Foreign aid for health and infant mortality in Sub-Saharan Africa

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Abstract
Death of children in their first one year after birth has been a major health issue of great concern in sub-Saharan Africa. Due to lack of fund in developing countries, foreign aid has been a major supplement to finance basic sectors which impact directly on socioeconomic lives of the people including the health sector. The region has been a recipient of health aid overtime especially after the millennium declaration but knowledge of such on specific health indicator such as infant mortality rate is vague. This study therefore assessed the effects of foreign aid for the health sector on infant mortality in the region. The study used data from 2000-2019 covering forty-six (46) SSA countries retrieved from the OECD, WDI, WGI and UNICEF. The data were analyzed with system GMM while Pooled OLS and the Fixed Effect models were estimated to check for robustness. Inferences were drawn at 5 percent level of significance. Results revealed that health aid, domestic health expenditure, access to improved water and government effectiveness reduced IMR. The study concluded that health aid improved infant mortality in the region and recommended deliberate efforts aimed at improved budgetary spending on healthcare, more judicious utilization of foreign aid and improved provision of safe drinking water to the populace in order to reduce infant mortality in the region.

Keywords*:* Infant Mortality, Health Aid, Sub-Saharan Africa

Introduction
Despite great health improvement in the developed countries, less improvement is seen in the developing countries (Goldin, 2019). The lack of good health of individuals in most developing countries has reduced their potential for economic growth and development. Common factors cited to be affecting the health of individuals as reflected in the poor health situation in most developing countries are scarcity of quality and affordable health care facilities, high level of illitracy and poverty (Kosack, 2003). Furthermore, the various isolated cases of inter-tribal and civil wars (especially as experienced in the 1980s and the 1990s), political unrest and natural disasters such as flooding and drought have contributed to the poor health conditions of the

people, especially in the sub-Sahara African region. This is so as the foregoing unfortunate events most often than not displace people from their homes and make them live in displaced people or refugee camps without adequate facilities but which are mostly overcrowded with higher possibility of disease transmission.

One of the key indicators of the health of a society is the rate of death of children in the first 12 months of life otherwise referred to as infant mortality rate. It is the probability of deaths of children who are less than a year of age for every 1000 babies who were alive (WHO, 2015). Inadequate prenatal care and lifestyles such as alcohol consumption, smoking and drug abuse by pregnant women and many other factors may result in complications which may lead to infant mortality (CDC, 2020). According to Genowska (2015) several environmental factors contribute to infant mortality. These include but not limited to health infrastructure, improved sanitation, immunization of children and mothers' level of education.

All the 191 member states of the United Nations (UN) came together in 2000 to define a clear roadmap to achieve holistic development and came up with the development plan referred to as the Millennium Development Goals (MDGs). Specifically, the goals were aimed at reducing the menace of illiteracy, poverty, hunger, disease, environmental degradation, and discrimination against women. The MDG4 was "to reduce child mortality" and this showed the importance of child health in achieving the development goals. After the millennium declaration which resulted in the MDGs, it was realized that due to inadequate financial capacity most of the developing countries may not be able to achieve the goals at the target date. Hence, the cooperation and assistance of the international community was thought to be needed (Radelet, 2004). This has culminated in more in-flow of foreign aid otherwise known as official development assistance (ODA) into most developing countries.

