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# **Women's Water Access Is Associated With Measures of Empowerment and Social Support: A Cross-sectional Study in Sub-Saharan Africa**

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## **Abstract**

Water access is an important global issue that impacts health and wellbeing and has been recognized by the United Nations as a significant area for improvement. Despite some global improvements from the Millennium Development Goals (MDGs) targets, regions with the most compromised water access are still experiencing significant deficits. Among those regions, Sub-Saharan African (SSA) Countries are the most affected. Socio-ecological factors intersect to further contribute to this compromise in water resources, and community structures and social supports need to be considered. Women's empowerment and social support have been shown to have an impact on community health and wellbeing, but the association with water access is not well researched. This cross-sectional study considers these relationships and aims to identify water access for women living within SSA and assess its relationship with measures of women's empowerment and social support. Using data from the Gallup World Poll, our study highlights an association between these factors, suggesting a role for community and female capacity-building to empower women and foster relationships within SSA communities to further work toward improvements in water resources.

**Keywords:** Water access, water security, empowerment, social support, Sub-Saharan Africa, capacitybuilding

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## 1.0 Introduction

The *Global Risk Report* places water crises in its top five global risks in terms of societal impact (World Economic Forum, 2016). In 2010, the United Nations recognized the human right to clean drinking water and sanitation (United Nations, Department of Economic and Social Affairs, 2014). This closely aligned with the Millennium Development Goals (MDG 7.C): “to halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation” (United Nations, 2015, p.58). The MDG target for drinking water was met in 2010, as the percent of the global population with access to improved drinking water increased from 76 percent in 1990 to 91 percent in 2010 (Mulenga, Bwalya, & Kaliba-Chishimba, 2017). Among various definitions, water security has recently been defined as “the ability to access and benefit from affordable, adequate, reliable, and safe water for wellbeing and a healthy life” (Jepson, Wutich, Collins, Boateng, & Young, 2017, p.3). Despite the improvements, progress was dispersed unequally among the least industrialized countries in regions such as Caucasus, Central Asia, Northern Africa, Oceania and Sub-Saharan Africa (SSA) failing to meet the target (Armah et al., 2018). Many countries in these regions experience very low water security due to a wide variety of factors, including inadequate governance, and poor water management, safety, quality, and accessibility, among others (Gain, Giupponi, & Wada, 2016). Moreover, despite substantial efforts to improve water access, in 2015, 663 million people still lacked access to safe drinking water, and 2.4 billion people lacked improved sanitation facilities; nearly half of those without improved access lived in SSA (World Health Organization, 2017).

Globally, water is increasingly a scarce resource, but in SSA, there is an additional potential threat to regional security (Freitas, 2013). It is postulated that the increasing pressure and need for water resources could lead to unrest, political tensions, and armed conflicts in SSA, further highlighting the significance of water access in this region (Du Plessis, 2019). Access to safe drinking water and improved sanitation are essential for human survival. Water use at a household level has considerable implications for health, education, income and leisure time, with limited access to improved water and sanitation services presenting greater risks for poor health and social outcomes (Watkins, 2006). Therefore, water access should be treated as a social good rather than solely an economic one (Guardiola, García-Rubio, & Guidi-Gutiérrez, 2014).

Households’ access to clean water affects individuals’ economic activities. For example, the time burden of fetching water when not available in or near the home, limits the amount of time available for income-generating activities in SSA. This is particularly problematic among women and girls who tend to shoulder this burden (Ahmadi, Sinclair, Melgar-Quinonez, & Cortbaoui, 2017). Similarly, this may constrain the amount of time that can be dedicated to going to school, community events, childcare, or enjoying leisure activities (Gomez, Perdiguero, & Sanz, 2019). Notably, statistics show that rural women and children collectively spend approximately 40 billion hours each year fetching water in SSA (UN Women, 2014). Within the SSA context, these systematic gender disparities also exist in healthcare, the workforce, education, income, and political representation (Kulkarni, 2018). Although to date water access and water scarcity have been more acute in rural

areas, increasingly trends highlight a decline in urban availability and quality, particularly due to demand as a result of urbanization and population growth, lack of treatment facilities and mismanagement, among others (Dos Santos et al., 2017).

