DISAGGREGATED EFFECTS OF INFANT AND ADULT MORTALITY ON ECONOMIC GROWTH IN NIGERIA

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ABSTRACT
This study is the empirical investigation of the effects of infant and adult mortality on economic growth. The effects are disaggregated into these age specific mortalities. The objective is to assess the disaggregated effect of mortalities in adults and infants on economic growth in Nigeria. We used Descriptive analysis with Secondary data on the Nigerian economy mostly from 1983 to 2023 and the Auto Regressive Distributed Lag (ARDL) technique to embark on the study. The disaggregated estimations (respective estimations) and analysis reveal that mortality in adults has a negative and significant effect on the growth of the Nigerian economy both in the short and long run, but infant mortality has a positively significant effect in the short run and a negative effect in the long run. Therefore, we recommend that government spending on health should be increased efficiently, the economic condition of the populace should be improved by providing more job opportunities to increase labour participation and income and a holistic approach should be taken to reduce adult and infant mortality rate.

Keywords: Adult mortality, Economic growth, Infant mortality and Well-being.
JEL Classification: I150, I310, O11

1. INTRODUCTION
Adult and infant mortality are important variables that could affect the economic growth of any nation. Mortality decline, be it that of infant or adult, produces economically significant increase in consumption. The death of an active member of the household reduces earnings and that of infant reduces expenditure on food items significantly (Kalemli-Ozcan, et al., 2000; Wagstaff, 2007).

Nigeria has a very high rate of first day death in the globe (12th highest rate) and a very high rate of mortality among infants (one of the highest in Africa). It has been confirmed by the United Nations that Nigeria has a very high rates of mortality among infants (one of the ten countries with highest infant mortality rates in Africa) (UNICEF, 2018). The ranking of Nigeria was 152nd out of 176 countries, therefore, among the 25 worst nations to be a child. (Save the Children International, 2016; Okwuwa and Adejo, 2020). Nigeria has a relatively high adult mortality compared to other nations. In 2017, Nigeria's adult mortality was 348, it was 341 in Cameroun (Central Africa), 218 in Sudan (North Africa), 213 in Kenya (East Africa) and in

South Africa, it was 318, while in Japan, China, Germany and United States of America it was as low as 51, 78, 67 and 73 respectively (WDI, 2021; UNICEF, 2021).). Infant and Adult Mortality are therefore issues of concern in Nigeria. The North-West and Northeast part of Nigeria has the highest level of infant mortality compared to the Southwest, Southeast and South-South, although the extent of deprivation and death was attributed to high rate of poverty in the northern region of Nigeria (Damilola et al, 2022; Richard, Opeyemi, Michael and Emmanuel, 2023).

Economic growth occurs when people provide for their future needs through savings and investment, but when people expect that they will not live long, they do not have incentive to save and this can hinder growth in the economy (Lorentzen, *et al.*, 2008). When the people in a poor nation are not able to pay for medical care, and adequate security, they cannot have longevity of life, but in a nation, where there is adequate security and the populace can pay for good medical care, they can live long, be motivated to save and this can result in the much desired growth in the economy (Lorentzen *et al.*, 2008).

Infant mortality level can be used to measure how well a society meets the needs of newborns, infants, and pregnant women (Reidpath and Allotey, 2003). It is crucial for the measurement of the standard of living, health conditions of the people, and socioeconomic development. It is a very sensitive measure of the population's health (Goran Miladinov, 2020) and the disparities in infant mortality rates could be responsible for most of the discrepancies in longevity (Baker and Fugh-Berman, 2009). High mortality of infants during the first year of life, could be an indicator showing unfavourable environmental, social, and economic conditions (Lawn, Cousens and Zupan, 2005; Claeson *et al.*, 2000). However, the population that falls between 15 and 60 years are a very important part of the population of every nation because they are largely the most active of the working population. The population below 15 and above 60 depends on them. As a result of this, the active working population is a significant determinant of the economic performance of any nation. Also, economic theory declares that labour has a positive relationship with output, therefore, if this group decreases, certainly, production output and economic growth will decrease.

The objective of this paper, therefore, is to empirically study the disaggregated effect of adult mortality and infant mortality on economic growth in Nigeria. This is done by reviewing conceptual, theoretical and empirical literature, presenting the methodology and data, discussing the results and findings, then concluding with recommendations.

