The Relationship between Quality Water Supply and Ghanaians' Health Improvement: The Role of Governance Effectiveness

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Abstract
this present study's objective was to assess governances' role in quality water supply and its impact on Ghana's health improvement. To that, data spanning from 1996 to 2018 was utilized in time series. However, time-series methodologies such as unit root test, cointegration test, correlation matrix, ARDL regression, and Granger causality test were performed to arrive at the study's findings. The study found that governances' role in the supply of quality water to rural communities and the entire country positively improve the health status of the people. In that, increasing the effort churned out by regulatory organizations and the government's effectiveness; thus, governance quality improves people's health conditions, thereby increasing their life expectancy at birth. In essence, the study found that governance quality and health improvement are bidirectional in terms of causality. The study recommends that all governances be brought on deck to support the function to provide safe and quality water supply to the rural population and the entire country.

Keywords: *Household quality water supply; Health improvement; Life expectancy at birth; Governance's perspective; Governance quality*

1. Introduction

In poverty-stricken countries, achieving the target of adequate water supply will involve the rise in water supply availability for domestic purposes, bringing about change in water-use, improving water quality, and water management culture. However, there is the availability of adequate water supply for domestic purposes in advanced countries. However, their seeming responsibility is to ensure the water supply's sustainability per people's demands at the burgeoning pressures of pollution (Hunter et al., 2010). For some years now, about a billion of the world's population in developing countries cannot access safe, quality, and sustainable water supply. A reliable, safe, easily accessible, and affordable water supply is essential for the quality of life or good health. In essence, the proposed amount of water needed each per person day is 7.5 litres for drinking and 50 litres for all consumptions such as personal hygiene, food hygiene and preparation, laundry needs, and domestic cleaning (Howard & Bartram, 2003). Moreover, the demands of ecosystems and agriculture have suppressed domestic water consumption not only in developing countries but also in developed countries as per capita domestic consumption hugely surpass these values (Data 360, 2010). Many experts believe that the amount of water needed by each person is supposed to 1,000 cubic meters of quality and freshwater per capita per annum (Rijsberman, 2006). Relatively, it is easier to widen the coverage of water supply by constructing more water systems. However, it is cumbersome to ensure the sustainability of such systems over a longer period. However, it requires governances' conscious effort to ensure the sustainability of the water systems. Water makes up about 70% of the earth's surface and is one of the most important sources vital to sustaining life. Rapid urbanization and industrialization have led to a deterioration of quality water supply at an alarming rate, resulting in severe diseases. As reported, in developing countries, 80% of the diseases are waterborne diseases, which have led to 5 million deaths and 2.5 billion illnesses. The most common of these diseases in Ghana are diarrhea, typhoid, gastroenteritis, cryptosporidium infections, some forms of hepatitis, and giardiasis intestinal worms. In Ghana, waterborne diseases cause a GDP loss of 0.6–1.44% every year. This makes it a pressing problem, particularly in a developing country like Pakistan (Ahmed, et al., 2019). In low-income countries, numerous studies have linked health and cost benefits that are associated with good drinking water supply; these studies focused on the improvement of quality water supply and its impact on the incidence of acute infectious diarrhea (Clasen et al., 2007; Haller et al., 2007; Hutton & Bartram, 2008). Diarrhea is the second most common disease in developing countries, and poor-quality water supply is a pertinent risk factor Pruss & Havelaar, 2001; Fewtrell et al., 2005; Shizhu et al., 2019).

Since the early 1980s, Esrey et al. (1991) ' scholarly work have paved the way for numerous arguments concerning water quality and quantity in eradicating diarrhea incidence. Esrey and other scholars' arguments have brought about the importance of water supply interventions, specifically point-of-use household water treatment technologies. Consequently, other arguments emerged. Their view is that occasional short-term shortages in water supply and treatment could significantly challenge numerous public health benefits concerning water supply improvements (Hunter et al., 2009). These scholars' argument does not neglect the efforts of improved water supply through household or community water supply and treatment technologies. Moreover, it highlights the essence of developing systems that could supply water in the long term period. Quality water supply is a critical consideration in domestic, agricultural, and industrial water supply, sherries, and aquaculture production, aquatic recreation, and ecosystems' health. Professionals in many disciplines should understand the factors controlling concentrations of quality water supply variables and the effects of quality water supply on ecosystems and humans. The efficient management of water resources requires knowledge about quality water supply (Claude, 2019).