Water and environment research have highlighted the intersection between water security and sanitation, gender equality, and empowerment in recent years given the significant roles of women in water supply activities (Ivens, 2008). Improved water access and sanitation do benefit women through reduced time for fetching water as this protects against (a) gender-based violence, (b) animal attacks, (c) musculoskeletal impairments, and (d) disease (Gender Water Alliance [GWA] & United Nations Development Programme [UNDP], 2006; Pommells, Schuster-Wallace, Watt, & Mulawa, 2018; Sorenson, Morssink, & Campos, 2011). However, implementation of water programs that relieve women of water-fetching activities does not necessarily result in improvements in gender equality, since men often hold decision-making power and women are then allocated to other tasks that men feel are most valuable for the household (GWA & UNDP, 2006). Additionally, water program sustainability might be limited as water supply facilities are unlikely to receive repair given that it does not impact men's daily responsibilities (Ivens, 2008). Water programs are not consistently addressing root concerns, like gender inequality, which may also drive the use of high-risk water and sanitation practices (Chew et al., 2019; Vedachalam et al., 2017). Empowering participatory approaches to water programs have been encouraged to address gender inequality and promote water program sustainability (Ivens, 2008).

Empowerment of women and girls is a topic of interest and investment for global development given the significant role that women and girls play in the home. However, as Cornwall and Rivas (2015) describe, often empowerment is not well defined in research and is not considered within the reality of gender inequality. The variation in the definition of empowerment is also a concern regarding consistent measurement in global health research (Richardson, 2018). Women's empowerment involves the process of creating and increasing the ability for women to make their own decisions, where this focus on agency considers the initial resources available and the achievements produced through the process (Kabeer, 1999). In the current study, although measures were limited, relevant survey questions were combined to create an empowerment score where agency, resources, respect, and achievements are considered quantitatively.

Kabeer's (1999) definition of empowerment refers to resources, which also can include social resources. Social capital is considered in international health research given the links between social capital and health (Coker et al., 2002; Harpham, Grant, & Thomas, 2002). Social capital generally refers to the structural and contextual environments that impact social relations within a group; whereas social support is described at the individual level referring to the connections that support the individual (Harpham et al., 2002).

The pathways linking different dimensions of water access to factors such as women's empowerment and their social involvements are highly complex. Although this study cannot fully address these phenomena, it aims to assess: (a) differences in water access for women in SSA in rural compared to urban regions, and (b) the relationship between women's water access, empowerment, and social support in rural and urban regions.

## 2.0 Methods

### 2.1 Data

The Gallup World Poll (GWP) collects data of the non-institutionalized population aged 15 and older in more than 140 countries with a total sample size of roughly 150,000 individuals (Food and Agriculture Organization, 2016). The samples are probability-based and nationally representative. An average of 1,000 individuals per country is surveyed using face-to-face or telephone interviews (Food and Agriculture Organization, 2016). The present analysis includes data from women of 35 SSA countries from the 2017 GWP (n=17,891) (see Figure 1). Other SSA countries were omitted due to lack of data for the variables of interest. Permission to analyze this data has been obtained from GWP through Food and Agriculture Organization (FAO) Voices of the Hungry and the data collection follows Gallup Ethics Guidelines.

Figure 1. Thirty-five SSA countries included in this study.



Source: GWP Data Analysis and Map Creation using mapchart.net, 2019

### 2.2 Exposure and Control Variables

Four questions from the GWP survey related to water access were used as the principal independent variables in this study (see Table 1). Responses to the aforementioned four variables were then summed to create a water access score on a continuum from zero to four, where a score of zero is reflective of ‘poor’ water access and a score of four as ‘good’. Various socio-demographic factors were controlled for, including household size, education levels, household income, and employment.

### 2.3 Outcome Variables

Dependent variables examined in this study included: empowerment score and social life index. A detailed description of these categorical variables can be found in Table 1. GWP indicators relevant to the empowerment score were summed to create the overall empowerment score, where zero is reflective of ‘low empowerment’ and three of ‘high empowerment’. Similarly, the social life index ranges from zero to three, where zero represents ‘poor social support,’ and three as ‘high social support.’

Table 1. *Characteristics of Dependent and Independent Variables*

		Potential Responses and Scores
<b>Water Access Items<sup>a</sup></b>		
1	In the city or area where you live, are you satisfied or dissatisfied with the quality of water?	0) Dissatisfied 1) Satisfied
2	What is the main source of drinking water for members of your household?	0) Unimproved <sup>1</sup> 1) Piped into dwelling <sup>2</sup>
3	In the area where you currently live, would you say there has been enough water for growing crops, or not?	0) No 1) Yes
4	Again, thinking of the last 12 months, in the area where you currently live, would you say there has been enough water for raising livestock, or not?	0) No 1) Yes
<b>Empowerment Items<sup>b</sup></b>		
1	In this country, are you satisfied or dissatisfied with your freedom to choose what you do with your life?	0) Dissatisfied 1) Satisfied
2	Think about where you were, what you were doing, who you were with, and how you felt. Were you treated with respect all day yesterday?	0) No 1) Yes
3	Now, please think about yesterday, from the morning until the end of the day. Think about where you were, what you were doing, who you were with, and how you felt. Did you learn or do something interesting yesterday?	0) Yes 1) No
<b>Social Life Index</b>		
	The Social Life Index assesses a respondents' social support structure and opportunities to make friends in the region where they live.	0) Low 50) Moderate 100) High

Source: Micro data analysis of GWP, 2017

<sup>a</sup>Reliability test = The Bartlett’s and Kaiser-Meyer-Olkin (KMO) tests for water-related questions were carried out. These questions have moderate internal consistency (KMO = 0.554; Chi sq = 13367.211; p<0.0000).

