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WASH Levels and Associated Human Health Risks in War-Prone West African Countries: A Global Indicators Study (2015 to 2021)

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ABSTRACT: Water, Sanitation and Hygiene (WASH) levels have been shown to have impacts on health. However, the knowledge of WASH levels in war-prone West African countries is limited. The study extracted data (2015–2021) from the Joint Monitoring Programme (WHO/UNICEF), World Bank and Demographic and Health Surveys (DHS) to estimate WASH levels in the study countries. Pearson correlation analysis was used to establish the association among the WASH levels. Results showed that women had better access to safe water (56.39%), good sanitation (59.36%) and good hygiene (60.23%) compared to men. The urban population had better access to safe water (57.60%), good sanitation (61.23%), and good hygiene (65.65%) than the rural population. Among the countries under study, Nigeria had the highest access to safe water (36.10%) and good sanitation (24.41%), while Mali had the highest access to good hygiene (27.93%). Pearson correlation analysis showed a strong positive association between safe water and good hygiene ($r = .998$), safe water and sanitation ($r = .996$) and hygiene and sanitation ($r = .998$) at .00 significant levels. Based on the findings, it is recommended that integrated WASH programmes with combined infrastructure development, behaviour change campaigns and community engagement should be encouraged to ensure peaceful and sustainable access to WASH levels.

KEYWORDS: Conflict, health, hygiene, sanitation, war, water and war-prone West Africa

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Background

Access to Water, Sanitation and Hygiene (WASH) has become one of the top priorities in defining and promoting health, peace and literacy in societies. Studies have shown that WASH and health are closely linked;^{1,2} however, the significance of WASH levels and their related risks on human health in war-prone West African countries cannot be overstated. Conflicts and wars severely disrupt access to WASH services, leading to disease outbreaks and other health complications.^{3,4} For instance, overcrowded refugee camps and temporary settlements often result in poor hygiene practices, limit access to water and sanitation facilities and heighten infection risks.^{13,14} According to the World Health Organization,⁵ waterborne diseases often arise during conflicts due to the destruction of WASH systems. Ali⁶ and Timmis et al⁷ argue that the destruction of WASH quality is responsible for over 80% of all illnesses and deaths in developing countries. Approximately 660 million people in Africa lack access to improved water sources, while 1.8 billion lack basic WASH facilities, including toilets and latrines.^{8–12}

Several West African countries, including Nigeria and Mali, have endured prolonged conflicts.^{15–17} Nsaibia et al¹⁸ add that the ongoing conflicts and wars have resulted in the displacement of millions of people, created a humanitarian crisis

and worsened WASH associated problems in the countries. During conflicts and wars, funds and technical expertise needed for maintaining WASH systems often get redirected to provide relief items and humanitarian services, and this leaves the majority of the population without access to basic WASH services.

Besides the direct impacts on WASH infrastructure, conflicts and wars also affect individual behaviours relating to hygiene and sanitation, due to the lack of peace and stability.^{19,20} This means that improving access to WASH facilities in these war-prone countries is crucial for promoting health, particularly for vulnerable groups such as strangers and children. International organisations, like UNICEF and WHO under the United Nations' Millennium Development Goal (MDG) sanitation target, have made commendable efforts to provide technical and financial assistance for WASH projects in West Africa. But there is still a deficit.²¹ According to Cernev and Fenner,²² SDGs, which consist of 17 specific goals and 169 targets, address global issues relating to poverty, hunger, health, gender equality, clean water, sanitation and peace. However, despite these efforts, significant WASH challenges persist, with lasting impacts on health. Koubi²³ similarly asserted that conflicts and wars have detrimental effects on WASH levels: as the frequency and intensity of these conflicts and wars increase, access to WASH is reduced, creating quantifiable health consequences. WASH levels in West Africa are inadequate and require urgent attention from governments, NGOs and other stakeholders to enhance access to

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safe drinking water, sanitation facilities and basic hygiene, especially in rural areas and war-prone countries.^{19,24} To broaden understanding of the current state of WASH levels in West Africa, this study is purposed to estimate access to WASH levels in five war-prone West African countries.

Method

Source of data

The Joint Monitoring Programme (WHO/UNICEF), the World Bank and the Demographic and Health Surveys (DHS) indicators were the sources of data for this paper. These indicators provide sufficient data on access to WASH worldwide. The datasets explain WASH levels and provide high-quality, timely and consistent information on global development and poverty reduction. Countries under study included countries with at least 5 years of a complete database on access to WASH (2015–2021).

