Mortality and Economic Consequences of Handwashing

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Abstract

Handwashing has increasingly become important in this COVID-19 pandemic. This study aims to examine the consequences of handwashing on mortality and economy. Data from the World Development Indicators of the World Bank were used in the study for 82 countries in the world during 2009–2017. The dependent variables were GDP per capita and adult mortality rate. The main independent variable was the percentage of population with basic handwashing facilities including soap and water. The control variables included the percentage of population using at least basic drinking water services, the percentage of population using at least basic sanitation services, and HIV incidence. The data was analyzed using a structural regression model. The results of the study show that the adult mortality rate was negatively associated with the percentage of population with basic handwashing facilities including soap and water, even after controlling for other factors. The percentage of population using at least basic drinking water services, the percentage of population using at least basic sanitation services, and HIV incidence also had significant association with adult mortality. GDP per capita was negatively associated with the adult mortality rate.

Keywords
Handwashing, Adult mortality rate, GDP per capita, Control variables, Structural regression model.

1. Introduction

The total number of Corona virus disease (COVID-19) cases and deaths has increased, respectively, more than five times and almost three times since May 1, 2020. Lack of obedience to the new normal health protocol is among the causes of this significant increase of COVID-19 cases and deaths, including cleaning hands frequently.

WHO (2020) reported that in 2016, poor sanitation and hygiene was the cause of 829,000 deaths yearly due to diarrhea and 1.9% of global burden of disease. On the other hand, in 2017, 90% (6.8 billion people) of the world population using at least basic drinking water service, an increase from 82% (five billion) in the year of 2000 (UNICEF and WHO 2019). The provision of safe water, sanitation, and hygiene (WASH) is important in protecting human health from all infectious disease pandemic, including COVID-19 (WHO 2019a; WHO and UNICEF 2020, Hashi et al. 2017, Rochelle & Julien 2013).

Mortality its directly determined by its proximate determinants including environmental contamination and infection (Mosley and Chen 2003). As a consequence, mortality affects economic development through shortening the productive years and hence reducing productivity (Lorentzen et al. 2008).

Adult mortality rate varied across countries in the world. United Nations (2017) reported that during 1990–2015, adult mortality rate declined around 23% in Africa, 30% in Asia, and 33% on Latin America and the Carribean. What are the factors of this variation? How is the association between environmental contamination and infection and adult mortality? What is the consequence of adult mortality on economic growth?

This study generally aims to investigate the effects of handwashing on adult mortality rate and economic growth. Specifically, the objectives of the study are to examine the association between handwashing on mortality after controlling for the effects of drinking water, sanitation, and HIV incidence and to investigate the effects of mortality on economic growth.

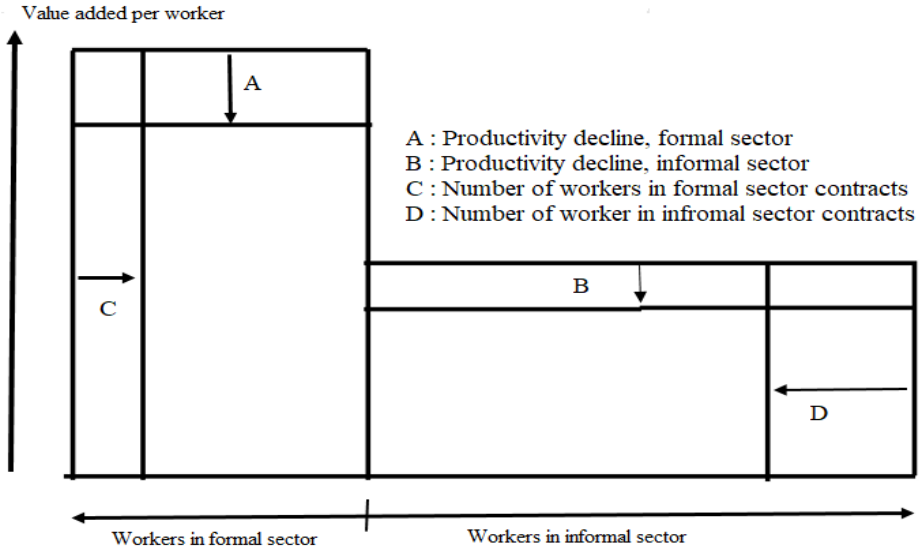
2. Literature Review

The relationship between the socioeconomic and medical determinants and mortality has been studied (Mosley & Chen 2003; Cutler et al. 2006; Belon et al. 2012; Santy & Samosir 2019). Specifically, adult mortality is influenced by various factors, including HIV incidence (Sahn 2018; WHO 2019b) and basic drinking water services, basic sanitation services, and basic handwashing facilities (Curtis and Cairncross 2003; Prüss-Üstün et al. 2016; World Health Organization 2019a).