<sup>b</sup>Reliability test = The Bartlett’s and Kaiser-Meyer-Olkin (KMO) tests for empowerment items were carried out. The KMO statistic was 0.532 and the Bartlett’s Sphericity test x2 value was 723.814 (p<0.0000).

<sup>1</sup>. Public–community tap, open well in dwelling, open well in yard–plot–homestead, open public–community well, protected well in dwelling, protected well in yard–plot, protected public–community well, spring, river–stream, pond–lake, dam, rainwater, tanker truck, bottled water–water bag–sachet, tube well–bore hole and other.

<sup>2</sup>. Tap–piped into house, tap–piped into yard–plot.

## 2.4 Statistical analyses

Statistical analyses were performed using IBM SPSS version 24. The analysis procedure included three main steps: (a) analyses of numerical data to identify the descriptive characteristics of dependent, independent and control variables; (b) analyses of the associations between dependent, independent and control variables through running crosstabs analyses—bivariate; and (c) analyses to determine whether the sets of dependent variables are influenced by having access to water—multivariate (mixed-effect regression).

## 3.0 Results

### 3.1 Descriptive Statistics

Characteristics of the sample for rural and urban women are presented in Table 2.

*3.1.1 Rural areas.* Overall, approximately 45% of respondents lived in households with seven or more people, 75% had an elementary education as their highest education, 26% reported an annual household income between zero and 4,999 US dollars, and more than half reported living with a partner or being married (56%). Moreover, roughly 48% had a high social life index score—relied on other people in time of need and able to make friends—and 35% had a high empowerment score. In terms of water access score, only 6.6% of respondents had a high accumulated score in rural areas, and only 18% had access to piped water.

Table 2. *General Characteristics of Sample of Women in SSA Countries by Rural (n=12,242) and Urban (n=5,649) Areas.*

			Rural	Urban
			%	%
<b>Socio-demographic factors</b>	Age groups (n.s)	15–25	37.8	38.4
		26–49	45.9	45.3
		50–64	11.6	11.0
		65 and over	4.8	5.3
	Household size ***	1 to 3	18.3	21.8
		4 to 6	37.7	40.9
		7 and more	44.0	37.2
	Education ***	Low Elementary	75.1	53.9
		Secondary	23.8	42.0
		Completed four years of education beyond high school.	1.1	4.1
	Employment status ***	Unemployed	8.2	11.7
		Out of workforce	38.5	40.1
		Employed part-time	26.5	24.1

**Table 2 continued**

		Employed full-time	26.8	24.1
	Marital ***	Single–never married	29.5	42.3
		Divorced–separated– widowed	14.2	13.4
		Married–living with partner	56.3	44.4
	Annual Household (HH) Income ***	0–4,999\$	25.6	14.3
		5,000–9,999	23.1	17.2
		10,000–14,999	20.2	20.0
		15,000–19,999	17.7	22.7
		20,000–and more	13.4	25.8
<b>Empowerment items</b>	Freedom in life (n.s)	Yes	74.0	74.7
	Treated with respect ***	Yes	80.4	84.5
	Opportunity to learn ***	Yes	55.5	59.3
	Accumulated empowerment score ***	0 (No)	5.4	4.0
		1	19.2	17.0
		2	39.9	39.0
		3 (High)	35.6	40.0
<b>Social life index</b>	Social life index ***	0 (No)	12.7	12.8
		50	39.5	36.2
		100 (High) (Ref)	47.9	51.0
<b>Water-related questions</b>	Water quality ***	Satisfied	54.5	58.9
	Water types ***	Improved	18.5	50.9
	Enough water for crops ***	Yes	44.6	51.7
	Enough water for livestock ***	Yes	45.6	47.9
	Accumulated water access score ***	0 (Low)	25.4	14.5
		1	24.5	23.5
		2	22.1	25.3
		3	21.4	21.6
		4 (High)	6.6	15.1

Chi-square signifiante: \*= p<0.05; \*\*= p<0.01; \*\*\*= p<0.001; n.s=non signifiant  
 Source: Micro data analysis of GWP, 2017.