The Millennium Development Goals made significant contributions to improving global health since its establishment (WHO, 2014). For example, World Bank data showed that world average infant mortality rate declined from 52.8 per 1000 livebirths in 2000 to 31.5 per 1000 livebirths in 2015 while it declined from 91 per 1000 livebirths in 2000 to 57 per 1000livebirths in 2015 in sub-Saharan Africa (SSA). It can however be observed that SSA still lags behind the world average suggesting that the region might be one of those holding the world back with regard to infant mortality. In the same vein, some countries in the region such as Central Africa Republic, Somalia and Nigeria with IMR of 89.7 per 1000 livebirths, 82.8 per 1000 livebirths and 79 per 1000 livebirths respectively as at the MDG target year of 2015 were also among those holding the region backward when compared with 12.7 for Mauritius and Seychelles and 28.5 for South Africa for the same year. In addition, the first 13 highest ranking countries regarding infant death globally as at 2017 were in SSA (World Bank, 2018). After the expiration of the MDGs in 2015, the United Nations General Assembly again adopted the Sustainable Development Goals (SDGs) with 2030 as target date. This was to consolidate and build on the achievement of the MDGs. The new development agenda consists of 17 goals with the third one focusing on good health and well-being, and the aim is to “ensure healthy lives and promote well-being for all at all ages”. SDG-3 has 13 different targets and 28 indicators to measure progress towards targets. Each of the targets is related to the health of individuals. According to World Health Organization -WHO (2018), over 50 SDG indicators which are related to health targets of the SDGs were agreed upon to measure health outcomes.

There have been continuous in-flow of ODA into developing countries, especially those meant for the health sector otherwise called health aid. Health sector ODA are given by donors to developing countries to improve health infrastructures, control the prevalence of infectious disease and to implement other projects necessary to achieve health improvement. Most often than not, aid is aimed at a specific health issue, such as control of tuberculosis, training and re-training of health workers in specific areas of need, construction of hospitals and installation of diagnostic facilities among others (Doucouliagos *et al.,* 2019). The increase in aid for health has been mostly enjoyed by countries in the sub-Saharan African region, as the region received 32.9% ($12.3 billion) of world Development Assistance for Health funds in 2017 (Institute for Health Metric and Evaluation- IHME, 2018). Furthermore, health-aid to SSA was US$727,056,000 in 2002 and rose to US$1,838,135,000 in 2010 and US$6,049,992,000 in 2018 (OECD Creditor Reporting System, 2021). The increase in aid in-flow has been due to the commitment of rich nations and international development organizations to help developing countries achieve global development goals. In addition, more than 50 percent of health aid in 2018 was given to SSA and the largest recipient country for the year was Nigeria which received US$951 million with Ethiopia and Tanzania coming second and third respectively (Knox, 2020).

The second target of the Goal 3 of the SDG is to end preventable deaths of newborns and children under 5 years of age by 2030, with all countries aiming to reduce neonatal mortality to 12 per 1,000 live births and under-5 mortality to 25 per 1,000 live births. Available World Bank data show that in 2019 IMR was 3.3 per 1,000 livebirths in the European Union, 14 in Latin America and the Caribean (LAC) while it was still as high as 51.7 in SSA. Some developing countries tend to rely heavily on external aid to finance their health programmes. This manifests for instance in Mozambique in 2015 as less than 15 percent of the country's health expenditure was from domestic sources while the remaining were from foreign donors. (World Health Organization, 2018). There is the need to examine the effectiveness of foreign aid for health in reducing IMR in the region given the fact that few of such empirical studies have been carried out and results have been contradictory. Some gaps have been identified in the methodologies of some of the existing studies which have been taken into consideration in the present study. Some of the available studies employed interval data which may mask marginal effects (e.g Burnside and Dollar, 2000 &Wilson, 2011) while some neglected the issue of endogeneity and some did not try alternative analytical procedures (e.g Burfeind, 2014). In addition, most of the studies bothering on foreign aid have concentrated on its impact on economic growth. Studies in this category are those of Burnside and Dollar (2000), Collier and Dollar (2002), Easterly *et al.* (2004), Dalgaard (2004) etc. The present study examined the effects of foreign aid for the health sector on IMR using up-to-date available data alongside appropriate method of data analyses.

