Impact of Child Healthcare Investment on Infant Mortality in Nigeria

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Abstract

The study examined the impact of healthcare investment on infant mortality in Nigeria. Secondary data covering the period from 1995 to 2023 were used for the study. The data set were first tested for stationarity properties to avoid spurious regression estimates using Augmented Dickey Fuller (ADF) test. In addition, the study employed Autoregressive Distributed Lag Model (ARDL) Bound test technique to ascertain long-run relationship between public healthcare investment and infant mortality as well as examine the impact of healthcare investment relating to child support programmes (CSPINV), children immunization (IMMINV), improving Nutrition (NUTINV) and education (EDUINV) on infant mortality in Nigeria. The ARDL Bound testing confirmed that, there is long-run relationship between healthcare expenditure and infant mortality in Nigeria for the period of study. The ARDL long-run coefficients further confirmed that, public investment on child support programmes (CSPEX) and improving Nutrition (NUTINV) exhibited long run positive impact on infant mortality in Nigeria. On the other hand, public investment on children immunization (IMMINV) and education (EDUINV) exhibited long-run negative impact on child mortality in Nigeria. The estimated co integration error correction term (ECT) was negative and statistically significant indicating that, the speed of adjustment at which the previous year's shock of the explanatory variables converging back to the long-run equilibrium in the current year is approximately 31%. In line with the findings, the study recommended for the Nigerian government to make concerted efforts towards proper health-fund coordination to enhance nutrition security, corroborate with traditional, non-governmental as well as international organization to intensify sensitization on immunization programs and activities, mobilize and monitor disbursement of funds meant to finance programmes that will support child rights, healthy development and general wellbeing of the children.

Keywords: Child Support, Immunization, Nutrition, Child Education, Infant Mortality

Introduction

Child mortality is a very disturbing demographic experience especially in developing countries, which has fascinated the attention of various stakeholders including researchers and policymakers. Today, combating this scourge is considered a key policy objective and strategy. At the same time, international organizations, such as the United Nations Children's Fund (UNICEF), the World Bank and the World Health Organization (WHO) have incorporated the objective of reducing child mortality in most of their future programmes (WHO, 2018).

According to WHO (2022), substantial global progress has been made in reducing childhood mortality since 1990. The total number of under-5 deaths worldwide has declined from 12.8 million in 1990 to 5 million in 2021. Since 1990, the global under-5 mortality rate has dropped by 59%, from 93 deaths per 1000 live births in 1990 to 38 in 2021. Globally, the number of neonatal deaths also declined, from 5.2 million in 1990 to 2.3 million in 2021. However, the decline in neonatal mortality from 1990 to 2021 has been slower than that of post-neonatal under-5 mortality.

There are approximately 6,400 newborn deaths every day, amounting to nearly 47% of all child deaths under the age of 5-years. Unfortunately, survival gains have stalled significantly since 2010, and 54 countries will fall short of meeting the SDG target for under-5 mortality and 63 countries will not achieve the SDG target for neonatal mortality. Unless swift action is not taken to improve health services and quality of care for newborns and children under-5, many young lives will be unnecessarily lost (WHO, 2022).

Globally, infectious diseases, including acute respiratory infections, diarrhoea and malaria, along with pre-term birth complications, birth asphyxia and trauma and congenital anomalies remain the leading causes of death for children under 5. Access to basic lifesaving interventions such as skilled delivery at birth, quality postnatal care, breastfeeding and adequate nutrition, vaccinations, and treatment for common childhood diseases can save many young lives (WHO, 2022). Children continue to face tragically differing chances of survival based on where they are born. In fact, two regions, sub-Saharan Africa and southern Asia, account for more than 80% of the 5 million under-5 deaths in 2021. In addition, Sub-Saharan Africa had the highest neonatal mortality rate in 2021 at 27 deaths per 1 000 live births, followed by Central and Southern Asia with 22 deaths per 1 000 live births. In fact, a child born in sub-Saharan Africa is 11 times more likely to die in the first month of life than a child born in the region of Australia and New Zealand (WHO, 2022).

There has been a myriad of initiatives and programmes geared towards improving the health status of Africans. Some of the programs include Coca Cola Africa Foundation, with special focus on malaria and HIV/AIDS, Global Alliance for Africa, with special focus on women and children, Action Health Incorporated (AHI), aimed at improving the health of adolescents, the UNICEF strategy called Integrated Maternal, Newborn and Child Health (IMNCH) and several others. With all these put in place, child mortality still remains a challenge in West Africa, and health is necessary for economic growth, especially in a country like Nigeria with the majority of the rural population, including children, are actively involved in agricultural and other labour-intensive means of sustenance.