Curtis and Cairncross (2003) carried out a study on the impact of washing hands with soap on the risk of diarrhea in a community using a random-effects meta-analysis. They found that, using global data, the risk of diarrhea could be reduced by 47%. The potential number of deaths due to diarrhea can be avoided by one million by handwashing. Another study by WHO (2001) estimated that washing hands with soap and water could decrease the number of deaths due to diarrhea by around 35% in Burkina Faso.

Meanwhile, Campbell et al. (2015) developed a conceptual framework of the association between water, sanitation, and hygiene (WASH) and maternal and perinatal health. In the framework it was described about the chemical and biological risk relationships between WASH and maternal and perinatal health through two mechanisms: "in-water association" and "behavior association." "In-water association" includes nonorganic contaminants, water-system related infections, water-based infections, and water borne infections. "Behavior associations consist of behaviors leading to water-washed infections, water-related insect-vector infections, and behaviors leading to non-infectious diseases/conditions. WASH influences maternal and perinatal health outcomes that can be considered in global and national development strategies.

Infectious disease is one of the main causes of death and morbidity in particular in hospital (Joynt and Gomersall 2013). Specifically, human immunodeficiency virus/acquired immune deficiency syndrome (HIV/AIDS) is a determinant of adult mortality in South Africa (Sartorius et al. 2013). HIV/AIDS also has a negative effect on economic growth. As can be seen from Figure 1, HIV/AIDS influences valued added per economic sector, formal and informal. HIV/AIDS causes productivity decline on both sectors. HIV/AIDS also causes a decline in the quantity of workers in both sectors. If value added and number of workers in macroeconomic decline, both in formal and informal sectors, then economic growth will decline.



Source: Sahn (2018).

Figure 1 HIV/AIDS: Productivity losses, Sectoral shift, and GDP per Capita

HIV/AIDS is one of main causes of morbidity and mortality in West Africa (Sahn 2018). During the 20th century, in the United States of America (USA) and other high income countries, the economic growth in real income is in line historically with mortality rate decline caused by the increase in life expectancy at birth (Cutler 2006).

Mortality decline significantly produces economic improvement in schooling and consumption (Kalemli-Ozcan et al. 2000). Mortality decline through education opportunity can cause consumption improvement. Lorentzen et al. (2008) proposed and argument that as a whole, mortality affects aggregate economic growth. High adult mortality reduces economic growth by shortening time horizons. A greater death risk in prime productive years was associated with higher level of risky behavior, higher fertility, and lower investment in physical capital. Adult mortality explained almost all economic growth tragedy in Africa.

Based on the above literature review, it is hypothesized that higher adult mortality rate is negatively associated with handwashing and economic growth. In addition, it is hypothesized that higher adult mortality rate is negatively associated with drinking water and sanitation and is positively associated with HIV incidence.

3. Data and Methods

3.1. Data

Data used in this study came from the World Development Indicators of the World Bank. The data covered 82 countries during 2009–2017 with complete data on the variables used in the analysis. The dependent variables were GDP per capita, PPP (current international $), and adult mortality rate (per 1,000 adults). The main independent variable was the percentage of population with basic handwashing facilities including soap and water. The control variables included incidence of HIV (per 1,000 uninfected population ages 15–49), the percentage of population using at least basic drinking water services, and the percentage of population using at least basic sanitation services (% of population).

3.2. Methods

Data in this study was analyzed employing univariate, bivariate, and multivariate analyses. Univariate analysis was used to examine the summary statistics of variables used in the model that is the number of observations, mean, standard deviation, and minimum and maximum value. Bivariate analyses were conducted to assess the correlation between each independent variable and dependent variable. Multivariate analysis was carried out to investigate the association between independent variables and dependent variables using Stata (StataCorp 2019).

