An Empirical Analysis of Infant Mortality: Evidence from sub-Saharan Africa Countries

POPOOLA, Oladayo Timothy[1]

[1] Department of Economics, Ahmadu Bello University, Zaria, Nigeria

Correspondence: Popoola, O. Tim., Department of Economics, Ahmadu Bello University, Zaria, Nigeria. Tel: 234(0)813-574-5100.

Abstract

Newborn deaths are often used as measure of living standard of citizens as well as health indicator of nations. The rate is so high in developing countries, and more in sub-Saharan Africa (SSA) region. This paper therefore investigated the main drivers of infant mortality in a sample of eight SSA nations. The empirical findings reveal that newborn deaths are negative and statistically significant with the quality and availability of water supplies, sanitation facility, improved standard of living; but positively related and statistically significant to the increase in pollution level these countries. The study therefore recommend that government's efforts should also be directed towards enhancing effective child healthcare services, provision of infrastructural facilities such as, improving access to drinkable water, and citizens' welfare.

Keywords: Infant Mortality, Children Health Outcomes, Economic Growth

JEL Classification: I15, I38, J13

1. Introduction

Infant mortality is frequent used not only as a social and economic development measures, but also as an important measure of living standard of citizens as well as health indicator of nations. In year 2000, World Health Organization (WHO) observed that reduced rate of infant mortality can best be achieved through collective efforts and good health system, which should be the ultimate obligation of government, with private system providing supplementary supports. In general, increase child-health financing is important because; one, it's citizens' human right (see for example, Sen, 1999; Fiala and Arthur, 2014); two, infant mortality often measures socio- economic outcomes of citizens, from children's health, nutrition and education to their future labour supply, employment and productivity. Three, it determines economic growth, fostering economic development and reduces poverty (see Roemer, 1956; Anyanwu and Erthijakpor, 2007; Amiri and Gerdtham, 2013; Pillai, Maleku and Wei, 2013 and Kotsadam *et al.,* 2017). New-born health is paramount to all nations particularly in terms of economic progress and development (Amiri and Gerdtham, 2013). This is also one of the emphasis of SDGs 3 (achieving healthy outcomes for all citizens at all ages in all nations before year 2030).

For newborn to make it to their first year of living and beyond, Kotsadam et al. (2017) argued that this depend on the numerous factors. Especially those that relate with the health of mother, infections, access to immunizations, clean drinkable water, access to food, and sanitation are all paramount to the reducing infant and maternal mortalities rates for more efficient quality of living and economic productivities. It is important to note that while several developed nations have experience improvement in infant health over the recent decades, the average infant mortality rate in sub-Saharan Africa (SSA) region stood at 1 in every 14 live births against the global average of 1 in 27 live births; and under- five mortality ratio for SSA average stand at 1 in every 9 births compare to global average of 1 in 20 births (UNICEF, 2013).

Evidence from previous studies that including Burchett and Mayhew (2009), Mesiko and Mojekwu (2012), Pillai *et al.* (2013), Amiri and Gerdtham (2013), Fagbamigbe and Alabi (2014), Osawe (2014), Adepoju (2015), Stidham *et al.* (2015) and Kotsadam *et al.* (2017) further reports disparities in infant healthcare service delivery to health financing, socio-economic factors, environmental factors, child nutritional status, parental income and proximate to health facility in SSA countries. However, to improve new-born health in SSA nations, access to health infrastructure and facilities provision seem to be important. This demonstrate that an efficient service delivery with adequate government expenditure on children health system seem to important in explaining how the region can achieve SDGs 3. Hence, the focus of this paper is to empirically investigates main socio-economic factors for

improving health of new-born in the SSA countries. The paper was organized as follow; section two reviewed literature, while section three contained the methodology. Four presented the paper's analysis of data and discuses results. And finally, five focused on summary of the findings and policy recommendations.