Helping people gain access to the quality water supply is one of the most important health-related infrastructure programs globally. Pathogenic microorganisms in drinking water, the leading cause of diarrhea, have drawn much attention in public health and other related fields. Also, chemical impurities are growing threats in many developing countries, especially in ones experiencing rapid industrialization. Many governments and international organizations have launched water-related programs and interventions all over the world as an effective way to improve people's health and welfare (Zhang, 2011). Quality water supply is required to maintain a clean environment, good health, and a healthy nation at large. However, limited access to quality water supply and water management practices can promote the spread of waterborne diseases, which causes 6.3% of the deaths recorded around the world (WHO/UNICEF, 2015). The world has been warned of possible water crisis by 2050, if the trend in water supply continues in that pace. Furthermore, the estimate is that, water demand globally will exceed supply by over forty percent (40%), and this estimate could put about 45% of global GDP at risk, 40% of gain production at risk, and 52% of global population at risk (WEF, 2015; WWDR, 2016).

Ghana faces an encounter in accessing quality water resulting in 70% of diseases. Subsequently, those in low-income groups are the most affected (AfDB/OECD, 2007; Boateng & Adams, 2013). Most households store and transport water in their houses because they do not have piped water linked to their buildings. Under these conditions, water may become polluted when consumed (UNICEF, 2015). However, households are obliged to use this unhygienic and less dependable water, leading to waterborne diseases and paying more for dangerous water than the rich do for clean water (AfDB/OECD, 2007). Water quality testing is, in this way, essential within households in rural areas (WHO and UNICEF, 2015), specifically when availability, access, and quantity remains a foremost challenge. When the quality water supply is meritoriously safeguarded, organized, water quality can be guaranteed and controlled. Also, it encompasses looking for important contamination points where uniformity can be exposed. Predominantly in rural areas, it is against this background that water quality assessment and constant monitoring have to be carried out to ensure that people obtain safe, ideal, and good water supply (UNICEF, 2015).

In the case of quality water supply, the ultimate rationale for effective government's coordination is sustained improvements in the local citizens' health status. The original purpose of the large-scale investment in the water supply and utilization of potable water was to reduce water-related diseases among the local population. The governances in the water sector emerged from a participatory process of planning and implementing these investments. Governance coordination is essential in order to sustain these investments by ensuring that water supply facilities are managed and maintained effectively, that the water they produce is safe at all times, that arrangements for replacing or expanding the water schemes are functioning, and that the citizens for whose benefit the schemes were established are actively and substantively involved in key decisions relating to the water systems (Jackson & Gariba, 2002). Based on this assumption, this study intends to assess the role that governances play in ensuring quality water supply to households for health improvement. Specifically, the government's effectiveness and regulatory quality in policy formulation and implementation for providing sustainable water to rural communities in Ghana.

To the best of our knowledge, no study has employed econometric techniques to investigate the nexus between quality of water supply and health improvement with the moderating effect of governance quality in the Ghanaian context. Therefore, this present study exhibits a new paradigm of study in that context. Moreover, it offers an insight into policy direction for quality water supply which literally support basic needs to improve wellbeing of people.

The study comprises part one, thus, introduction, part two; methodology and data, part three; results and discussion, part four thus, the study's conclusion.

1.1 The concept of governance quality, quality water supply and health improvement

Admittedly, much interest has engulfed the water governance or accountability. The reason emanates from the benefits and the practice. More importantly, governance quality regarding water supply encompasses the quantification of water resources and the consumption of water same as the financial accounting which provides in-depth information on income and expenditure. Specifically, water governance stems from the fact that "we cannot plan and manage what we do not measure" (FAO, 2018). Understanding quality governance of water supply comprises assessing spatial and seasonal variations in rainfall, the hydro-logical cycle with uncertainty of extreme droughts and floods. Undoubtedly, the account of long-term and medium-term variations in demand among all water consumers such as farmers, communities, energy sector, the environment and industry should inform decisions in water infrastructure investment. Water infrastructural investments such as storage, pumping, and planning for climate change. Moreover, the communities or societies or governances need information nonetheless more answers to some pertinent questions regarding water demand and supply (FAO, 2018). The fundamental basis of good governance in water supply is to provide reliable data and, sound and effective policies (World Bank, 2006).

