region	Tigray	974	10.0 (9.41-10.60)
	Afar	952	9.8 (9.19-10.37)
	Amhara	896	9.2 (8.63-9.78)
	Oromia	1466	15.0 (14.33-15.75)
	Somali	1366	14.0 (13.33-14.71)
	Benishangul Gumuz	809	8.3 (7.76-8.86)
	SNNPR	1185	12.2 (11.52-12.81)
	Gambela	642	6.6 (6.11-7.09)
	Harari	553	5.7 (5.23-6.15)
	Addis Ababa	420	4.3 (3.92-4.73)
	Dire Dawa	491	10.0 (9.41-10.60)
Type of place of residence	Urban	1814	18.6 (17.84-19.38)
	Rural	7940	81.4 (80.62-82.16)
Number of household members	⩽5	4276	43.8 (42.86-44.83)
	>5	5478	56.2 (55.17-57.14)
Number of under-5 children	⩽2	7806	80.0 (79.22-80.91)
	>2	1948	20.0 (19.19-20.78)
Religion	Orthodox	2846	29.2 (28.28-30.09)
	Catholic	61	0.6 (0.49-0.8)
	Protestant	1723	17.7 (16.92-18.43)
	Muslin	4952	50.8 (49.78-51.76)
	Traditional	96	1.0 (0.81-1.2)
	Other	76	0.8 (0.62-0.97)
Educational status of respondents	No education	6271	64.3 (63.34-65.24)
	Primary	2458	25.2 (24.35-26.07)
	Secondary	666	6.8 (6.34-7.35)
	Higher	359	3.7 (3.32-4.07)
Husband/partner's education status	No education	4518	49.1 (48.04-50.08)
	Primary	2986	32.4 (31.48-33.39)
	Secondary	932	10.1 (9.52-10.75)
	Higher	701	7.6 (7.09-8.17)
	Don't know	72	0.8 (0.62-0.98)
Wealth index	Poor	3252	33.3 (32.41-34.28)
	Middle	3249	33.3 (32.40-34.27)
	Rich	3253	33.4 (32.40-34.27)

Table 2. The prevalence of reported diarrhea and other determinant variables of the included participants, 2016, Ethiopia Demographic and Health Survey.

VARIABLES	CATEGORY	NUMBER (N)	PROPORTION (%) AT 95% CI
Had diarrhea recently	No	8684	89.0 (88.39-89.64)
	Yes, last 2 weeks	1070	11.0 (10.36-11.61)
Sex of child	Male	4975	51.0 (50.01-52.0)
	Female	4779	49.0 (48.0-49.99)
Sources of drinking water	Improved	5788	59.3 (58.36-60.31)
	Unimproved	3966	40.7 (39.69-41.64)
Time to get to the water source (min)	On-premises	1664	17.1 (16.33-17.82)
	1-30	4576	46.9 (45.92-47.91)
	31-60	1792	18.4 (17.62-19.15)
	Others	1722	17.7 (16.91-18.42)
Latrine type	Improved	1690	17.3 (16.59-18.09)
	Unimproved	3780	38.8 (37.79-39.72)
	No facility/bushes/field	4284	43.9 (42.94-44.91)
Toilet facilities shared with other households	No	3643	66.6 (65.34-67.84)
	Yes	1781	32.6 (31.33-33.81)
	Others	46	0.8 (0.63-1.12)
Disposal of the youngest child's feces when not using a toilet	Safe	2422	24.8 (23.98-25.70)
	Unsafe	7332	75.2 (74.3-76.02)
Frequency of listening to the radio	Not at all	7452	76.4 (75.55-77.23)
	Less than once a week	1146	11.8 (11.12-12.40)
	At least once a week	1156	11.9 (11.22-12.51)
Frequency of watching television	Not at all	7718	79.1 (78.31-79.92)
	Less than once a week	782	8.0 (7.49-8.57)
	At least once a week	1254	12.9 (12.21-13.54)

childhood diarrhea is statistically significantly increased for having more than 2 children under 5 (AOR: 1.21, 95% CI: 1.01-1.46) and having more than 5 family members (AOR: 1.18, 95% CI: 1.03-1.36). Compared to those mothers/caretakers with higher education, the odds of developing diarrhea among children whose mothers/caretakers with no formal education have decreased by 1% (AOR: 0.99, 95% CI: 0.66-1.47).