2. Literature Reviews

Conceptually, newborn mortality is deaths before the baby first birthday. To Osawe (2014) infant mortality refers to numbers of deaths of newborn baby under the age of one. According to Adedini (2013), newborn deaths concern the likelihood of newborns prior to their first birthday. This remained one of the national and global concern that need adequate attention. Figure 1 depicted that SSA region has the highest newborn deaths compare to other regions of the world. For example, Nigeria loses about 2,300 children in every single day. This makes the nation the 2nd largest contributor to infant deaths in the world after Chad. It is pertinent to note that, both Nigeria and Chad are from SSA region.
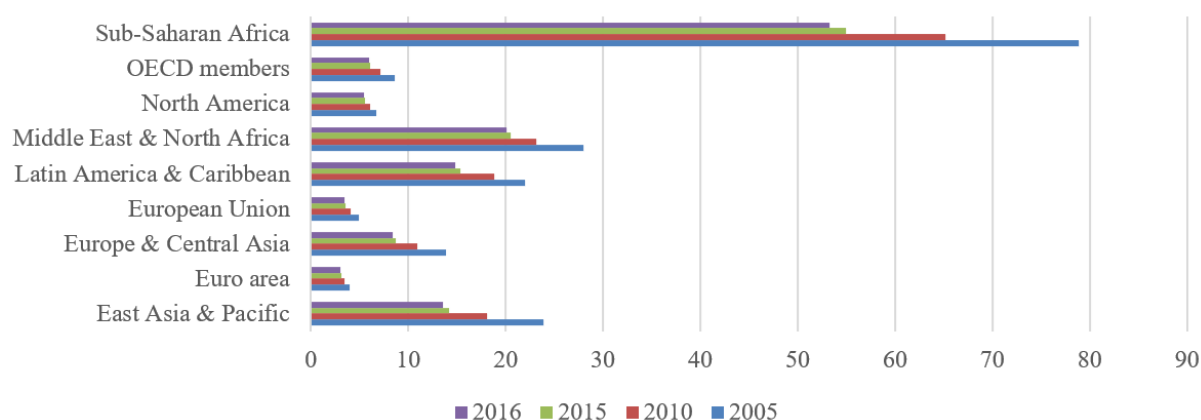

Figure 1. World Regional Statistics of Infant Mortality Rate

Source: World Bank, 2018

There are three categories of general sources of threat to the life of the mother during pregnancy and child birth. This include the poor accessibility to health services in supply due to poor health financing, is often the most immediate cause of death during child birth. These conditions contribute to high levels of morbidity resulting in maternal mortality; maternal mortality research focuses on proximate causes of death such as lack of emergency medical care for childbirth (Burchett and Mayhew, 2009). Most often, maternal mortality ratios are a function of both economic and social developments. Of all the social indicators, one that clearly discriminates between developing and developed countries is maternal mortality ratio. Hence, adequate funding is paramount to reducing mortalities.

Theoretically, the principal-agent theory (also known as agency theory), helped to explains the importance of health financing from agents to reduce deaths. Wagner (1958) opined that increasing public financing of health activities. He postulated that there are inherent tendencies for rise in economic growth from more expansionary government's spending. Wagner's public financing of 1958 further explains the expanding state expenditure activities on health which has both short- and long-run implications. This implies that health spending enhances provision of immunization, treated-mosquito nets, and more access to healthcare services. In term of empirical evidences, several studies on new-born health outcomes in developing countries (see, Barenberg et al. 2015, for India; Hartwig et al. 2015, for Indonesia; Alves and Belluzzo, 2005 for Brazil; Godson and Mojekwu, 2012; Adetoro and Amoo, 2014; and Kotsadam et al. 2017 for Nigeria) have provide evidence to show different factors responsible for high infant deaths. However, improvement in infant health cannot be measured without considering those factors that concern adequate health infrastructure including, drinkable water, housing condition, and pollution.