A path was depicted to model the structural relationships between independent variables and dependent variables (Figure 2). There were two dependent variables: adult mortality rate and GDP per capita. Therefore, there were two regression models constructed. Firstly, a regression model between hand washing and adult mortality rate was constructed controlling for the effects of HIV incidence and access to basic drinking water and basic sanitation services. Secondly, another regression model between adult mortality rate and GDP per capita was built.

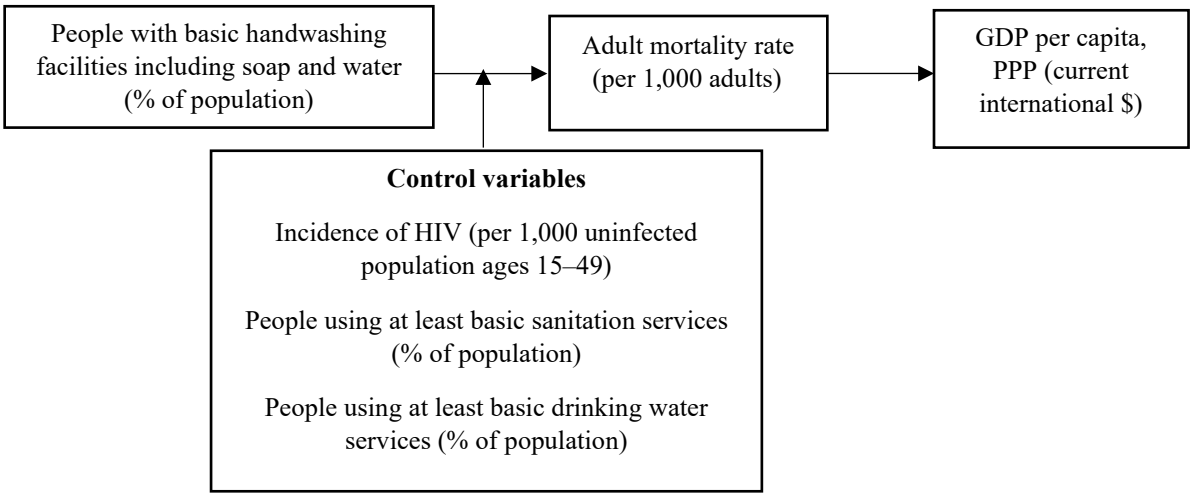


Figure 2 Analytical framework: Structural Model

4. Results and Discussion

The results of the univariate analysis, that is the summary statistics of variables used in the model, are presented in Table 1. These include the number of observations, mean, standard deviation, and minimum and maximum value. It can be seen that GDP per capita ranged from a low of 637 international $ to a high of 39,061 international $, adult mortality rate varied greatly between 4.7 and 559.6 per 1,000 adults, the percentage of population with basic hand washing facilities including soap and water differed between 0.9% and 100.0%, HIV incidence ranged between a low of 0.0 to a high of 27.4 per 1,000 uninfected population ages 15–49, the percentage of population using at least basic drinking water services varied between 31.7% and 99.9%, and the percentage of population using at least basic sanitation services differed between 5.5% and 99.4%.

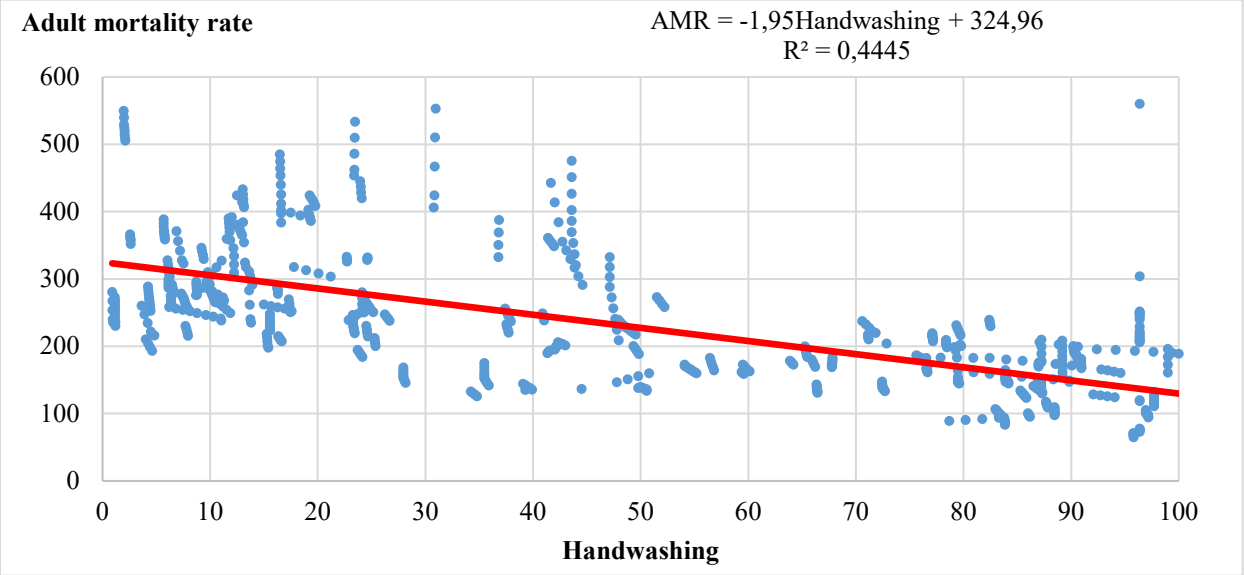
Table 1 Summary statistics of variables in the model: number of observations, mean, standard deviation, and minimum and maximum value: 82 countries in the world 2009–2017