In low-income countries, governance quality is often regarded as poor due to governance weaknesses, and lack of capacity to man institutions (World Bank, 2005). Nonetheless, the factors that result to governance weakness could be attributed to understaffing, lack of professional skills, inadequate resources, poor motivation, and poor organisational management. Specifically, these are as a result of ineffective and inappropriate policies formulated and implemented from central authorities to local authorities. Moreover, the rampant of corrupt practices distort effective and efficient service delivery (Stockholm International Water Institute, 2005). In the context of water supply, lax in policy implementation from the authorities charged with that mandate exacerbate the inadequate political will from the highest order and the lousy performance of private firms or individuals in executing contracts awarded to them to provide services in water supply. That notwithstanding, staff of authorities mandated to execute the provision of water supply are crippled with constraints associated with their roles.

Empirically, some studies claim that the relationship between quality water supply and health improvement are proportionally related. Hence, increasing access to quality drinking water could lead to the decrease in diarrhoeal disease risks (Esrey et al., 1991). Hunter et al. (2009) understands that occasional short-term shortages in water supply and failures in water treatment tremendously weaken public health. In line with this, Guerrant et al. (2002) contend that there is strong connection between malnutrition, poor educational and physical growth, and diarrhoeal disease in children which literally suppresses their potentials. To be more specific, the impact of poor quality water supply or inadequate water supply inversely relate to the wellbeing of people, often those living in developing countries (Grey & Sadoff, 2007). Apparently, some scholars pinpointed that investment in quality water supply consistently is associated with increase in food production, and the reduction in infectious diseases. The investment in quality water supply should encompass low-cost water irrigation systems, water harvesting technologies, and the production of clean water for domestic use (Sanchez & Swaminathan, 2005; Rosegrant & Meijer, 2002).

Conventionally, massive investments are required in the supply and provision of quality water. According to Hutton and Varughese (2016), approximately US$114 billion is needed annually to achieve the SDGs 6.1 and 6.2. Evidently, corruption has been fingered as an impediment to achieve this stride. Corruption ruthlessly undermines governments' effectiveness in public service delivery (Water Integrity Network, 2016). Most governments' ineffectiveness in curbing corrupt practices have endangering health outcomes, deplorable short-term effects, people's livelihoods and food security literally causing environmental unsustainability, economic underdevelopment, and socio-political instability. On the verge of corrupt practices, water supply and management aspects are affected by cost inflation of drinking water, disruptions in reliable water supply, and large-scale of water pollution. Consequently, these issues affect the quality of lives of citizens (Transparency International, 2008). With reference to the 2013 Delft Statement on Water Integrity, governance ineffectiveness or failure is the major cause of water crises but not scarcity of water (Water Integrity Network, 2016).

3. Methodology and Data

3.1 Methodology

To achieve the study's objective of assessing the impact of governances and quality water supply on health improvement, the study employed some econometric techniques to that effect. The techniques employed are unit root test, cointegration test, correlation matrix, ARDL regression method, and Granger causality test.

Firstly, a unit root test is performed to check for the order of stationarity among the variables. The unit root test assumes that there is evidence of unit root in the variables; hence, they are not stationary, thus the null hypothesis. However, the alternate hypothesis stipulates that there is no unit root in the variables or data series; hence the variables are stationary. The expectation is that evidence of no unit root is to be accepted at a 5% significance level or less vice versa. In this regard, Levin, Lin & Chu (2000) test, Im, Shim & Pesaran (2003) test, and Maddala & Wu (1999) tests were used. Upon confirmation of the variables' stationarity, the next step is to ascertain the cointegration relationship between the dependent and the independent variables. The cointegration test assumes a long-run relationship between the dependent and the independent variables; hence at a 5% significance level or less, the null hypothesis of the cointegration test should be rejected.

The third step to ensure the statistical significance of the study's findings is to check for multicollinearity in the model, thus ensuring no two independent variables are highly correlated with the dependent variable. According to Sun et al. (2002), no two independent variables should have correlation coefficients of -/+0.70 with the dependent variable. If it happens so, then there is evidence of multicollinearity; therefore, there would be a problem of endogeneity in the model.

