



Estimating global water, sanitation, and hygiene levels and related risks on human health, using global indicators data from 1990 to 2020

Michael Aboah * and Michael K. Miyittah 

Department of Environmental Science, School of Biological Sciences, University of Cape Coast, Cape Coast, Ghana

*Corresponding author. E-mail: michael.aboah@stu.ucc.edu.gh

 MA, 0000-0002-4588-2372; MKM, 0000-0002-2033-7108

ABSTRACT

Water quality improvement, sanitation, and hygiene have been demonstrated to have positive impacts on health, social, and economic development. However, global understanding of water quality, sanitation, and hygiene is limited. The study extracted data from the Joint Monitoring Programme (WHO/UNICEF) and the Demographic and Health Surveys (DHS) to estimate global water, sanitation, and hygiene (WASH) levels. Statistical tools of univariate and multivariate analyses were used to process global access to WASH. Results show that men (53%) had access to safe water compared to women. Women (67%), on the other hand, demonstrated better hygiene practices than men (33%). In addition, adults had access to safe water compared to children, the elderly, and strangers. Globally, there is low water quality in landlock developing countries compared to small island developing states. The categorisation of countries into economic states of low, upper-middle, and high-income countries directly affects water quality, sanitation, and hygiene. Continentally, Africa recorded the least water quality, sanitation, and hygiene levels. Thus, African countries must learn from the best practice in governmental policies and management systems from other continents regarding water improvement, sanitation, and hygiene.







Key words: disease, global, human health, hygiene, water and sanitation

HIGHLIGHT

















- The paper seeks to meet global WASH level, reduce poverty, and hunger and protect human rights. Also, to preserve and maintain safe WASH which is critical for achieving the 2030 Agenda. Thus, poor water quality, sanitation, and hygiene affect human health, and social and economic development.

GRAPHICAL ABSTRACT

Water Sanitation and Hygiene Level by Continents

Countries by Continents	Good Hygiene	Good Sanitation	Good Water Quality
Africa Continent			
Other Continents			

Water Sanitation and Hygiene Level By Income Levels

Countries by Income Level	Good Hygiene	Good Sanitation	Good Water Quality	Income Level
Low-Income Countries				
Lower-Middle-Income Countries				
High-Middle Income Countries				
Upper-Income Countries				

INTRODUCTION

The desire to eradicate poverty and hunger, and protect human rights in every country has been at the heart of the United Nations (UN) member States' revolutionary ambition of the 2030 Agenda (Cafer *et al.* 2015). Access to safe water, sanitation, and hygiene (WASH) is critical in achieving the 2030 Agenda (UNICEF & Unicef 2016). Unfortunately, inadequate water quality, sanitation, and hygiene are responsible for 432,000 fatalities each year globally (Bain *et al.* 2018). Fewtrell *et al.* (2005) reported how proper WASH prevents disease outbreaks and fatalities. According to the World Health Organization (WHO 2007, 2018), a \$1.00 investment in sanitation and hygiene helped save \$5.50 medical expenditures, reduce premature deaths, and increase economic production (UNICEF 2018). Thus, poor water quality, sanitation, and hygiene affect human health, social development, and economic development (Winkler *et al.* 2017).

In addition, the UN General Assembly has been pushing for safe and clean drinking water and sanitation as a fundamental human right since 2010 and requested member countries to embrace safe, hygienic and affordable access to water and sanitation (World Health Organization 2018, 2019, 2020, 2021). Target 6.2 of the Sustainable Development Goals (SDGs) demands everyone have access to sufficient and equitable water and sanitation (Hutton & Varughese 2016). The UN Deputy Secretary-General further issued this sanitation call in 2013 to eliminate open defaecation by 2025 (WHO/UNICEF 2015). Analyses of the worldwide burden of illness and sanitation levels, and their impacts on sanitation targets have been going on with the support of the WHO (Prüss-Ustün *et al.* 2019).

In the light of the above, a high-priority strategy has been given to WASH activities in order to enhance human health, with the ultimate goal to improve the social and economic development, particularly in developing countries (Orgill-Meyer & Pattanayak 2020). Several studies have evaluated WASH activities across national levels, but the understanding of WASH

at the global level and its impacts on human health is limited (Mihelcic *et al.* 2008; Schwarzenbach *et al.* 2010; Rush 2013). Therefore, the objective of this study is to use available data from 1990 to 2020 to model global WASH on human health, using statistical tools of univariate and multivariate analyses.