Variable	Observation	Mean	Standard deviation	Minimum	Maximum
GDP per capita, PPP (constant 2011 international $)	738	6691.54	6,167.15	636.88	39,060.91
Mortality rate, total (per 1,000 adults)	738	229.54	96.75	4.65	559.61
People with basic handwashing facilities including soap and water (% of population)	738	48.88	33.04	0.90	100.00
Incidence of HIV (per 1,000 uninfected population ages 15–49)	738	1.79	3.84	0.00	27.4
People using at least basic drinking water services (% of population)	738	76.25	17.98	31.73	99.93
People using at least basic sanitation services (% of population)	738	55.93	29.41	5.47	99.37

Source: World Bank (2020) (Author's compilation).

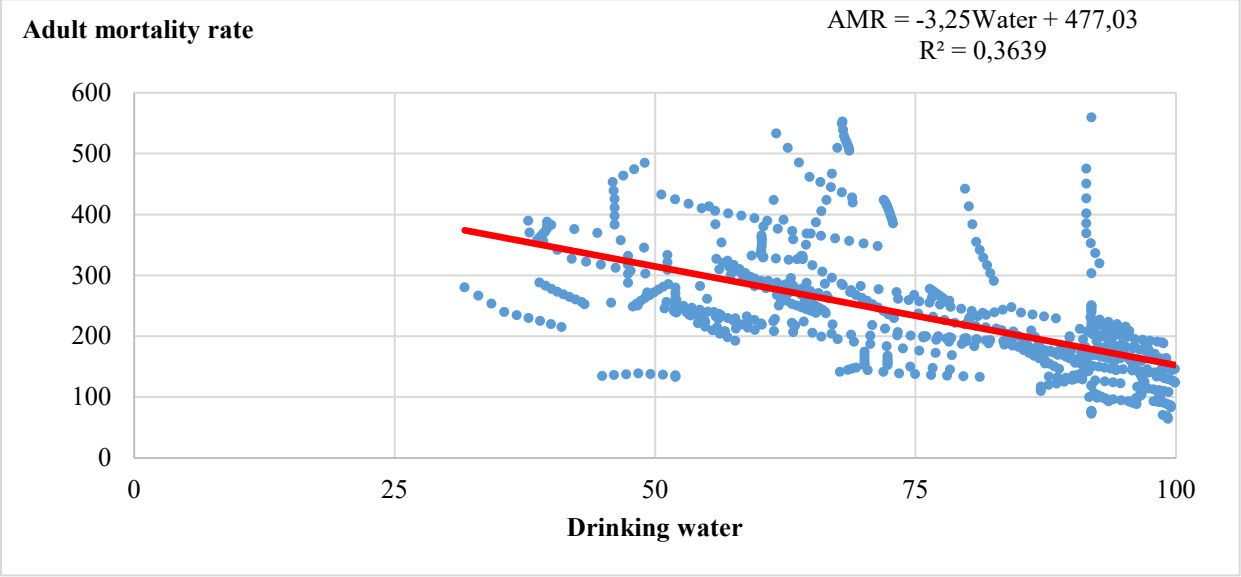
The results of bivariate analyses are presented in Figure 3 – Figure 7. It can be seen that the adult mortality rate had a negative correlation with the percentage of population with basic hand washing facilities including soap and water (Figure 3), using at least basic drinking water services (Figure 4), and using at least basic sanitation services (Figure 5). The higher the percentage of population with basic hand washing facilities including soap and water, using at least basic drinking water services, and using at least basic sanitation services, the lower the adult mortality rate. An increase of one percent in the percentage of population with basic hand washing facilities including soap and water, using at least basic drinking water services, and using at least basic sanitation services will cause a decline in the adult mortality