Subsequently, the study's model's estimation becomes necessary after all the appropriate diagnostic tests have been proven fitness. At this juncture, the study utilizes the ARDL regression method to estimate the variables' coefficients to ascertain the impact of the independent variables on the dependent variables. The proposed model for the ARDL in this study can be found below:

$$Health\ improvement = f(Governance\ quality, Quality\ water\ supply)$$

After taking the natural logarithm of the variables, the equation can be found as:

$$HIM_t = \alpha_1 + \sum_1^p \beta_1 HIM_{t-i} + \sum_1^p \beta_2 \begin{Bmatrix} QWTP \\ QWRP \end{Bmatrix}_{t-i} + \varepsilon_t$$

$$HIM_t = \alpha_1 + \sum_1^p \beta_1 HIM_{t-i} + \sum_1^p \beta_2 GQ_{t-i} + \sum_1^p \beta_3 \begin{Bmatrix} QWTP \\ QWRP \end{Bmatrix}_{t-i} + \varepsilon_t$$

$$HIM_t = \alpha_1 + \sum_1^p \beta_1 HIM_{t-i} + \sum_1^p \beta_2 GQ_{t-i} + \sum_1^p \beta_3 \begin{Bmatrix} QWTP \\ QWRP \end{Bmatrix}_{t-i} + \sum_1^p \beta_4 GQ * \begin{Bmatrix} QWTP \\ QWRP \end{Bmatrix}_{t-i} + \varepsilon_t$$

In the equation, HIM represents the dependent variable, thus health improvement, GQ represents the governance quality; thus, government's effectiveness, QWTP, and QWRP represent quality water supply to the entire country and rural communities, respectively. However, t represents the period of 1996 to 2018, ε represents the error term, α_1 represents the coefficient of the intercept, β_1 $to\beta_3$ represent the coefficients of the independent variables, and p represent the optimal lag length to be estimated.

3.2 Data

This study used data spanning from 1996 to 2018 in time series. The study's dependent variable is health improvement, and independent variables are governances' perspectives in managing and ensuring safe water supply and quality water supply and household quality water supply. These variables are measured by proxies that can be found in table 1 below. Also, the source of data can be found in table 1.

Table 1 Variables description and measurements

Indicators	Variable description	Measurement	Source
QWPT	People using safely managed drinking water services (% of population)	Household Quality water supply	World Development Indicators, World Bank
QWPr	People using safely managed drinking water services, rural (% of rural population)	Rural household Quality water supply	World Development Indicators, World Bank
HIM	Life expectancy at birth, total (years)	Health Improvement	World Development Indicators, World Bank
GE	Governance effectiveness : Corruption control, political stability and absence of terrorism, regulatory quality, rule of law, voice and accountability and government effectiveness: Measures on scores of +2.5 thus strong, -2.5 thus weak	Governance Effectiveness	Worldwide Governance Indicators, World Bank

4. Results and discussion

4.1 Summary statistics

Table 2 displays the summary statistics of the variables used in the study. The average health improvement (life expectancy at birth) for the sample period was 4.091 years annually from the table. Moreover, the supply of safe drinking water to the entire population grew at an average 3.040% per annum. The supply to the rural population grew at an average rate of 0.772% per annum. To understand the role that governances play in managing the entire country to ensure effectiveness and efficiency of the country's resources, it can be reported governances' role deteriorated at an average score of -0.025 per annum. The standard deviation of the variables confirms that they are homogenously related, and also, the variables are normally distributed. The normal distribution assertion can be confirmed from the Jarque-Bera test and its probabilities. Figure 1 depicts the scattered plot of relationship between health improvement and, quality water supply and governance quality. From the figure, positive correlation can be identified among the variables. This outlines a strong positive relationship between quality water supply, governance quality and health improvement.