3.1.2 *Urban areas.* Similar to rural regions in SSA, 37% of respondents in urban areas reported living in households with seven or more people, 54% categorized as having a low education, and 45% were married or living with partners. In addition, more than 40% had a high empowerment score, and 51% reported having a high social life index score. For water access, 60% reported satisfaction with quality of water, and more than 50% had access to piped water. In addition, water access score indicated that roughly 15% of respondents answered positively to all four water access questions.

### 3.2 Crosstabs Analyses

Detailed findings from crosstabs analyses are presented in Tables 3 and 4.

3.2.1 *Rural areas.* Water access score was significantly associated with all socio-economic factors. However, the strength of associations was weak for household size (0.08;  $p < 0.0001$ ); education (0.18;  $p < 0.0001$ ); and household income (0.10;  $p < 0.0001$ ). With regards to the dependent variables, a positive association was observed between water access score and the social life index (0.19;  $p < 0.0001$ ), and with the empowerment score (0.16;  $p < 0.0001$ ).

3.2.2 *Urban areas.* Similar to rural areas, all socio-economic factors—household size (0.08;  $p < 0.0001$ ); education (0.12  $p < 0.0001$ ); and household income (0.07;  $p < 0.05$ )—were significantly related to water access score. With regards to dependent variables, positive associations were observed between water access score and social life index (0.20;  $p < 0.0001$ ), and with empowerment score (0.16;  $p < 0.0001$ ).

Furthermore, regardless of area of residence, significant associations were observed between dependent variables and socio-economic factors (see Table 4). Specifically, significant associations were found between education levels, household size and income, and employment status and empowerment score. Similar findings were found with the social life index; however, household size within urban regions was not significantly associated.

Table 3. *Crosstabs Analyses Between Water-related Factors and Socio-economic Factors in SSA Countries by Area of Residence—Rural (n=12,242) and Urban (n=5,649)*

	Water quality		Water types		Water for crops		Water for livestock		Water access score	
	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
<b>Household size</b>	0.041 **	0.029 n.s	0.099* *	0.135* *	0.016 n.s	0.017 n.s	0.027 * n.s	0.004 n.s	0.078* *	0.077* *
<b>Education</b>	0.012 n.s	0.022 n.s	0.257* *	0.227* *	0.018 n.s	0.027 n.s	0.009 n.s	0.035* n.s	0.148* *	0.124* *
<b>HH Income</b>	0.032 *	0.026 n.s	0.123* *	0.131* *	0.045* *	0.018 n.s	0.031 * n.s	0.040 n.s	0.098* *	0.074* *
<b>Empowerment score</b>	0.148 **	0.127* *	0.092* *	0.061* *	0.072* *	0.108* *	0.069* *	0.107* *	0.157* *	0.159* *
<b>Social life index</b>	0.164 **	0.152* *	0.125* *	0.134* *	0.090* *	0.104* *	0.090* *	0.089* *	0.189* *	0.202* *

Chi-square significance : \*=  $p < 0.05$ ; \*\*=  $p < 0.001$ ; n.s = non significant

Source: Micro data analysis of GWP, 2017.

### 3.3 Unadjusted Mixed Effect Regression

Results from the unadjusted mixed effect regression analyses between water access score, dependent and controlling variables in rural vs urban areas can be found in Table 5.

*Table 4. Crosstabs Analyses Between Dependent Variables and Socio-economic Factors by Area of Residence (Rural [n=12,242] and Urban [n=5,649]).*

	Household size		Education		HH Income		Employment	
	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
<b>Empowerment score</b>	0.043* *	0.054* *	0.221* *	0.145* *	0.066* *	0.076* *	0.113* *	0.092* *
<b>Social life index</b>	0.042* *	0.031 n.s	0.110* *	0.151* *	0.095* *	0.114* *	0.069* *	0.063* *

Chi-square signifiacnce : \*= p<0.05; \*\*= p<0.001; n.s = non signifiant

Source: Micro data analysis of GWP, 2017.

**3.3.1 Rural areas.** Results showed that an individual’s water access score was significantly associated with all of the dependent variables. More specifically, individuals with a low water access score—score of 0—were significantly more likely to report low levels of empowerment (-0.60 [P= < 0.001]) and social life index (-0.53[P= < 0.001]). With regards to the socio-economic factors, water access score was found to be significantly associated with household size (-0.23 [P= < 0.001]), education (-0.24 [P= < 0.001]), and household income (-0.36 [P= < 0.001]).

**3.3.2 Urban areas.** Results for urban areas showed (see Table 5) that among socio-economic factors, only household income was significantly related to water access score (-0.13 [P= < 0.05]). Moreover, water access score was significantly and inversely associated with a low empowerment score (-0.57 [P= < 0.001]), and social life index (-0.36 [P= < 0.001]).