2. LITERATURE REVIEW

2.1 Conceptual Literature

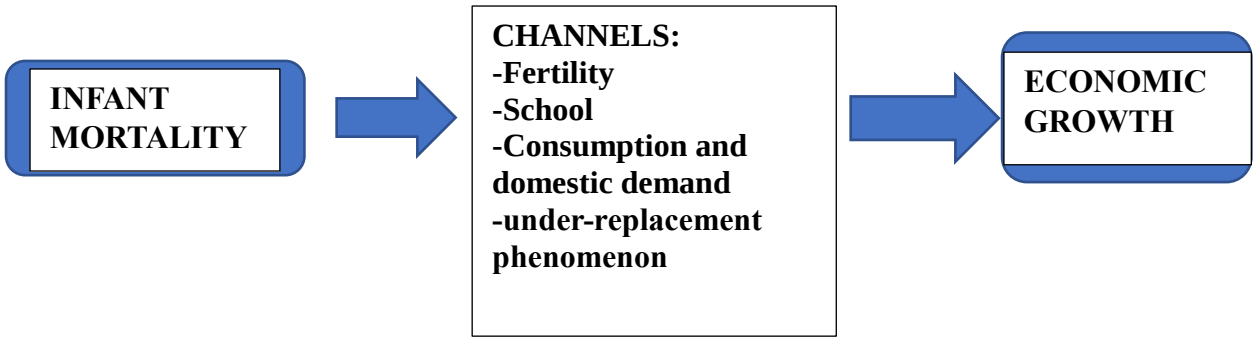
Age-specific Mortality Rate: It is mortality according to a given age group. The numerator is the number of deaths in that age group of the population and the denominator is the number of people in that given age group. The mortalities in this category are infant and adult mortality rate (Wise *et al.,* 1988; Center for Prevention and Disease Control, 2004).

Infant Mortality: It is the death among children that are younger than a year. It is measured by the infant mortality rate, and it is the number of deaths of children under a year per 1000 live births (David, 2018). It is usually used to measure health status because it shows the state of the health of the mother and her baby in pregnancy and after. The health of the mother and her baby depicts the accessibility to prenatal care and behaviours, post-natal care and behaviours (proper nutrition and childhood vaccination), infection control and sanitation. Infant mortality is calculated as: (deaths among children less than one year old reported in each period/ number

of live births in the same period) x1,000 (Wise *et al.,* 1988; Center for Prevention and disease control, 2004).

Adult Mortality: It is the deaths that occur within the adult population of ages 15 to 60. Its rate represents the probability that a person who is 15 years old will die before he/she will be 60 years old. It could also mean the percentage of total deaths of both male and female between ages 15 and 60 (per 100 total population). The adult mortality rate presented in the WDI database shows the probability that those who are 15 years old will die before they are 60 years old (per 1,000 persons) (WDI, 2018).

Figure 2.1: Channels by which Infant Mortality Affects Economic Growth (Transmission Mechanism)



Source*:* Authors' adaptation and elaboration of Lorentzen, et al., (2008)

Figure 2.1 represents the transmission mechanic between Mortality among infants and Economic Growth. These channels include:

Fertility: Some researchers suggest that to have a change from high to low mortality, there must necessarily be a fall in infant mortality. Mortality in infants may influence fertility through behavioural or child replacement effect of couples when they deliberately decide to have more children to compensate for dead children (Doepke, 2005; Kalemli-Ozcan, 2003; Galor, 2005). This increase in the rate of fertility may in turn negatively affect economic growth. Meanwhile, in a place where the mortality among infants is low, parents would most probably choose a reduced fertility level which will not allow the growth in population and could bring about growth in per capita income and the economy. Higher human capital investment is connected to change in fertility behaviour, through a quantity-quality trade off (Becker and Lewis, 1973) to a higher growth rate in technology (Lucas, 1988) and to an increased level of output (Mankiw *et al.,* 1992).

