

BMJ Open Demographic disparities in unimproved drinking water and sanitation in Ghana: a nationally representative cross-sectional study

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ABSTRACT

Objective The government of Ghana has targeted universal access to safe drinking water by 2025 and elimination of open defecation by year 2030. This study explored the use of unimproved drinking water and unimproved sanitation and assessed their association with demographic factors.

Design This was a secondary data analysis of the 2017 Ghana Maternal Health Survey, a nationally representative cross-sectional survey. Open defecation households were mapped to show regional differences. Weighted logistic regression was used to assess the association of demographic variables with use of unimproved drinking water and unimproved toilet facilities.

Setting Ghana.

Participants A total of 26 324 households were included in the analysis.

Primary and secondary outcome measures Use of unimproved drinking water and unimproved toilet facilities.

Results Out of the 26 324 households, 8.9% used unimproved drinking water while 81.6% used unimproved sanitation. Open defecation was practised by 15.2% of Ghanaian households, with a prevalence of 58.8%, 6.7% and 12.5% in the Northern, Middle and Coastal zones, respectively. In the multivariate analysis, rural households ($p<0.001$), households with more than five members ($p<0.001$), households with heads less than 25 years ($p=0.018$), male-headed households ($p<0.001$) and household heads with no/low level of education ($p<0.001$) were significantly associated with drinking unimproved water. Also, rural households ($p=0.002$), households in the Northern zone ($p<0.001$), single-member households ($p<0.001$), households with heads less than 25 years ($p<0.001$) and household heads with no/low level of education ($p<0.001$) were significantly associated with using unimproved toilet facilities.

Conclusion The target of universal access to safe drinking water by 2025 and elimination of open defecation by 2030 seems impossible to be achieved if appropriate measures are not implemented. We recommend that state authorities, health partners and non-governmental organisations support local-level sanitation plans and strategies.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ The study used data from a nationally representative survey of more than 26 300 households to assess unimproved drinking water and unimproved sanitation in Ghana.
- ⇒ Sampling weights were applied to account for the non-proportional allocation of the sample to the different regions and to obtain national/regional representation of the survey results.
- ⇒ The findings of this study can be generalised to households in Ghana.
- ⇒ The study was limited to assessing household and demographic characteristics associated with unimproved water and sanitation use.
- ⇒ Household-level morbidity data were not collected as part of the survey to be used to assess their association with use of unimproved drinking water and toilet facilities.

INTRODUCTION

Safe drinking water and sanitation are human rights and their access is fundamental to human health and well-being.¹ However, despite progress in the provision of safe drinking water and proper sanitation globally, close to two billion people continue to drink water contaminated with faeces,² with more than half of the world's population still using poor sanitation services.³ It is estimated that 673 million people globally have no toilet facilities and practise open defecation.³

Poor sanitation practices are associated with several adverse health outcomes, including diarrhoea, neglected tropical diseases, vectorborne diseases, stunting, antimicrobial resistance, anaemia, spontaneous abortion and preterm birth.⁴ Particularly, diarrhoeal diseases, with poor water quality and poor sanitation as major risk factors, are among the leading causes of death globally, with a higher burden in the developing world.⁵ The use of contaminated water contributes to over

800 000 deaths and over 49 million disability-adjusted life years, mainly due to diarrhoeal diseases.³

In Ghana, 12.7% of households drink unsafe water and 80.6% use unimproved toilet facilities, with 18.8% practising open defecation.⁶ Diarrhoeal disease resulting from drinking contaminated water is one of the most reported illnesses in health facilities in Ghana. Also, about 25% of all under-5 mortalities in Ghana are due to diarrhoea.^{7,8} A Joint Monitoring Programme report of the WHO and UNICEF has revealed that more than 4000 Ghanaian children die from diarrhoea every year and approximately 23% of children in Ghana experience chronic malnutrition resulting from poor water and sanitation.⁹

Availability and access to safe drinking water and proper sanitation are therefore of paramount importance to health and well-being. They are essential to disease prevention and contribute to improvement in nutrition.¹ In line with Sustainable Development Goal (SDG) 6, which aims to 'Ensure availability and sustainable management of water and sanitation for all',¹⁰ the government of Ghana has targeted universal access to safe drinking water by 2025 and to eliminate open defecation by 2030.¹¹

Several international and national interventions aimed at expanding access to safe drinking water and proper sanitation are in place in Ghana.^{12–14} Even so, similar to reports from other countries,^{15–17} in Ghana, availability and access to safe drinking water and proper sanitation depend on several factors, including geographical location. Data from the most recent Ghana Demographic and Health Survey (DHS) show that although close to 90% of households in Ghana get their drinking water from improved sources, about 75% of households in the Northern region use improved drinking water.^{18,19} Likewise, over 70% of the population in Northern Ghana (previously Northern, Upper East and Upper West regions) practise open defecation, although about 20% of the entire country's population practise open defecation.²⁰

With a focus on SDG 6, which aims to 'Ensure availability and sustainable management of water and sanitation for all',¹⁰ this study aimed to explore the use of unimproved drinking water and unimproved sanitation in Ghana and to assess the association of demographic factors with use of unimproved drinking water and unimproved sanitation. Also, with an interest in open defecation, the study explores the regional distribution of open defecating households in Ghana. The results of this study will help inform appropriate stakeholders on factors to consider in the provision of improved drinking water and sanitation.