According to the Nigeria Demographic Health Survey (NDHS, 2018), the under-five mortality rate in Nigeria is 132 per 1,000 live births meaning that 1 in 8 Nigerian children never reach the age of 5. Infant deaths, which account for half of child mortality, have declined from 87 per 1000 live births in 1990 to 67 in 2018. One (1) Nigerian woman dies in childbirth every 10 minutes, and 1 Nigerian child under-5 years of age dies every minute (NPC, 2019).

To achieve this target, global efforts were galvanized to produce technologies that would ensure child health the world over. The production and distribution of effective vaccines and technology that protect children against the known childhood killer diseases were promoted. The primary health care (PHC) system in every country of the world was identified as the main driver for successful struggle against childhood deaths. The PHC centres were expected to provide the platform for the delivery of ante-natal and post-natal care for women, during which the babies would also be immunized against childhood killer diseases. Consequently, one primary function of the health centres was to promote access to health interventions and thus reduce childhood mortality.

Although child mortality has decreased dramatically since 1990, Nigeria is yet to meet the Sustainable Development Goals (SDGs) targets, regardless of national and international implementation projects on the reduction of mortality. Previous empirical studies in Nigeria and several developing countries revealed numerous predictors of mortality (Oluyemi & Omolara,

2020; Daniel, Nazeem, Pammla & Elon, 2020; Liliana & Christian, 2019; Ashagidigbi, Adewumi, Olagunju & Ogunniyi, 2018; Ayinmoro, Fayehun & Ogunsemoyin, 2019). These findings triggered intervention initiatives which aimed to identify the factors responsible for the high mortality rates and the most appropriate techniques for tackling them. Nigeria is yet to meet the Sustainable Development Goals (SDGs) targets, regardless of national and international implementation projects on the reduction of mortality. The literature is hence inconclusive on the issue of health investments and corresponding health outcomes, and this study sought to revisit the issue and hence examine the impact of health care investments on infant mortality in Nigeria.

However, The Millennium Development Goals (MDGs) have set targets for development in African nations that signed up for the programme. Of the set targets, the MDG 4 is centered on reducing child mortality by two-thirds, by the year 2015. The target was set in 1990. With the current rate of decline in child mortality rates in Africa, south of the Sahara, the target rate of child deaths will not be achieved. There has been a myriad of initiatives and programs geared towards improving the health status of Africans. Some of the programs include Coca Cola Africa Foundation, with special focus on malaria and HIV/AIDS, Global alliance for Africa, with special focus on women and children, Action Health Incorporated (AHI), aimed at improving the health of adolescents, the UNICEF strategy called Integrated Maternal, Newborn and Child Health (IMNCH) and several others. With all these put in place, child mortality still remains a challenge in West Africa, and health is necessary for economic growth, especially in a country like Nigeria with the majority of the rural population, including children, are actively involved in agricultural and other labour-intensive means of sustenance.

Tackling the death of children, whether during prenatal, early or late neonatal, childhood or adolescent age is posing a difficult task in Nigeria. Studies have shown that mortality rates and risk factors varied by bio-demographic and socio-economic characteristics (Addisalem, Abebaw & Engidaw, 2020; Sanni, Michael, Godson, Shah, Ghose & Bernard, 2023). The factors associated with childhood mortality from studies done in Ethiopia and Benin Republic were place of residence, mothers' educational level, religion, current breastfeeding status, type of birth, sex of child, birth order, and family size and lack of mother's postnatal check-up visits after delivery (Addisalem, Abebaw & Engidaw, 2020; Sanni, Eugene & Nicholas, 2020). In Nigeria similar factors associated with under-five mortality were reported as wealth index, age at first birth, religion of fathers and mothers, lack of parental formal education, poverty and living in rural areas, season of birth, inter-pregnancy interval and distance from health care facilities (Sanni, Michael, Godson, Shah, Ghose, & Bernard, 2023).

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Conceptual Clarifications

Child Health Care Investment

The concept of healthcare investment conveys different meaning to different people at different levels. Kerry (2021) pointed that, healthcare investment spend by venture capitalists is often seen

as an indicator of where current and future technology needs may be present within healthcare. These needs can be driven by factors including patient needs/expectations, societal changes, technological advances and others. Health investment are these days often carried out in areas like behavioural health, remote patient monitoring (RPM), telehealth, cybersecurity, virtual fitness and others. Health Investments are being driven by high utilization, changes in reimbursement policy from both government and private payers, and remote patient monitoring opportunities. Telehealth can drive efficiency and improve cost, while also allowing expanded access to care and reduced patient demand on facilities. Preventative population health management leveraging telemedicine also helps reduce avoidable readmissions to the emergency department by engaging patients more frequently at a lower cost.