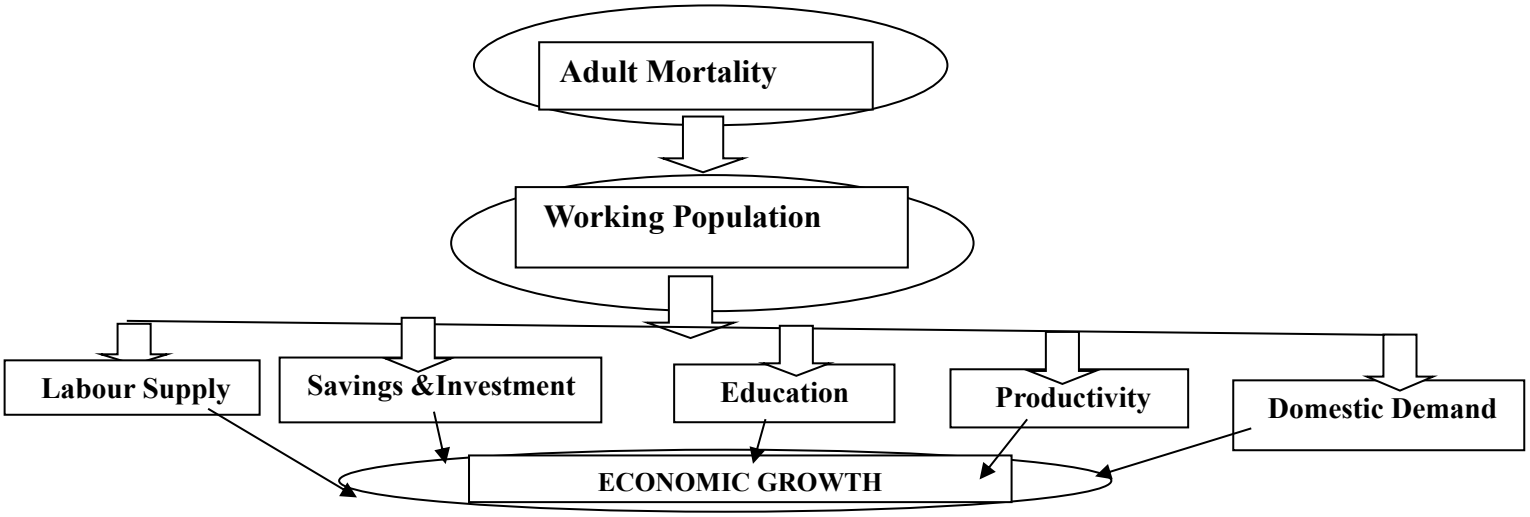
School: Infant mortality will affect school enrolment (education), which will eventually affect the human capital development and growth in the economy. Increase in mortality among infants will lead to a fall in school enrolment because these infants are the ones to grow up and enroll in primary school and then secondary school.

Consumption and Domestic Demand: Household consumption includes the consumption of the infants in the form of food, clothing, drugs, and other needs. Therefore, a rise or fall in infant mortality rate will affect the consumption and domestic demands of the household which is a part of the aggregate demand that can trigger growth in the economy. A high level of aggregate demand and consumption is expected to bring about a high national income. Reduction in mortality amongst infants will also lead to an increase in consumption as it is obvious that a

household with living infants will consume more than households with dead infants. This increase in consumption can lead to economic growth as consumption is a very important component of the national income.

Under-replacement phenomenon: Increase in infant mortality will give rise to the under-replacement phenomenon which means less children will reach adulthood, and this will reduce labour supply, output and economic growth.

Figure 2.2: Channels by Which Adult Mortality Affects Economic Growth



Sources: UNDP, 2016 and authors' modification, 2025.

Figure 2.2 shows the transmission mechanic between Adult Mortality and Economic Growth. These channels include:

Labour Supply: Labour supply, especially when they are educated and trained, affects production output. The effect on production is especially strong between ages 20 and 54(the peak working years). When there is a fall in the adult mortality, labour supply (the number of people available for work) gets bigger, especially when the labour market can absorb them. Therefore, there will be a rise in the worker's number per production and output (Bloom, *et al.,* 2003).

Savings, Capital, and Wealth Accumulation: Working-age population earns more and can save. When these working individuals are appropriately educated and trained, their ability to save money is expected to be greater. When there is an increase in savings, it could serve as a resource for investments that boost economic performance. It can also serve as investment resources by households and governments to enhance productivity. Additionally, savings by private households could provide the accumulation in capital, which is important for growth in finance, as we have learnt from the growth experience of East Asia (Krugman, 1994; Young, 1994, Higgins, 1998; Asian Development Bank, 1997; Kelley and Schmidt, 1995, 1996; Young, 2005).