METHODS

Data source and data description

The data used in this study were from the 2017 Ghana Maternal Health Survey (GMHS),⁶ which was the second maternal health survey following the first one conducted

in 2007.²¹ The 2017 GMHS, which collected household-level and individual-level data on maternal health and maternal mortality in Ghana, was cross-sectional in design and nationally representative.

The sampling frame for the 2017 GMHS was the 2010 Population and Housing Census of Ghana.²² The survey sample was obtained using a stratified two-stage approach. For stratification, the 10 administrative regions of Ghana were grouped into rural and urban areas, which resulted in 20 sampling strata. In the first stage, probability proportional sampling was used to select a total of 900 enumeration areas (clusters) from all the regions. An enumeration area covers an average of 161 households.²² This resulted in 466 clusters from urban areas and 434 clusters from rural areas. In the second stage, 30 households were randomly sampled from each of the 900 clusters. This produced a total sample size of 27 000 households.

Data for this analysis were obtained from the DHS programme, on submitting a research project detailing the purpose of the data request. In total, 27 001 households were sampled for the survey, of which 26 500 were occupied at the time of the survey. From the 26 500 occupied households, 26 324 (99%) were interviewed. Data from these 26 324 households were used for secondary data analysis. All study respondents provided informed consent for their participation in the survey. Additional details of the survey design and methodology can be found in the survey report.⁶

Study variables

The variables used in the analysis include data on households' use of unimproved drinking water and unimproved toilet facilities. Other study variables include place and region of households' location, zone and household size. On the characteristics of household heads, data on age, sex and level of education were included. A detailed description of the study variables is presented in [table 1](#). WHO guidelines were used to classify the type of water and sanitation/toilet facilities as unimproved.²³

Patient and public involvement

No patient was involved. Key stakeholder meetings will be organised to share the findings of this study with appropriate stakeholders.

Statistical analysis

Data analysis was conducted using Stata V.14.0. Sampling weights were applied to account for the non-proportional allocation of the sample to the different regions and to obtain national/regional representation of the survey results. Weights were calculated separately for each sampling stage and for each cluster based on sampling probabilities. Details of the design and sampling weights can be found in the survey report.⁶

R statistical software (R V.3.4.1 and RStudio V.1.3.959) was used to generate maps showing the proportion of households practising open defecation by region. The

Table 1 Description of study variables

Variable	Description	Variable type
Household		
Household	A person or group of related or unrelated persons who live together in the same dwelling unit(s), who acknowledge one adult male or female as the head of the household, who share the same housekeeping arrangements, and who are considered a single unit.	N/A
Unimproved drinking water	Households drinking from unprotected dug wells, unprotected spring and surface water (river, dam, lake, pond, stream, etc).	Dependent variable
Unimproved toilet facilities	Households' use of shared* flush toilet to piped sewer system/septic tank/pit latrine, shared* ventilated improved pit latrine, shared* pit latrine with a slab, shared* composting toilet, flush toilet not to sewer/septic tank/pit latrine, pit latrine without slab/open pit, bucket, hanging toilet/hanging latrine, and open defecation.	Dependent variable
Open defecation	No toilet facility: defecating in the bush, field, etc.	N/A
Place of residence	Household's location (urban, rural).	
Region of residence	Household's regional location from the 10 administrative regions in Ghana (Western, Central, Greater Accra, Volta, Eastern, Ashanti, Brong Ahafo, Northern, Upper East, Upper West).	Independent variable
Zone	Household's location from the three major geographical regions in Ghana (ie, Coastal: Western, Central, Greater Accra and Volta regions; Middle: Eastern, Ashanti and Brong Ahafo regions; and Northern: Northern, Upper East and Upper West regions).	Independent variable
Household size	Number of persons who are the usual residents of a household. This has been classified as a single-member, two to five members and more than five members.	Independent variable
Household head		
Household head	An adult man or woman recognised as the head of the unit by the other members of the household unit or by herself if living alone.	N/A
Age	Age of household head. This has been grouped into <25 years, 25–35 years, 36–45 years and >45 years.	Independent variable
Sex	Sex of household head (male or female).	Independent variable
Level of education	Household head's highest level of education (no education, primary education, middle/junior secondary school (JSS)/junior high school (JHS), secondary/senior secondary school (SSS)/senior high school (SHS), more than secondary).	Independent variable
*Shared with other households. JHS, Junior High School; JSS, Junior Secondary School; N/A, not applicable; SHS, Senior High School; SSS, Senior Secondary School.		

proportion of households using unimproved drinking water and unimproved toilets facilities was presented by the level of the different demographic variables (place/region/zone of residence, household size, age of household head, gender of household head and level of education of household head). χ^2 test was used to assess the association of demographic variables with use of unimproved drinking water and unimproved toilet facilities.