Similarly, World Health Organization (2020) opined that, investment for health and well-being means investing to achieve the highest attainable standard of health for all at all ages, within each country and across countries. Human health and well-being are interrelated with sustainable development in a complex, bidirectional and dynamic way, in that investment in population health while leaving no one behind enables all three dimensions of sustainable development (social, economic and environmental), while investing in a healthy planet with inclusive and sustainable growth and fair and secure societies leads to healthy, happy, resilient and empowered people, families and communities. When attempting to assess investment for health and well-being, the basic financial concept of return on investment needs to be extended to take in a wider concept of value, capturing aspects across the triple bottom line of economic, social and environmental value. Decisions made purely on costs and instant return may not reflect wider and longer-term benefits. This led to the Social Return on Investment (SROI) evaluation method, which aims to capture not only the financial aspect (i.e. monetary or monetarized economic and socioeconomic benefits) but also the social aspects, such as empowerment, social cohesion and political participation, which are assessed in different quantitative and qualitative ways.

In the same vein, David and Bobby (2018) defined as health investments formal expenditures to either produce or care for health, stressing that many aspects of health and well-being are not commodities to be exchanged in a marketplace, but rather goods to be preserved through the commonwealth. Therefore, governments at every level are well positioned to balance investments through the use of tools such as appropriations, tax policies, and mandates. Even though federal, state, and local budgets may be stressed, government investments in population health and well-being are among the more promising opportunities to drive long-term economic and social vitality. In many jurisdictions, elected leaders and voters have come to support increased investments in programs such as early childhood development.

Children Immunization Expenditure

The meaning of concept of children immunization expenditure has been provided by different authorities and scholars. WHO (2022) views immunization expenditure as the expenditure indicators included in the WHO and UNICEF Joint Reporting Form (JRF) aim to capture spending on routine immunization, and on vaccines. These are key elements of the financial sustainability of immunization programmes. Since 1990s, the WHO and UNICEF Joint Reporting Form (JRF) mechanism has been collecting data on immunization expenditure indicators as part of a set of immunization indicators designed to measure system performance and trends in WHO Member States (WHO, 2022).

In addition, WHO (2021) provided a situation analysis of immunization expenditure report which seeks to disseminate current knowledge on immunization expenditure to support policy-makers in making evidence-based decisions. Key facts are presented as responses to common questions. Reported data showed that, globally, US$ 68 was spent on immunization per surviving infant (or US$ 1.30 per capita). This represented 0.02% of the world's gross domestic product and 0.3% of current health expenditure. Large differences existed between country income groups in reported spending levels on immunization and the share they represent of resources allocated to immunization. Reported data indicated that as countries became richer, they spent more on immunization per capita (possibly due to higher vaccine prices and delivery cost) and governments paid an increasing share of total immunization spending (replacing external aid). The proportion of public spending, of health expenditure and of gross domestic product, estimated from countries' reported spending on immunization, declined as countries became richer.

Furthermore, Olumide, Chidiabere, Akinyede, Pamela and Kenneth (2017) reported that, Nigeria has an estimated population of 186 million with 23% of eligible children aged 12-23 months fully immunized. Government spending on routine immunization per surviving infant has declined since 2006 meaning the immunization budget needs to improve. By 2020, Nigeria will be ineligible for additional Global Alliance for Vaccination and Immunization (Gavi) grants and will be facing an annual vaccine bill of around US$426.3m. There are several potential revenue sources that could be utilized to fill the potential funding gap, these are however subject to timely legislation and appropriation of funds by the legislative body. Innovative funding sources that should be considered include tiered levies on tele-communications, airline, hotel, alcohol, tobacco, sugar beverage taxes, lottery sales, crowd-sourcing, optimized federal state co-financing etc.

However, Benjamin, Ogoamaka and Obinna (2014) opined that, Immunization is one of the most cost-effective public health interventions to reduce child mortality. In Nigeria, vaccine-preventable diseases account for approximately 22% of childhood deaths, per year. It is the policy of the Federal Government of Nigeria to provide immunization services and potent vaccines free to all population at risk of vaccine preventable diseases. However, the cost of vaccines is spiraling with new ones being introduced. Also, current international financing for vaccines is not sufficient to sustain both progress in coverage and the introduction of the new vaccines. Therefore, it has become pertinent to explore how immunization is financed in Nigeria. Internet searches were conducted in Pubmed and Medline databases and Journal hosts including African Journal Online (AJOL) and Health Inter Network Access to Research Initiative (HINARI) using specific search terms and strategies. Grey literature was obtained by soliciting reports from the federal Ministry of Health and major organizations involved immunization and from international reports. The Nigerian health system is generally funded from federation account. Funding of immunization services is the collective responsibility of all tiers of government through statutory budgetary allocation from the Federal, State and Local Government Areas. Other sources include external donors, development partners, private sector and the community. However, these funds are disproportionately captured by the rich at the expense of the poor and by the urbanites at the expense of the rural dwellers as depicted in measles immunization coverage. There are lots of financing bottle neck in financing immunization including inadequate funds, delays in release of designated funds, inefficient use of funds, non-sustainable financing by donors, unintended consequences of Polio eradication initiative and poor integration as well as non-profitability of vaccines.