Education is one of the most important investments that can enhance productivity. Education and training are required for people to learn new skills and be better-skilled workers,

which could enable them to adjust or fit into new businesses in an industrial environment that is rapidly changing. A rise in the level of productivity could result in a rise in the level of output that could eventually lead to growth in the economy. People are motivated to get education and training that will enable them to earn high income and accumulate wealth that could sustain them in old age when they realize that they will live longer (Ross, 2004; IPPF, 2013). Also, people in the age gap of 40 and 65 spend less on children and it may be important for them to get ready for retirement, so they seem to save more. (Bloom, *et al.*, 2003).

The accumulation- driven productivity gain of East Asia development has been explained in literature over the years to be partly because of demographic factors. Investment and savings rates can both be influenced by population distribution (demography). Some of the earliest works that investigated the East Asian experience found that the East Asian investment and savings rates were greatly impacted by decline in adult mortality which later led to growth in their economy (Higgins and Williamson, 1997; Higgins, 1998).

Adult mortality affects investments in human capital through its effect on education investment. As adult mortality rates reduce, parents may decide to sponsor their children to a higher level of education. They may also invest more money in their children's education because they know that these children will benefit from a long working life with income. These investments in education that lead to increased productivity and better wages will enable them to afford an improved living standard. More productive labour will produce more output that will lead to economic growth (Bloom *et al*, 2001; International Labour Office, 1996; Jamison *et al.,* 1996).

Domestic Demand and Consumption: When there is a decrease in the mortality of adults, there will be an increase in the working population and this will lead to greater domestic demand, especially if they are gainfully employed, because their income will afford them the purchasing power for effective demand. Change in effective demand (increase) could imply a change (increase) in aggregate demand that eventually leads to growth in the economy.

Productivity**:** When the number of people in the work force rises (because of reduced adult mortality) as compared to growth in the dependents, there could be enhanced productivity but there should also be good governance, training, skills development, health, and job creation. This boost in economic productivity would result in the growth of the economy, ceteris paribus (Bloom *et al,* 2001).

2.2 Theoretical Literature

There are numerous theories that support the fact that mortality in infants and adults affects the growth of the economy. Some of these include:

Fertility Behaviour Theory: This theory presents the precautionary demand for children and how it can increase fertility which could result in growth in population and a fall in the ratio of labour-capital and economic growth (Kalemli-Ozcan, 2003). It explains that parents will give birth to more children because they do not want to end up with none or too few surviving offspring. This precautionary motive or "hoarding" according to this theory is affected more by adult mortality than infant mortality, since it is difficult for parents to replace adult children.

Human Capital Accumulation and Physical Investment Theory**:** This theory presented an elementary logic on how mortality affects investment and growth in the economy as follows:

In a situation where instantaneous utility function is given as $U(ct)$, a probability of survival of p, and a discount factor β, in a two-period model, agents optimize $U(ct) + p\beta u(ct + 1)$. When the survival probability p reduces, there will be a reduction in investment and savings,

which will result in lower growth. This framework was also applied to accumulation in human capital. This theory explains that adult mortality will affect accumulation more than infant mortality since these decisions are made on the returns it will bring about in adulthood (Chakraborty *et al.,* 2007; Soares 2005; Kalemli-Ozcan 2002, 2003; Cervellati and Sunde 2005; Chakraborty 2004; Kalemli-Ozcan *et al.,* 2000; Ehrlich and Lui, 1991;). Other relevant theories are Economic growth theories (Neoclassical and Endogenous Growth theories), Cobb Douglas Production Function Theory and Epidemiological Transition Theory.

2.3 Review of Empirical Literature.

Empirical study on adult mortality and infant mortality over the years have resulted in varying results depending on the methodology and the type of data used to carry out the study. Some of the results could also be said to be affected by the geographical location of the study as socio-economic factors could play a key role in mortality studies**.** Some of these studies are reviewed in this section as follows:

The findings of Ben-Shlomo and Davey (1999) showed no correlation between deprivation on early childhood and adult mortality. Lorentzen, *et al.,* (2008), carried out their empirical investigation on adult mortality and found that it reduced economic growth by shortening time horizon. They used several subnational and national data, studying endogeneity issues and the age pattern of their mortalities. Their study confirms the theories that says that mortalities in adults affects growth in the economy via fertility and physical capital investment. They concluded that, these channels (fertility and physical capital investment) via which mortality affects the growth of the economy does so at almost the same proportion. When Anyanwu and Erhijakpor (2009) used the Robust Ordinary Least Squares (ROLS) model and Robust Two-Stage Least Squares (R2SLS) method to carry out their study on income per capita and mortality in infant, their result shows that the link (relationship) between mortality in infants and per capita income is not strong(weak). Lehmijoki and Palokangas (2011) used the family optimization model to examine mortality in adults, demographic growth and growth in the economy. They found that investment and income stream that is stimulated by mortality in adults result into economic growth.