by, respectively, 1.95, 3.25, and 1.94 per 1,000 adults or 195, 325, and 194 per 100,000 adults. Meanwhile, the HIV incidence had positive correlation with adult mortality rate (Figure 6). The higher the HIV incidence is the higher the adult mortality rate. An increase of one in HIV incidence will lead to an increase in the adult mortality by 16.9 per 1,000 adults or 169 per 10,000 adults. In addition, the adult mortality rate and GDP per capita was negatively correlated (Figure 7). The higher the adult mortality rate the lower the GDP per capita. An increase of one in the adult mortality rate will lead to a decline in GDP per capita by 19.6 international $.



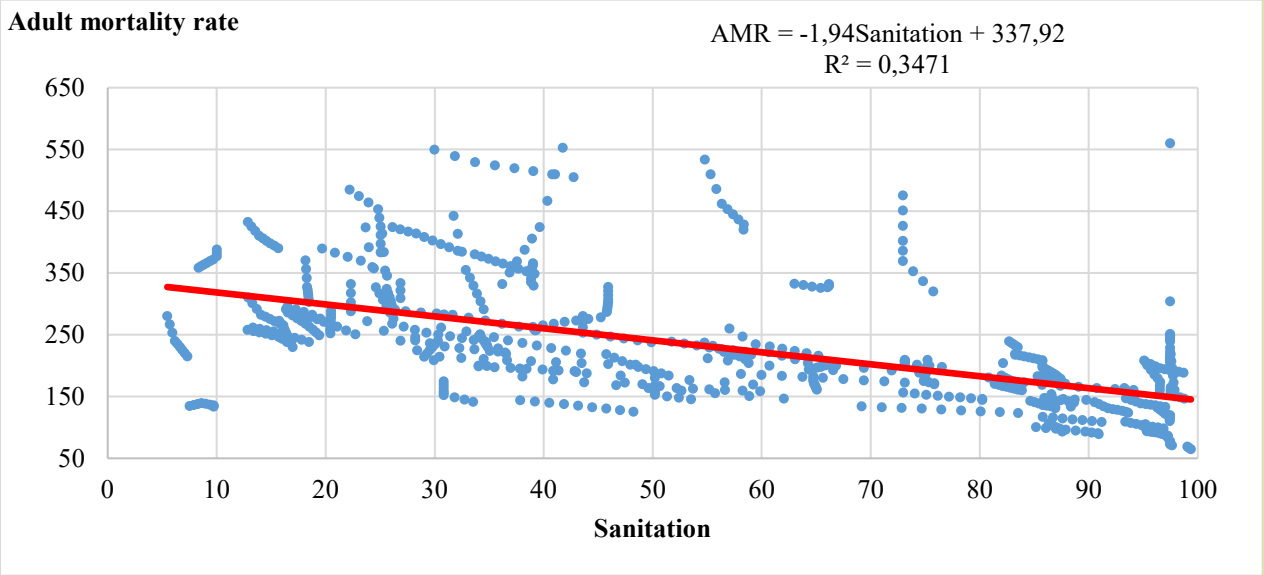
Source: World Bank Data. Accessed April 2020 (Author's compilation).

Figure 3 Percentage of population with basic hand washing facilities including soap and water and adult mortality rate: 82 countries in the world 2009–2017