Nutrition Expenditure

Conceptualizations of nutrition expenditure have been provided authoritatively. Hiroyuki, Jenny and Xinshen (2021) defined public expenditure on improving Nutrition as expenditure's used to reducing poverty and improving food and nutrition security. Public expenditures (PE), their sizes, and allocations across sectors, are some of the important instruments for the public sector to contribute toward sustainable development goals (SDGs). However, knowledge gaps remain as to how PEs have actually contributed to key SDG outcomes in the past, including the eradication of poverty and hunger, and the improvement in food and nutrition security in sustainable manners (SDGs 1 and 2). PEs in different sectors has been significantly associated with key indicators under SDGs 1 and 2. Specifically, greater PEs for agriculture and health sectors have had relatively positive effects on total factor productivity growth in agriculture, reduced consumer food price indices, reduced poverty, reduced stunting, underweight or overweight among children under 5.

In a similar tune, Wang, Shibata, Winoto, Tanimichi, Qureshy and Ghimire (2022) opined that, Nutrition investments affect human capital formation, which in turn affects economic growth. Malnutrition is intrinsically connected to human capital. Under nutrition contributes to nearly half of child mortality, and stunting reduces productivity and earnings in adulthood. Improving nutrition requires a multisectoral effort, but it is difficult to identify and quantify the basic financing parameters as used in traditional sectors. What is being spent and by whom and on what? To address these questions, nutrition public expenditure reviews (NPERs) determine the level of a country's overall nutrition public spending and assess whether its expenditure profile will enable the country to realize its nutrition goals and objectives. When done well, NPERs go beyond simply quantifying how much is spent on nutrition; they measure how well money is being spent to achieve nutrition outcomes and identify specific recommendations for improvement. A Guiding Framework for Nutrition Public Expenditure Reviews presents the key elements of an NPER and offers guidance, practical steps, and examples for carrying out an NPER.

More so, Olutayo, Yeside and Victor (2023) asserted that, financial resources that are commensurate with the magnitude of malnutrition problem are requisite for effective interventions to reduce malnutrition. Understanding the amount and nature of sectoral investments in nutrition is important for advocating and mobilizing increased government budgetary allocations and release. Analyzing agricultural budgets from 2009 to 2022 of Nigeria's federal government, Nutrition-related budget lines were identified using a keyword search and were then classified as nutrition-specific, nutrition-sensitive, or potentially nutrition-sensitive, based on defined criteria. Potentially nutrition-sensitive items were further screened. Budget lines finally included as nutrition allocations directly targeted improvements in nutrition or intermediate outcomes in pathways between agriculture and nutrition. Budget lines were summed, and these nominal values were adjusted for inflation (using the consumer price index for each year) to obtain real values. Nutrition allocations in the agriculture budget increased considerably even after adjusting for inflation and went from 0.13% of agriculture capital budget in 2009 to 2.97% in 2022; while the real value of total government agricultural budget declined. Large budgetary increases coincided with the development/launch of costed strategies with nutrition-sensitive agriculture components. Still, there were some missed opportunities to increase nutrition allocations (Olutayo, Yeside & Victor, 2023).

Education Expenditure

Different authors and organization provided the meaning of education expenditure at different times. Noel (2020) defined public expenditure on education as the component of education expenditure that comes from national, regional, and local government units to finance and/or produce educational services. Under UNESCO's National Education Accounts (NEA) framework, a country's education expenditure comes from three main sources: government or public sector, private sector (households and firms), and rest of the world (through grants and aid) (UNESCO, 2016). These funds may be used for different levels of education including preprimary, primary, secondary, technical-vocational, tertiary, and nonformal. Educational expenditure includes current expenditures (such as teaching and nonteaching staff compensation, textbooks and other teaching materials, and other goods and services) and capital expenditures.

UNESCO (2014) defined public expenditure on education as total current and capital expenditure on education by local, regional and national governments, including municipalities. Household contributions are excluded. The term covers public expenditure for both public and private institutions.

Similarly, OECD (2015) defined expenditure on education as an investment that can foster economic growth, enhance productivity, contribute to personal and social development and reduce social inequality. The proportion of total financial resources devoted to education is one of the key choices made by governments, enterprises, students and their families. The demand for high-quality education, which can translate into higher costs per student, must be balanced against other demands on public expenditure and the overall tax burden. Policy makers must also balance the importance of improving the quality of educational services with the desirability of expanding access to educational opportunities.