Weighted univariate and multivariate analyses were performed using logistic regression to assess the association of demographic variables with use of unimproved drinking water and unimproved toilets facilities. The 10 regions of Ghana were classified into three major geographical regions, namely Northern, Middle and Coastal (see [table 1](#)). Given the fewer categories, study zone was used in the regression analysis and not region of residence. Results were reported as OR and 95% CI. Statistical significance was established at a level of 5%.

Given the interest in all the demographic factors and backed by the results of previous literature (association of unimproved drinking water and/or toilets facilities with place of residence,^{24–26} region/zone,^{18 19} household size,^{19 27} age,¹⁹ gender^{28 29} and level of education^{19 29}), all the variables were included in the multivariate analysis regardless of their significance in the univariate analysis.

RESULTS

Characteristics of households and household heads

The characteristics of the households and the household heads included in the 2017 GMHS are presented in [table 2](#). A total of 26 324 households were included in the analysis, with 55.8% of the households in urban areas and 44.2% in rural areas. Most of the households were from the Middle zone (41.0%) and Coastal zone (47.9%), with majority of the households having two to five members

Table 2 Characteristics of households and household heads

Variable	Unweighted frequency n=26 324	Weighted frequency n=26 324	Weighted percentage
Household characteristics			
Place of residence			
Urban	13 590	14 678	55.8
Rural	12 734	11 646	44.2
Region of residence			
Western	2011	2700	10.3
Central	1973	2559	9.7
Greater Accra	2856	4966	18.9
Volta	1894	2387	9.1
Eastern	2685	3019	11.5
Ashanti	3628	5383	20.5
Brong Ahafo	2425	2392	9.1
Northern	3816	1552	5.9
Upper East	2773	831	3.2
Upper West	2263	534	2.0
Zone			
Northern	8852	2917	11.1
Middle	8738	10 794	41.0
Coastal	8734	12 613	47.9
Household size			
Single member	4736	5335	20.3
2–5 members	14 643	15 175	57.6
>5 members	6945	5814	22.1
Household head			
Age			
<25 years	1512	1610	6.1
25–35 years	7025	6991	26.6
36–45 years	6140	6284	23.9
>45 years	11 647	11 439	43.5
Gender			
Male	18 206	17 495	66.5
Female	8118	8829	33.5
Level of education			
No education	8267	5958	22.6
Primary	3098	3204	12.2
Middle/JSS/JHS	8477	10 266	39.0
Secondary/SSS/SHS	3300	3731	14.2
More than secondary	3182	3165	12.0

JHS, Junior High School; JSS, Junior Secondary School; SHS, Senior High School; SSS, Senior Secondary School.

(57.6%). Most of the households were headed by a male (66.5%), and a higher proportion of the household heads were above 45 years (43.5%). Also, majority of the household heads had middle/Junior Secondary School/Junior High School education.

Unimproved drinking water and unimproved toilet facilities among Ghanaian households

Out of the 26 324 households included in this study, 8.9% (95% CI 7.5% to 10.6%) used unimproved drinking water (table 3). Use of unimproved drinking water was higher among rural households (17.8%, 95% CI 14.8% to 21.2%) compared with households in urban areas (1.9%, 95% CI 1.4% to 2.5%). Regional differences were observed in the use of unimproved drinking water ($p<0.001$), with a higher proportion of households in the Northern region (20.4%, 95% CI 16.2% to 25.5%) and Volta region (20.3%, 95% CI 14.0% to 28.6%) using unimproved drinking water and a lower proportion of households in the Greater Accra region (0.3%, 95% CI 0.1% to 1.3%) using unimproved drinking water. Use of unimproved drinking water was higher in households with more than five members (14.5%, 95% CI 12.2% to 17.1%) and was higher in households headed by male members (10.3%, 95% CI 8.7% to 12.3%). The level of education of the household head was associated with the household's use of unimproved drinking water. Use of unimproved drinking water was higher among households whose heads have no formal education (15.4%, 95% CI 13.2% to 17.8%) and lower among households whose heads have higher education beyond secondary school (1.7%, 95% CI 1.1% to 2.4%).