Literature Review

Some available studies have examined the relationships existing between foreign aid and health outcome but aid literature has contrasting views about the effectiveness of foreign aid on health outcomes. For instance, Boone (1996) examined the effect of overall ODA on life expectancy and infant death and concluded that aid does not benefit the poor. Mishra and Newhouse (2007) used data from 1973-2004 covering 118 countries to assess the nature of the relationship between ODA meant for the health sector and infant death. It was reported that health aid had significant effect on infant death. If health aid per capita was doubled, there was going to be a 2% decline in infant mortality rate and this implied that, for the average country, increasing per capita health aid by US$1.60 per year is associated with 1.5 fewer infant deaths per thousand live births. It was observed that the estimated effect was small, relative to the targets of the MDGs which were the global development targets at the time of the study. Kizhakethalackal (2009) used unbalanced panel dataset of 112 developing countries in four-year averages from 1974-2005. Results showed that health-aid (in the aggregated or disaggregated forms) never turned out to be significant. The results further showed that there was no complementarity as the interaction of aid and physician density returned insignificant coefficient. It suggested that not only aid failed to have any impact but it also does not help even if some countries have better physician stocks than others.

Yousuf (2012) used data covering 135 countries from 1975-2010 to assess the relationship between ODA for health and infant death. The study reported that aid had positive effect on infant mortality rate and if per capita aid was doubled infant mortality will reduce by 1.3 percent. This translated to a decrease of about 790 mortalities per a million livebirths. The study therefore expressed skeptism regarding the ability of the countries to achieve the MDGs at the then 2015 target date. Burguet and Soto (2013) examined whether or not some part of decline in child death witnessed in developing countries could be attributed to the surge in development aid since the turn of the millennium. The study utilizaed panel data from 2000-2008 covering more than 130 developing countries obtained from the OECD Creditors Reporting System. Total aid had no significant effect on child mortality but disaggregation revealed that some sectoral aid had significant impact which are larger in countries with higher child mortality rate before the millennium declaration. Despite the rigour of the detailed analyses performed by the study it only included government effectiveness and corruption among the set of explanatory variables and neglected a number of relevant variables which may impact directly on IMR.

Burfeind (2014) investigated the effectiveness of foreign aid for health on the child mortality rate in 47 developing countries across four continents using fixed effect model estimation procedure. The study reported negative and significant effect of external resources for health as a percentage of health spending and government resources on the child mortality rate in developing countries. Kotsadam, *et al.* (2018) investigated the effect of foreign aid on infant death in Nigeria using a micro level data of foreign aid for the country. The study adopted the difference-in-difference approach and fixed effect procedure. The study reported that physical closeness to active aid projects reduces infant death. Furthermore, it was reported that aid was more effective in enhancing infant survival groups which could be described as less privileged such as in rural areas and children of Muslim women. It was also reported that there seemed to be biases in the location of aid projects as they were not located in the areas with higher infant mortality.

Toseef *at al*. (2019) investigated whether foreign aid has been successful in enhancing the health of residents in recipient countries since the commencement of MDGs. The study looked at the annual death rate, life expectancy, measles and diphtheria vaccination rates, and infant mortality as population health indicators. For each of these metrics, fixed effects multivariate regressions with different specifications were computed using a panel dataset covering 90 developing countries, observed yearly between 2001 and 2015. The results showed that, since 2000, foreign aid had little to no impact on population health. Although the effect was very negligible, the study did find some evidence that ODA had raised life expectancy in poor nations. The report suggested further examination of the connection between foreign aid and health outcomes in order to get value for money. Doucouliagos *et al.* (2019) covering 96 recipient countries assessed the effects of health aid on infant mortality conditional on the level of governance. They found that strong governance (government effectiveness or control of corruption) is a prerequisite for health aid's ability to reduce infant mortality. Going into the specific details, the study reported that foreign aid for health to a country that witnessed a standard deviation increase in government effectiveness reduced infant mortality by about 4 percent. This underscores the need for good governance in order to ensure that foreign aid have the desired impact in recipient countries.

Adebanji *et al.* (2020) assessed the effect of ODA on child mortality in Nigeria using data from 1981-2018 and reported that that real GDP, government health spending, international aid, and carbon dioxide emissions significantly reduced mortality. Kiross *et al.* (2020) determined the impact of health care expenditure on infant mortality in SSA using panel data on 46 countries in the region from 2000 to 2015. Results suggested that public and external health care spending had significant negative association with infant and neonatal mortality while private health expenditure was not. The study concluded that public spending on healthcare and funds from external sources were crucial in reducing infant and neonatal mortality in the region.