After adjusting for variables, whether households were users of an improved water supply (AOR 1.02; 95% CI: 0.88-1.19) compared to their counterparts, the likelihood of developing childhood diarrhea increased by 2%, although the association was not statistically significant. The study showed that sanitation services and childhood diarrhea were negatively associated, but the association was not statistically significant. Children living in households with improved latrine facilities were 8% less likely to develop diarrhea than children living in households to practice open defecation (AOR: 0.92, 95% CI: 0.72-1.18). Moreover, the odds of having diarrhea were 9% lower among children living in households with unimproved latrine facilities compared to those practicing open defecation (AOR: 0.91, 95% CI: 0.69-1.19). The association between childhood diarrhea and unsafe disposal of child feces in households was statistically significant (AOR: 1.32; 95% CI: 1.14-1.54). Adjusting for variables, the unsafe disposal practices of child feces in the study significantly increased the likelihood of childhood diarrhea (Table 3).

Discussion

This study identifies the status and association of childhood diarrhea documented and improved water supply and

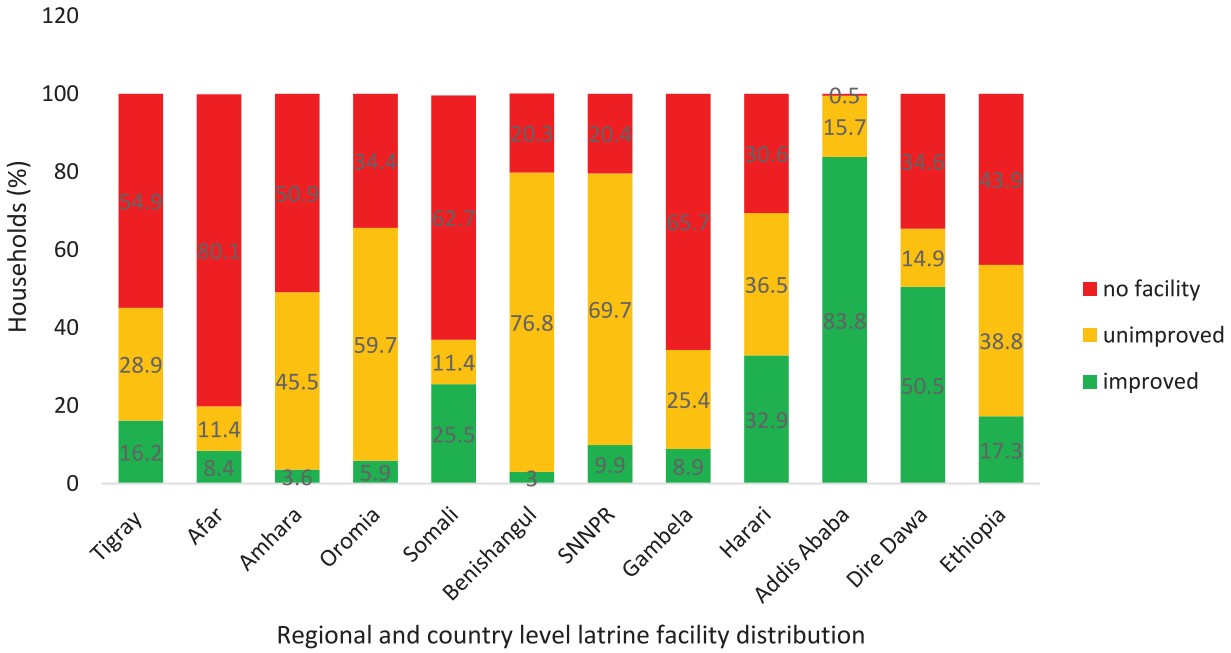

Figure 1. The distribution of latrine facility by regional states and country.