Meanwhile, Erdoğan, *et al.,* (2013) carried out their research using panel data analysis techniques to investigate the link (relationship) between growth in the economy and mortality among infants, 1970-2007 using 25 high income OECD nations. They studied the effect of real GDP per capita on the mortality rates of infants. Their results reveal that mortality in infants significantly affects real GDP per capita. The correlation was found to be negative in most nations. They concluded that as nations become richer and develop new strategies, mortality in infants for such nations reduces.

Deluna and Peralta (2014) who had studied the link (relationship) between health outcomes and income in the Philippines found that mortality in infant is conversely related to per capita GDP. Carla et al*,* (2014) researched on the effect of health capital on Spanish economic growth from 1980 to 2007 using mortality in infants as proxy for health. They considered investments, fertility and school as the three transition mechanisms via which mortality in infants may influence growth in the economy and found that investment is the strongest channel. Their results showed that investment and school affect growth in the economy positively, while the effect is negative for fertility. Additionally, infant mortality had reverse effect on the channels and its effect on economic growth came out negative and statistically significant. In a study of the least developed countries, Salvador, Maria and Elena (2016) observed that child mortality only responds negatively with decreasing gross domestic product and does not show significant response when gross domestic product increases.

Holyachi and Kengnal (2017) researched on mortality in infants and growth of the Indian economy. Their results revealed co-integration between Infant Mortality Rate (IMR) and growth of the Indian economy. Ogunjimi and Adebayo (2019) assessed health outcomes and growth in Nigerian economy, 1981 – 2017 adopting the Toda-Yamamoto causality framework and their results indicate that there is the existence of significant relationship among the variables, especially in the long run. Ebeh, *et al.,* (2019) in their research on the Nigerian economy discovered that infant mortality influences the growth of the economy negatively.

Nikkil, Yuan, Collin, William and Eileen (2020) found that adults with higher schooling showed lower level of mortality compared to those with no school at all. Also, higher mortality is common among the poor and least educated people (Anthony, Lilian & Suneetha, 2012; Cally & Boingotlo, 2014). In a similar study, Elo and Preston (1996) affirmed that education differential is more among men than women but reduces when control for income, marital status and place of residence. However, in investigation of India economy, Adel and Imene (2023) showed that female literacy, economic growth and renewable energy consumption have an important role in reducing neonatal mortality rate. The finds of Adel and Imene (2023) and Salvador et al (2016) show the possibility of economic growth in decreasing child mortality in some countries. This further buttress on the findings of Lin (2006) that the effect of economic instability on the infant, neonatal, and post neonatal mortality rates showed strong effect in the eastern part of Taiwan, which is the region with the fewest health care resources.

There are varying empirical results on the effect of mortality on economic growth, be it of infants or adults. While Eboh, *et al.,* (2022) shows a positive effect, that of Hansen and Lönstrup (2015) shows a negative influence on economic growth.

3. METHODOLOGY

3. 1 Theoretical Framework

Several theories have been reviewed in the preceding section, but the theoretical framework that suits our objective is the neoclassical theory of economic growth. The equation for it is stated as $Y = K^{\alpha}(AL)^{1-\alpha}$ (3.1)

Y = GDP, K = capital, L= the labour force A = labour productivity, $\boldsymbol{\alpha}$ = output elasticity with respect to capital (Todaro & Smith, 2011). $\boldsymbol{\alpha}$ = the elasticity of output with respect to capital (the % rise in GDP resulting from a 1% rise in human or physical capital). (Peter and Bakari, 2018). As represented in equation 3.1, the function has constant returns to scale, so that a rise in input will yield the same proportion of increase in output, while holding one constant and increasing the other will yield less proportionate increase. (Gould and Ruffin, 1993). By extension, a reduction in, say, labour while holding capital constant will bring about less output. Traditional neoclassical growth theory opines that growth in output will result from one or more of these three factors- (i) growth in labour input (reduced mortality can bring about growth in labour) and quality (via education and training), (ii) capital increase and (iii) technological improvement (Todaro and Smith, 2011).