Study countries

The selection of the countries was based on the WHO and UNICEF's classification of countries and West African countries with records of conflicts and wars. The selected countries were classified based on access to WASH levels. Gender (men and women), area (rural and urban) and countries (Côte d'Ivoire, Liberia, Mali, Nigeria and Sierra Leone) were the variables contained in the dataset. Sierra Leone experienced a civil war from 1991 to 2002. This resulted in tens of thousands of deaths and the displacement of over 2 million people.²⁵ Liberia engaged in civil war from 1989 to 2003, resulting in the deaths of about 250 000 people and the displacement of over a million people.²⁶

Mali experienced a series of conflicts since 2012 and this resulted in thousands of deaths and the displacement of hundreds of thousands of people.²⁷ Côte d'Ivoire experienced a civil war in 2002.²⁸ This war lasted until 2011, resulting in the death of over 3000 people and the displacement of thousands more.²⁹ Nigeria engaged in conflicts and security challenges and still facing the Boko Haram insurgency, communal clashes, and farmer-herder conflicts.³⁰ These conflicts have resulted in the displacement of millions of people and the loss of thousands of lives and the destruction of properties.³¹

Data analysis

The researcher analysed dataset on access to WASH levels in 5 war-prone West African countries with complete information (2015–2021). The dataset was analysed in 'Statistical Package for the Social Science (SPSS) version 26 (IBM, Chicago, IL, USA) and Microsoft Office Excel 2019 (Microsoft Corporation, Redmond, WA, USA)'. Access to WASH levels was analysed by countries or areas, gender, and people. Descriptive statistics including percentages and frequencies

were used to describe the socio-demographic and access to WASH levels in the countries.

The Pearson correlation analysis was used to establish the association among WASH levels in the 5 war-prone West African countries. The Pearson correlation coefficient ranged from -1 to $+1$, with -1 indicating a perfect negative correlation, 0 no correlation and 1 a strong positive correlation. The statistical significance level for all analyses was set at $.01$, indicating a 99% certainty that the results represent access to WASH levels in the various countries under study. The findings of the study were presented in the form of a 'cross-tabulation' and figures.

Results

This section presents findings on access to WASH levels among 5 war-prone West African countries under study. It also displays tables, figures and the output of Pearson correlation analysis.

Gender and area disparities in WASH accessibility (2015–2021)

Figure 1 compares WASH level disparities between gender (men and women), people (children, adults, elderly and strangers) and area (urban and rural) (2015–2021). The data revealed that women had better access to safe water (56.39%), good hygiene (60.23%) and good sanitation (59.36%) compared to men with safe water (43.61%), good hygiene (39.77%) and good sanitation (40.64%). Urban populations demonstrated better access to safe water (57.60%), good hygiene (65.65%) and good sanitation (61.23%) compared to rural areas at 42.40%, 34.35% and 38.77%, respectively. Regarding access to WASH levels among the people, adults had higher access to safe water (33.30%), good hygiene (35.31%) and good sanitation (30.13%) compared to children. Children, on the other hand, had better access to safe water (28.25%), while the elderly had access to good hygiene (26.15%) and good sanitation (28.98%). Strangers had the least access to WASH levels compared to children, adults and the elderly, indicating that conflicts and wars affect access to WASH in the study areas.

Figure 2 compares access to WASH levels in rural and urban areas from 2015 to 2021. In terms of rural access to water, Mali had the highest percentage at 23.13%, followed by Liberia at 21.40%, Nigeria at 19.66% and Côte d'Ivoire at 19.04%. Sierra Leone had the lowest access at 16.78%. Regarding rural sanitation, Nigeria had the highest percentage of access at 20.18%, followed by Sierra Leone at 20.11%, Côte d'Ivoire at 20.07%, Mali at 19.84%, and Liberia at 19.80%. In relation to the hygiene levels in rural areas, Sierra Leone had the lowest access to basic hygiene at only 0.79%, compared to Liberia (35.97%), Côte d'Ivoire (26.77%), Mali (24.07%) and Nigeria (12.40%).