Table 2 Summary statistics

	HIM	GQ	QWRP	QWTP	GQ*QWTP	GQ*QWRP
Mean	4.091	-0.025	0.772	3.040	-0.044	0.122
Median	4.090	-0.012	1.352	3.049	-0.040	0.131
Maximum	4.155	0.116	2.438	3.595	0.382	0.374
Minimum	4.043	-0.246	-1.520	2.573	-0.634	-0.087
Std. Dev.	0.040	0.119	1.545	0.379	0.335	0.132
Skewness	0.164	-0.607	-0.574	0.050	-0.459	0.367
Kurtosis	1.537	2.044	1.720	1.528	1.863	2.381
Jarque-Bera	2.155	2.290	2.834	2.085	2.048	0.885
Probability	0.340	0.318	0.242	0.353	0.359	0.642
Observations	23	23	23	23	23	23

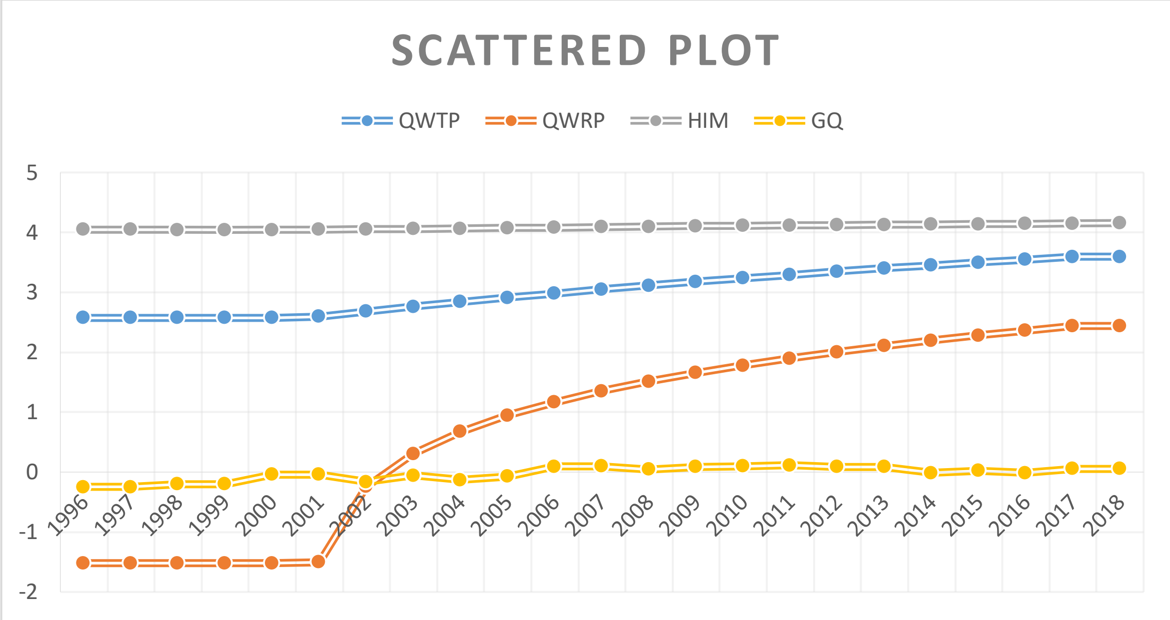

Figure 1 scattered plot depicting relationship between health improvement and other variables

3.2 Unit root test

Table 3 presents the unit root test results. According to the results, there is no evidence of unit root among the variables. All the four tests performed to confirm that at both level form and first difference, none of the variables have unit root; hence they are stationary. Therefore, the null hypothesis of unit root is rejected 5% and 1% significance level respectively.

Table 3 Unit root test

Group unit root test: Summary			
Method	Statistic	Prob.**	Significance
Level form			
Levin, Lin & Chu t*	-2.372	0.009	**
Im, Pesaran and Shin W-stat	-0.779	0.218	
ADF - Fisher Chi-square	9.411	0.309	
PP - Fisher Chi-square	3.326	0.912	
First Difference			
Levin, Lin & Chu t*	-0.174	0.431	
Im, Pesaran and Shin W-stat	-3.928	0.000	***
ADF - Fisher Chi-square	31.230	0.000	***
PP - Fisher Chi-square	30.631	0.000	***

Note: *** indicates 1% significance level, ** indicates 5% significance level

4.3 Cointegration test

Table 4 exhibits the results of the study's cointegration test. From the table, both the unrestricted cointegration rank tests for Trace and Maximum Eigenvalue confirm the cointegration relationship between the dependent and the independent variables. However, at none to At most 3 of the trace test, the variables are cointegrated at 1% and 5% significance level. Also, at none to at most 1 of the Max-Eigen test, the variables are cointegrated at a 1% significance level but not at most 2. Nevertheless, at most 3, the variables are cointegrated at 5% significance. These findings substantiate the fact that there is a long-run relationship between the dependent and the independent variables; hence the regression estimates can be inferred as the long-run relationship or impact.