### 3.4 Adjusted Mixed Effect Regression (Empowerment)

Results for adjusted mixed-effect regression analyses between scores for empowerment and water access score by controlling the role of socio-economic factors in SSA by area of residence are presented in Table 6.

**3.4.1..Rural areas.** According to the unadjusted model, the strength of association is stronger among women who report a low empowerment score compared to higher scores (-0.36 (P= <0.001). Women with a low empowerment score also had low income (-0.20 (P= <0.001), less education (-0.30 (P= <0.001), and unemployment status (-0.16 (P= <0.001). The adjusted model showed that water access score remained significant with the empowerment score (-0.32 (P= <0.001).

**3.4.2 Urban areas.** Similar to rural areas, results for urban areas indicated that an empowerment score of zero is associated with a reduction in water access score (-0.36 [P= <0.001]). Moreover, socio-economic factors such as education (-0.16 [P= <0.001]), household income (-0.14 [P= <0.001]) and employment (-0.13 [P= <0.001]) were also found to be significantly associated with water access score. Similar to rural areas, there was an association between women with a water access score of zero and a low empowerment score (-0.32 [P= <0.001]).

Table 5. *Unadjusted Mixed-effect Regression Analyses Between Water Access Score and Dependent Variables by Socio-economic Factors in SSA by Area of Residence: Rural (n=12,242) and Urban (n=5,649)*

		Water Access Score							
		Rural				Urban			
		95% CI				95% CI			
		Estimate	Sig	L	H	Estimate	Sig	L	H
<b>Household size</b>	7 and more	-0.233	0.00	-0.298	-0.169	-0.007	0.874	-0.104	0.088
	4 to 6	-0.114	0.00	-0.176	-0.052	0.029	0.519	-0.060	0.119
	1 to 3 (Ref)								
<b>Education</b>	Low	-0.241	0.031	-0.461	-0.021	-0.032	0.718	-0.209	0.144
	Moderate	-0.164	0.143	-0.385	0.055	0.0375	0.678	-0.139	0.214
	High (Ref)								
<b>HH Income</b>	0-4,999\$	-0.358	0.00	-0.430	-0.286	-0.132	0.016	0.239	-0.024
	5,000-9,999	-0.295	0.00	-0.367	-0.222	-0.170	0.001	-0.271	-0.068
	10,000-14,999	-0.275	0.00	-0.350	-0.199	-0.126	0.011	-0.223	-0.029
	15,000-19,999	-0.180	0.00	-0.257	-0.103	-0.074	0.022	-0.168	0.019
	20,000-and more (Ref)								
<b>Empowerment score</b>	0 (No)	-0.598	0.00	-0.694	-0.501	-0.574	0.000	-0.742	-0.405
	1	-0.324	0.00	-0.385	-0.264	-0.365	0.000	-0.458	-0.273
	2	-0.171	0.00	-0.220	-0.123	-0.183	0.000	-0.255	-0.111
	3 (High) (Ref)								
<b>Social life index</b>	0 (No)	-0.526	0.00	-0.593	-0.459	-0.616	0.000	-0.718	-0.514
	50	-0.303	0.00	-0.348	-0.257	-0.234	0.000	-0.304	-0.164
	100 (High) (Ref)								

Source: Micro data analysis of GWP, 2017.

Table 6. *Adjusted Mixed Effect Regression Analyses Between Accumulated Scores for Empowerment and Water Access Score by Controlling the Role of Socioeconomic Factors in SSA by Area of Residence: Rural (n=12,242) and Urban (n=5,649)*

		<b>Empowerment Score</b>					
		Rural			Urban		
		Estimate	Sig	95% CI (L-H)	Estimate	Sig	95% CI (L-H)
<b>Accumulated water access score</b>	0 (Low)	-0.315	0.000	-0.388; -0.243	-0.318	0.000	-0.402; -0.233
	1	-0.147	0.000	-0.219; -0.076	-0.235	0.000	-0.309; -0.160
	2	-0.137	0.000	-0.209; -0.066	-0.136	0.000	-0.208; -0.063
	3	-0.003	0.919	-0.075; 0.068	-0.037	0.333	-0.112; 0.038
	4 (High) (Ref)						
<b>Household size</b>	7 and more	-0.002	0.908	-0.052; 0.046	-0.025	0.470	-0.092; 0.042
	4 to 6	-0.000	0.92	-0.046; 0.044	-0.036	0.248	-0.098; 0.025
	1 to 3 (Ref)						
<b>Education</b>	Low	-0.222	0.006	-0.381; -0.063	-0.112	0.067	-0.233; 0.007
	Moderate	-0.000	0.972	-0.046; 0.044	0.036	0.555	-0.083; 0.156
	High (Ref)						
<b>HH income</b>	0-4,999\$	-0.119	0.000	-0.174; -0.063	-0.054	0.166	-0.132; 0.022
	5,000-9,999	-0.073	0.009	-0.129; -0.018	-0.097	0.008	-0.169; -0.025
	10,000-14,999	-0.072	0.011	-0.127; -0.016	-0.112	0.001	-0.180; -0.044
	15,000-19,999	-0.081	0.004	-0.138; -0.0253	-0.034	0.300	-0.098; 0.030
	20,000-and more (Ref)						
<b>Employment</b>	Unemployment	-0.155	0.000	-0.216; -0.094	-0.122	0.002	-0.201; -0.043
	Out of workforce	-0.184	0.000	-0.224; -0.145	-0.083	0.004	-0.140; -0.026
	Employed part-time	0.0233	0.276	-0.0186; 0.065	0.004	0.879	-0.058; 0.068
	Employed full-time (Ref)						