In urban areas, Mali had the highest access to water at 21.72%, followed by Nigeria at 20.68% and Côte d'Ivoire at 19.97%. Liberia and Sierra Leone had the lowest access to water in urban areas at 21.72% and 17.92%, respectively. Mali

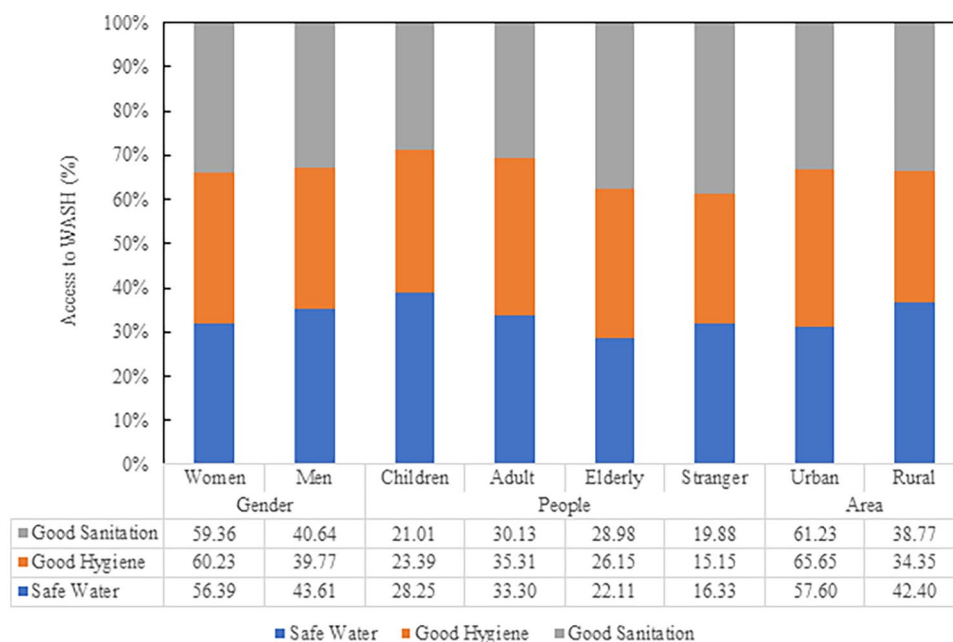


Figure 1. Gender and area disparities in WASH accessibility (2015-2021).

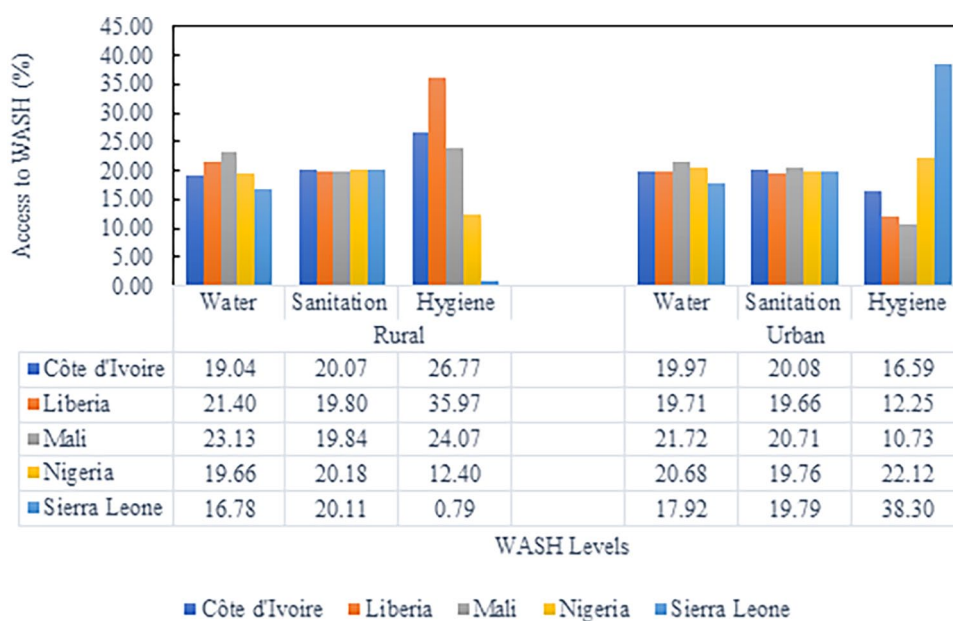


Figure 2. WASH levels within rural and urban areas (2015-2021).

had the highest sanitation rate at 20.71%, followed by Côte d'Ivoire at 20.08%, Sierra Leone at 19.79%, Nigeria at 19.76% and Liberia at 19.66%. In urban areas, Sierra Leone had the highest hygiene level at 38.30%, followed by Nigeria (22.12%), Côte d'Ivoire (16.59%), Liberia (12.25%) and Mali (10.73%).

