Rural-Urban schism: Access to improved water and sanitation in Sub-Sahara Africa

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Abstract

Background: Access to potable water and adequate sanitation remains a major public health challenge, particularly in sub-Saharan Africa (SSA), where coverage is critically low, especially in rural areas. Despite progress, disparities between urban and rural populations persist, impacting health outcomes and overall well-being.

Objective: This study aimed to identify factors influencing access to improved water sources and sanitation in selected SSA countries.

Methods: The study analyzed Demographic and Health Survey (DHS) data from 31 SSA countries. A complex survey design was used to assess disparities in water and sanitation access. Descriptive and multivariate analyses, including Poisson regression models, were conducted to determine associations between demographic factors and access to improved water and sanitation.

Results: Overall, 75.8% of the population had access to improved water sources, while 52.0% had access to improved sanitation. However, rural dwellers had significantly lower access (64.0% for water, 40.0% for sanitation) compared to urban residents (93.0% for water, 74.0% for sanitation). Socioeconomic factors such as wealth index, education level, and sex of the household head were significantly associated with access. The poorest households had only 51.0% access to improved water compared to 97.0% among the wealthiest. Educational attainment was significantly linked with improved access [APR=1.04(1.03 – 1.05)], while female-headed households had slightly higher access rates for improved water source than male-headed households (APR = 1.08(1.07 – 1.09).

Conclusion: Disparities in access to improved water and sanitation persist, particularly among rural populations and lower-income groups. Governments in SSA should prioritize investments in water and sanitation infrastructure, particularly in rural areas, to address these inequities. Sustainable policies and targeted interventions are necessary to bridge the gap and ensure universal access to clean water and sanitation.

Keywords: Improved water source, sanitation, sub-Saharan Africa, rural-urban disparity, Demographic and Health Survey

Introduction

Access to safe water and sanitation are fundamental human rights and essential for overall health. However many people worldwide still lack these necessities [1]. The challenge is even more daunting for sub-Sahara Africa (SSA) where coverage levels for both potable water and sanitation remain critically low [2].

Since 2000, significant strides have been made to improve household access to clean and safe water, sanitation, and hygiene (WASH) [2]. Sub-Saharan Africa recorded notable gains, with 328 million people gaining access to basic drinking water and 163 million gaining access to basic sanitation services since 2000[3]. However, in most countries in the region, less than half of the population has a hand-washing facility with soap and water available at home[4]. Also, limited access to safe drinking water and adequate sanitation remains a major public health challenge particularly in rural areas of SSA. Consistent with disparities observed in access to other essential services, households in rural areas and urban slums have relatively poorer access to improved water and sanitation facilities compared to urban households in SSA[5].

This study therefore seeks to identify the factors driving access to improved water sources in some selected SSA countries and provide actionable recommendations to mitigate the disparity in access to improved water sources and sanitation between rural and urban dwellers in SSA.

Materials and Methods

Study Description

This study used nationally representative household survey data from the Demographic and Health Survey (DHS) for selected sub-Saharan Africa (SSA) countries. DHS data are secondary data which provide several indicators for monitoring and impact assessment in the areas of population, health and nutrition. DHS data are open source and can be accessed on DHS website (www.dhsprogram.com). The selection criteria for including a country in this study were as follows: the country should be found in SSA and should have DHS dataset between 2014-2025.

Study countries

A total of 31 countries in SSA met the criteria. Where multiple datasets were available for one-time frame for the same country, the most recent survey was used (Table 1).

Study outcomes and their definition

The study outcomes are improved water sources and sanitation. The WHO/UNICEF Joint Monitoring Program (JMP) 2017 report has reviewed the definition of improved and unimproved water sources and sanitation facilities and has established additional criteria relating to service levels. For drinking water, improved sources are those that have the potential to deliver safe water by nature of their design and construction. According to report, an improved source should meet these three criteria: it should be accessible on the premise, water should be available when needed and the water should be free from contamination. Packaged water (bottled water and sachets of water) and delivered water are now classified as improved. The outcome variable was assigned a value of "0" for unimproved water sources and "1" for improved water sources.

For sanitation, improved facilities are those designed to hygienically separate excreta from human contact. The three main criteria for having a safely managed sanitation services are: treated and disposed

of in situ, stored temporarily and then emptied, transported and treated off-site and transported through sewer with waste water and then treated off-site.

Key predictor variable

The predictor or independent variable was selected based on literature review and practical significance. Type of residence, wealth index were the key variables for this study. The effect of the area of stay and the net income of household, in literature and practical significance, has been shown to be driving access to water sources and sanitation. For sanitation too, unimproved sanitation was assigned a value of "0" and improved sanitation was assigned a value of "1".