The proportion of households that used unimproved toilet facilities was 81.6% (95% CI 80.1% to 82.9%). Use of unimproved toilet facilities was higher among rural households (86.6%, 95% CI 84.7% to 88.2%), in the Northern zone (92.8%, 95% CI 91.5% to 93.9%), among single-member households (85.5%, 95% CI 83.7% to 87.1%), among households headed by people less than 25 years (92.8%, 95% CI 90.6 to 94.6) and among households whose heads have no formal education (90.6%, 95% CI 89.5% to 91.7%). Use of unimproved toilet facilities was more prevalent in the Upper East region (94.6%, 95% CI 92.8% to 95.9%) and less prevalent in the Greater Accra region (70.8%, 95% CI 65.6% to 75.4%).

Regional distribution of open defecating households in Ghana

Open defecation was reported among 15.2% of all households in Ghana. As presented in figure 1, significant regional differences were observed in households that practise open defecation, with a prevalence of 58.8%, 6.7% and 12.5% in the Northern, Middle and Coastal zones, respectively. Open defecation was more prevalent in the Northern zone, with prevalence ranging from 53.6% in the Northern region to 70.3% in the Upper East region. Among all the 10 regions, open defecation was lowest in the Ashanti region (4.1%), followed by the Eastern region (5.4%), all located in the Middle zone.

Association of demographic factors with use of unimproved drinking water

At a 5% significant level, all the demographic variables except for age of household head were independently associated with use of unimproved drinking water

Table 3 Use of unimproved drinking water and toilet facilities among Ghanaian households

Variable	Total number of households	Households using unimproved drinking water			Households with unimproved toilet		
	N	n	% (95% CI)	P value	n	% (95% CI)	P value
Overall	26324	2350	8.9 (7.5 to 10.6)	–	21468	81.6 (80.1 to 82.9)	–
Household characteristics							
Place of residence							
Urban	14678	280	1.9 (1.4 to 2.5)	<0.001	11387	77.6 (75.4 to 79.6)	<0.001
Rural	11646	2070	17.8 (14.8 to 21.2)		10081	86.6 (84.7 to 88.2)	
Region of residence							
Western	2700	419	15.5 (8.8 to 25.9)	<0.001	2231	82.6 (79.2 to 85.6)	<0.001
Central	2559	204	8.0 (4.6 to 13.5)		2161	84.4 (80.5 to 87.7)	
Greater Accra	4966	15	0.3 (0.1 to 1.3)		3514	70.8 (65.6 to 75.4)	
Volta	2387	486	20.3 (14.0 to 28.6)		2037	85.3 (81.6 to 88.4)	
Eastern	3019	485	16.1 (11.3 to 22.4)		2235	74.0 (69.2 to 78.4)	
Ashanti	5383	114	2.1 (1.2 to 3.7)		4430	82.3 (79.3 to 84.9)	
Brong Ahafo	2392	223	9.3 (6.1 to 14.1)		2152	90.0 (87.1 to 92.2)	
Northern	1552	317	20.4 (16.2 to 25.5)		1438	92.7 (90.5 to 94.3)	
Upper East	831	67	8.1 (5.6 to 11.5)		786	94.6 (92.8 to 95.9)	
Upper West	534	20	3.8 (1.8 to 8.0)		483	90.5 (87.2 to 93.1)	
Zone							
Northern	2917	405	13.9 (11.4 to 16.7)	0.027	2707	92.8 (91.5 to 93.9)	<0.001
Middle	10794	822	7.6 (5.9 to 9.8)		2707	81.7 (79.6 to 83.6)	
Coastal	12613	1123	8.9 (6.6 to 11.9)		9944	78.8 (76.4 to 81.1)	
Household size							
Single member	5335	344	6.5 (5.2 to 7.9)	<0.001	4562	85.5 (83.7 to 87.1)	<0.001
2–5 members	15175	1164	7.7 (6.3 to 9.3)		12279	80.9 (79.3 to 82.4)	
>5 members	5814	841	14.5 (12.2 to 17.1)		4627	79.6 (77.6 to 81.5)	
Household head							
Age							
<25 years	1610	149	9.2 (7.0 to 12.1)	0.110	1495	92.8 (90.6 to 94.6)	<0.001
25–35 years	6991	569	8.1 (6.6 to 10.0)		6019	86.1 (84.4 to 87.6)	
36–45 years	6284	542	8.6 (7.0 to 10.5)		5199	82.7 (80.9 to 84.4)	
>45 years	11439	1091	9.5 (8.1 to 11.2)		8755	76.5 (74.6 to 78.4)	
Gender							
Male	17495	1808	10.3 (8.7 to 12.3)	<0.001	14167	81.0 (79.4 to 82.5)	0.009
Female	8829	542	6.1 (5.0 to 7.5)		7301	82.7 (81.1 to 84.2)	
Level of education							
No education	5958	916	15.4 (13.2 to 17.8)	<0.001	5399	90.6 (89.5 to 91.7)	<0.001
Primary	3204	422	13.2 (10.6 to 16.2)		2836	88.5 (86.4 to 90.3)	
Middle/JSS/JHS	10266	812	7.9 (6.3 to 9.8)		8571	83.5 (82.0 to 84.9)	
Secondary/SSS/SHS	3731	148	4.0 (3.1 to 5.1)		2929	78.5 (76.0 to 80.8)	
More than secondary	3165	52	1.7 (1.1 to 2.4)		1734	54.8 (51.0 to 58.5)	