Although, extensive research efforts have been put into investigating the effect of health aid on health outcomes in literature, especially, for developing countries, there are still obvious gaps. Some of the studies used interval average data which may mask the effect if higher frequency version of the data set had been used. Though, the use of such interval average may be justified from missing data point of view, the implication may be grievous. Some studies neglected endogeneity in their analyses and this may render the results invalid due to bias. Few other studies such as Kizhakethalackal (2009) and Kotsadam *et al.,* (2018) failed to introduce more relevant control variables which are germane to the effectiveness of health aid such as government effectiveness and control of corruption. A number of studies (e.g Kiross *et al.,* 2020) did not consider alternative models for robustness. The present study addressed the aforementioned deficiencies by including as many relevant control variables as possible, tried alternatives models and used up-to-date available data in response to the perceived deficiencies of some of the existing literatures.

Methodology

Model Specification, Data Measurement and Data Sources

The study draws on some of the reviewed literature to develop an empirical model of IMR with some relevant control variables stated implicitly as:

$$IMR = f\begin{pmatrix} AID, SSER, HEXP, POP, TOP, CORR, GOV, AIW, GDPC, \\ FET, PHY \end{pmatrix} \quad (1)$$

Equation 1 can be explicitly stated thus:

$$\begin{aligned} IMR_{it} &= \alpha_0 + \alpha_1 IMR_{it-1} + \alpha_2 AID_{it} + \alpha_3 SSER_{it} + \alpha_4 HEXP_{it} + \alpha_5 POP_{it} \\ &+ \alpha_6 TOP_{it} + \alpha_7 CORR_{it} + \alpha_8 GOV_{it} + \alpha_9 AIW_{it} + \alpha_{10} GDPC_{it} \\ &+ \alpha_{11} FET_{it} + \alpha_{12} PHY_{it} + \eta_i + \mu_t + \varepsilon_{it} \end{aligned} \quad (2)$$

In addition to the main study variable, that is health aid (AID) measured at 2010=100 and as share of GDP, other control but relevant variables included were secondary school enrollment rate (SSER) measured in percentage to examine the effect of education, health expenditure as percentage of GDP (HEXP), access to improved water (AIW) measured as percentage of population, GPD per capita (GDPC) to represent income in 2010 constant US Dollar, fertility rate (FET) and number of physician per 1000 (PHY) otherwise referred to as physician density, population (POP), trade openness (TOP) which is measured as the ratio of trade to GDP and government variables i.e corruption index (CORR), government effectiveness (GOV) whose roles were to unveil the effect of governance on the health outcome. The η captures country specific effect, μ = time specific effect, ε = error term, α = slope co-efficient, i = cross section of countries while t = time period. It is worthy of note that corruption was measured using annual control of corruption index prepared by Kaufmann *et al*. (2009) and leaning on ealier ones such as Kaufmann *et al*. (2003) and Kaufmann *et al*. (1998) which ranks countries on a scale from –2.5 (high corruption) to 2.5 (low corruption). This index was rescaled by subtracting country scores from 2.5 so that higher values correspond with higher corruption levels. This procedure is in line with Ackay (2006).

Data from 2000-2019 on infant mortality rate, population, trade openness, secondary school enrolment, domestic health expenditure, GPD per capita, fertility rate and physician density were obtained from the World Bank World Development Indicator (WDI). Data on control of corruption and government effectiveness were retrieved from the World Governance Indicators (WGI), health aid data were from the OECD Creditors Reporting System (CRS) while data on access to improved drinking water was obtained from United Nations International Children's Emergency Fund (UNICEF).

Estimation Techniques

The pre-Estimation involved descriptive analyses such as mean, median, mode, measures of dispersion, measures of asymmetry and measures of normality of distribution and correlation analyses. The system-Generalized Method of Moment (System GMM) regression technique is the most appropriate for the present study. Literature has established that aid and human development (which include health outcomes such as infant mortality) have a simultaneous relationship which causes endogeneity and the system GMM is built to address the problems including the ability to correct for variable measurement errors, unobserved country endogeneity and omitted variable bias. It combines the model's regressors in level forms and their first differences in a system. There are two main categories of GMM which are the system GMM and differenced GMM (Arellano & Bover, 1995; Blundell & Bond, 1998). The GMM procedure allows for the control for persistence in IMR levels since it has behavioural effects that persist. This is checked by correlation exercise between health indicator and its corresponding first lag.