3.2 Model Specification

Our specific objective is to assess the disaggregate effect of infant and adult mortality on the growth of the Nigerian economy. To achieve this, we adapted the model of Lorentzen, *et al.,* (2008), who also used the neoclassical theory of growth and include control variables for proper

representation of the sectors of the economy and economic growth variables. The model is as follows:

RGDPG=f (IM, YPI, FERT, GFCF, SE, GEGDP, OPN. INF, LFP) (3.2)

RGDPG= f (AM, YPI, FERT, GFCF, SE, GEGDP, OPN. INF, LFP) (3.2b

Where, IM= Infant Mortality (deaths of children between 0 and 1year per 1000 live births); AM = Adult Mortality (combination of adult female and male mortality); RGDPG = Real GDP growth (%);YPC= per capita income (GDP divided by midyear population; in naira);SE = Secondary School Enrolment (% gross) for education; GEGDP = Expenditure of government as % of GDP; LFP = labour force participation Rate (%); FERT= Fertility (%); GFCF= gross fixed capital formation (% of GDP); OPN=trade openness (% of GDP); INF= inflation (%)

The econometric specification of the functions in Equations (3.2a and 3.2b) thus becomes:

$$RGDPG_t = \alpha_0 + \alpha_1 IM_t + \alpha_2 YPC_t + \alpha_3 FERT_t + \alpha_4 GFCF_t + \alpha_5 SE_t + \alpha_6 GEGDP_t + \alpha_7 OPN_t + \alpha_8 INF_t + \alpha_9 LFP_t + \varepsilon_t \quad (3.3a)$$

$$RGDPG_t = \alpha_0 + \alpha_1 AM_t + \alpha_2 YPC_t + \alpha_3 FERT_t + \alpha_4 GFCF_t + \alpha_5 SE_t + \alpha_6 GEGDP_t + \alpha_7 OPN_t + \alpha_8 INF_t + \alpha_9 LFP_t + \varepsilon_t \quad (3.3b)$$

a priori expectation: $\alpha_1, \alpha_3, \alpha_8<0$; $\alpha_2, \alpha_4, \alpha_5, \alpha_6, \alpha_7$ and $\alpha_9>0$

Also, we recast Equations (3.3a and 3.3b) as an ARDL model of the form,

$$\begin{aligned}\Delta RGDPG_t = {} & \theta_0 + \theta_1 \sum_{i=1}^{n} \Delta RGDPG_{t-i} + \theta_2 \sum_{i=0}^{n} \Delta IM_{t-i} + \theta_3 \sum_{i=0}^{n} \Delta InYPC_{t-i} \\ & + \theta_4 \sum_{i=0}^{n} \Delta FERT_{t-i} + \theta_5 \sum_{i=0}^{n} \Delta GFCF_{t-i} + \theta_6 \sum_{i=0}^{n} \Delta SE_{t-i} + \theta_7 \sum_{i=0}^{n} \Delta GEGDP_{t-i} \\ & + \theta_8 \sum_{i=0}^{n} \Delta OPN_{t-i} + \theta_9 \sum_{i=0}^{n} \Delta INF_{t-i} + \theta_{10} \sum_{i=0}^{n} \Delta LFP_{t-i} + \varphi ECM_{t-1} + \beta_{11} IM_t \\ & + \beta_{12} lnYPC_t + \beta_{13} FERT_t + \beta_{14} GFCF_t + \beta_{15} SE_t + \beta_{16} GEGDP_t + \beta_{17} OPN_t \\ & + \beta_{18} INF_t + U_t\end{aligned}$$

Equation 3.5a

$$\begin{aligned}\Delta RGDPG_t = {} & \theta_0 + \theta_1 \sum_{i=1}^{n} \Delta RGDPG_{t-i} + \theta_2 \sum_{i=0}^{n} \Delta AM_{t-i} + \theta_3 \sum_{i=0}^{n} \Delta InYPC_{t-i} \\ & + \theta_4 \sum_{i=0}^{n} \Delta FERT_{t-i} + \theta_5 \sum_{i=0}^{n} \Delta GFCF_{t-i} + \theta_6 \sum_{i=0}^{n} \Delta SE_{t-i} + \theta_7 \sum_{i=0}^{n} \Delta GEGDP_{t-i} \\ & + \theta_8 \sum_{i=0}^{n} \Delta OPN_{t-i} + \theta_9 \sum_{i=0}^{n} \Delta INF_{t-i} + \theta_{10} \sum_{i=0}^{n} \Delta LFP_{t-i} + \varphi ECM_{t-1} \\ & + \beta_{11} AM_t + \beta_{12} lnYPC_t + \beta_{13} FERT_t + \beta_{14} GFCF_t + \beta_{15} SE_t + \beta_{16} GEGDP_t \\ & + \beta_{17} OPN_t + \beta_{18} INF_t + U_t\end{aligned}$$