JHS, Junior High School; JSS, Junior Secondary School; SHS, Senior High School; SSS, Senior Secondary School.

(table 4). In the multivariate analysis, place of residence ($p<0.001$), household size ($p<0.001$), age of household head ($p=0.018$), gender of household head ($p<0.001$)

and level of education of household head ($p<0.001$) were significantly associated with use of unimproved drinking water.

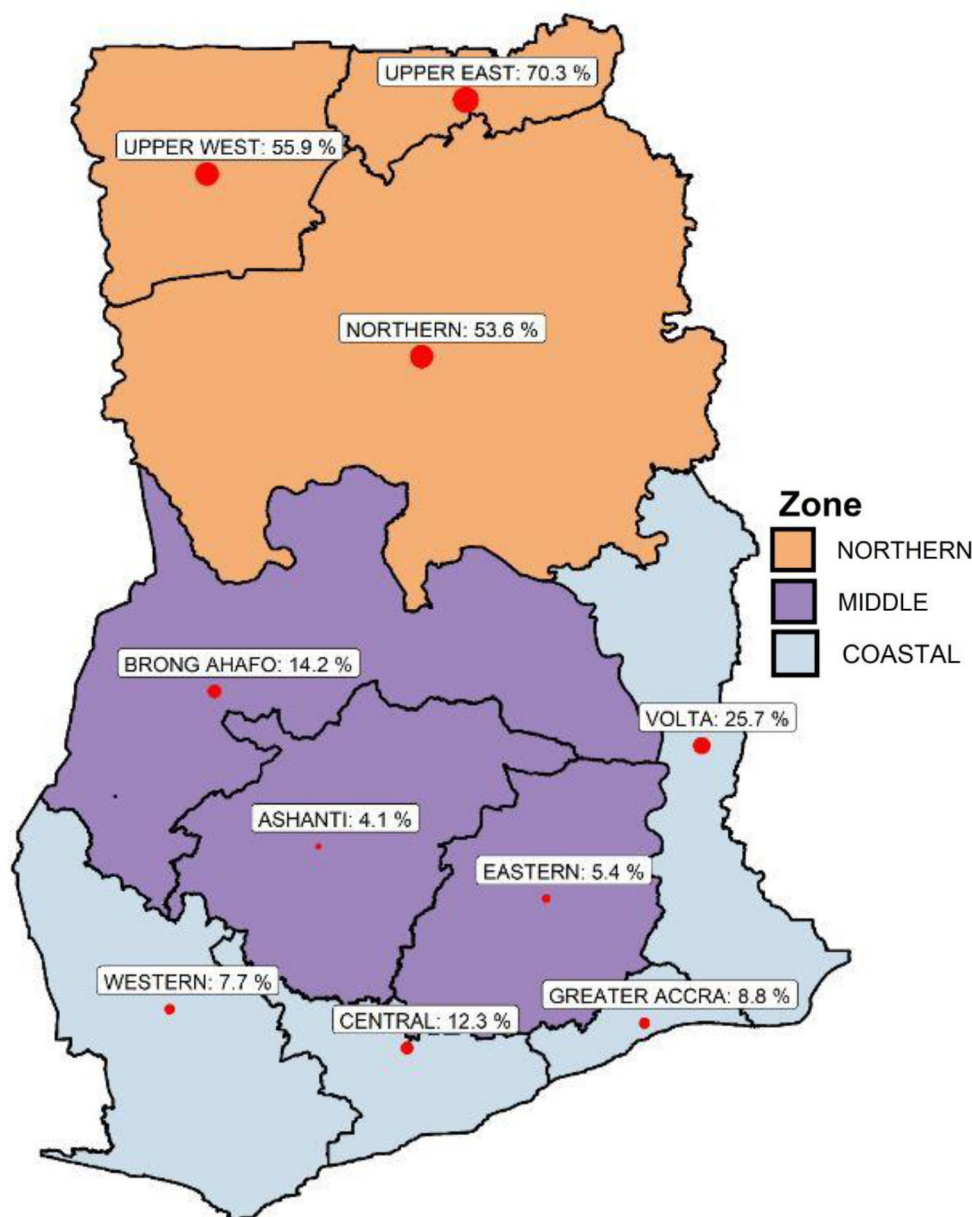


Figure 1 Distribution of open defecating households in Ghana by region.