MATERIALS AND METHODS

This study obtained the data from Joint Monitoring Programme (WHO/UNICEF) and the Demographic and Health Surveys (DHS) on global WASH. The WHO/UNICEF and DHS are sources of comparative quantitative data on countries worldwide (Jonah *et al.* 2018). These global datasets are open-source access and freely available online. The data on WASH were collected at the global level. In view of this, WHO/UNICEF is a collaborative framework established to ensure universal health coverage, via a primary health care and health systems approach; maternal and child nutrition; mental health and psychosocial wellbeing and development; public health emergencies. Also, the DHS is based on probability sampling using existing sampling frames, primarily population censuses (Marivoet & De Herdt 2018). DHS surveys are done every five (5) years and feature huge sample sizes ranging from 5,000 to 30,000 families, allowing for comparability over a period (Benova *et al.* 2018). The indicators are based on probability sampling, that is, population censuses (Corsi *et al.* 2012). They contain data on WASH for various countries' populations and WASH monitoring indicators (White *et al.* 2013). As a result, the collections offer high-quality, timely and consistent data on global development and poverty reduction (Wu *et al.* 2020). The criteria for selecting the countries for the study using the Joint Monitoring Programme (WHO/UNICEF) and DHS datasets on WASH activities included countries with WASH datasets not less than 10 years. The data comprise of discontinuous numeric values and variable data measured over a defined time frame. The data provided several indicators for monitoring and assessing impacts on population, health, and nutrition. Thus, using WHO/UNICEF and the DHS datasets from 1990-2020 will help ensure global representation of WASH occurrences in a quantifiable and comparable form.

Study countries

In total, 117 countries were covered in the study. The available data with the most current information to the study on each country within the time frame was selected. The study countries were grouped on WHO classification. The variables captured in the study include income levels (i.e., low, lower-middle, upper-middle, and high), demographics, continents and regions. Gender comprises of men and women; people (i.e. children, adults, elderly, and strangers). Regions include (i.e., fragile or extremely fragile states, least developed countries (LDCs), landlocked developing countries, small island developing states), and the continents comprise of Africa, America, Antarctic, Asia, Australia, and Europe.

Statistical analysis

Data analysis was limited to countries with complete data availability on safe WASH access. Data were analysed using Microsoft Office Excel 2019 (Microsoft Corporation, Redmond, WA, USA) and Statistical Package for the Social Science (SPSS) version 26 (IBM, Chicago, IL, USA). Descriptive statistics for socio-demographic and exposure variables were reported as proportions and percentages. The study analysed global WASH levels, and the results were grouped continent by continent.

The researchers used inferential and multivariate techniques to analyse access to WASH. The multivariate analysis theoretically adjusted significant compositional and contextual elements to ensure valid output. Nonetheless, the Pearson correlation coefficient, which measures the linear relationship between two variables, was utilised to quantify this relationship (Sullivan *et al.* 2007). A positive correlation exists between two variables when an increase in one causes an increase in the other.

On the other hand, a negative correlation suggests that, high measurement on one variable tends to be associated with low measurement on the other variable and vice versa. It has a value ranging from -1 to 1 , where -1 denotes a perfect negative linear correlation between two variables, zero (0) denotes no linear association, and 1 denotes a strong positive linear relationship between the two variables. As a result, the statistical significance level for all analyses was set at 0.05. There is a 95% certainty that WASH is linked. In the results, the outputs were provided as a cross-tabulation.

RESULTS

Worldwide classification of WASH

Figure 1 shows the worldwide classification of WASH into gender, people, regions and income levels. Under gender, men's access to safe water is higher than women and children. Similarly, adults had higher access to safe water than children, the elderly, and strangers. Men also featured a high hygiene level compared to children, the elderly and strangers. On the other hand, the adults recorded the highest hygiene level, followed by water safety and sanitation. Also, water quality was the highest compared to water safety and hygiene levels. Furthermore, strangers had more access to quality water than sanitation and hygiene.

With respect to WASH of classified countries across the globe by region, small island developing states' water quality, sanitation, and hygiene levels were the highest, followed by the landlocked developing countries, fragile or extremely fragile states and LDCs.