Table 4 Cointegration test

Unrestricted Cointegration Rank Test (Trace)					
Hypothesized		Trace	0.05		
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**	Sig.
None *	0.990	160.817	47.856	0.000	***
At most 1 *	0.885	64.588	29.797	0.000	***
At most 2 *	0.426	19.202	15.495	0.013	**
At most 3 *	0.302	7.551	3.841	0.006	**
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)					
Hypothesized		Max-Eigen	0.050		
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**	Sig.
None *	0.990	96.229	27.584	0.000	***
At most 1 *	0.885	45.386	21.132	0.000	***
At most 2	0.426	11.651	14.265	0.124	
At most 3 *	0.302	7.551	3.841	0.006	**

Note: *** indicates 1% significance level, ** indicates 5% significance level

4.4 Correlation matrix

The computation of the correlation matrix is essential to unravel the independent variables' collinearity status with the dependent variables. However, the assumption is that no two independent variables should have correlation coefficients of -/+0.70 with the dependent variable. Evidence from Table 5 suggests that there is multicollinearity among the variables. Moreover, all the independent variables are positively correlated with the dependent variable at a 1% significance level.

Table 5 Correlation matrix

Correlation Probability	HIM	QWRP	QWTP	GQ_QWTP	GQ_QWRP	GQ
HIM	1					
QWRP	0.431***	1				
QWTP	0.498***	0.542***	1			
GQ_QWTP	0.522***	0.791***	0.741***	1		
GQ_QWRP	-0.213	-0.398*	-0.268	-0.222	1	
GQ	0.320***	0.600***	0.742***	0.998***	-0.285	1

Note: *** indicates 1% significance level, * indicates 10% significance level

4.5 Results from ARDL regression method

Table 6 presents the estimation results from the ARDL regression. From the table, all indications confirm that governances' perspective and quality water supply could positively improve the health of the rural and entire population of the country. To stress on the findings, at lag (-1), an improvement in governance quality, thus governances' perspective in providing resources to ensure safe and quality water supply could significantly improve the health of the people living in rural communities. However, a percentage point increase in governance quality score could increase the life expectancy at birth by 0.007 years. Also, a percentage point improvement in the score of governance quality could increase life expectancy at birth by 0.006 years, thus improving health. In the model where governance quality intercept with quality of water supply, the results depict that improvement in governance quality could lead to 0.005 and 0.031 years of life expectancy considering safe and clean water supplied to the rural and entire population, respectively. However, the intercept of governance quality with quality water supplied to the rural population inversely relate to their health improvement. Hence, the ineffectiveness of governance in terms of policies formulation and implementation garnered towards the provision of quality water could negatively affect health improvement of the rural population and the entire population significantly.

Moreover, the supply of quality water, thus safely drinking water-could, improves rural communities' health between 0.002 and 0.005 years in their life-expectancy years. On the other hand, the supply of quality water, thus safely drinking water, could improve the health of the entire population between 0.041 and 0.057 years in the country's life-expectancy years as a whole. The model diagnostic tests confirm the goodness of the model; hence the results produced are statistically reliable and suitable for inference. More specifically, the Ramsey reset test confirms that there is stability in the models at a 5% significance levels, respectively. Also, the LM and heteroskedascity tests confirm no problem of statistical issues with the models because both tests showed p-value more than 5%.