3. Methods

3.1 Model Specification

The model specified in the paper is based on panel data regressions for infant health outcomes. The paper model specification is consistent with Romer (1986) and empirical literature reviewed. In accordance with these literature,

quality and availability of water supplies, sanitation facility, improved standard of living; and low level of pollution serves as an indicator to improve infant health outcomes. Thus;

$$IMR_{it} = \alpha_{it} + \beta_1 IWS_{it} + \beta_2 ISF_{it} + \beta_3 POL_{it} + \beta_4 RGDP_{it} + \mu_{it} \tag{1}$$

where IMR_{it} is infant or newborn deaths, α_{it} is regional/country-specific effect; IWS_{it} the improved water supplies; ISF_{it} is improved sanitation facilities; POL_{it} the level of pollution; $RGDP_{it}$ denote per capita GDP; and μ_{it} the error term.

As specified in Equation 1 above, the equation examines the direct impact of major drivers of infant mortality rate on infant health outcomes in sub-Saharan Africa region. The paper expects these drivers to have inverse or negative effect on infant mortality rate except level of pollution. However, improving standard of living would help to decrease infant mortality rate (see Osawe, 2014; Godson and Mojekwu, 2012).

3.2 Data Source and Scope

A panel dataset for eight sub-Saharan African countries. These are, Equatorial Guinea, Congo Republic, Nigeria, Angola, Gabon, Chad, Cameroon, and Cote d'Ivoire) from 2000 to 2015 were compiled for the study. The study sourced all variables from World Development Indicators (2018) databases.

3.3 Method of Analysis

The study employed descriptive statistics, correlation matrix and Panel Regression analysis; on both the dependent and independent variables selected from the dataset. The econometric approach would be based on panel data regressions in equation (2). The study controlled for country fixed-effects (FE) which control of unobserved factors that differ between the selected SSA countries but are constant over time for each country. The study taken on the following general form for the fixed effect of panel data model, where i represent a country and t denotes year.

$$y_{it} = g^1 X_{it} + v_i + e_t \tag{2}$$

Where v_i is the effects of variables particular to i^{th} nation. These are often fixed with time. FE allows for a very intuitive interpretation of the results. As a following step, the study would FE to RE by employing Hausman test, with the null hypothesis (H_o) of random effects and alternative (H_1) of fixed effects is appropriate.

4. Findings and Discussions

4.1 Panel Regression Results

Table 1 reveal the FE estimation findings. The estimation results indicated that newborn health significantly depend on clean drinkable water, level of standard of living, and housing condition. The table (Table 3) also indicated, there is clear negative nexus between IMR, drinkable water and toilet quality and access in selected SSA countries; but it was positively related to pollution level.

Table 3. FE Estimation Findings

	Infant Mortality Rate (IMR)	
Variable	**Coefficient**	**t-statistics**
Constant	275.42*** (13.76)	20.00
IWS	-2.8637*** (0.2008)	-14.26
ISF	-0.7626*** (0.2139)	-3.57
POL	0.2171*** (0.0617)	3.52
EG	-0.0001 (0.0002)	-0.86
Adj. R^2	0.7381	

*** represent significance at 1%; ** at 5%; and *significance at 10%. While statistics in parentheses are robustness standard errors

Notably, the negative sign of improved access to drinkable water, and safe environment. In addition, the positive sign of pollution is as expected. This is in line with the study of McCord *et al,* (2017) that ecology of diseases leads to high child mortality increases as pollution rises. Similar findings were obtained from RE estimation as shown in Table 2.

Table 2. RE Estimation Findings

	Infant Mortality Rates (IMR)	
Variable	**Coefficient**	**t-statistics**
Constant	255.146*** (14.5197)	17.57
IWS	-2.5572*** (0.1863)	-13.72
ISF	-0.6289*** (0.1682)	-3.74
POL	0.1685*** (0.0621)	2.72
EG	-0.00032 (0.00021)	-1.53
Adj. R^2	0.73	

*** represent significance at 1%; ** at 5%; and *significance at 10%. While statistics in parentheses are robustness standard errors

The specification from Hausman's test indicates that RE model is appropriate and consistent (see Table 3).