Equation (3.5b)

The long run parameters are represented by $\beta_{11} \ldots \beta_{18}$ while the short run parameters

are represented by $\theta_1 \ldots \theta_{10}$. Also, the error correction model which measures the speed of adjustment of the short run to long run equilibrium is represented by φ.

Mortality study could be done using primary or secondary data (Ogala, *2024;* Jorji et al., 2024; Ngeh et al, 2023; Timothy and Oluwaseyi, 2023; Joseph Paul and Margret, 2024). However, due to the nature of the variables for this study, we used secondary data mostly from 1983 to 2023, sourced from WDI (2019, 2020, 2021 and 2022), UNESCO Institute for Statistics (2020), National Bureau of Statistics (2022, 2023), CBN Statistical Bulletin and UNICEF (2024).

4. RESULTS AND DISCUSSIONS ON FINDINGS.

Considering the nature of the data (time series data) and variables available for this research, it is important that we first investigate their time series properties and stationarities, so as to avoid a spurious regression**. Table 4.1** results reveal that real GDP growth, fertility, adult mortality, and infant mortality, are stationary at level while the others at first difference using the Augmented Dickey-Fuller test. However, the Phillips-Perron test reveals that real GDP growth is stationary at level and the others at first difference. This reveals that the variables we are using for the study have different orders of integration ((I(0) and I(1)). Therefore, the ARDL bounds testing approach is suitable to assess the long run relationship amongst the variables. The model was specified to examine how the effect of infant mortality on growth of the economy compares to that of mortality among adults in Nigeria. Therefore, we proceeded to implement the ARDL.

Table 4.1: Unit Root Test Results

Augmented Dickey-Fuller (ADF)Test				**Phillips-Perron (PP) test**		
Variable	Level	First Difference	Order of Integration	Level	First Difference	Order of Integration
Real GDP growth	-3.982*	-10.314**	I(0)	-3.982*	-12.114**	I(0)
Adult Mortality	-4.352*	-12.472**	I(0)	-1.598	-4.540*	I(1)
Infant Mortality	-8.427**	-3.243	I(0)	-2.051	-4.566*	I(1)
Per Capita income	-2.600	-4.265**	I(1)	-3.032	-4.855**	I(1)
Fertility	-5.19**	-2.673	I(0)	-0.334	-4.023*	I(1)
Trade openness	-2.176	-4.704***	I(1)	-2.053	-11.246**	I(1)
Secondary enrolment(%Gross)	-3.223	-4.458**	I(1)	-1.962	-6.659**	I(1)
Government Expenditure (% GDP)	-1.957	-5.707**	I(1)	-1.957	-5.707**	I(1)
Gross Fixed Capital Formation (% GDP)	-2.641	-5.134**	I(1)	-2.564	-5.134**	I(1)
Labour Participation Rate	-1.836	-7.080**	I(1)	-2.014	-7.247**	I(1)
Inflation	-3.009	-6.549**	I(1)	-2.877	-10.369**	I(1)

** denotes the rejection of the null hypothesis at the 1% significant level and * rejection of the null hypothesis at the 5% significant level. **Source:** Authors' calculations using estimation data.

We estimated the error correction model and obtained short run dynamic relationship, and the results are reported in Table 4.2**.** The results show that adult mortality has a negative and significant effect on the growth of the economy in the short run with coefficients of 15.033 (at 5% level of significance) while infant mortality has a positive effect in the short run and with the coefficient of 3.096 at the same level of significance. The long run analysis reveals that mortality in infants and adults have negative and significant effect on the growth of the economy with coefficients of 1.396 and 1.291 at 5% and 1% level of significance respectively.

Table 4.2: ARDL Results Showing the Effect of Infant and Adult Mortality on Economic Growth.