Relatively, World Bank (2023) views public expenditure on education as government expenditure on education, total (% of government expenditure). Public expenditure on education consists of current and capital public expenditure on education includes government spending on educational institutions (both public and private), education administration as well as subsidies for private entities (students/households and other private entities. In Nigeria, public expenditure on education was reported at 5.1402 % in 2021, according to the World Bank collection of development indicators, compiled from officially recognized sources.

Child Support Programmes Expenditure

Public expenditure on child support programmes conveys' different meaning to scholars' international as well as non-governmental organizations. UNICEF (2014) defined public expenditure on children support programme as "the amount of public resources used to finance programmes (or their components) that specifically or indirectly promotes the wellbeing of children and the fulfilment of child rights, regardless of the administrative body, the sector, the funding source or economic classification (current or capital expenditures)" To identify and classify the child-focused social expenditure in the country, a three-stage approach is used. First, a set of basic preliminary steps to provide a general background and overview of the county and its budgetary allocation will be carried out. Second, the objectives of each of the budgetary programmes will be revised and, based on their specific objectives and the target population; programmes will be classified as either child-focused or non-child-focused. Finally, as a third

stage, child-focused expenditure will be classified using two different analytical criteria for the analysis (Economic and Children's rights).

In the same vein, OECD (2023) views expenditure on child support programmes as public spending on family benefits, including financial support that is exclusively for families and children. Spending recorded in other social policy areas, such as health and housing, also assist families, but not exclusively, and it is not included in this indicator. Broadly speaking there are three types of public spending on family benefits: Child-related cash transfers (cash benefits) to families with children, including child allowances, with payment levels that in some countries vary with the age of the child, and sometimes are income-tested; public income support payments during periods of parental leave and income support for sole parents' families. Public spending on services for families (benefits in kind) with children, including direct financing and subsidizing of providers of childcare and early education facilities, public childcare support through earmarked payments to parents, public spending on assistance for young people and residential facilities, public spending on family services, including centre-based facilities and home help services for families in need. Financial support for families provided through the tax system, including tax exemptions (e.g. income from child benefits that is not included in the tax base); child tax allowances (amounts for children that are deducted from gross income and are not included in taxable income), and child tax credits, amounts that are deducted from the tax liability. This indicator is broken down by cash benefits and benefits in king and is measured in percentage of GDP.

Furthermore, Peter (2023) opinioned that programs to support children are a key component of the federal budget, representing a critical investment in the nation's future, helping to alleviate child poverty and supporting the next generation of productive adults. The latest kid's share report from the Urban Institute provides a view of resources targeted to children, placing such spending in the larger context of the country's budget. The report contains valuable insights about federal spending and tax incentives designed to help children and how those activities compare to other priorities within the budget.

Infant Mortality

The concept of infant mortality has been defined differently by scholars and organizations. UNICEF (2021) defined infant mortality or the under-five mortality rate as the probability of a child dying between birth and exactly 5 years of age, expressed per 1,000 live births. There are different ways to calculate the under-5 mortality rate, depending on the data collection method. Globally, infectious diseases, including pneumonia, diarrhoea and malaria, remain a leading cause of under-five deaths, along with preterm birth and intrapartum-related complications.

World Health (WHO) (2019) views infant mortality as the mortality of children under the age of five. The child mortality rate, also under-five mortality rate, refers to the probability of dying between birth and exactly five years of age expressed per 1,000 live births. It encompasses neonatal mortality and infant mortality (the probability of death in the first year of life).

Nevertheless, Markéta (2015) pointed that child mortality is a sensitive indicator of social progress and disparities, in the twentieth century, the chances of surviving the period of infancy would rarely exceed 80%. General improvement in nutrition and childcare, followed by key medical discoveries and public health action, resulted in an unprecedented secular decline in infant

mortality, which took place in all industrialized countries and which continues until present. Nowadays, infant mortality primarily depends on the neonatal survival of high-risk babies born preterm or with low birth weight.

Empirical Review

It is important to provide empirical evidences on the impact of healthcare investment on infant mortality in Nigeria and other part of the globally as provided by different scholars. Wenhui, David, Miriam, Katy, Etienne and Yewande (2023) estimate the health and financial risk protection benefits across different wealth groups in Nigeria if a policy of public financing of maternal, newborn, and child health (MNCH) interventions were to be introduced. The study did an extended cost-effectiveness analysis to estimate the health and financial risk protection benefits, across different household wealth quintiles, of a public-financing policy that assumes zero out-of-pocket costs to patients at the point of care for 18 essential MNCH services. The analysis shows that, public financing of essential MNCH interventions in Nigeria would provide substantial health and financial risk protection benefits to Nigerian households. These benefits would accrue preferentially to the poorest quintiles and would contribute towards reduction of health and socioeconomic inequalities in Nigeria. The distribution would be more pro-poor if public financing of MNCH interventions could target poor households.