Figure 3 compares WASH level differences in each of the study countries (2015-2021). From the Figure, Nigeria had the highest access to water (36.9%) compared to Côte d'Ivoire (23.40%), Sierra Leone (20.45%), Mali (18.72%) and Liberia (1.33%). In terms of sanitation, Nigeria (24.41%) had the highest access, followed by Côte d'Ivoire (21.86%) and Mali (20.06%), while Sierra Leone had the lowest access rate

(19.01%). Regarding hygiene, Mali had the highest level (27.93%) compared to Nigeria (27.43%), and Côte d'Ivoire (22.07%), whereas Sierra Leone (10.63%) and Liberia (11.94%) had the lowest access to hygiene.

Table 1 shows WASH categories based on demographic characteristics. As shown in the Table, women had better access to hygiene (38.12%), followed by sanitation (32.66%) and water (29.22%). Men had better access to water (37.78%) compared to sanitation (34.88%) and hygiene (27.34%) levels. Regarding WASH levels among people, children had the highest percentage of access to safe water (34.31%) compared to good sanitation (33.91%) and safe hygiene (31.78%). Access to

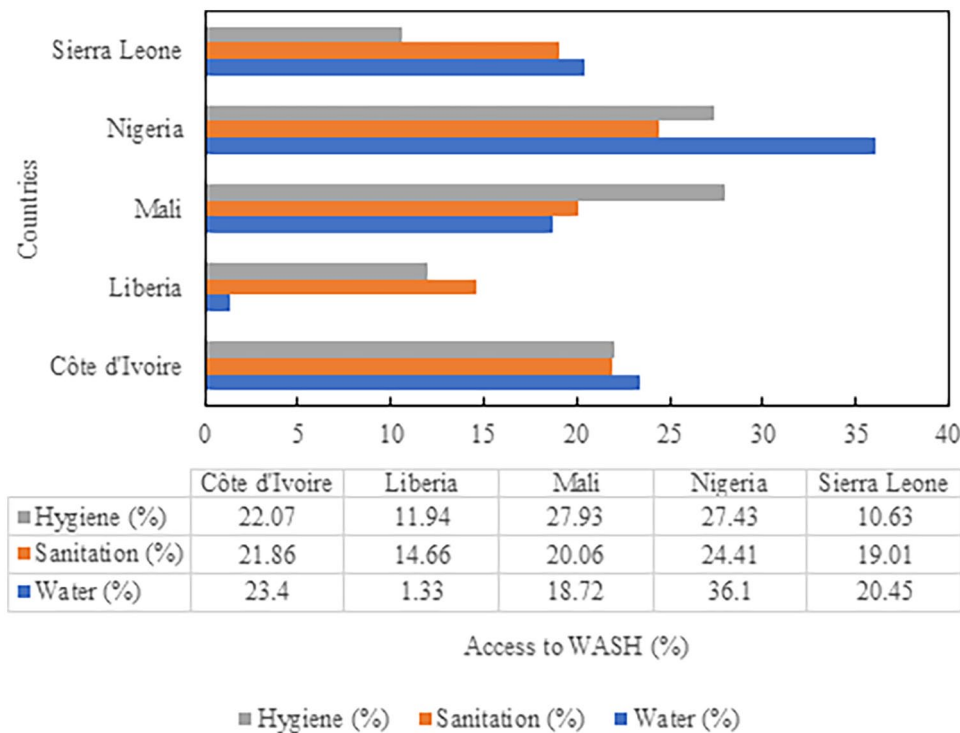


Figure 3. Comparing WASH levels across countries under study (2015-2021).

Table 1. Wash levels cross countries based on demographics characteristics.

		WATER	HYGIENE	SANITATION
Gender	Women	29.22	38.12	32.66
	Men	37.78	27.34	34.88
People	Children	34.31	31.78	33.91
	Adult	31.62	35.13	33.25
	Elderly	29.15	37.17	33.68
	Stranger	34.43	32.65	32.92
Area	Urban	32.48	36.17	31.35
	Rural	37.52	28.83	33.65
Countries	Côte d'Ivoire	34.75	32.78	32.47
	Liberia	26.76	35.75	37.49
	Mali	28.06	41.87	30.07
	Nigeria	41.05	31.19	27.76
	Sierra Leone	40.83	21.22	37.95

good hygiene (35.13%) was high among adults compared to good sanitation (33.25%) and safe water (31.62%). Moreover, access to good hygiene (37.17%) among the elderly was the highest compared to good sanitation (33.68%) and safe water (29.15%). Strangers had the highest access to safe water (34.43%) compared to sanitation (32.92%) and hygiene (32.65%) levels. The urban population had better access to

hygiene (36.17%) compared to water (32.48%) and sanitation (31.35%). The rural population had higher access to water (37.52%) compared to sanitation (33.65%) and hygiene (28.83%) levels.