Source: Micro data analysis of GWP, 2017.

### 3.5 Adjusted Mixed Effect Regression (Social Life Index)

Results for adjusted mixed-effect regression analyses between accumulated scores for social life index and water access score by controlling the role of socioeconomic factors in SSA by area of residence are presented in Table 7.

**3.5.1 Rural areas.** Results for the unadjusted analyses showed that for women who have a low social life index, the water score is decreased (-17.75[P= < 0.001]). Similarly, HH income was significantly associated with social life index. The results showed that for women in rural areas with a low level of HH income, their social life index was reported as a low score (-9.519 [P=< 0.0001]). Also, other socio-economic factors such as household size, education and employment level, were also found to be significantly related to the social life index (see Table 8). Moreover, the adjusted model showed that women with a low water access score had a decrease in social life index (-15.93 [P= <0.001]).

**3.5.2 Urban areas.** Findings from the unadjusted model indicated that women with a low water access score had a decreased social life index (-19.44 [P= <0.001]). All socio-economic factors, except HH size, were significantly associated with social life index. Results for the adjusted model maintained that a low water access score was inversely associated with women’s social life index (-17.897 [P= <0.001]).

Table 7. *Adjusted Mixed Effect Regression Analyses Between Accumulated Scores for Social Life Index and Water Access Score by Controlling the Role of Socioeconomic Factors in SSA by Area of Residence: Rural (n=12,242) and Urban (n=5,649)*

		Social Life Index					
		Rural			Urban		
		Estimate	Sig	95% CI (L-H)	Estimate	Sig	95% CI (L-H)
<b>Water access score</b>	0	-15.93	0.00	-18.812; -13.06	-17.897	0.00	-21.341; -14.45
	1	-8.618	0.00	-11.459; -5.777	-9.047	0.00	-12.072; -6.023
	2	-9.301	0.00	-12.140; -6.462	-6.535	0.00	-9.483; -3.588
	3	-0.861	0.55	-3.707; 1.983	-1.828	0.24	-4.876; 1.219
	4 (Ref)						
<b>HH income</b>	0-4,999\$	-7.479	0.00	-9.669; -5.289	-8.371	0.00	-11.520; -5.222
	5,000-9,999	-3.993	0.00	-6.178; -1.808	-7.515	0.00	-10.441; -4.589
	10,000-14,999	-2.689	0.01	-4.890; -0.488	-6.253	0.00	-9.015; -3.490
	15,000-19,999	-0.894	0.43	-3.126; 1.337	-1.990	0.13	-4.605; 0.623
	20,000-and more (Ref)						
<b>Household size</b>	7 and more	1.202	0.22	-0.740; 3.145	2.552	0.07	-0.234; 5.339
	4 to 6	-0.371	0.68	-2.180; 1.437	-0.643	0.61	-3.145; 1.859

**Table 7 continued**

		1 to 3 (Ref)					
<b>Education</b>	Low	-5.244	0.10	-11.535;	-6.917	0.00	-11.814;
			2	1.045		6	-2.020
	Moderate	-1.240	0.69	-7.520;	0.986	0.61	-3.145;
			9	5.0400		4	1.859
	High (Ref)						
<b>Employment</b>	Unemployment	-4.606	0.00	-7.031;	<b>-5.901</b>	0.00	-9.086;
			0	-2.180		0	-2.716
	Out of	-3.306	0.00	-4.863; -	-2.363	0.02	-4.954;
	workforce		0	1.749		5	-0.324
	Employed	1.628	0.05	-0.036;	-0.219	0.86	-2.798;
part-time		5	3.293		8	2.360	
	Employed						
	full-time (Ref)						

Source: Micro data analysis of GWP, 2017.