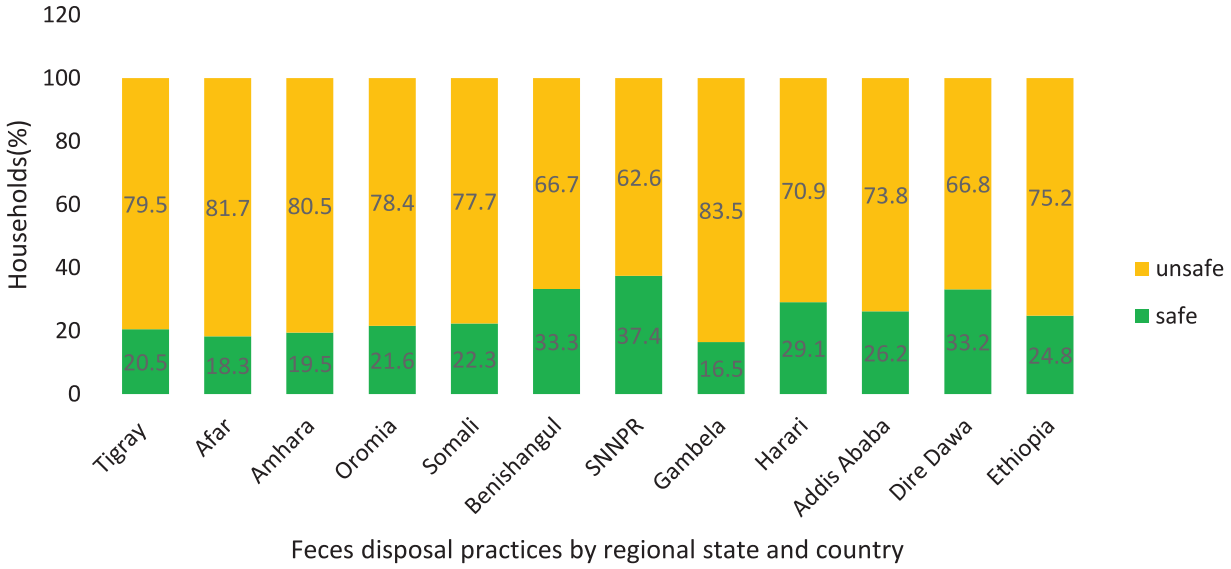

Figure 2. Prevalence of safe child feces disposal practices by regional states and country.

sanitation usage in Ethiopia based on data from the 2016 Demographic and Health Survey. This study found that the improved latrine utilization of the study participants was 17.3%, which is lower than that of studies conducted in Uganda (21.3%), Indonesia (69%), Vietnam (47.1%),[15,27,28] and SDG targets to achieve and sustain 100% access to improved sanitation in rural and urban areas by 2030.[29] This study also found that the improved water supply utilization of the study participants was 59.3%, even though there was variation between regional states. This finding was lower than study's findings from Indonesia (62%), India (83%), and the Democratic People's Republic of Korea (93.7%).[15,30,31] However, this finding is higher than that in another study from Indonesia (31.6%).[32] The possible explanations for this finding being different might be related to sample size, study setting, socioeconomic, and differences in the year of study.

Furthermore, 24.8% of the study participants practiced safe child feces disposal. It is relatively similar to findings reported in India (23.7%)[33] and Bangladesh (20%).[34] However, the findings were lower than those reported in Ethiopia (33.68%),[35] Indonesia (47%),[15] Uganda (75%),[36] and Kenya (70%).[37] The difference could be related to the study participants' socio-economic differences or implementation of the sanitation approach of child feces disposal practices in the community.

In this study, the odds of having childhood diarrhea were significantly higher among children living in households that