From the Table, Côte d'Ivoire had the highest access to water (34.75%) compared to good hygiene (32.78%) and good sanitation (32.47%). Liberia had better access to good sanitation (37.47%) compared to good hygiene (35.75%) and water (26.76%). Mali had the highest access to good hygiene at 41.87%, followed by good sanitation (30.07%) and safe water (28.06%). Nigeria had the highest access to safe water at 41.05%, followed by good hygiene (31.19%) and good sanitation (27.76%). Sierra Leone recorded the highest access to water at 40.83%, followed by sanitation (37.95%) and hygiene (21.22%).

Discussion

The results showed that conflicts and wars influence WASH levels. In addition, conflicts and wars reduce access to WASH levels and make provision for health more difficult.

Gender and area disparities in WASH accessibility (2015-2021)

From Figure 1, women's better access to water (56.39%), sanitation (59.36%) and hygiene (60.23%) compared to men indicates that conflicts and wars influence access to WASH. During the time of conflicts and wars, men are usually targeted and therefore, move away from homes where WASH services are available, leaving all WASH facilities to women.

For this reason, men have less access to WASH services than women, increasing their susceptibilities to pathogens like bacteria, viruses and parasites.^{32,33} This finding supports Kayser et al³⁵ who found that there are disparities in access to WASH between males and females. These disparities are problematic because Conflict Theory holds that conflicts and wars affect human health as well as access to WASH levels. The theory further asserts that during conflicts and wars, water and sanitation systems get destroyed. This limits access to clean water, proper sanitation facilities and hygienic conditions and increases the risks of waterborne diseases which negatively impact human health.³⁴

Better access to safe water (33.30%), good hygiene (35.31) and good sanitation (30.13%) among adults compared to children, the elderly and strangers suggests that adults are relatively better equipped with resources and infrastructure to meet their WASH needs. Children, on the other hand, had better access to safe water, good hygiene, and good sanitation compared to the elderly and strangers. This could be due to the policies of governments and organisations that focus on providing basic needs and services to children, which can recognise their vulnerability and ensure their well-being. In addition, schools and child-centric programmes often emphasise hygiene and sanitation practices, contributing to better access of children. Nevertheless, strangers had the least access to WASH levels compared to children, adults and the elderly. This suggests that conflicts and wars affect access to WASH services. During times of conflict, infrastructure, such as water supply systems and sanitation facilities, are damaged or disrupted, leading to limited access for all individuals, including strangers. The findings imply that conflicts and wars play a significant role in determining the availability of safe water, hygiene practices, and sanitation facilities.

Better access to safe water (57.60%), good sanitation (61.23%) and hygiene (65.65%) among the urban population compared to the rural might be due to an increase in rural population during conflicts and wars. The urban population then move into the rural areas for shelter or protection and this increases the burdens on WASH services. This situation reduces equal access to safe water, good sanitation and hygiene even though there are better WASH services and programmes in the urban areas. As Gates et al³⁶ argued, the degree in which conflicts and wars influence WASH and human health should be a source of concern.

WASH level within rural and urban areas (2015-2021)

From Figure 2, there was variation in access to WASH levels among the rural areas and this might be due to inadequate investments in water infrastructure and the lack of international aid efforts to support and promote effective WASH systems. In rural areas, Mali had the greatest water access rate (23.13%) compared to Liberia (21.40%), Nigeria (19.66%) and

Côte d'Ivoire (19.04%) and this could be due to the enhancement of the integrated groundwater and surface water availability and resilience programmes. It might also be due to the implementation of Integrated Water Resources Management (IWRM) action plans at both district and community levels. On the other hand, the low water access rate among Liberia, Nigeria, Côte d'Ivoire and Sierra Leone might be due to the lack of effective government water sectors to continue supporting improved water accessibility. This suggests that war-prone countries, consisting of Liberia, Nigeria and Côte d'Ivoire and Sierra Leone ought to build partnership initiative programmes with international bodies that focus on more responsive water management systems, particularly making underground water accessible in the rural areas. This demonstrates the positive impact of access to WASH on public health. The lower access rates in Liberia, Nigeria, Côte d'Ivoire, and Sierra Leone might result in a higher prevalence of waterborne diseases and other related health issues, including cholera and diarrhoeal diseases.³⁷⁻⁴⁰