## 4.0 Discussion

Water is essential for sustaining life; however, insufficient water resource preservation and climate change have had increasingly adverse effects on water availability, resulting in an alarming rate of water scarcity (Mulenga et al., 2017). Globally, one of the regions most affected by this reality is SSA (World Health Organization, 2017). In fact, of respondents from the SSA countries included in this study, more than two-thirds must leave home to collect water. The consequences of poor water access and quality are far reaching and the pathways linking them to health, well-being and other development outcomes are complex (Besada & Werner, 2015; Sorenson et al., 2011). Considering the social determinants of health and the web of factors that influence health, it is important to examine the role of social supports, empowerment, and physical access to resources—like water—for populations, particularly those who are marginalized, such as women and girls, who hold distinct influence on the future of their communities (Ivens, 2008). Although this study does not consider the processes and outcomes of empowerment and social supports, it considers the possible associations with related factors with a focus on water given the centrality of clean water access to global development. This study provides an overview of water access for women in rural and urban regions of SSA, describes associations between water access, women’s empowerment and social support, and examines the relationship between socio-demographic factors, like income, and water access.

### 4.1 Water Access for Women

Water access is limited in SSA countries, as shown by our results indicating that less than 60% of women living in rural and urban regions of SSA report satisfaction with water quality and 45–52% report adequate water for agriculture. More marked is that less than 20% of women in rural areas reported having access to improved water sources through access to piped water, which would improve water sanitation. It is important to note that this measure does not capture improvements made to water sources like hand pumps, which are used more predominantly in rural regions (Ivens,

2008). Further work is needed to consider this important aspect of water access and the context-specific challenges that exist.

Lower household income was found to be associated with lower water quality and overall water access score. This reaffirms the importance of addressing income-related inequality, moving people out of poverty, and ensuring that, at a minimum, everyone's basic needs are met, including the human right to water security. In the same way, the results indicate that improvements in education are related to water access. Income and education can be considered important areas for possible interventions in the future to help improve water access for women and their families in this region.

#### **4.2 Water Access and Empowerment**

In this study, although a validated index to measure empowerment was not used, the applied empowerment score was significantly associated with the water access score in both rural and urban areas. This relationship was further described with individuals with poor water access having a decrease in empowerment score as shown in Table 6.

This work includes survey data about one's freedom to make decisions, respect, and learning opportunities as components of empowerment. Although these measures are limited, freedom to make decisions about one's life—referred to as agency—is a core concept of empowerment (Kabeer, 1999; Richardson, 2018). Having adequate resources is also important, which involves having access to a supportive environment (Richardson, 2018). Living in an environment where one feels respected is essential for empowerment; for women, a supportive environment is one that is gender equal. Richardson refers to empowerment as a process over time where achievements are made to meet one's goals (Richardson, 2018). An aspect of this process involves having opportunities to learn, as defined by the individual, on a regular basis. Therefore, this study included data on learning opportunities as part of the empowerment score. Although the empowerment score does not consider all measures of resources available, types of achievements, nor the subjective aspects of empowerment, we highlight the environment and outcomes for women living in SSA. The time burden associated with fetching water when not available in or near the home has been documented for households in SSA, which prevents participation in other activities, including income-generating and educational activities (Agesa & Agesa, 2019; Allen, Morazan, & Witt, 2018). An essential element of one's empowerment is increased control over their life circumstances (Kabeer, 1999). Individual personal control refers to one's belief regarding the extent that they are able to bring about good events and avoid bad ones (Peterson & Stunkard, 1989). Limitations on participation in activities due to time fetching water and caring for a large household may limit such control and disempower individuals.

In light of the broad definition of empowerment, the similar associations between income, education, and empowerment with water access in this study are justified. As mentioned, educational opportunities and material resources are components of empowerment; therefore, often, women who have access to education and a higher income, are also more empowered (Richardson, 2018). The similar associations of social support could also be justified in this way, as women who have supportive relationships may be more likely to feel respected, thus more empowered. It is important to note that empowerment involves each of these areas; therefore, women who have the greatest combination of these characteristics are the most likely to also be empowered (Kabeer, 1999; Richardson, 2018). For example, women with social

support but low education and income, may still be disempowered or vice versa. Water access interventions must consider the significance of women and girls having access to improvements in each of these areas to optimize the likelihood of empowerment and water access change.

Globally, women and girls have a primary responsibility for management of water supply, sanitation and health (Demie, Bekele, & Seyoum, 2016; Geere & Cortobius, 2017). Women and girls collectively spend 200 million hours each day fetching water. As this burden falls predominantly on their shoulders, they are often targeted as agents of change for solving the global water crisis (Allen et al., 2018). Unequal power and access to choices and resources between genders has highlighted the importance for achieving gender equality and empowering women; however, gender equality and women's empowerment must go beyond material resources, and individual transformation (Cornwall & Rivas, 2015). Addressing structural inequalities will not be possible without addressing the needs of women regarding water, sanitation, and hygiene (UN Water, n.d.). Future research to further examine the complex gender dimensions at play within this context is needed.