It is also most applicable when the number of cross section (countries in this case) are more than the number of periods (years in the present study) i.e N(46)>T(20). According to Blundell and Bond (1998), the biases which may be linked with difference estimators are corrected by the system GMM estimator. It is also applicable when there are non-strict exogenous regressors, fixed effects and heteroskedasticity and autocorrelation within each country's data but not across the countries. The orthogonal deviation was used to transform equation 2 while time dummies which take care of time specific effects were included in order to lower the level of autocorrelation among countries and the idiosyncratic term which will improve the robustness of the estimation in line with the assertion of (Roodman, 2009a).

Furthermore, Roodman (2009b) posited that the number of instruments should not be more than the number of groups or countries (cross-section). This became imperative to prevent the proliferation of instruments or over-identification which causes biasedness of GMM estimator, over-fitting of endogenous variables and weakening of Sargan/Hansen tests. To make result more robust, instruments were collapsed and set to a lag limit of 2 and longer lags for transformed equation and limit of 2 for level equation. In addition, some instruments were removed until the retained set were found to be exogenous as revealed by Sargan and the Hansen test.

The post-estimation tests include the testing for serial correlation on the idiosyncratic error terms whose presence will render instrumental variables invalid through the AR(1) and AR(2) tests. It further includes tests of the overall validity of instruments using the Sargan and the Hansen tests and assessment of the robustness of the model by estimating the pooled OLS and the fixed effect for the model to provide a useful bound check for the lagged dependent regressors whose good estimate must lie between its pooled OLS and within-group estimate in order to establish robustness of the GMM as posited by Bond (2002).

Results and Discussion

Preliminary Analyses

Table 1i: Results of descriptive analyses

	Infant Mortality	AID	GDPC	Fertility Rate	Health Exp/GDP	Corru ption	Govt. Effective
Mean	59.53	0.3484	2290	4.85	1.83	3.11	-0.71
Median	57.90	0.18	989.6	4.99	1.58	3.21	-0.74
Maximum	139.50	5.39	20533	7.68	7.12	4.33	1.05
Minimum	11.80	2.3E-7	194.9	1.36	0.04	1.28	-1.88
Std. Dev.	24.34	0.5163	3193	1.23	1.17	0.62	0.61
Skewness	0.26	3.59	2.57	-0.49	1.37	-0.69	0.53
Kurtosis	2.81	23.48	10.12	3.18	5.12	2.91	2.79
Jarque-Bera	11.86	17998	2953	37.81	455.72	70.22	42.76
Probability	0.0027	0.0000	0.000	0.00	0.0000	0.0000	0
Observation	920	917	919	920	910	874	874

Source: Author's Computation

Table 1ii: Results of descriptive analyses (contd.)

	Water Access	Physicians/'000	Population	Sec. Sch Enrolment	Trade Openness
Mean	72.64	0.24	17820385	42.06156	72.05
Median	72.42	0.10	10409229	38.56234	62.04
Maximum	99.87	2.53	1.91E+08	99.90385	311.35
Minimum	24.58	0.008	81131.00	6.111570	16.67
Std. Dev.	14.90	0.38	27421484	21.19822	37.44
Skewness	-0.29	3.25	3.56	0.655153	1.80
Kurtosis	2.77	15.21	18.19	2.804324	8.60
Jarque-Bera	15.12	2919.14	10783.17	49.58413	1617.51
Probability	0.0005	0.0000	0.0000	0.000000	0.0000
Observation	915	366	920	678	877