Analysis

Since this is a complex survey data, pooled data from all SSA countries were weighted and set to survey to adjust for multi-stage sampling technique employed for the data collection (Clustering and stratification). Descriptive statistics were computed. Univariate analysis of predictors of access to improved water and sanitation was carried out using Rho-Scott chi-square test of association. This test was used to estimate the association between predictor variables.

Poisson regression model with incident rate ratio was fitted to the data at the multivariate level. A p-value of <0.05 was determined as statistically significant. Stata version 17.0 was used for the analysis.

Ethical consideration

Permission for data was obtained from the DHS program through the program's website. Since this study uses secondary data, no ethical consent was obtained from participants.

Results

Descriptive statistics:

Table 1: Access to water sources

Country	Year	Proportion with improved water source	Proportion with unimproved water source
Angola	2015/2016	66.4	33.6
Burkina Faso	2021	84.0	16.0
Benin	2017/2018	71.5	28.5
Burundi	2016/2017	82.9	17.1
Cong DR	2013/2014	48.7	51.3
Cote D'Ivoire	2021	84.9	15.1
Cameroun	2018	78.5	21.5
Ethiopia	2016	68.6	31.4
Gabon	2019/2020	92.2	7.8
Ghana	2022	90.5	9.5
Gambia	2019/2020	95.0	5.0
Guinea	2018	79.2	11.8
Kenya	2022	80.3	19.7
Liberia	2019/2020	84.0	16.0
Lesotho	2023/2024	91.2	8.8
Madagascar	2021	47.7	52.3
Mali	2018	69.0	31.0
Mauritius	2019/2021	80.2	19.8

Malawi	2015/2016	87.1	12.9
Mozambique	2022/2023	61.5	38.5
Nigeria	2018	75.4	24.6
Rwanda	2019/202	80.3	19.7
Sierra Leon	2019	66.9	33.1
Senegal	2023	90.8	9.2
Chad	2014/2015	55.8	44.2
Togo	2013/2014	67.6	32.4
Tanzania	2022	73.4	26.6
Uganda	2016	79.0	21.0
South Africa	2016	95.2	4.8
Zambia	2018	72.4	27.6
Zimbabwe	2015	78.4	21.6

Among the study countries South Africa had the highest (95.20%) access to improved drinking water with Madagascar having the most proportion (52.30%) to unimproved drinking water.

Table 2: Access to sanitation facilities

Country	Year	Proportion with improved sanitation (%)	Proportion with unimproved sanitation (%)
Angola	2015/2016	63.2	36.8
Burkina Faso	2021	63.1	36.9
Benin	2017/2018	32.9	67.1
Burundi	2016/2017	49.6	50.4
Cong DR	2013/2014	39.0	61.0
Cote Divoire	2021	60.4	39.6
Cameroun	2018	59.4	40.6
Ethiopia	2016	15.6	84.4
Gabon	2019/2020	71.9	28.1
Ghana	2022	63.1	36.9
Gambia	2019/2020	65.5	34.5
Guinea	2018	50.6	49.4
Kenya	2022	69.2	30.8
Liberia	2019/2020	40.5	59.5
Lesotho	2023/2024	66.0	34.0
Madagascar	2021	33.3	66.7
Mali	2018	54.8	45.2
Mauritania	2019/2021	38.3	61.7
Malawi	2015/2016	82.5	17.5

Mozambique	2022/2023	28.1	71.9
Nigeria	2018	47.1	52.9
Rwanda	2019/202	72.8	27.2
Sierra Leon	2019	51.6	48.4
Senegal	2023	74.4	25.6
Chad	2014/2015	13.8	86.2
Togo	2013/2014	40.3	59.7
Tanzania	2022	55.8	44.2
Uganda	2016	38.0	62.0
South Africa	2016	74.4	25.6
Zambia	2018	52.9	47.1
Zimbabwe	2015	66.2	33.8

Table 2 shows the proportion with access to improved sanitation. From the descriptive analysis, we found that Gabon had the highest proportion (71.90%) of people with improved sanitation with Chad having the highest proportion of unimproved sanitation (86.20%)