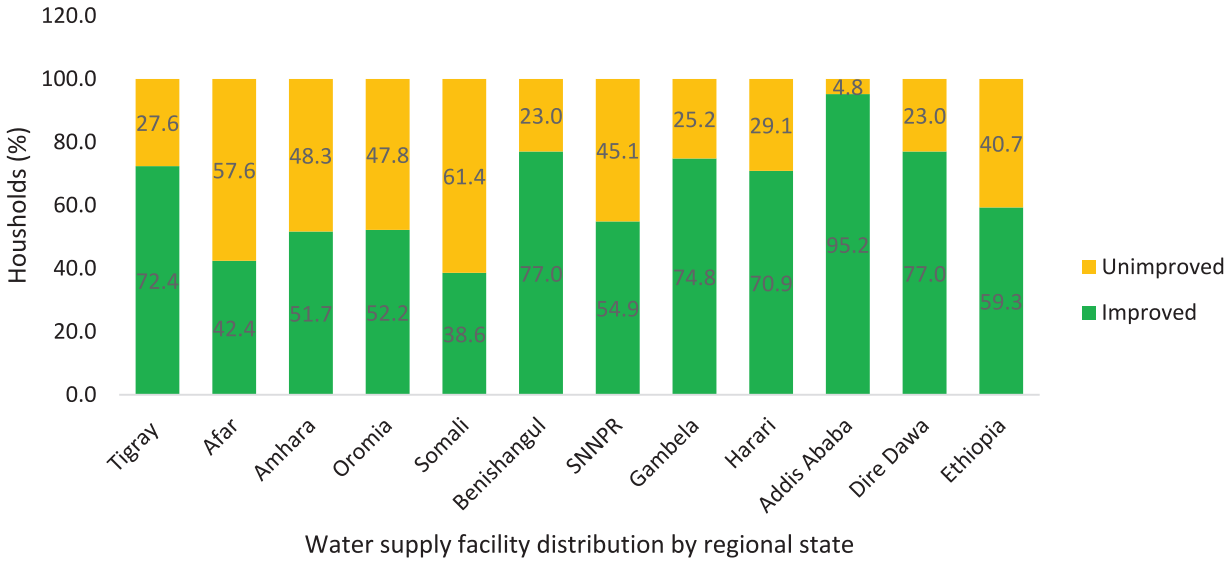

Figure 3. The distribution of sources of drinking water usage by regional states and country.

Table 3. Unadjusted and adjusted odds ratio for the determinant variables of reported childhood diarrhea, 2016 Ethiopia Demographic and Health Survey.

VARIABLES	CATEGORY	REPORTED DIARRHEA	TOTAL	UNADJUSTED (BIVARIATE)	ADJUSTED (MULTIVARIABLE)
		NO (%)		OR (95% CI)	OR (95% CI)
Region	Tigray	122 (12.5)	974	0.90 (0.64-126)	0.85 (0.57-1.27)
	Afar	104 (10.9)	952	1.05 (0.74-1.48)	1.03 (0.71-1.49)
	Amhara	116 (12.9)	896	0.87 (0.62-1.22)	0.85 (0.57-1.28)
	Oromia	167 (11.4)	1466	1.01 (0.73-1.38)	0.99 (0.70-1.41)
	Somali	86 (6.3)	1366	1.92 (1.35-2.73)*	1.81 (1.25-2.61)*
	Benishangul	75 (9.3)	809	1.26 (0.87-1.82)	1.27 (0.85-1.90)
	SNNPR	168 (14.2)	1185	0.78 (0.56-1.08)	0.84 (0.57-1.24)
	Gambela	85 (13.2)	642	0.84 (0.59-1.21)	0.80 (0.52-1.22)
	Harari	60 (10.8)	553	1.06 (0.72-1.56)	1.10 (0.74-1.2)
	Addis Ababa	31 (7.4)	420	1.62 (1.02-2.56)*	1.53 (0.93-2.51)
	Dire Dawa	56 (11.4)	491	Ref	Ref
Type of place of residence	Urban	183 (10.1)	1814	1.12 (0.95-1.33)	1.05 (0.77-1.42)
	Rural	887 (11.2)	7940	Ref	Ref
Number of household members	⩽5	518 (12.1)	4276	Ref	Ref
	>5	552 (10.1)	5478	1.23 (1.08-1.40) *	1.18 (1.03-1.36)*
Number of under-5 children	⩽2	903 (11.6)	7806	Ref	Ref
	>2	167 (8.6)	1948	1.40 (1.17-1.66) *	1.21 (1.01-1.46)*
Religion	Orthodox	330 (11.6)	2846	Ref	Ref
	Catholic	8 (13.1)	61	0.87 (0.41-1.84)	0.88 (0.41-1.90)
	Protestant	228 (13.2)	1723	0.86 (0.72-1.03)	0.91 (0.70-1.18)

(Continued)

Table 3. (Continued)