Source: Author's Computation

Table 1i and 1ii present the results of the descriptive statistics of the study variables. Infant mortality rate averaged 59.53 per 1,000 livebirths during the period of the study. This was higher than the situations in most other regions of the world. For instance, infant mortality rate was 3.2 per 1,000 live births in the European Union, 13 in East Asia and the Pacific, 14 in Latin America and the Caribbean and 19.8 in Middle East and North African region in 2018 (World Bank, 2020). The average of health expenditure share of GDP was 5.14 percent. This was a bit lower than 6.35 for EAP, 7.22 for LAC and the world average value of 9.47 in the periods covered by the study. This may be a pointer to the relatively lower investment in health by governments in the SSA region compared with other developing regions of the world. Results showed that the mean fertility rate was 4.85 live births per woman in SSA. This is higher than the 2.28 livebirths per woman in the Latin America and the Caribbean (LAC) region during the same period. The number of physicians per 1000 of the population value of 0.24 was far below the WHO recommended ratio of 1: 1,000. Although, according to Kumar and Pal (2018), 44 percent of the WHO member countries have not been able to achieve the recommended ratio. The SSA average was low compared with the 1.35 per 1,000 in East Asia and the Pacific (EAP) region, 1.93 in the LAC region and 3.58 in the European Union for the same period. Access to improved water in SSA averaged 72.64 percent of the population during the period of the study. This was better than 46 percent in Central and Southern Asia but lesser compared to 97 percent in Finland and 96 percent in the United States.

Table 1i and 1ii also presents the summary statistics of other non-health variables, among which is GDP per capita. The average GDP per capita for the period of the study was $2,290.37 (Two thousand two hundred and ninety Dollars thirty-seven Cents). This was far below the world average value of $9,557.36 and the average in some other regions in the world. This portrays a situation of near *growth disaster* in the region. For instance, GDP per capita was $8,771.75 in LAC, $7,701.95 in EAP and $5,799.52 in Middle East and North Africa (MENA) regions. The low GDP per capita may affect health demand and health outcome of the people negatively. Trade openness figure reflects the depth of international trade relative to the concerned countries' GDP. The average value in SSA during the study period was 72.05 percent. This reveals a high level of trade in the region and far above those of some other comparable developing regions. For instance, trade openness was 43.62 percent in LAC and 59.86 percent in EAP during the same period while it was 79.7 in the European Union. Secondary school enrolment rate may reflect the level of education/enlightenment of the people in a country and the average enrolment rate in the region was shown to be 42.06 percent. This suggests a very wide gap to cover in terms of secondary school education in the region. Education was thought to aid health awareness and precautionary practices capable at improving health outcomes.

All the study variables except fertility rate and corruption skewed positively while in terms of kurtosis, life expectancy at birth, infant mortality rate, corruption, access to improved drinking water and secondary school enrolment rate were mesokurtic in distribution i.e they had moderate peaks. The Jaque-Bera statistic combines the properties of measures of skewness and kurtosis to access the normality of the distribution of series and the statistic confirmed that none of the series was normally distributed.

Table 2: Results of Correlation Analyses

	IMR	AID	GDPC	FERT	HEXP	CORR	GOV	AIW	PHY	POP	SSER	TOP
IMR	1											
AID	0.18	1										
GDPC	-0.62	-0.42	1									
FERT	0.80	0.30	-0.80	1								
HEXP	-0.51	-0.14	0.58	-0.53	1							
CORR	0.63	0.08	-0.61	0.64	-0.54	1						
GOV	-0.15	-0.28	0.24	0.17	0.18	-0.35	1					
AIW	-0.72	-0.29	0.70	-0.73	0.46	-0.57	0.41	1				
PHY	-0.56	-0.32	0.86	-0.72	0.29	-0.44	0.14	0.57	1			
POP	0.29	-0.10	-0.14	0.22	-0.33	0.32	0.31	-0.24	-0.06	1		
SSER	-0.72	-0.27	0.63	-0.73	0.36	-0.54	0.39	0.68	0.62	-0.14	1	
TOP	-0.32	-0.15	0.47	-0.50	0.27	-0.40	0.26	0.30	0.37	-0.37	0.49	1

Source: Author's Computation

Table 2 presents the results of product moment correlation analyses conducted on all the study variables. The results showed that there was no such high correlation between any combination of proposed regressors to raise concern about multicollinearity in the model to be estimated.