Table 3: Factors associated with access to water source and sanitation

Variable	Improved water source (YES)	P-value	Improved sanitation (YES)	P-value
Residence				
Urban	169930(93.0%)	0.000*	133168(74.0%)	0.000*
Rural	180350(64.0%)	0.000*	112258(40.0%)	0.000*
Wealth Index				
Poorest	45905(51.0%)	0.000*	18106(20.0%)	0.000*
Poorer	57490(64.0%)	0.000*	33204(37.0%)	0.000*
Middle	69099(76.0%)	0.000*	47975(53.0%)	0.000*
Richer	84537(89.0%)	0.000*	65710(69.0%)	0.000*
Richest	93250(97.0%)	0.000	80431(84.0%)	0.000*
Sex				
Male	247820(75.0%)	0.000*	174138(53.0)	0.000*
Female	102461(78.0%)	0.000	71287(55.0)	0.000*
Highest Education				
No education	94734(67.0%)	0.000*	52748(38.0%)	0.000*
Primary	107100(71.0%)	0.000*	74597(50.0%)	0.000*
Secondary	107439(84.0%)	0.000*	82273(64.0%)	0.000*
Higher	41007(94.0)	0.000*	35807(83.0%)	0.000*

Residence, wealth index, sex of household head and highest education level were found to be associated with access to water and sanitation. For folks in urban areas, 93.0% had access to improved water compared to 64.0% in rural areas. For wealth index, people in the poorest wealth quintile had 51.0% access to improved water while those in the richest quintile had 97.0% access to improved water source. For sanitation, the poorest quintile had the lowest access to improved sanitation compared to 84.0% for those in the richest quintile. Those who had education beyond secondary had the highest access to both improved water (94.0%) and improved sanitation (83.0%).

Table 4: Multivariable analysis of access to water source and demographic characteristics

Variable	APR	P>|t|	95% CI
Residence			
Urban	Ref	Ref	Ref
Rural	0.83	*0.001	0.81– 0.84
Wealth Index			
Poorest	Ref	Ref	Ref
Poorer	1.25	*0.001	1.23 – 1.27
Middle	1.43	*0.001	1.41 – 1.46
Richer	1.58	*0.001	1.55 –1.61
Richest	1.65	*0.001	1.62 – 1.69
Sex of HHH			
Male	Ref	Ref	Ref

Female	1.06	*0.001	1.05 – 1.06
Highest Education			
No education	Ref	Ref	Ref
Primary	1.00	0.82	0.99 – 1.01
Secondary	1.02	*0.001	1.01 – 1.03
Higher	1.04	*0.001	1.03 – 1.05

The Poisson regression for access to water sources as against demographic characteristics of household heads revealed that people living in rural areas are 17% less likely to have access to improved water sources compared to those in urban areas, and this was statistically significant (APR = 0.83[0.81– 0.84]). With regards to wealth index, we found that people in the richest quintile had a 1.65 higher likelihood of having access to improved water source compared to those in the poorest quintile (APR = 1.65[1.62 – 1.69]). Also, the results revealed that household heads with higher education had a 1.04 times prevalence ratio compared to those with no education (APR = 1.04[1.03 – 1.05].

Table 4: Multivariable analysis of access to water source and demographic characteristics

Variable	APR	P>|t|	95% CI
Residence			
Urban	Ref	Ref	Ref
Rural	0.83	*0.001	0.81– 0.84
Wealth Index			
Poorest	Ref	Ref	Ref
Poorer	1.79	*0.001	1.74 – 1.84
Middle	2.44	*0.001	2.36 – 2.51
Richer	2.97	*0.001	2.86 –3.07
Richest	3.33	*0.001	3.21 – 3.46
Sex of HHH			
Male	Ref	Ref	Ref
Female	1.08	*0.001	1.07 – 1.09
Highest Education			
No education	Ref	Ref	Ref
Primary	1.18	*0.001	1.16 – 1.20
Secondary	1.20	*0.001	1.18 – 1.23
Higher	1.30	*0.001	1.27 – 1.31

The multivariate analysis showed that residence, wealth index, sex of household head and educational level were all strongly linked with access to improved water sources and sanitation. Just like for access to water sources, the results revealed that household heads in rural areas were 17.0% less likely to have access to improved sanitation (APR = 0.83[0.81– 0.84] and this was statistically significant. Similarly, household heads in the richest quintile had a 3.33 prevalence ratio compared to the poorest quintile of having access to improved sanitation (APR = 3.33[3.21 – 3.46])

Discussion

On aggregate, we found access to improved water sources in all countries was 75% and for access to sanitation, 52%. This result is similar to the results by Armah et al.,2018. In their study, they found access to improved water sources was 74% and access to improved sanitation to be 53% [1]. This slight difference may be attributed to the periods considered and the number of countries included in this study. There has been a consistent increase in access to water sources with a decrease in access to improved sanitation. This trend may be attributed to the high population growth and urbanization across the sub-region. However, this study revealed marked differences in access to improved water sources and sanitation among urban and rural dwellers. Overall, 64.0% of rural dwellers had access to improved water sources as compared to 93% for urban dwellers. In a similar study, the authors found that only 4% of the

global urban population uses unimproved drinking water sources compared to 19% in the rural population[5]. For access to improved sanitation, rural folks had 40.0% access compared to 74% access for urban folks. Similar to a study in Indonesia, they found that living in rural areas, dwellers had an 11.35% lower probability of access to improved sanitation as compared to urban dwellers[6].