Similarly, Charles and Simon (2020) examined Nigeria's critical dimensions of infant mortality and access to primary health centres (PHCs) as behavioural tendencies capable of shaping the present and future of infancy, childhood, the family and the nation, using Bwari community as a case study. Thus, the emphasis is on the environment, attitudes and behaviours that shape the present and prepares the future development of children and society. The research employed qualitative and quantitative methods with testable hypotheses. Findings reveal that respondents' socio-economic characteristics intermediate on extent of accessing available health care facilities. The respondents' relatively high literacy, urban residency and civil service jobs, health talks from medical professionals, free medical treatment and, very importantly, zero infant mortality outcome, suggest that environment, human capital quality and health outcomes have relationships. Yet, Nigeria records one of the worst global health indices, suggesting a scenario of two nations, driven by an exclusive governance model that perpetuates social inequality, and glaring rural neglect.

Furthermore, Adeagbo (2020) attempt to provide empirical evidence of the impact of public health expenditure on infant mortality rate in Nigeria between 1991 and 2018 using time series data. The Fully Modified Ordinary Least Square (FMOLS) analytical method was used to examine the relationships. Various robustness checks were carried out to ensure the reliability of the result for policy makers. Findings revealed that all variables employed positively impacted INFM except for Diphtheria, Pertussis, and Tetanus (DPT) immunization and female literacy rate.

In the same vein, Eboh and Metiboba (2021) used annual panel data to assess the effect of health-care expenditure and immunization on the under-five mortality rate in 30 selected African countries for the period 2000- 2017. Multiple regression technique was adopted for the data analysis and the robust fixed regression estimator was preferred to the random effects as determined by Hausman test. The findings indicated that domestic government general health expenditure had a significant negative effect on the under-five mortality rate. However, the effect of domestic private health expenditure on under-five mortality was not significant while external health expenditure had a significant negative effect on under-five mortality rate. The impact of

diphtheria immunization on under-five mortality was significant. It was concluded that, except domestic private health expenditure, government and external forms of health expenditure coupled with diphtheria immunization were significant factors for the reduction of the under- five mortality in the selected countries.

Nevertheless, Yannick (2022) analyzes the impact of malnutrition on infant mortality and life expectancy in a sample of 36 African countries during the 2003 to 2018 period. The economic implications of malnutrition are examined through the vicious cycle of poverty, malnutrition, low productivity, and further malnutrition. It was hypothesized that malnutrition at infancy contributes to high mortality and leads to lower labor productivity in adults through the reduction of their life span, because more and more skilled laborers leave sooner. The results of the two-way, fixed-effect panel model strongly showed that mild or moderate malnutrition reduces infant mortality, whereas severe malnutrition leads to an increase in deaths among children under 5. The results show a mitigated impact of malnutrition on life expectancy. Also, growth in the gross domestic product significantly reduced the infant mortality rate, but any increase in income per capita was not followed by a reduction of death in children.

On the contrary, Michael and Jessica (2020) examine the relationship between maternal nutrition and infant mortality and found good evidence linking poor maternal nutrition to several leading causes of infant mortality, including birth defects, preterm birth, fetal growth restriction, and maternal complications of pregnancy (preeclampsia, anemia, infections/ inflammation). Maternal folate and B12 deficiencies have been associated with neural tube defects, while deficiencies in B vitamins, vitamin K, magnesium, copper, and zinc have also been linked to other birth defects.

On the other hand, Hanbo (2022) examines the effect of maternal education on child mortality in Bangladesh by exploiting quasi-experimental variations in the duration of exposure to a school stipend project for identification. Results from the instrumental variable estimation indicate that an additional year of maternal schooling reduces both under-five and infant mortality by about 20 percent. The findings are statistically significant and robust to a number of model specifications, including survival models controlling for right censoring of child mortality. Analysis of potential mechanisms suggests that maternal education reduces child mortality through greater wealth and literacy, positive assortative mating, lower fertility, delayed marriage and childbearing, greater health-related knowledge, better health-seeking behaviors, and female empowerment, but not through female employment.

More so, Ayinmoro, Fayehun, Ogunsemoyin (2019) examined the interaction of maternal education and household environment on child mortality in Nigeria. Using Mosley and Chen's analytical framework, 45,603 children (12-59 months) were selected from NDHS 2013 dataset. Interaction of maternal education and household environment was found to be significant ($p<0.05$) predictor of child mortality in Nigeria. Children aged 12 to 59 months that live in a disadvantaged household environment and whose mothers do not have formal education have a higher risk of child mortality than those with formal education. This study confirms the significance of maternal education to child survival in Nigeria.