### ***4.3 Water Access and Social Life Index***

Results from this study revealed that low social support was associated with poor water access, indicating that social support may be an important, although under recognized, determinant of water access in SSA. There are several potential explanations for this association. Social support, referring to supportive behaviors that help to form relationships with other community members, can be linked to increased collective action, which can build social networks to better address water problems at both macro and micro levels (Heaney & Israel, 2008). The former is particularly powerful when communities with high levels of trust and collective efficacy are able to organize a joint response to local water issues (Bisung, Elliott, Schuster-Wallace, Karanja, & Bernard, 2014). On a micro level, possessing strong social support can help reduce stressors related to safety while fetching water as women can count on each other and go out in groups. Women who must walk long distances for water are at a heightened risk of assault and sexual abuse; however, social support through a sense of solidarity and promoting collective action to walk together can reduce this risk (Baker, Story, Walser-Kuntz, & Zimmerman, 2018). Further, apart from creating a sense of solidarity, having social support in terms of perceived instrumental support, or being able to count on others in times of need, may mean individuals can count on the provision of water from others in times of shortage (Nath, Inoue, & Pretty, 2011).

### ***4.4 Rural and Urban Regions***

Understanding the similarities and differences between water access, empowerment, and social support within different regions of SSA is valuable in targeting initiatives to the unique challenges that these regions face. This work highlights that access to improved piped water in urban regions is much more common and available compared to rural areas. This can have a significant impact on water sanitation within rural regions where hand pumps are more common and present maintenance challenges over time (Ivens, 2008). There is a trend toward a lower water access score as it relates to agriculture—crops—for rural regions, which is concerning given the significant use of agriculture rurally (New Partnership for African Development [NEPAD], 2013; Water Footprint Network, n.d.). It is difficult to



determine if this trend relates to differences in water sources, socio-demographics, and/or increased need for water given high agricultural activities. Further work exploring these nuances may ensure water security for agricultural development in the future. The significant association of household size, education and household income within rural regions with the water access score is valuable to note to emphasize the disparities that exist for those living in rural compared to urban regions. Despite these differences, empowerment and social support remain important factors to explore related to water access for both rural and urban regions.

#### **4.5 Limitations**

There are several limitations that must be considered within this study. The cross-sectional approach used means that no causal inferences can be made and changes over time cannot be assessed. Moreover, the factors explored are bound to the questions available in the GWP. For instance, there is no question regarding the distance needed to fetch water, nor do we know the positionality of the respondent within the household—head or other. What is more, analysis of water access and several of the dependent variables, such as empowerment, are currently constrained by research methods and measurement approaches, therefore, the summed scores may not capture the variables comprehensively. For example, to date, no gold standard for comprehensively measuring water access or water security exists. Nevertheless, significant improvements in this direction have been achieved through the Household Water Insecurity Experience Scale project which spans across 24 low- and middle-income countries in four continents (Young et al., 2019).

In addition, although the reliability tests were significant for the empowerment, social support, and water access scores, it is unclear how well these measures capture these areas of interest. Empowerment is complexly defined, and this work does not consider the subjective, situational, and qualitative aspects of empowerment. More research is needed to define and explore appropriate measurement tools of these complex concepts more adequately. Another important limitation to note is that this work pooled data from 35 countries in SSA; there are unique challenges that these countries face, and these differences are not described here.

#### **5.0 Conclusion**

There is a critical need to address the lack of adequate water access in SSA, which will continue to become more imperative as the effects of climate change and population growth become more pervasive. This cross-sectional analysis of water access and various socio-ecological factors confirms that water access is related to various aspects of one's life, beyond those commonly presented in the literature. Empowerment, social support, education, and income are all significantly associated with water access, indicating that water access concerns are part of a highly complex system that warrants further investigation. The overlap and relationships between women's empowerment and social support with the water access score is of particular interest given the limited literature with these factors as determinants of water security. Further work to explore the role of community and female capacity strengthening as a means to empower women and enhance social supports as it relates to water resources is needed. This study was unable to assess political, macro-economic and institutional factors; however, these can and often do, lead to water deprivation, even in areas where resources are generally plentiful, and should be considered in future investigations (Rutten, n.d.). This work highlights that the

current Sustainable Development Goals for 2030 are interrelated and that dynamic multidimensional interventions, innovations and policies are required for sustainable change.

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