Again, we found that place of residence was a significant factor in accounting for the variation in access to improved sanitation and water in the multivariable analysis. We found that living in urban areas, there was a high likelihood of having access to improved water sources and sanitation compared to living in rural areas. In a similar study in India, the authors also found a marked difference in access to improved water sources and sanitation. In their study latrine facilities within the homes of rural dwellers trailed their urban counterparts by at least a quarter of households[7]. Another study that sought to determine the difference in access to improved sanitation in Indonesia found that access to improved sanitation among urban dwellers was three times the access among rural dwellers[6]. Again, a similar study using DHS data for selected SSA countries showed significant differences in access to improved water sources and sanitation[8]. Several reasons may explain these stark differences in rural-urban access to WASH. In urban areas, population density is higher and so access to basic amenities such as clean water sources and health-related information may be higher compared to rural areas where population density is lower hence the less likelihood of access to improved infrastructure especially for water and sanitation. This may contribute to the differences in access seen in this study. The high levels of illiteracy and poverty especially in rural areas may also have contributed to the disparities in access to improved water sources and sanitation in SSA. Also, inequitable financing by Governments in SSA may explain the disparity in infrastructure that drives access to WASH services.

Also, we found that wealth index was a significant factor in access to improved water sources and sanitation. In our study, we found significant differences between the richest and poorest quintiles. In a similar study in Zambia, the authors found that access to improved water sources and sanitation was concentrated among the wealthier households and increased with increasing wealth quintile[9]. In another

similar study in Malawi, the authors found that there was a reduction in the population with access to improved water source and sanitation in the poorest quintile[10]. This observed disparity may be linked with the fact that a household with high net income may be more likely to have built or use water closet (flush toilet) or have available protected running source of water within the confines of their home.

We also found highest educational level completed by household head to be significantly linked to access to improved water source and sanitation. Across the levels of the highest educational level completed, the prevalence rate increased from no school to higher school in our study. This is consistent with a similar study in Ghana which sought to investigate the determinants to access to improved water sources and sanitation. Their study found that household heads with higher education were more likely to have access to improved water sources and sanitation facilities on their premises[11]. Another similar study set in Brazil found that poor access to water and sanitation was the effect of either a failure to complete high school or obtain higher education[12]. This may be because members who have higher education may be well-informed about the need for improved sources of water and sanitation and how these are uniquely linked to the improvement of health status of their household. The knowledge they may have acquired through formal education is what may be informing this observed trend.

We also found the sex of the household to be significantly linked to access to improved water sources and sanitation. In our study we found that female household heads have a higher prevalence to access to improved water source and sanitation. A similar study in Benin also found similar results. Their study found that heads of house who were female had higher odds of access to improved water and sanitation[13]. In SSA, gendered roles are key and this may explain this observed trend.

Conclusion

Poor drinking water source and poor sanitation are harbingers for the onset of infectious diseases such as cholera. As SSA is experiencing rapid demographic changes in the shape of increased population size and rapid urbanization, it is imperative for governments in SSA to invest in providing access to water sources

and sanitation as urbanization is an important vehicle for perpetuating infection spread due to dense population. The findings show that rural areas have limited access to improved water source and sanitation and this can be a precursor for the onset of infectious diseases. Governments in SSA should prioritize improving access to improved water sources and sanitation particularly in the rural areas where economic inequality is dire.

Abbreviation

SSA: Sub-Sahara Africa, DHS: Demographic and Heath Survey, JMP: Joint Monitoring Program

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Ethics Declaration

Not applicable

Consent to Publish Declaration

Not applicable.

Consent to Participate Declaration

Written consent was obtained from the study participants.

Data Availability Declaration

The dataset supporting our findings are available upon request to the corresponding author

Authors' contribution

NIZ, BKJ and BL designed the study. NIZ conceptualized and analyzed the data. BKJ and BL conducted literature search and edited the entire work. All authors read and approved the final manuscript.

Competing interest Declaration

There is no competing interest.

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