Table 3: Results of the Infant Mortality Rate Model

	Main Results			Robustness Check Results					
	Two-Step System GMM			Pooled OLS model			Fixed Effect Model		
	Coeff.	S.E.	t-stat	Coeff.	S. E.	t-stat	Coeff.	S. E.	t-stat
Const.	0.2252	0.834	0.27	-0.0683	0.0482	-1.42	-0.9132	0.593	-1.54
L1.IMR	0.9303***	0.161	5.77	0.9514***	0.1510	6.30	0.8527***	0.178	4.79
HDN	-0.341***	0.117	-2.90	-0.0612**	0.0260	-2.35	-0.0238*	0.012	-1.94
SSER	-0.0443*	0.021	-2.12	-0.0003	0.0021	-0.14	-0.0009	0.001	-1.47
HEXP	-0.2979**	0.144	-2.07	-0.0044**	0.0018	-2.51	-0.0016	0.003	-0.48
InPOP	-0.0158	0.040	-0.40	-0.0015	0.0018	-0.82	0.0461	0.036	1.28
TOP	0.0060	0.003	0.23	0.0021	0.0035	0.60	0.0031	0.003	1.07
CORR	0.0452	0.162	0.28	0.0049	0.0054	0.90	-0.0038	0.011	-0.33
GOV	-0.1095**	0.046	-2.40	-0.6900**	0.3350	-2.06	-0.0301	0.014	-2.17
AIW	-0.0232**	0.012	-2.01	-0.2067	0.1829	-1.13	-0.002***	0.001	-3.51
InGDPC	-0.5648*	0.305	-1.85	- 0.0079*	0.0045	-1.77	-0.074***	0.022	-3.33
InFert	0.3264	1.126	0.29	0.0193	0.0112	1.72	0.0067	0.042	0.16
InPhy	0.0601	0.261	0.23	0.0028	0.0030	0.94	-0.0085	0.005	-1.79
AR(1) p-value	0.017	-	-	-	-	-	-	-	-
AR(2) p-value	0.494	-	-	-	-	-	-	-	-
Hansen test p-v.	0.202	-	-	-	-	-	-	-	-
Sargan test p-value	0.198	-	-	-	-	-	-	-	-
R-Squared	-	-	-	0.9831	-	-	-	-	-
Adj. R^2	-	-	-	0.9807	-	-	-	-	-
F-Stat (Prob)	354.93 (0.0000)	-	-	11754.76 (0.0000)	-	-	1071.47 (0.0000)	-	-
No. of instruments	19	-	-	-	-	-	-	-	-

S.E = Standard Error; *, ** and *** implies significant at 10%, 5% and 1% respectively
Source: Author's Computation

Result of the impact of health aid on infant mortality in SSA

In order to achieve the main objective of the study, equation 2 was estimated using the system GMM technique for reasons stated earlier. Results presented in Table 3 showed that lagged IMR, health aid, health expenditure, government effectiveness, access to improved drinking water and GDP per capita significantly affected IMR. The lagged IMR coefficient was positive and significant at 1 percent risk level. The coefficient value of 0.9303 implied that a percent increase in the previous year IMR increased the contemporaneous IMR by 0.93 percent. Health aid negatively and significantly (P<0.01) affected IMR. A percent increase in health aid reduced IMR by about 0.34 percent. The result coincides with what was expected on *a priori* ground and implied that increase in foreign aid for the health sector significantly reduced infant mortality. Such external resources are usually useful in construction of hospitals, installation of state of the art diagnosis facilities, drug subsidy, re-training of health personnels etc. Each of these impact on health improvement both directly and indirectly. The result aligned with the report of Adebanji *et al.* (2020) in Nigeria and the report of Kiross *et al.* (2020) which covered SSA. Meanwhile, Doucouliagos *et al.* (2019) reported that effectiveness of health aid was conditioned on good governance in an assessment of 96 aid recipient countries. The report of this study however contradicted that of Toseef *et al.* (2019) which reported that health aid had no significant effect on infant mortality in a study which covered 90 developing countries.