Dependent Variable = HIM						
HIM(-1)	0.876	0.489	0.879	0.526	0.909	0.616
	(61.841)***	(14.075)***	(67.577)***	(16.054)***	(133.170)***	(13.847)***
GQ			0.007	0.006	0.005	0.031
			(2.215)**	(2.774)**	(3.337)**	(1.269)**
GQ(-1)					0.006	0.054
					(3.716)**	(2.140)**
QWRP	0.005		0.004		0.002	
	(12.600)***		(10.600)***		(4.816)***	
QWRP(-1)					0.001	
					(1.888)*	
QWTP		0.057		0.052		0.041
		(15.951)***		(14.386)***		(8.374)***
GQ*QWRP					-0.004	
					(-4.024)***	
GQ*QWRP(-1)					-0.006	
					(-5.902)***	
GQ*QWTP						-0.009
						(-1.086)
GQ*QWTP(-1)						-0.017
						(-2.016)*
C	0.509	1.921	0.498	1.783	0.375	1.448
	(8.801)***	(14.640)***	(9.417)***	(14.473)***	(13.511)***	(8.687)***
R-squared	0.999	0.999	0.999	0.999	0.999	0.999
Adjusted R-squared	0.999	0.999	0.999	0.999	0.999	0.999
F-statistic	14252.370***	21944.15***	11463.83***	19786.73***	36542.88***	12641.41***
LM Test:	4.532	3.581	0.828	3.581	0.752	0.526
Prob. F(2,16)	0.231	0.06	0.455	0.06	0.365	0.123
Heteroskedasticity Test:	3.235	2.371	1.765	2.371	2.659	1.983
Prob. F(3,18)	0.297	0.105	0.190	0.105	0.152	0.083
Ramsey RESET Test	2.365	8.209	0.064	8.209	0.124	0.965
Prob.	0.003	0.011	0.004	0.011	0.003	0.002

Table 6 Results from ARDL regression estimates

Note: *** indicates 1% significance level, ** indicates 5% significance level

4.6 Granger causality test

The test for granger causality reveals the direction causality or linkage of causal relationships among the variables. Usually, two directions are expected in the granger causality test, thus bidirectional or unidirectional. Bidirectional causality implies that both variables in the test are causality related; hence a variation in each other affects one another. In contrast, unidirectional causality implies that only one variable causes the other but not vice versa.

Table 7 presents the Granger causality test results. The table shows that health improvement (life expectancy at birth, HIM) and water quality supplied to the rural population (QWRP) have bidirectional causality as well as clean water supplied to the rural population (QWRP) and the entire population (QWTP). In an account of unidirectional causality, the study realized that the health improvement (HIM) granger causes the quality of water supplied to the total population (QWTP); governance quality (GQ) granger causes the quality of water supplied to the rural population (QWRP). Also, governance quality (GQ) granger causes water supply quality to the entire population (QWTP). More importantly, the study found that governance quality intercept of quality water supply to the rural population (GQ*QWRP) granger causes health improvement (HIM). Also, governance quality intercept of quality of water supplied to the rural population (GQ*QWRP) granger causes quality of water supplied to the rural population (QWRP), and governance quality intercept of quality water supplied to the entire population (GQ*QWTP) granger causes quality of water supplied to the entire population (QWTP).

The findings from the Granger causality robustly support the regression analysis performed with the ARDL regression method. It substantiates the findings that governance quality and quality water supply positively influence health improvement. However, to ensure a safe and quality water supply that could improve the health of the rural population and the entire population, the government ought to improve its effectiveness in formulating and implementing policies that could improve water supply and ensure health improvement.

Table 7 Granger causality test

Pairwise Granger Causality Tests

Null Hypothesis:	Obs	F-Statistic	Prob.	Sig.
QWRP does not Granger Cause HIM	21	4.430	0.029	**
HIM does not Granger Cause QWRP		10.818	0.001	***
QWTP does not Granger Cause HIM	21	2.134	0.151	
HIM does not Granger Cause QWTP		2.824	0.089	*
GQ*QWTP does not Granger Cause HIM	21	0.264	0.771	
HIM does not Granger Cause GQ*QWTP		1.581	0.236	
GQ*QWRP does not Granger Cause HIM	21	7.439	0.005	**
HIM does not Granger Cause GQ*QWRP		0.327	0.726	
GQ does not Granger Cause HIM	21	0.163	0.851	
HIM does not Granger Cause GQ		1.677	0.218	
QWTP does not Granger Cause QWRP	21	27.882	0.000	***
QWRP does not Granger Cause QWTP		4.646	0.026	**
GQ*QWTP does not Granger Cause QWRP	21	2.213	0.142	
QWRP does not Granger Cause GQ*QWTP		1.449	0.264	
GQ*QWRP does not Granger Cause QWRP	21	3.178	0.069	*
QWRP does not Granger Cause GQ*QWRP		0.853	0.445	
GQ does not Granger Cause QWRP	21	3.023	0.077	*
QWRP does not Granger Cause GQ		1.452	0.263	
GQ*QWTP does not Granger Cause QWTP	21	3.380	0.060	*
QWTP does not Granger Cause GQ*QWTP		0.941	0.411	