The highest rate of access to rural sanitation in Nigeria compared to Sierra Leone, Côte d'Ivoire, Mali and Liberia might be due to effective government policies and initiatives focussing on improving rural sanitation. It might also be due to the involvement of international development programmes and aid efforts, targeting improving rural sanitation in Nigeria.^{41,42} On the contrary, low sanitation rates recorded for Sierra Leone, Côte d'Ivoire, Mali and Liberia compared to Nigeria might be caused by low community involvement in sanitation projects and the lack of awareness campaigns and educational programmes, encouraging better sanitation practices in rural areas. In relation to the hygiene levels in rural areas, Sierra Leone had the lowest access rate, compared to Liberia, Côte d'Ivoire, Mali and Nigeria. This might be due to inadequate infrastructure development, such as piped water networks, sewage systems, and waste disposal facilities in the rural areas. According to Bishoge,⁴³ the lack of sufficient water provision systems as well as sanitation services contributes to the reduction in the implementation of hygiene programmes in a given society.

Within urban areas, the access rate of water in Mali was the highest at 21.72% compared to Nigeria (20.68%), Côte d'Ivoire (19.97%), Liberia (19.71%) and Sierra Leone (17.92%). This could be due to robust investments in water infrastructure and effective urban planning, ensuring a reliable supply of clean water. Nigeria and Côte d'Ivoire closely followed Mali, indicating similar efforts in infrastructure development and water supply and this contributes to better health outcomes. Conversely, Sierra Leone faced challenges, resulting in the lowest access rates, which might be linked to difficulties in infrastructure development, funding shortages, or geographic constraints. Regarding access to sanitation in urban areas, Mali took the lead, probably due to successful urban planning and investment in sanitation facilities. Côte d'Ivoire followed closely, implementing effective sanitation

policies and programmes. Sierra Leone, although not the highest, maintained a relatively good level of access to sanitation, reflecting ongoing efforts in sanitation improvement. This contributes to improved health and minimising disease outbreaks, including malaria, dengue fever, and Zika virus infection. However, Nigeria and Liberia lagged behind due to hurdles in sanitation infrastructure development, policy enforcement, or public awareness campaigns.

In terms of access to hygiene in urban areas, Sierra Leone recorded the highest rate, probably due to successful hygiene promotion campaigns, educational initiatives, and behaviour change programmes. Nigeria followed Sierra Leone, indicating reasonably effective hygiene programmes, though not to the same extent. Côte d'Ivoire ranked third in urban hygiene access, suggesting moderate success in promoting good hygiene practices. This contributes to the reduction in hygiene related health issues, including parasitic infections such as giardiasis and amoebiasis.⁴⁴ Côte d'Ivoire's moderate success suggests a positive impact on public health. Liberia and Mali's lower levels of urban hygiene access might lead to health issues. It is therefore recommended that sufficient educational programmes promoting good hygiene practices should be encouraged in Liberia and Mali.

WASH levels across countries (2015–2021)

From Figure 3, access to water (36.10%) and sanitation (24.41%) in Nigeria was better compared to Côte d'Ivoire, Sierra Leone, Mali and Liberia and due to well-developed water reservoirs, pipelines and treatment systems. According to Uduma et al,⁴⁵ the country is located (near rivers like Niger and Benue) where water is readily available, contributing to an increase in sanitation in the country. Access to water and sanitation connotes better health and the prevention of health risks as well as waterborne diseases such as cholera, typhoid, and diarrhoea among Nigerians more than in Côte d'Ivoire, Sierra Leone, Mali and Liberia. On the other hand, low access to water and sanitation in Côte d'Ivoire, Sierra Leone, Mali and Liberia might be caused by political instability, rapid urbanisation and limited financial resources. This hinders investments in water and sanitation infrastructure. However, this limited access to safe drinking water can also cause health issues. Contaminated water sources can lead to outbreaks of diseases, which can be particularly devastating during times of conflicts and wars when healthcare systems are already strained. Livingston⁴⁶ asserted that access to water and sanitation contributes to quality health. Luyckx et al⁴⁷ explained that this is a problem because the lack of access to good sanitation could lead to disease outbreak or affect effective functioning of healthcare systems, particularly during times of conflicts and wars. The lack of access to water and sanitation can force some of the people to be victims of drinking contaminated water that causes respiratory and cardiovascular diseases, affecting