Relatively, Ashagidigbi, Adewumi, Olagunju and Ogunniyi (2018) investigated the linkage and effect of maternal education and household wealth on incidence of child mortality in rural Nigeria. The study made use of data obtained from the 2013 Nigeria Demographic and Health Survey (NDHS2013). Logit, probit and Principal Component Analysis models were the analytical techniques adopted. The findings revealed that mothers residing in the north-west

recorded the highest percentage of no formal education (54%). Also, asset deprivation (poverty rate) is 63%, though higher in the northern divide than in the south. About 44 percent of the rural households recorded child mortality, with north-west households having the highest. The results revealed that maternal education improves households' wealth; also, households with low level of maternal education and wealth index have the likelihood of recording higher child mortality rate in rural Nigeria.

In an attempts to explore the contributing factors that cause high infant and child mortality rates in 14 African countries using panel data for the period of 2000–2018, Mohammad, Khosrul and Rasheda (2022). The panel corrected standard error (PCSE), the Feasible generalized least square (FGLS) models, and the pair-wise Granger causality test have been applied as methodological approaches. The public health expenditure, numbers of physicians, globalization, economic development, education, good governance, and HIV prevalence rate have been revealed as the determinants of infant and child mortality in these countries. All these variables except the HIV prevalence rate negatively affect the infant and child mortality rates, while the HIV prevalence rate is found to be positive. Bidirectional and unidirectional causal relationships between the variables are also attained.

However, Fagbamigbe, Salawu, Abatan and Ajumobi (2021) identified the compositional and contextual factors associated with under-five (U5M) and infant (INM) mortality in Nigeria from 5 MCMC Bayesian hierarchical Poisson regression models as approximations of the Cox survival regression model. The 2018 DHS data of 33,924 under-five children were used. Life table techniques and the Mlwin 3.05 module for the analysis of hierarchical data were implemented in Stata Version 16. The overall INM rate (INMR) was 70 per 1000 live births compared with U5M rate (U5MR) of 131 per 1000 live birth. The INMR was lowest in Ogun (17 per 1000 live births) and highest in Kaduna (106), Gombe (112) and Kebbi (116) while the lowest U5MR was found in Ogun (29) and highest in Jigawa (212) and Kebbi (248). The risks of INM and U5M were highest among children with none/low maternal education, multiple births, low birth weight, short birth interval, poorer households, when spouses decide on healthcare access, having a big problem getting to a healthcare facility, high community illiteracy level, and from states with a high proportion of the rural population in the fully adjusted model. Infant- and under-five mortality in Nigeria is influenced by compositional and contextual factors.

Also, Phommachanh, Essink, Wright, Broerse, Mayxay (2021) investigated maternal health literacy on mother (MHL) and child health care using community cluster survey in two southern provinces in Laos. The cross-sectional survey was conducted using a questionnaire on health literacy in relation to care during pregnancy, childbirth, and the postpartum period. The study interviewed 384 mothers with children aged under five years; 197 from urban and 187 from rural areas. Descriptive and inferential statistics were applied to analyze the data. It was found that, overall, MHL of Lao mothers was very low in both urban and rural areas; 80% of mothers had either inadequate or problematic MHL, while only 17.4% had sufficient and 3.5% excellent MHL. The MHL scores were significantly higher in urban than in rural areas. One third of mothers found it very difficult to access, understand, appraise and apply information on mother and child (MCH). Health personnel were the main source of MCH information for the mothers. Years of schooling, own income, health status, and number of ANC visits significantly predicted a higher level of MHL.

Assessing whether government health expenditures have an impact on the health sector performance in Nigeria for the period (1979-2019), Gwaison (2021) employs the expo facto

research design. The annual time series data were sourced from World Development Indicators (WDI) and the Statistical Bulletin of the Central Bank of Nigeria (CBN) for several years. The dynamic ordinary least square (DOLS) estimation method is employed to measure the coefficient of the parameters to test the four hypotheses developed. The findings of the study indicate that capital health expenditure and recurrent health expenditures are positively related to the performance of the health sector proxy by life expectancy rate but statistically insignificant. However, capital health expenditure is statistically significant to life expectancy.

Similary, Onofrei, Vatamanu, Vintil and Cigu (2021) empirically analyze the relationship between public health expenditure and health outcomes among EU developing countries and further studied how the status of good governance, health care system performance, and socioeconomic vulnerabilities affect the public health's outcomes in the selected countries. Using regression analysis and factor analysis, the study documented that public health expenditure and health outcomes are in a long-run equilibrium relationship and the status of health expenditure can improve life expectancy and reduce infant mortality. It was further found that, the effectiveness of health and the way to reduce infant mortality or to improve life quality is directed conditioned by good governance status. Moreover, the consolidation of health care system performance directly improves the quality of life among EU developing countries.