The odds of using unimproved drinking water were about eight times higher among rural households compared with urban households (OR: 8.89, 95% CI 6.01 to 13.14). Households with more than five members had higher odds of using unimproved drinking water compared with single-member households (OR: 1.49, 95% CI 1.16 to 1.90). The odds of using unimproved drinking water were lower among households headed by older people (OR: 0.65, 95% CI 0.49 to 0.85 for 36–45 years; OR: 0.68, 95% CI 0.50 to 0.92 for >45 years) compared with households headed by persons less than 25 years. The odds of drinking unimproved water were about two times higher among male-headed households compared with female-headed households (OR: 1.82, 95% CI 1.52 to 2.18). Compared with households whose heads have more than secondary level education, the odds of using unimproved water were higher among

households headed by people with no/lower level of education (OR: 6.53, 95% CI 4.48 to 9.52 for those with no formal education; OR: 5.89, 95% CI 4.10 to 8.48 for those with primary education; OR: 3.45, 95% CI 2.48 to 4.81 for those with middle/Junior Secondary School/Junior High School education; OR: 2.03, 95% CI 1.37 to 3.00 for those with secondary/Senior Secondary School/Senior High School education).

Association of demographic factors with use of unimproved toilet facilities

As presented in [table 5](#), at a 5% significant level, all demographic variables were independently associated with use of unimproved toilet facilities. In the multivariate analysis, place of residence ($p=0.002$), zone of residence ($p<0.001$), household size ($p<0.001$), age of household head ($p<0.001$) and level of education of household head

Table 4 Association of demographic factors with households' use of unimproved drinking water

Variable	Univariate analysis			Multivariate analysis		
	OR	95% CI	P value	OR	95% CI	P value
Household characteristics						
Place of residence						
Urban	1		<0.001	1		<0.001
Rural	11.10	7.74 to 15.92		8.89	6.01 to 13.14	
Zone						
Northern	1.65	1.12 to 2.43	<0.001	0.57	0.36 to 0.90	0.052
Middle	0.84	0.55 to 1.29		0.70	0.45 to 1.09	
Coastal	1			1		
Household size						
Single member	1		<0.001	1		<0.001
2–5 members	1.20	0.98 to 1.48		1.05	0.84 to 1.30	
>5 members	2.45	1.98 to 3.03		1.49	1.16 to 1.90	
Household heads' characteristics						
Age						
<25 years	1		0.114	1		0.018
25–35 years	0.87	0.69 to 1.10		0.78	0.61 to 0.99	
36–45 years	0.93	0.72 to 1.19		0.65	0.49 to 0.85	
>45 years	1.03	0.79 to 1.35		0.68	0.50 to 0.92	
Gender						
Female	1			1		
Male	1.76	1.51 to 2.06	<0.001	1.82	1.52 to 2.18	<0.001
Level of education						
No education	10.81	7.51 to 15.56	<0.001	6.53	4.48 to 9.52	<0.001
Primary	9.02	6.22 to 13.08		5.89	4.10 to 8.48	
Middle/JSS/JHS	5.12	3.65 to 7.17		3.45	2.48 to 4.81	
Secondary/SSS/SHS	2.45	1.66 to 3.63		2.03	1.37 to 3.00	
More than secondary	1			1		

JHS, Junior High School; JSS, Junior Secondary School; SHS, Senior High School; SSS, Senior Secondary School.

($p < 0.001$) were significantly associated with use of unimproved toilet facilities.

The odds of using unimproved toilet were 1.34 times higher among rural households compared with urban households (OR: 1.34, 95% CI 1.11 to 1.61). Compared with households in the Coastal zone, households in the Northern zone had higher odds of using unimproved toilet facilities (OR: 2.74, 95% CI 2.17 to 3.44). Households with two to five members (OR: 0.67, 95% CI 0.59 to 0.77) and those with more than five members (OR: 0.51, 95% CI 0.44 to 0.59) had lower odds of using unimproved toilet compared with single-member households. The odds of using unimproved toilet were lower among households headed by older people (OR: 0.60, 95% CI 0.45 to 0.80 for 25–35 years; OR: 0.41, 95% CI 0.31 to 0.54 for 36–45 years; OR: 0.22, 95% CI 0.16 to 0.29 for >45 years) compared with households headed by persons less than 25 years. Compared with households whose

heads have more than secondary level education, the odds of using unimproved toilet facilities were higher among households headed by people with no/lower level of education (OR: 10.89, 95% CI 9.01 to 13.18 for those with no formal education; OR: 8.21, 95% CI 6.48 to 10.41 for those with primary education; OR: 5.58, 95% CI 4.82 to 6.46 for those with middle/junior secondary school/junior high school education; OR: 3.12, 95% CI 2.67 to 3.65 for those with secondary/senior secondary school/senior high school).