the health and quality of life of people in the countries under study.⁴⁸

Mali (27.93%) and Nigeria (27.43%) had high hygiene levels compared to Côte d'Ivoire (23.40%), Leone (10.63%) and Liberia (11.94%) because of the promotion of effective hygiene programmes in Mali and Nigeria. A higher sanitation access rate, as seen in Nigeria (21.48%), can lead to better waste disposal practices. However, the limited access to resources such as clean water, sanitation facilities and soap to maintain good hygiene contributed to low access to hygiene in Côte d'Ivoire, Sierra Leone and Liberia.^{49,50} This might exacerbate the spread of diseases, contributing to health crises. Thus, countries with limited access to hygiene would find it difficult to maintain high levels of hygiene practices during conflicts and wars. This indicates that conflicts and wars affect access to WASH, particularly in Côte d'Ivoire, Sierra Leone and Liberia compared to Mali and Nigeria.

Wash levels cross countries based on demographics characteristics

From Table 1, women's better to hygiene signifies that women prioritise hygiene practices such as handwashing, proper food handling, etc. This might be due to the influence of cultural and social factors (privacy and safety concerns) that often make women play the main role in family hygiene, including personal care, childcare and maintaining cleanliness. Men's inadequate access to hygiene facilities might contribute to the spread of hygiene-related diseases, including respiratory and skin ones as well as parasitic infestations. According to the World Health Organisation, when access to regular water supplies is disrupted, people tend to resort to collecting water through unhygienic means, which lead to severe health consequences. Also, the lack of water systems such as pipelines and treatment facilities, and intentional disconnection of power supply to water stations during conflicts and wars contributes to the lack of access to safe water, particularly among men.

Children had the highest rate of access to safe water compared to good sanitation and good hygiene (31.78%) and this indicates that efforts have been made to prioritise providing safe water to children, although access to good sanitation and good hygiene practices also remains relatively high. Adults had higher access to good hygiene (35.13%) compared to good sanitation (33.68%) and safe water (31.62%). While adults have relatively good hygiene practices, access to safe water and sanitation might be slightly lower. The elderly had the highest rate of access to good hygiene (37.17%) compared to good sanitation (33.68%) and safe water (29.15%). This indicates that emphasis has been placed on promoting good hygiene practices among the elderly, while access to safe water and sanitation could be improved. Strangers had the highest percentage of access to safe water (34.43%) compared to good sanitation (32.92%) and good hygiene (32.65%). This connotes that

Table 2. WASH levels correlation analysis of the war-prone West Africa Countries (2015-2021).

		WATER	SANITATION	HYGIENE
Water	Pearson correlation	1	0.996**	0.998**
	Sig. (two-tailed)		0	0
	Sum of squares and cross-products	15877.45	19000.63	15495.05
	Covariance	2268.207	2714.376	2213.578
	N	8	8	8
Sanitation	Pearson correlation	0.996**	1	0.998**
	Sig. (two-tailed)	0		0
	Sum of squares and cross-products	19000.63	22935.26	18619.27
	Covariance	2714.376	3276.465	2659.895
	N	8	8	8
Hygiene	Pearson correlation	0.998**	0.998**	1
	Sig. (two-tailed)	0	0	
	Sum of squares and cross-products	15495.05	18619.27	15183.55
	Covariance	2213.578	2659.895	2169.078
	N	8	8	8

Abbreviation: N, number of years.

**Correlation is significant at the .01 level (two-tailed).

access to WASH levels in the areas studied is influenced by the intensity and frequency of conflicts and wars. WASH programmes whose core values dictate peace and security ought to be considered for promoting access to WASH levels in the countries.