Variable	Infant	Adult
Short-Run Relationship		
ΔMortality	3.096(3.505) ***	-15.033 (-2.485) **
Δ Fertility rate	-49.318 (-4.558) ***	-81.752(-2.751) **
ΔGross Fixed Capital Formation (% GDP)	0.227 (1.730) *	0.415 (3.558) ***
Δ Log of per capita income	107.977(3.885) ***	114.225 (4.909) ***
ΔGovernment expenditure	1.149 (2.084) **	1.603 (3.482) ***
ΔTrade openness	0.047 (0.836)	0.185 (2.830) **
Δlabour Participation Rate	1.375(2.312) **	3.222(2.581) **
ΔInflation	-0.083(-2.875) ***	-0.113(-2.692) ***
ΔSecondary school enrolment (-1)	0.484 (3.340) ***	0.642 (4.295) ***
Long-Run Relationship		
Error correction (ECM_{t-1}) (Speed of Adjustment)	-0.983 (-6.095) ***	-0.937(-5.684) ***
Mortality	-1.291 (-3.905) ***	-1.396 (-3.924) ***
Fertility rate	-0.725(-0.480)	-9.932 (-3.646) ***
Gross Fixed Capital Formation (% GDP)	0.064 (0.742)	0.233 (4.304)
log of Income per capita	1.012 (0.038)	28.778 (1.178)
labour Participation Rate	1.651(2.272) **	1.468(2.085)
Government expenditure	0.183 (0.399)	1.327 (3.073) ***
Trade openness	0.180(2.742) ***	0.057 (1.761) *
Inflation	-0.066(-3.053) ***	-0.105(-2.772) ***
Secondary school enrolment	0.164 (0.543)	0.350 (1.212)
R-squared	0.875	0.864
Adjusted R-squared	0.789	0.786
Durbin-Watson statistics	2.037	2.009

***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively

Source: Authors' calculations, using estimation data

Our regression results indicate that mortality in adults has greater effect on the growth of the Nigerian economy than infant mortality both now and in the future. This implies that increase in adult mortality will bring about decline in economic growth more than the increase in infant mortality would, especially in the long run. This is not surprising as there have been a lot of medical advancement and vaccination programmes that has brought down the rates of mortality among infants over the years in Nigeria. Also, the concept of adult mortality has not been given the attention it demands. More importantly, it is the adults, not the infants that make up the working population who engage in the production that brings about growth in the economy.

5. CONCLUSIONS AND RECOMMENDATIONS.

Mortalities among infants and adult have negative and significant effect on the Nigerian economy, in the future. Although the effect of mortality among infant appears positive now, we can not ignore its negatively significant effects in the future. The fact that the immediate effect of mortality among adults on the growth of the economy is negative, reveals that urgent actions have to be taken to curb the increasing adult mortality rate. There is no doubt that there is need to reduce infant and adult mortality rate. It confirms that all aspects of mortality have a significant effect on economic growth. Therefore, the holistic approach to tackle the problem of mortality in Nigeria will mean addressing each of the components (infant and adult mortality) appropriately, especially as regard to how they affect economic growth. Adult mortality has a negative and significant effect on economic growth. This is not surprising because it is the adults that are directly involved in production process. This is in consonant with the work of Kalemli-Ozcan, 2002; Brander and Dowrick, 1994; Kelley and Schmidt, 1995; Kormendi and Meguire, 1985; Bloom and Williamson, 1998. This then presents the fact that government need to throw more weight on addressing factors that leads to adult mortality in order to reduce the economic loss resulting from it. The negative long run effect of infant mortality also indicates the need to embark on measures that will curb infant mortality as failure to do so will not be favourable to the growth of the economy in the future. The significance of income per capita in our study as also revealed by Taofik and Ditep, 2022 underscores the need to improve the economic condition of the populace if decline in infant and adult mortality is to be accomplished.

Considering these afore mentioned policy implications of results, we recommend measures that will bring about decline in infant and adult mortality and growth in the economy such as a well-functioning and well-equipped medical system, provision of job opportunities that could lead to increased labour participation rate, income and economic growth. The rise in income will also enable the populace to afford good sanitation, drugs and diets that could initiate decline in infant and adult mortality and enable them to live a long and healthy life. The education sector should also be given priority in government funding, not only because of its positive effect on economic growth but also due to its effect on fertility and mortality.

The disaggregated effects of mortality on economic growth along gender divide and the assessment of the impact of socio-cultural factors on mortality are some of the future research areas in mortality studies.

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