Table 5. Hausman Specification Result

	Newborn Deaths
Chi-square	67
Probability	0.000

5. Conclusion

This paper investigates major drivers of high infant mortality in SSA region from recent 2000 to 2015 employing panel model analysis (FE, RE and Hausman tests). The findings suggest that access to drinkable water, quality and clean housing, control of pollution, and enhance quality living are paramount to reduce newborn deaths in the region. Therefore, governments of SSA nations are encourage to focus attention to policies and strategies that will improve living standard of their citizens.

References

Adedini, S. A. (2013). *Contextual Determinants of Infant and Child Mortality in Nigeria.* A Doctoral Thesis submitted to the Faculty of Humanities, University of the Witwatersrand, Johannesburg, South Africa

Adepoju, A. O. (2015). Differential Pattern in Child Mortality Rate in Rural Nigeria. *Annual Research & Review in Biology, 7*(5), 309-317. https://doi.org/10.9734/ARRB/2015/9643

Adetoro, G. W., & Amoo, E. O. (2014). *A Statistical Analysis of Child Mortality: Evidence from Nigeria.* Journal of Demography and Social Statistics, 1, 110-120.

Alves, D., & Belluzzo, W. (2005). Child Mortality and Socioeconomic Status in Sub-Saharan Africa. *African Population Studies, 19*(1), 1-11.

Amiri, A., & Gerdtham, U. G. (2013). *Impact of Maternal and Child Health on Economic Growth: New Evidence based Granger Causality and DEA Analysis*, Partnership for Maternal Newborn and Child Health

Antai, D. (2010). Migration and Child Immunization in Nigeria: Individual and Community-level Contexts. *British MedicalCare Public Health, 10*(1)

Anyanwu, J. C., & Erhijakpor, A. E. O. (2007). *Health Expenditure and Health Outcomes in Africa*, Economic Research Working Paper, 91.

Azmat G. (2009). Health care financing and health outcomes in Pacific Island countries. *Health Policy and Planning, 24*, 72-81.

Baird, F. S. (2009). *Aggregate income shocks and infant mortality in the developing world.*

Berger, M. C., & Messer, J. (2002). Public financing of Health Expenditures, Insurance, and Health Outcomes. *Applied Economics, 34*(1), 125-139. https://doi.org/10.1080/00036840210135665

Burchett, H. E., & Mayhew, S. H. (2009). Maternal mortality in low-income countries: what interventions have been evaluated and how should the evidence base be developed further? *International Journal of Gynecology and Obstetrics, 105*(1), 78-81. https://doi.org/10.1016/j.ijgo.2008.12.022

Fagbamigbe, A. F., & Alabi, O. (2014). Differentials and Correlates of Infants Mortality in Nigeria: A

Comparative Survival Analysis between North East and South West Nigeria. *International Journal of Tropical Disease and Health, 4*(8), 869-886. https://doi.org/10.9734/IJTDH/2014/9597

Fiala, C., & Arthur, J. H. (2014). "Dishonorable Disobedience" -Why refusal to treat in Reproductive healthcare is not conscientious objection. *Women Psychosomatics Gynecology and Obstetrics, 1*, 12-23. https://doi.org/10.1016/j.woman.2014.03.001

Howlader, M. R. (2014). *An Estimation of Health Production Function of Bangladesh*, Directorate of Secondary and Higher Education, Dhaka

Issa, H., & Ouattara, B. (2005). *The Effect of Private and Public Health on Infant Mortality Rates: Does the Level of Development Matters,* May 2005.

Jinadu, M. K., Olusi, S. O., Agun, J. I., & Fabiyi, A. K. (1991). Childhood Diarrhea in rural Nigeria: Studies on prevalence, mortality and socio-environmental factors. *Journal of Diarrhea Diseases Research, 9*(4), 323-327.

Kotsadam A., Ostby, G., Rustad, S. A., Tollefsen, A. F., & Urdal, H. (2017). *Development Aid and Infant Mortality*, Working Paper 39.