From Figure 1, safe WASH level countries per income demonstrate that lower-income countries recorded the least WASH level, followed by the lower-middle-income countries, upper-middle-income, and high-income countries. Notwithstanding, water safety, sanitation and hygiene level was high among the high-income countries. Water quality was also high within the upper-middle-income compared to sanitation and hygiene levels, while hygiene level was the highest among the lower-middle-income relating to the lower-middle-income. Nevertheless, sanitation was the highest among the lower-income countries and then hygiene and water quality. Thus, income level influences water quality, sanitation, and hygiene of countries across the globe.

Rural and urban WASH levels across the globe

Figure 2 shows WASH activities in rural versus urban areas across the globe. The results indicate that rural and urban water quality, sanitation and hygiene levels worldwide between 1990 and 2020. The data depicts hygiene level as the highest (83%), followed by sanitation and water quality. Nonetheless, global urban recorded 74%, 82%, and 83% sanitation, water safety and hygiene, respectively, compared to rural sectors at 24%, 18%, and 17%, respectively. In summary, global urban hygiene was the highest, followed by sanitation and water quality, while sanitation level was the highest among the rural sectors compared to water quality and hygiene.

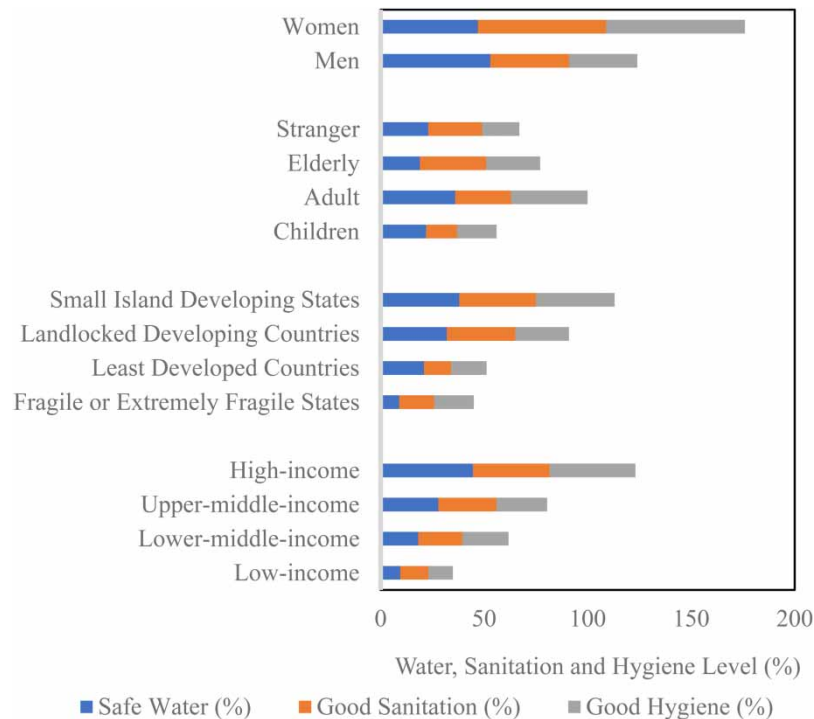


Figure 1 | Worldwide classification of WASH (1990–2020).

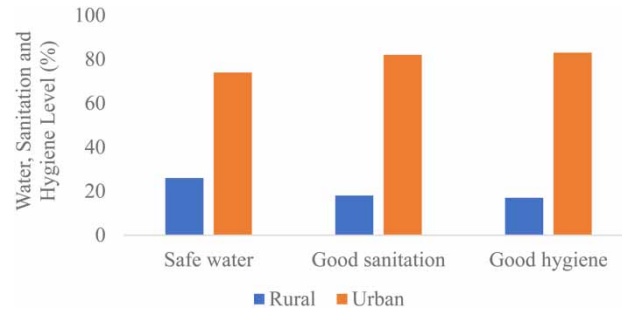


Figure 2 | Rural and urban WASH levels across the globe (1990–2020).

Table 1 presents WASH classification based on demographic information. From the Table, the demographic findings show that 53%, 38%, and 33% of the men across the globe had access to safe WASH, compared to women, 47%, 62%, and 67%, respectively. Women's sanitation and hygiene level is higher than the men's 38% and 33%, respectively. However, the hygiene level for women globally from 1990 to 2020 was the highest, followed by sanitation and water quality. In contrast, water quality (53%) was the highest among men worldwide, relating to sanitation (38%) and hygiene (33%). Also, the elderly (19%) recorded the least globally to have access to safe water, followed by children (22%), strangers (23%), and adults (36%). On the other hand, sanitation level was high among the adult (27%) and subsequently by elderly (32%), strangers (26%), and children (15%). Hygiene level among strangers (18%) was the least among the people in the world compared to children (19%), elderly (26%), and adults (37%). Children recorded the lowest value in water quality, sanitation and hygiene levels, followed by strangers, the elderly, and adults.