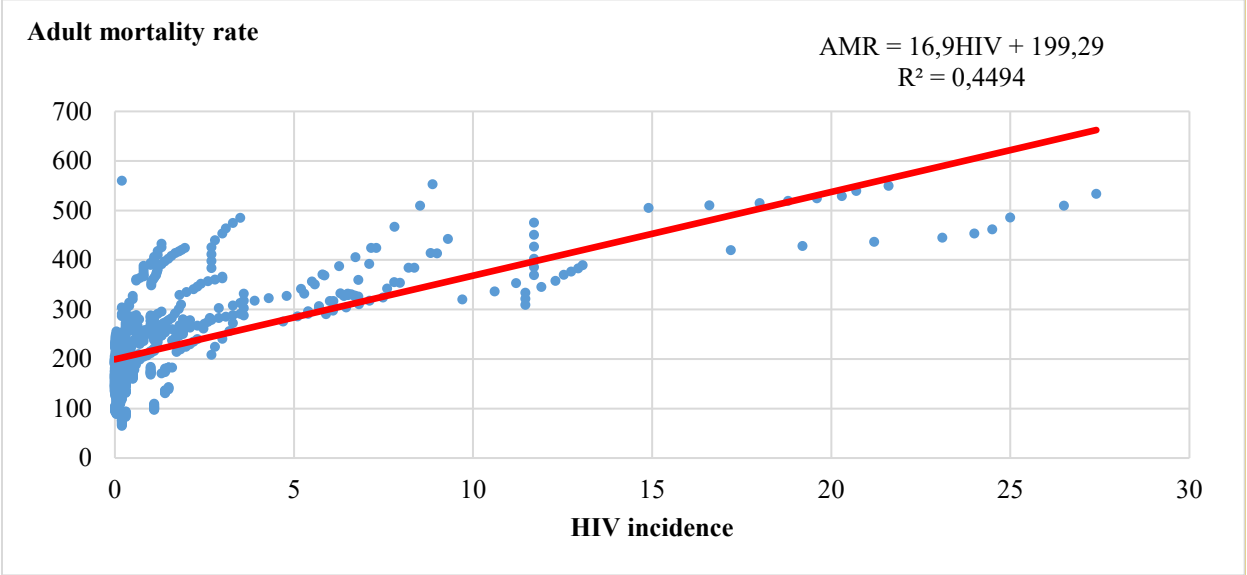
Source: World Bank Data. Accessed April 2020 (Author's compilation).

Figure 4 Percentage of population using at least basic drinking water services and adult mortality rate: 82 countries in the world 2009–2017



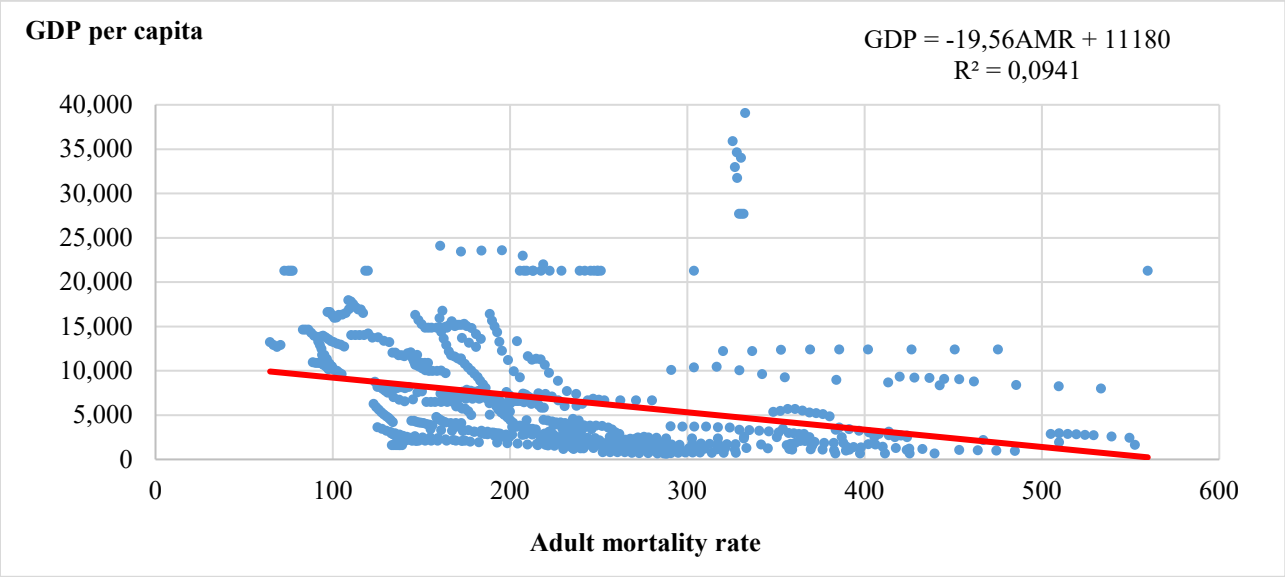
Source: World Bank Data. Accessed April 2020 (Author's compilation).