Education came up with significant negative coefficient as expected and the value implied that an increase in school enrollment by 1 percent decreased infant mortality rate by 0.0443 percent in the region for the study period. This aligns with the fact that it was expected that the more the people get educated and become enlightened the more they are aware of precautionary measures and health seeking behaviours they need to adopt which may reduce infant mortality in the society. Domestic health expenditure (HEXP) had negative coefficient which was significant at 5 percent level. Infant mortality declined by about 0.3 percent due to one percent increase in domestic health expenditure. The negative sign of the coefficient aligned with *a priori* expectation.

The coefficient of GDP per capita was negative and significant ($P<0.1$) in line with *a priori* expectation. It is known that in a setting where there is no universal health coverage or free access to medical care such as the situation in SSA, per capita income plays a major role in healthcare as out-of-pocket expenditure may become the order of the day where access and utilization of healthcare depend on people's ability to pay which is a function of income. The results showed that a percentage increase in GDP per capita caused a 0.56 percent reduction in infant mortality in SSA.

Improvement in government effectiveness is expected to improve public service delivery whose one of the major component is health service. In line with *a priori* expectation government effectiveness came up with significant ($P<0.05$) negative coefficient. A unit increase in government effectiveness index decreased infant mortality by 0.11 percent. The implication was that as government improves the way services are carried out it translated into decreased infant mortality possibly as medical services are rendered more effectively. Access to improved drinking water returned negative coefficient in line with expectation which was significant at 5 percent significance level. It is believed that unsafe drinking water is a source of many diseases and infants are more prone to such diseases emanating from unclean water due to their low immunity and possibly fragile internal organs which are still growing.

Post Estimation Assessments

The GMM estimation procedure requires that tests of autocorrelation of both the first and the second order be carried out on the differenced error term. These tests are called AR(1) and AR(2) respectively. The p-value of AR(1) for the IMR model was 0.0175 which implied that the null hypothesis of "no first order autocorrelation" is rejected. The rejection of the hypothesis which implies the presence of first order autocorrelation in the differenced idiosyncratic error term is expected because of the process through which the error series are usually generated. The AR(2) p-value was 0.494 which implied acceptance of the null hypothesis of "no second order autocorrelation" which is in line with expectations. Hence, the estimated GMM model was confirmed to be valid (Table 3).

It is essential that the instrumental variables used in the GMM estimation be valid, else the estimates may not be consistent. It is worthy of note that consistency is one of the desirable properties of an estimator. The Sargan and Hansen tests assessed whether or not the instruments were exogenous and valid. The probability value of the Sargan and Hansen tests of 0.198 and 0.202 respectively implied that the set of instrumental variables used in the estimation could be taken as valid.

The pooled OLS and fixed effect models were estimated to establish the robustness of the estimated GMM model. According to Roodman (2009a), the estimated coefficient of the dependent variable lagged by one period must lie between the values of the Pooled OLS and the Fixed Effect Model. Table 3 revealed that the coefficient of the lagged IMR in the two step system GMM lies between its values in fixed effect and pooled OLS estimates, i.e. $0.8527 < 0.9303 < 0.9514$. Hence, the estimated GMM model was confirmed to be robust.

Conclusion

The study assessed the effects of health aid on IMR in sub-Sahara Africa (SSA). Based on the findings of the study, it was concluded that health aid significantly reduced IMR in SSA. Government health expenditure proved to be an important factor in infant mortality reduction and these have implications for policy in the region. It is worthy of note that income, access to improved drinking water and government effectiveness were also key to infant mortality in SSA. Therefore, more judicious use of health aid is recommended. In addition, governments in SSA are urged to increase their domestic health expenditure to compliment the contribution of health sector aid. Improved efforts to enhance government service delivery in the health sector, improved provision of safe drinking water to the people and policies capable of achieving noticeable growth and development in the economies of the region were also advocated.

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