Table 2 shows the probability or the likelihood of WASH levels across the globe with respect to income levels, regions and continents, adding up to 1 or 100%. For example, as in **Table 2**, the likelihood of safe water for low-income countries is 0.1 or 10%. Similarly, the likelihood of safe water for lower-middle income, upper-middle income or high-income countries is 17%, 28%, and 45%, respectively. Notwithstanding, water safety (0.45), sanitation (0.37), and hygiene (0.42) levels were high among the high-income countries. Furthermore, sanitation level (0.28) was also high within the upper-middle-income countries as compared to water safety (0.28) and hygiene (0.24) levels.

The sanitation level (0.33) was high among the landlocked developing countries compared to water safety (0.32) and a little lower than hygiene (0.26). In the LDCs, water safety (0.21) was the highest compared to sanitation (0.13) and hygiene (0.17). Among the fragile or extremely fragile states, hygiene at 0.19 featured the highest before sanitation (0.17) and water quality (0.09). Water safety and hygiene among the small island developing states were simultaneously high (at 0.38 each) compared to sanitation.

In addition, Africa was the only continent that featured the least WASH at the proportion of 0.05, 0.07, and 0.05, respectively. On the other hand, the Antarctic recorded the highest water quality compared to the other continents, followed by Asia, Europe, America, and Australia. Furthermore, America and the Antarctic recorded the highest levels of sanitation across the globe from 1990 to 2020, and then followed by Australia, Europe, and Asia. America and Australia featured the highest

Table 1 | WASH level classification based on worldwide demographic information (1990–2020)

	World	Safe water (%)	Good sanitation (%)	Good hygiene (%)
Gender	Men	53	38	33
	Women	47	62	67
People	Children	22	15	19
	Adult	36	27	37
	Elderly	19	32	26
	Stranger	23	26	18

Table 2 | Probabilistic analysis of WASH level across the globe (1990–2020)

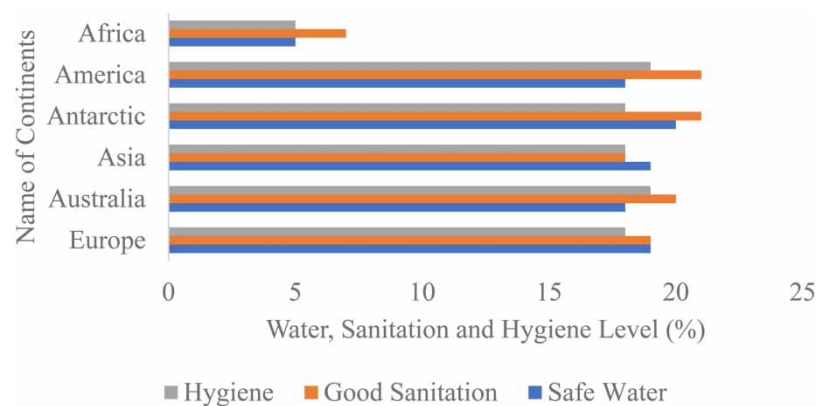
	World	Safe water	Good sanitation	Good hygiene
Income levels	Low-income	0.10	0.14	0.12
	Lower-middle-income	0.17	0.21	0.22
	Upper-middle-income	0.28	0.28	0.24
	High-income	0.45	0.37	0.42
Regions	Fragile or extremely fragile states	0.09	0.17	0.19
	LDCs	0.21	0.13	0.17
	Landlocked developing countries	0.32	0.33	0.26
	Small island developing states	0.38	0.37	0.38
Continents	Asia	0.19	0.17	0.19
	Africa	0.05	0.07	0.05
	America	0.18	0.20	0.20
	Antarctic	0.20	0.20	0.19
	Europe	0.19	0.18	0.19
	Australia	0.18	0.19	0.20

hygiene globally over the 1990–2020 period and subsequently by Asia, Europe, and the Antarctic. America and the Antarctic generally featured as the continents with safer water, good sanitation, and hygiene, followed by Australia, Europe, Asia, and Africa.