VARIABLES	CATEGORY	REPORTED DIARRHEA	TOTAL	UNADJUSTED (BIVARIATE)	ADJUSTED (MULTIVARIABLE)
		NO (%)		OR (95% CI)	OR (95% CI)
	Muslin	487 (9.8)	4952	1.20 (1.04-1.39)*	0.94 (0.75-1.18)
	Traditional	11 (11.5)	96	1.02 (0.54-1.92)	0.85 (0.43-1.66)
	Other	6 (7.9)	76	1.53 (0.66-3.55)	1.62 (0.68-3.85)
The highest educational level of respondents	No education	655 (10.4)	6271	0.98 (0.69-1.40)	0.99 (0.66-1.47)
	Primary	307 (12.5	2458	0.81 (0.56-1.16)	0.92 (0.62-1.35)
	Secondary	71 (10.7)	666	0.96 (0.63-1.47)	1.04 (0.67-1.60)
	Higher	37 (10.3)	359	Ref	Ref
Wealth index	Poor	320 (9.8)	3252	0.82 (0.72-0.98)*	1.02 (0.82-1.26)
	Middle	377 (11.6)	3249	1.02 (0.87-1.18)	1.01 (0.86-1.18)
	Rich	373 (11.5)	3253	Ref	Ref
Sex of child	Male	573 (11.5)	4975	0.89 (0.79-1.02)	0.88 (0.77-0.99)*
	Female	497 (10.4)	4779	Ref	Ref
Source of drinking water	Improved	643 (11.1)	5788	0.96 (0.85-1.10)	1.02 (0.88-1.19)
	Unimproved	427 (10.8)	3966	Ref	Ref
Time to get to the water source (min)	On-premises	179 (10.8)	1664	Ref	Ref
	1-30	504 (11.0)	4576	0.97 (0.81-1.17)	1.27 (0.96-1.68)
	31-60	185 (10.3)	1792	1.05 (0.84-1.30)	1.28 (0.94-1.74)
	Others	202 (11.7)	1722	0.91 (0.73-1.12)	1.03 (0.76-1.41)
Latrine facility type	Improved	155 (9.5)	1632	1.10 (0.93-1.36)	0.92 (0.72-1.18)
	Unimproved	464 (12.1)	3838	0.86 (0.75-0.98)*	0.91 (0.69-1.19)
	No facility	451 (10.5)	4284	Ref	Ref
Child feces disposal practices	Safe	314 (13.0)	2422	Ref	Ref
	Unsafe	756 (10.3)	7332	1.30 (1.13-1.49)*	1.32 (1.14-1.54)*

*Statistically significant at $P < .05$
Abbreviation: Ref, reference category.

practiced unsafe disposal of children's feces compared with those who practiced safe disposal. This is in agreement with studies done in Ethiopia[38] and Indonesia,[9] which showed that the odds of diarrhea are significantly greater in households practicing unsafe disposal of child feces. However, the analysis did not find a significant association between sanitation services and childhood diarrhea. Similar study findings of the analysis of the IDHS 2012 dataset were reported in Indonesia.[15] On the other hand, this study findings were inconsistent with the findings of a study that merged the data sets of 171 surveys of 70 low- and middle-income countries over the period 1986 to 2007.[39]

Additionally, the study did not find any significant association between improved drinking water sources and childhood diarrhea. The findings of this study were consistent with the findings of a study conducted in India.[40] Providing access to an improved water supply is an important cornerstone in reducing diarrheal disease rates. However, studies have identified that collecting water from improved sources does not have a guarantee to reduce the risk of diarrheal disease. Since the contamination of drinking water can occur in the distribution system or at home after water treatment has already occurred.[41,42]

Like previous studies that reported the highest presence of diarrhea in households with more than 1 under-5 child, this study showed that the likelihood of childhood diarrhea was higher in households who had 2 or more children. This could be because several numbers of children residing in a household were considered as a predictor of childhood diarrhea in

previous studies.[43,44] On the other hand, having a family size greater than 5 was more likely to increase the odds of childhood diarrhea in this study. This was supported by a report from southwest Ethiopia.[45]

Late study's findings showed that children living with the wealthy family were less exposed to diarrhea because the wealthy are associated with better access to household facilities related to better hygiene and sanitation and frequently use health services.[43,46,47] The findings of this study confirmed the previous findings that, as the households indexed as poor wealth index were more likely to develop childhood diarrhea compared to those indexed as rich.

The limitation of this study was the use of EDHS (secondary) data for this study, and therefore, all variables that influence childhood diarrhea were not included. The other limitations of this study are reporting bias, recall bias, seasonal issues during the survey period, and the issue of social desirability bias that may reduce childhood diarrhea reports from the study participants.

In conclusion, the current study showed that sanitation facilities were low, and more than half of the respondents used improved drinking water sources. The majority of the community still practiced unsafe child feces disposal. Moreover, diarrhea remains a public health prom among under-5 children in Ethiopia. On the other hand, the odds of developing childhood diarrhea were significantly associated with the residence in the Somali Region, having more than 2 under-5 children and having more than 5 household members, sex of the indexed child and safe disposal practices of child feces. Health facilities and local administrators should emphasize reducing crowding in households and promoting the safe disposal of child feces to reduce childhood diarrhea in communities.

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Author Contribution

NES designed the study concept, analyzed data interpretation of data, drafted, and revised the manuscript. The author reviewed and approved the final version of the manuscript.

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Data Availability

All relevant data are included in the paper.

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