DISCUSSION

This paper focuses on SDG 6, which aims to ensure availability and sustainable management of water and sanitation for all,¹⁰ and the government of Ghana's target of universal access to safe drinking water by 2025 and elimination of open defecation by 2030,¹¹ to assess the current

Table 5 Association of demographic factors with households' use of unimproved toilet facilities

Variable	Univariate analysis			Multivariate analysis		
	OR	95% CI	P value	OR	95% CI	P value
Household characteristics						
Place of residence						
Urban	1		<0.001	1		
Rural	1.86	1.54 to 2.26		1.34	1.11 to 1.61	0.002
Zone						
Northern	3.47	2.76 to 4.36	<0.001	2.74	2.17 to 3.44	<0.001
Middle	1.20	0.98 to 1.46		1.08	0.90 to 1.30	
Coastal	1			1		
Household size						
Single member	1		<0.001	1		<0.001
2–5 members	0.72	0.63 to 0.82		0.67	0.59 to 0.77	
>5 members	0.66	0.58 to 0.76		0.51	0.44 to 0.59	
Household heads' characteristics						
Age						
<25 years	1		<0.001	1		<0.001
25–35 years	0.48	0.36 to 0.64		0.60	0.45 to 0.80	
36–45 years	0.37	0.27 to 0.50		0.41	0.31 to 0.54	
>45 years	0.25	0.19 to 0.34		0.22	0.16 to 0.29	
Gender						
Female	1		0.009	1		0.117
Male	0.89	0.82 to 0.97		1.08	0.98 to 1.19	
Level of education						
No education	7.97	6.64 to 9.57	<0.001	10.89	9.01 to 13.18	<0.001
Primary	6.36	5.00 to 8.08		8.21	6.48 to 10.41	
Middle/JSS/JHS	4.18	3.61 to 4.83		5.58	4.82 to 6.46	
Secondary/SSS/SHS	3.01	2.57 to 3.54		3.12	2.67 to 3.65	
More than secondary	1			1		

JHS, Junior High School; JSS, Junior Secondary School; SHS, Senior High School; SSS, Senior Secondary School.

state of these targets using data from a nationally representative survey (2017 GMHS).⁶ The study also explored the regional disparities in open defecation in Ghana and highlights the results of the association of demographic factors with use of unimproved drinking water and sanitation.

Out of the 26 324 households included in this study, 8.9% used unimproved drinking water while 81.6% used unimproved sanitation. Although a substantial number of Ghanaian households now drink safe water, with just about 3 years until 2025, the date set for achieving the target of universal access to safe drinking water, about 1 out of every 10 households still drink unsafe/unimproved water. In Ghana, although there has been progress in making sanitation available to all by 2030,^{12–14 30} with over 80% of Ghanaian households still using unimproved sanitation, achieving the sanitation target by 2030 seems to be a mirage. Several reasons, including governments'

inability to provide proper disposal points for solid waste, lack of enforcement of sanitation laws, population growth, poor financing of sanitation policies, rural–urban migration, poor sanitation infrastructure and lack of sanitation technologies among others, account for the high poor sanitation in Ghana.³¹ There is a need to have a holistic approach to addressing these related factors, which requires political will, systems approach and involvement of key stakeholders, including non-governmental organisations working in water and sanitation-related fields.

Estimates from the UNICEF and the WHO showed that about 673 million people globally have no toilet facilities and practise open defecation.³ This is not different from what we found in Ghana, as 15.2% of Ghanaian households still openly defecate, with a prevalence of 58.8%, 6.7% and 12.5% in the Northern, Middle and Coastal zones, respectively. The slow progress in the provision of proper sanitation cannot be attributed to only financial

constraints, but is also due to lack of political will. Progress is slow, particularly in Sub-Saharan Africa, because governments do not see sanitation as a basic need as they consider others, such as the provision of healthcare infrastructure, building of schools, etc, a priority,^{32 33} even though all of these are linked to sanitation. To achieve universal coverage of proper/improved sanitation in Ghana, the government must provide support to local-level sanitation plans and strategies. While supporting communities, equity must be upheld to continue the stakeholder dialogue for interagency partnerships to expand access to both clean water and sanitation to prevent the transmission of infectious diseases. Furthermore, the provision of improved water, sanitation and hygiene should be viewed as one of the key components of healthcare as they contribute significantly to disease prevention.¹ Additionally, behavioural change is very important towards proper sanitation; else only focusing on just technology will not do us any good.