Continentially classified water safety, sanitation, and hygiene levels

Figure 3 shows WASH levels among the world's continents, and Africa recorded the least in all the three indicators compared to the other continents. Regarding Africa, sanitation was higher than water safety and hygiene levels. Water safety among the Asians was the highest compared to sanitation and hygiene levels. Asia demonstrated the same level of sanitation and hygiene. America and the Antarctic regions had their sanitation levels higher than the water safety and hygiene levels. America and the Antarctic regions recorded the highest sanitation level and different water safety and hygiene levels. Europe recorded the same level for water safety and sanitation and comparable values in hygiene. The sanitation level for Australia was higher than that of water safety and hygiene.

Notwithstanding, the Antarctic dominated in water quality and sanitation, followed by Europe. Likewise, America and the Antarctic recorded the highest peak for sanitation compared to other continents. Hygiene level was high among the Americans and Australians almost at the same value.

**Figure 3** | Continental classification of water safety, sanitation, and hygiene level (1990–2020).

DISCUSSION

Worldwide classification of WASH

The study revealed that there are issues with access to adequate WASH from 1990 to 2020. From Table 1, 53, 38, and 33% of men had access to safe WASH compared to women at 47, 62, and 67%, respectively. However, the findings showed that men had access to safe water compared to women. However, men had low sanitation and hygiene, and this might be because men did not particularly care much about their environment and health but rather economic activities and development. This assertion is supported by the literature that, lack of personal care on the side of men exacerbates poor sanitation and hygiene level among men globally (Hutton & Chase 2016). On the other hand, women's access to safe water needs to be improved worldwide as men improve sanitation and hygiene levels. Moreover, women and men must be represented equally globally, and concerted efforts must be made to ensure that women have access to safe WASH. As a result, national governments must incorporate gender concerns into their policymaking and decision-making processes, allowing women to voice their opinions and successfully participate in meaningful public discourse.

Correspondingly, adults have more access to safe water than children, the elderly and strangers because they can compete or walk a long distance to get safe water. This led to their high sanitation and hygiene level compared to children, the elderly and strangers. The adults also recorded the highest hygiene level, followed by water safety and sanitation. In addition, water quality was the highest among the children compared to sanitation and hygiene. Among the elderly, sanitation level was the highest compared to water safety and hygiene levels. Surprisingly, it is interesting to observe that strangers have higher water quality than sanitation and hygiene levels.

From Figure 2, small island developing states had below average even though they had moderate safe water, good sanitation and hygiene compared to other regions. Small island developing states have been noted to experience high rate of pollution, including surface and underground by domestic sewage and industrial effluents and the high demand for water due to agricultural activities. This is not surprising as small island developing states are particularly vulnerable to frequent natural catastrophes (e.g., cyclones and earthquakes), which can cause damage to their sewage and related water systems, damaging both surface and groundwater resources (Gheuens *et al.* 2019). Water supply, sanitation services, and hygiene are complex under the physical and socio-economic conditions of many small islands developing states. The financing and management of water supply and sanitation utilities to service growing populations and tourist facilities are complex when population concentrations and water sources are small and widely dispersed (Van der Velde *et al.* 2007). For landlocked developing countries, below average safe water and good sanitation were observed, with lower hygiene level. There are usually water quality issues in landlocked developing countries because of their high population and small water resources. Compounding the issues of landlocked developing countries, they do not have direct access to the sea and are economically deprived of the sea resources (Faye *et al.* 2004). In the case of LDCs, surprisingly sanitation was the poorest compared to water safety and hygiene. Apparently, LDCs are constantly exposed to water shortages, insufficient infrastructure for water access, floods and droughts, and contamination of rivers and large dams are all factors that contribute to the demand for safe water and good sanitation. Compounding the issues of safe water and good sanitation, over a billion people in developing nations do not have access to safe drinking water, resulting in poverty and the influence of climate change, and bad governance in the LDCs (Kumar *et al.* 2014). In the case of fragile or extremely fragile states, there exists poor water quality compared to sanitation and hygiene levels. Nevertheless, this poor water quality level might be due to the insufficient coping capacity of fragile states as they are exposed to several risks, which the states cannot mitigate (Desai & Forsberg 2020). The complex multidimensional fragility on the fragile states exerts so much pressure such that high levels of conflict, poverty, and inequality affect access to water quality, sanitation and hygiene. Thus, people in conflict or fragile states are twice as likely to be without safer access to water than those in stable countries (World Bank 2011). Hygiene featured the highest before sanitation and water quality among the fragile or extremely fragile states. This affirmed one of the findings of Mafuta *et al.* (2021), indicating that access to safe drinking water sources in fragile countries states is low. Overall, small island developing states' water quality, sanitation and hygiene levels were the highest, followed by the landlocked developing countries, the LDCs and fragile or extremely fragile states.