Figure 5 Percentage of population using at least basic sanitation services and adult mortality rate: 82 countries in the world 2009–2017



Source: World Bank Data. Accessed April 2020 (Author's compilation).

Figure 6 HIV incidence and adult mortality rate: 82 countries in the world 2009–2017



Source: World Bank Data. Accessed April 2020 (Author's compilation).

Figure 7 Adult mortality rate and GDP per capita: 82 countries in the world 2009–2017

The results of regression model for panel data of the economic and health consequences of hand washing are presented in Table 2. It can be seen that hand washing was significantly associated with the adult mortality rate statistically even after controlling for the effects of HIV incidence and access to basic drinking water and basic sanitation services. All control variables, HIV incidence and access to basic drinking water and basic sanitation services, also influenced the adult mortality rate significantly and statistically. In addition, adult mortality was a significant factor of economic welfare statistically.

The effect of hand washing on adult mortality was statistically significant at the less than 0.001 significance level. After controlling for other factors, an increase of one in the percentage of population with basic hand washing facilities including soap and water was associated with a decline in adult mortality rate by 0.7 deaths per 1,000 adults or 7 deaths per 10,000 adults. In this study, the percentage of population with basic hand washing facilities including soap and water was the second strongest factor that influenced adult mortality rate.

The effect of HIV incidence on adult mortality was also statistically significant at the less than 0.001 significance level. Other things being the same, an increase of one in the HIV incidence per 1,000 uninfected population ages 15–49 was associated with an increase in adult mortality rate by 13 deaths per 1,000 adults. In this study, the HIV incidence was the first strongest factor that affected adult mortality rate.

The effect of access to basic drinking water services on adult mortality was also statistically significant at the less than 0.001 significance level. Ceteris paribus, an increase of one in the percentage of population using at least basic drinking water services was associated with a decline in adult mortality rate by 0.9 deaths per 1,000 adults or 9 deaths per 10,000 adults. In this study, access to basic drinking water services was the third strongest factor that affected adult mortality rate.

The effect of access to basic sanitation services on adult mortality was also statistically significant at the less than 0.001 significance level. After controlling for other factors, an increase of one in the percentage of population using at least basic sanitation services was associated with a decline in adult mortality rate by 0.5 deaths per 1,000 adults or 5 deaths per 10,000 adults. In this study, access to basic sanitation services was the fourth strongest factor that affected adult mortality rate.

The effect of adult mortality on economic welfare on adult mortality was statistically significant at the less than 0.001 significance level too. An increase of one death per 1,000 deaths in adult mortality was associated with a decline in GDP per capita by 20.5 international $.

Table 2 Coefficient, standard error, *t*-statistic, *p*-value of regression model of the economic and health impacts of hand washing: 82 countries in the world 2009–2017

Variable	Coefficient	Standard error	*t*-statistic	*p*-value
Structural 1: Dependent variable = Mortality rate, total (per 1,000 adults)				
Constant	334.800	11.324	29.57	< 0.001
People with basic handwashing facilities including soap and water (% of population)	-0.674	0.140	-4.83	< 0.001
People using at least basic drinking water services (% of population)	-0.926	0.209	-4.43	< 0.001
People using at least basic sanitation services (% of population)	-0.451	0.160	-2.82	< 0.001
Incidence of HIV (per 1,000 uninfected population ages 15–49)	13.138	0.564	23.28	< 0.001
Structural 2: Dependent variable = GDP per capita, PPP (current international $)				
Constant	11,631.360	571.793	20.34	< 0.001
Mortality rate, total (per 1,000 adults)	-20.475	2.296	-8.92	< 0.001

Source: World Bank (2020) (Author's compilation).

5. CONCLUSION

The results of the study confirm the importance of hand washing in reducing adult mortality rates and as a consequence improving economic welfare. Eradication of HIV incidence and expansion of access to basic water and sanitation services are also crucial in declining adult mortality and rising economic welfare. Therefore, it is recommended that countries should make concerted efforts to promote and increase access to basic handwashing facilities including soap and water and to at least basic drinking water and sanitation services as well as to eradicate HIV incidence in order to reduce adult mortality rate and boost economic welfare.

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Biography

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