Lavallee, E., Mireille, R., & Rouband, F. (2008). Corruption and Trust in Political Institutions in sub-Saharan Africa, *Dial Development Institutions and Analysis de Long-term DT/2008-07.*

Mesike, C. G., & Mojekwu, J. N. (2012). Environmental Determinants of Child Mortality in Nigeria. *Journal of Sustainable Development, 5*(1), 65-75.

Mojekwu, J. N., & Ajijola, L. A. (2011). Developing a Model for Estimating Infant Mortality rate of Nigeria. *Journal of Research in International Business and Management, 1*(2), 164-170.

Morse, A. R. (2014). *Definitions of Maternal Mortality,* The Population Research Institute

Ogunjuyigbe, P. O. (2004). Under-Five Mortality in Nigeria: Perception and Attitude of the Yoruba towards the Existence of Abiku. *Demographic Research, 11*(2). https://doi.org/10.4054/DemRes.2004.11.2

Or, Z. (2001). *Exploring the Effects of Health Care on Mortality across OECD Countries*. Labour Market and Social Policy Papers 46, OECD Directorate for Employment, Labour and Social Affairs

Osawe, O. W. (2014). Determinant of Infant Mortality Rate: A Panel Data Analysis of African Countries. *Developing Country Studies, 4*(18), 111-115.

Ozumba, B. C., & Nwogu-Ikojo, E. E. (2008). *Avoidable Maternal in Enugu, Nigeria.* Public Health, 122(4), 354-360. https://doi.org/10.1016/j.puhe.2007.04.018

Pillai, V. K., Maleku, A., & Wei, F. (2013). Maternal Mortality and Female Literacy Rates in Developing Countries during 1970-2000: A Latent Growth Curve Analysis. *International Journal of Population Research, 2013*. https://doi.org/10.1155/2013/163292

Rodgers, G. B. (2002). Income and inequality as determinants of mortality: an international cross-section analysis. *International Journal of Epidemiology, 31*, 533-538. https://doi.org/10.1093/ije/31.3.533

Romer, P. M. (1990). Human Capital and Growth: Theory and Evidence. *Carnegie-Rochester Conference Series on Public Policy, 32*, 251-286. https://doi.org/10.1016/0167-2231(90)90028-J

Ross S. A. (1973). The Economic Theory of Agency: The Principal's Problem. *National Science Foundation, 63*(2), 134-139.

Ross, D. S., & Venkatech, R. (2015), *An Empirical Study of the Factors Influencing Quality of Healthcare and Its Effects on Patients' Satisfaction,* International Journal of Innovation Research in Science, Engineering and Technology, 4(2), 54-59

Sen, A. (1999). *Development as Freedom* (1st Ed) New York: Oxford University Press.

Stidham, H. K., Patton, E. W., & Crissman, H. P. (2015). A population-based study of U S Women's preferred versus usual sources of reproductive health care. *Journal of Obstet. Gynecol, 213*, 352.

UNICEF. (2013) World Health Indicators.

United Nations Children's Fund. (2012). *Levels and Trends in Child Mortality - Report 2012.*Estimates Developed by the United Nations Inter-Agency Group for Child Mortality Estimation.

United Nations Children's Fund. (2014). State of the World's Children Report, United Nations.

United Nations Children's Fund. (2015). The Inter-Agency Group for Child Mortality Estimation.

United Nations Inter-Agency Group for Child Mortality Estimation. (2013). *Levels and Trends in Child Mortality - Report 2013.* UN Inter-Agency Group for Child Mortality Estimation. New York.

Wagstaff, A., & Cleason, M. (2004). *The Millennium Development Goals for Health: Rising to the challenge,* Washington, D.C. World Bank.

World Bank. (1997). World Development Report, *World Bank, Washington, DC.*

World Bank. (2006). World Development Report, *World Bank, Washington, DC.*

World Bank. (2018). World Development Indicators, *World Bank Washington, DC.*