Nevertheless, low WASH levels in the lower-middle-income countries suggested inadequate WASH management systems. Thus, water management systems must be implemented to ensure an efficient delivery system to curb WASH-related diseases. Notwithstanding, water safety, sanitation and hygiene level was high among the high-income countries. High water quality, sanitation, and hygiene levels are due to efficient management systems. The upper-middle-income

status for safe water was similar to sanitation and hygiene levels. However, both safe water and sanitation were greater than hygiene level.

Similarly, sanitation was the highest among the low-income countries, followed by hygiene and water quality. Thus, income influences water quality, sanitation and hygiene level of countries across the globe. This view is supported by the literature that geographical disparities, good governance and enforceable policies favour water quality, sanitation, and hygiene. Therefore, it is noted that increasing the quantity of water allows for better hygiene practices. On the other hand, water crises can significantly impact agriculture and food production, particularly in fragile developing nations where food demand is rising, and chronic malnutrition is widespread.

Rural and urban WASH levels across the globe

From Figure 2, there are low levels of sanitation and hygiene among rural regions worldwide compared with the urban regions. These low water quality, sanitation, and hygiene might result from open defaecation, low water level and deforestation (Anthonj *et al.* (2020)). In addition, the study buttresses the fact that inadequate safe WASH in the rural regions globally results in health, economic and societal issues. In summary, global urban hygiene was the highest, followed by sanitation and water quality, while safe water level was the highest among rural sectors compared to sanitation and hygiene. The data also supports the fact that the poor living in villages, slums, and improper settlements are lacking safe drinking water and sanitation facilities (United Nations Human Settlements Programme 2003). On the contrary, urban regions globally have high water quality, sanitation and hygiene. These outcomes might be due to effective water distribution systems, good urban policies and access to basic toilets facilities. Thus, the WASH gap must be filled between the rural and the urban regions.

Continentially classified water safety, sanitation, and hygiene level

From Figure 3, Africa recorded the least in water quality, sanitation, and hygiene compared to the other continents. The data show that sanitation was higher than water safety and hygiene levels in Africa. However, statistically, Africa's water quality, sanitation, and hygiene levels do not correlate well. Thus, suggesting that other endogenous variables are intrinsic affecting water quality in Africa. The literature suggests that the key causes of water scarcity in Africa from 1990 to 2020 were physical and economic scarcity, deforestation, rapid population growth and climate change. Although precipitation is abundant in sub-Saharan Africa, it is seasonal and irregularly distributed, resulting in periodic floods and droughts.

Furthermore, although widespread economic growth is visible, poverty disparities abound and compounding the issues is the rapid population growth and rural-urban mobility. Therefore, these factors have made sub-Saharan Africa the poorest and the least developed region on the planet. According to the UN Food and Agriculture Organization's 2012 report, increasing water shortage is now one of the most pressing obstacles to long-term development (Boretti & Rosa 2019). This is because of the combined demands of agriculture and other industries, and increasing number of river basins have reached water scarcity situations. Water scarcity has a wide range of consequences in Africa, including health, education, agricultural production, sustainable development, and the possibility of further water disputes.

There is much poverty, food insecurity and hunger on the African continent. An improvement in water and sanitation can boost income and food purchasing power. In food and agriculture production, water is a necessary component. Perhaps, reducing hunger, establishing food security, increasing nutrition, and encouraging sustainable farming are all dependent on it. However, it suggests that the health benefits connected with improved water quality are less than those derived from increased water quantity, which allows for better personal and domestic hygiene practices. Therefore, improvements in water and sanitation do not always translate into better health in Africa. Thus, WASH education should be encouraged to enhance general health and living conditions.