GQ*QWRP does not Granger Cause QWTP	21	1.363	0.284	
QWTP does not Granger Cause GQ*QWRP		0.353	0.708	
GQ does not Granger Cause QWTP	21	3.991	0.039	**
QWTP does not Granger Cause GQ		0.951	0.407	
GQ*QWRP does not Granger Cause GQ*QWTP	21	0.440	0.651	
GQ*QWTP does not Granger Cause GQ*QWRP		0.129	0.880	
GQ does not Granger Cause GQ*QWTP	21	0.407	0.672	
GQ*QWTP does not Granger Cause GQ		0.358	0.705	
GQ does not Granger Cause GQ*QWRP	21	0.151	0.861	
GQ*QWRP does not Granger Cause GQ		0.418	0.666	

Note: *** indicates 1% significance level, ** indicates 5% significance level, * indicates 10% significance level

5. Results and Discussion

The findings confirm that governance quality and safe water supply to the entire population, and basically, the rural population is positively associated with health improvement, thereby increasing their life expectancy. Providing good and quality water to the population could significantly promote good and healthy living (Hunter et al., 2010). However, it behoves on the government to ensure effective initiatives and policies to provide incentives to other governances in providing safe and quality water. The ineffectiveness of institutions or governances responsible for providing quality and safe water is usually considered feeble in financial and managerial aspects for maintenance and operation. Also, there is a disconnection between the water environments, technology, and users' capability to maintaining the systems developed. Due to this, most rural and urban areas do not enjoy a safe and quality water supply, which deteriorates their health.

Governances' role in providing quality water for the population is considered significant. Hence, the government's effectiveness ensures some critical institution's independence, and inadequate public provision significantly improve many lives. In low-income countries, governments lag in terms of governance weakness (World Bank, 2005; Vitenu-Sackey & Alhassan, 2019). This deficiency varies from low motivation, lack of individual professional skills, poor organizational management, inadequate resources, and inappropriate handling of policies from the central authorities down to the local authorities. More importantly, corruption is a significant threat to delivering services in the private and public sectors (Stockholm International Water Institute, 2005; Vitenu-Sackey & Alhassan, 2019). To ensure quality and safe water supply, all governances ought to play their role effectively and persistently evaluate all initiatives initiated timely.

6. Conclusion and Policy Implication

This present study's objective was to assess governances' role in quality water supply and its impact on Ghana's health improvement. Concerning that, data spanning from 1996 to 2018 was utilized in time series. However, time-series methodologies such as unit root test, cointegration test, correlation matrix, ARDL regression, and Granger causality test were performed to arrive at the study's findings.

The study found that governance quality in the supply of quality water to rural communities and the entire country positively improve people's health status. In that, increasing the effort churned out by regulatory organizations and the government's effectiveness; thus, governance quality improves people's health conditions, thereby increasing their life expectancy at birth. In essence, the study found that governance quality and health improvement are bidirectional in terms of causality. It implies that the deterioration of governance quality translates into the deterioration of the health of the people. Therefore, to achieve a safe and quality water supply that significantly improves the people's well-being or health status, the government should formulate and implement sound policies garnered towards quality water supply. Consequently, improvements in numerous aspects of water supply epitomize significant prospects to improve public health (Hunter et al., 2010). Moreover, institutions in charge of regulating water supply should be independent of the government to eschew political interference and corruption, significant threats to the discharge of proper measures to ensure quality water supply.

Policy implication: The study found that there is a bidirectional causality between health improvement and quality of water supply to the entire population and rural population. Also, governance quality intercepts with quality of water supplied to the entire population and the rural population to be precise. Therefore, policymakers should direct policies which could ensure constant supply and, provision of quality and clean water. Moreover, ineffective policies would result in deterioration of health improvement perhaps instituting measures that could minimise inefficiency and strengthen governance. Such as corruption control, strengthening regulations and, providing logistics and finances, and recruiting competent and technical personnel to man the institutions mandated to act in that capacity. The study recommends that all stakeholders be brought on deck to support the function to provide safe and quality water supply to the rural population and the entire country.

Limitation to the study: The study acknowledge possible limitations that could originate from uncertainty and factors surrounding quality water provision such as stakeholders' perspective.

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