The urban population had better access to sanitation (36.17%) compared to water (32.48%) and hygiene (31.35%) due to the provision of better sanitation services, and resources and their proximity to administrative centres and economic hubs. Insufficient access to clean water and proper hygiene facilities increases the risk of waterborne diseases such as diarrhoeal diseases, cholera, typhoid, and hepatitis.³⁴ On the other hand, better access to water (37.52%) compared to hygiene (33.65%) and sanitation (28.83%) levels among rural populations might be because of the lack of hygiene and sanitation facilities during and after the time of conflicts and wars. During conflicts and wars, hygiene and sanitation systems or services are demolished and this worsens access to sanitation and hygiene facilities. According to the World Health Organization,⁵ the lack of access to hygiene and sanitation services increases anxiety (psychological stress) and anger (emotional stress). This contribute to misunderstandings and conflicts, perpetuating a cycle of instability as people fight over limited access to hygiene and sanitation facilities. This leads to the condition called the 'strongest survives'. The violation of human rights and frequent deaths compromise successful realisation of the Sustainable Development Goals,

particularly the fourth and sixth, which seek to promote universal access to safe water, sanitation and sustainable management of water resources. The lack of water contributes to waterborne disease and negative health impacts, resulting in rape cases and teenage pregnancy in war-prone countries. This finding indicates the level of inadequate access to WASH services between men and women and urban and rural areas in the understudy countries. Therefore, efforts to improve access to WASH services in urban and rural areas are crucial for promoting peace, stability and the overall well-being of the countries.

Table 2 shows the WASH levels correlation matrix of the war-prone African countries from 2015 to 2021. It indicates that there is a strong positive correlation between water and hygiene ($r=.998$), water and sanitation ($r=.996$) and hygiene and sanitation ($r=.998$) at a significant level of .00. This correlation analysis affirms that WASH is not isolated into separate components but operates as an integrated system. Access to water influences hygiene and sanitation levels and vice versa and thus adequate WASH is essential for accessing and improving human health. The results highlight the need for comprehensive efforts to improve WASH access for both genders and in both urban and rural areas. This includes enhancing infrastructure, promoting hygiene, and ensuring equitable distribution of resources to address the disparities and provide universal access to safe water, sanitation and hygiene among the countries under study.

Conclusion

This study estimated WASH levels of 5 war-prone West African countries, using global indicators data from 2015 to 2021. It revealed significant disparities in access to WASH levels among countries studied. Women had higher access to water (56.39%), sanitation (59.36%) and hygiene (60.23%) compared to men at 43.61%, 40.64% and 39.77%, respectively. The urban population had better access to water, sanitation, and hygiene compared to the rural population. Nigeria had the highest access to water and sanitation, while Mali had the highest access to hygiene. Côte d'Ivoire had the highest access to safe water, followed by good hygiene and good sanitation. Liberia had the highest access to good sanitation but lower access to good hygiene and safe water. Sierra Leone recorded the highest access to water, followed by sanitation and hygiene. In urban areas, Mali had the highest access to water, followed closely by Nigeria and Côte d'Ivoire. Conversely, Sierra Leone had the lowest access to water in urban areas. In rural areas, Nigeria had the highest access to sanitation, followed by Sierra Leone, Côte d'Ivoire, Mali and Liberia. Sierra Leone had the lowest access to basic hygiene, while Liberia, Côte d'Ivoire, Mali and Nigeria had significantly higher access. In urban areas, Mali had the highest level of sanitation, followed by Côte d'Ivoire, Sierra Leone, Nigeria and Liberia. Sierra Leone featured the highest hygiene rate, followed by Nigeria, Côte d'Ivoire, Liberia and Mali.

The correlation analysis revealed strong positive relationships between water and hygiene ($r = .998$), water and sanitation ($r = .996$) and hygiene and sanitation ($r = .998$) at .00 significant level. This suggests that access to water influences hygiene and sanitation levels and vice versa and thus access to safe water, improved hygiene and sanitation facilities is critical for promoting overall human health. Consequently, WASH programmes and policies need to address gender disparities in WASH access and empower both men and women in decision-making related to WASH. Moreover, investment in rural infrastructure and resources is crucial to close the urban-rural divide in access to WASH. To create lasting change and ensure the sustainability of WASH services in these countries, WASH programmes with a holistic approach that simultaneously promotes peacebuilding efforts, humanitarian interventions and post-conflict reconstruction are needed in the countries studied. Government and non-governmental organisations should reform policies and regulations to promote gender equality regarding WASH level accessibilities. International organisations should facilitate sharing of knowledge and collaboration among West African countries to exchange best practices and learn to improve their accessibility to WASH levels.

Data Availability Statement

All relevant data are available from an online repository or repositories. (Our World In Data/ World Bank Data/ World Development Indicators. WASH Level Data: <https://data.unicef.org/topic/water-and-sanitation/sanitation/>; <https://washdata.org/data/downloads#WLD>; The DHS Programme: https://dhsprogram.com/data/dataset_admin/index.cfm; Our World in Data: <https://ourworldindata.org/explorers/water-and-sanitation>).

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