Water safety among the Asians was high compared to sanitation and hygiene levels. Asia demonstrated the same peak for sanitation and hygiene. America and the Antarctic regions had their sanitation level higher than the water safety and hygiene levels. America and Antarctic regions recorded the same peak for sanitation but different heights for water safety and hygiene. Europe recorded the same level for water safety and sanitation and at the same time very strong in hygiene. The sanitation level for Australia was higher than that for water safety and hygiene, but equally comparable to Europe.

Notwithstanding, the Antarctic dominated in water quality and sanitation, followed by Europe. Likewise, America and the Antarctic recorded the highest level of sanitation compared to the other continents. Hygiene level was high among the Americans and Australians at the same time. Thus, Asia recorded the subsequent least WASH levels before Europe, Australia, and

Table 3 | Water safety, sanitation and hygiene Pearson correlation analysis of the world (1990–2020)

		Safe water	Good sanitation	Good hygiene
Safe Water	Pearson correlation	1	0.995 ^a	0.997 ^a
	Sig. (two-tailed)		0.000	0.000
	Sum of squares and cross-products	1,265.916	1,330.817	1,234.171
	Covariance	66.627	70.043	64.956
	<i>N</i>	41,780	41,780	41,780
Good Sanitation	Pearson correlation	0.995 ^a	1	0.997 ^a
	Sig. (two-tailed)	0.000		0.000
	Sum of squares and cross-products	1,330.817	1,412.366	1,303.855
	Covariance	70.043	74.335	68.624
	<i>N</i>	41,780	41,789	41,780
Good Hygiene	Pearson correlation	0.997 ^a	0.997 ^a	1
	Sig. (two-tailed)	0.000	0.000	
	Sum of squares and cross-products	1,234.171	1,303.855	1,210.334
	Covariance	64.956	68.624	63.702
	<i>N</i>	41,780	41,780	41,780

^aSignificant level at 0.01%.

the Antarctic regions. Nonetheless, these high levels in terms of sanitation among the continents outside Africa are due to effective governance, policies, and management systems.

From Table 3, the Pearson statistical correlation analysis on the strength of relationships between variables demonstrated a strong and an excellent correlation among water quality, sanitation and hygiene. Thus, the data show that from 1990 to 2020, water quality influences sanitation and hygiene and vice versa.

CONCLUSION

The study investigated global WASH distribution, using global indicators data from 1990 to 2020. The findings revealed that 53, 38, and 33% of men had access to safe WASH compared to women at 47, 62, and 67%, respectively. Adults had more access to safe water than children, the elderly, or strangers. As a result, adults had very good hygiene status, followed by water safety and sanitation. Similarly, the children had access to safe water; thus, their hygiene is greater than sanitation. Also, adults had more access to safe water than children, the elderly, or strangers. Also, it was observed that adults had the highest hygiene status, followed by water safety and sanitation. In addition, the children had the best water quality regarding sanitation and hygiene levels.

Urban regions globally in general had good water quality, sanitation, and hygiene, attributed to good water distribution systems, good urban planning, and access to basic toilet facilities. Africa has the poorest water quality, sanitation, and hygiene compared to the other continents. In comparison to sanitation and hygiene, Asians, on the other hand, have a high level of water safety. The sanitation levels in America and Antarctica were more pronounced than their water safety and hygiene scores. Europe was strong in water safety, sanitation and hygiene. Australia's sanitation score was however greater than its water safety and hygiene scores.

Nonetheless, the Antarctic took the lead in water quality and cleanliness, followed by Europe. Similarly, America and Antarctica had the highest sanitation peak compared to other continents. At the same time, the degree of hygiene with respect to Americas and Australia was high. However, increasing ranking order for WASH among the continents is as follows: Africa, Asia, Europe, Australia, America and Antarctica. Strong governmental policies, and management systems are most likely responsible for the high levels of sanitation across the continents outside Africa.

CONFLICT OF INTEREST

There is no conflict of interest between the authors regarding the publication of this paper; thus, the publication of this paper is free from authorship conflicts.

DATA AVAILABILITY STATEMENT

All relevant data are available from an online repository or repositories. (JMP (WHO/UNICEF) WASH Data: <https://data.unicef.org/topic/water-and-sanitation/wash-in-schools/>; JMP (WHO/UNICEF) WASH Data: <https://washdata.org/data/downloads#WLD>; The DHS Program: https://dhsprogram.com/data/dataset_admin/index.cfm; Our World in Data: <https://ourworldindata.org/explorers/water-and-sanitation>).

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