In our adjusted analysis, place of residence, household size, and age, gender and level of education of household heads were significantly associated with use of unimproved drinking water. With regard to sanitation, in the adjusted analysis, place and zone of residence, household size, and age and level of education of household heads were significantly associated with use of unimproved sanitation. Rural households were more than eight times more likely to use unsafe drinking water and were 1.34 times more likely to use unimproved sanitation compared with urban households. This rural–urban inequality in the use of improved drinking water and sanitation facilities has been reported in several other previous studies.^{24–26} Rural areas in Ghana and other Sub-Saharan African countries are mostly deprived of several basic amenities, including improved drinking water and sanitation.³⁴ Also, most rural dwellers have poor socioeconomic status,^{35 36} depriving them of adequate financial resources to afford the initial high cost of both water and sanitation facilities.

Household size was significantly associated with use of both unimproved drinking water and unimproved sanitation. Compared with single-member households, households with five or more members had higher odds of using unimproved drinking water. However, households with two or more members were less likely to use unimproved sanitation compared with single-member households. The results of our study are similar to the results of another nationally representative study¹⁹ that used data from the 2014 Ghana DHS,¹⁸ in which households with more members were more likely to have access to improved toilet facilities but not access to improved drinking water. The quantity of water consumed by a household is proportional to the size of the household, and larger households tend to consume more water.³⁷ Given that the use of improved water comes with a cost, this might be one of the reasons why households with five or more members are more likely to use unimproved water. Similar to our results on the association of household size with sanitation, other studies have reported

that the use of unimproved toilet facilities is less likely among larger households.^{27 37} The possible explanation could be that households with more members are likely to contribute and mobilise resources for the construction of improved toilet facilities.^{19 28}

Male-headed households were more likely to use unsafe drinking water compared with households headed by female heads. Our finding corroborates the significance of household heads in the choice of drinking water as reported in another study in Ghana¹⁹ and in similar studies conducted in Ethiopia²⁸ and Nigeria,²⁹ in which female-headed households were more likely to drink from improved water sources than male-headed households. In Ghana, household responsibilities that require water use such as cooking, cleaning and laundry are mostly performed by women. As such, it may be that female heads seek to reduce the burden of getting water from unimproved sources which are mostly distanced away from the house by making sure that the household has access to improved water within the house.¹⁹

Households with older household heads were less likely to drink unsafe water and were also less likely to use unimproved sanitation compared with households whose head of the family was less than 25 years. Similar results have been reported in another study conducted in Ghana.¹⁹ This may be because older household heads may be employed and hence have some level of income to be able to afford improved water and sanitation facilities. Also, the elderly may be more concerned about their privacy and health and may be more willing to use improved water and sanitation. In addition, as argued by Agbadi *et al*,¹⁹ in most communities in Africa, old age is associated with respect and civility. As such, older people may be compelled to use improved sanitation facilities to avoid being publicly exposed, as it is with use of unimproved sanitation facilities such as open defecation.

The significant association of no/low level of household heads' education with use of unsafe drinking water and unimproved sanitation has also been reported in other studies.^{19 29} The increased trend in the use of safe drinking water and improved sanitation with education can be attributed to how informed household heads with higher education are about the need to drink safe water and practise proper sanitation. Also, education empowers people to make better decisions concerning their health, hence the choice to use safe drinking water and proper sanitation.

Compared with the Coastal zone of Ghana, households in Northern Ghana were more likely to use unimproved sanitation. Several studies^{18–20} in Ghana have also reported high use of poor sanitation in Northern Ghana. Poverty is more prevalent in the Northern region of Ghana compared with the other regions. The absence of financial support for the construction of household toilets can be one of the major factors hampering the use of improved sanitation in Ghana, particularly in Northern Ghana where poverty is high.

The use of nationally representative data can be of great importance in tracking various health indicators. This study used data from the most recent GMHS to assess unimproved water and sanitation use among Ghanaian households. Although the study was limited to finding the household and demographic characteristics associated with unimproved water and sanitation use, the findings of this study can be generalised to households in Ghana. Owing to the cross-sectional nature of the study, causality cannot be inferred from the study results. Also, household-level morbidity data were not collected as part of the survey and so their association with unimproved drinking water and toilet facilities could not be assessed.

CONCLUSION

With the target of universal access to safe drinking water and elimination of open defecation in Ghana just a few years away to be achieved, about 1 out of every 10 households still drink unsafe/unimproved water, whereas over 15.2% of Ghanaian households still openly defecate. With these estimates, achieving these targets seems to be a mirage unless appropriate measures are implemented.

Open defecation was more prevalent in Northern Ghana, where almost 6 out of every 10 households openly defecate. Demographic factors were significantly associated with use of both unimproved drinking water and unimproved sanitation. We recommend that state authorities and non-governmental organisations support local-level sanitation plans and strategies. Also, while supporting communities, equity must be upheld by taking into account the variations in access as reported in this study to expand usage of both improved drinking water and sanitation.

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