Looking at the contribution of the health expenditure by the government on under-five mortality in Nigeria, Dominic, Romanus, Mary and Abigail (2020) employed the autoregressive distribution lag technique in examining the long-run effect of public health expenditure on under-five mortality in Nigeria. Data were sourced from the World Development Indicators for the period 1985–2017. Results from the study showed that though public health expenditure is statistically significant, it showed a positive relationship with the under-five mortality. The implication of this result is that 1 unit increase in public health expenditure would improve increase under-five mortality rate by 1.56 units. However, in the Nigerian context, this can be better explained by the lack of proper health-fund coordination and other factors such as maternal education.

In a related study, Oluyemi and Omolara (2020) analyzed empirically the impact of healthcare expenses on the mortality level of infants as well as Nigeria's neonatal mortality level. Vector auto regression model techniques, unit root tests and cointegration test were carried out using time series date for the period between 1986 and 2016. The outcome has revealed that expenditure on healthcare possesses a negative correlation with the mortality of infants and neonates. The study discovers that if the Nigerian government raises and maintains health expenditure specifically on activities focused on minimizing infant mortality, it will translate to reduction in infant mortality in Nigeria.

Nevertheless, Daniel, Nazeem, Pammla and Elon (2020) identified the social determinants of age-specific childhood (0–59 months) mortalities, which are disaggregated into neonatal mortality (0–27 days), post-neonatal mortality (1–11 months) and child mortality (12–59 months), and estimate the within-and between-community variations of mortality among under-five children in Nigeria. Using the 2016/2017 Nigeria Multiple Indicator Cluster Survey, the study performed multilevel multinomial logistic regression analysis on data of a nationally representative sample of 29,786 (weighted = 30,960) live births delivered 5 years before the survey to 18,497 women aged 15–49 years and nested within 16,151 households and 2227 communities. Unexpectedly, attendance of skilled health providers during delivery was associated with an increased neonatal mortality risk, although its effect disappeared during post-neonatal and toddler/pre-school stages. Also, our study found maternal-level factors such as maternal education, contraceptive use, maternal wealth

index, parity, death of previous children, and quality of perinatal care accounted for high variation (39%) in childhood mortalities across the communities. The inclusion of other compositional and contextual factors had no significant additional effect on childhood mortality risks across the communities.

On the other hand, Bolu-Steve, Adegoke, and Kim-Ju (2020) investigated the cultural beliefs about infant mortality among working mothers in Nigeria. A multistage sampling technique was used to sample (N = 2400) working mothers on their cultural beliefs in relation to infant mortality. The study used an indigenous questionnaire, "Cultural Beliefs of Infant Mortality Questionnaire (CBIMQ)." A series of hierarchical regressions and analysis of covariance (ANCOVA) were employed to test the hypotheses that cultural beliefs about infant mortality would vary by geography, ethnicity, age, income, education, and marital status. Findings revealed that age, education, and mothers' monthly income significantly predicted working mothers' cultural beliefs of infant mortality. Furthermore, results showed differences in marital status, urban vs. rural locality, ethnicity, and religious affiliation on working mothers' cultural beliefs of infant mortality.

Further study by Okwuwa and Adejo (2020) examined Nigeria's critical dimensions of infant mortality and access to primary health centers (PHCs) as behavioral tendencies capable of shaping the present and future of infancy, childhood, the family and the nation, using Bwari community as a case study. The research employed qualitative and quantitative methods with testable hypotheses. Findings reveal that respondents' socio-economic characteristics intermediate on extent of accessing available health care facilities. The respondents' relatively high literacy, urban residency and civil service jobs, health talks from medical professionals, free medical treatment and, very importantly, zero infant mortality outcome, suggest that environment, human capital quality and health outcomes have relationships.

In the same vein, Uche (2020) analyze the relationship between public health spending and health outcome using time series data in Nigeria over the period 1980 to 2017. The used the Hausman statistical tests to check for the existence of endogeneity, the proper method for estimating the model for this study is the two-stage least square regression model. The results showed that public health spending had no significant effect on health outcome except when interacted with governance quality. The interaction of government health spending with governance effectiveness as well as that for control of corruption improved health by inducing a fall in maternal deaths, whereas government health expenditure interacted with rule of law raised maternal mortality. Public health spending interacted with regulatory quality improved life expectancy while that for political stability with public health spending induced a fall in life expectancy, poor maternal and infant health. Political stability and the control of corruption had direct influence on maternal health.

Moreover, Bello (2020) sought to assess the relationship among expenditure on public health, governance as well as health outcomes. For the empirical analysis, the study adopts data ranging from 1985 to the year 2018. The study made use of an error correction model (ECM) for the short run analysis while an autoregressive distributed lagged (ARDL) model was adopted for examining the long run relationships between the variables of the study. The result showed that public expenditure on health has a positive significant impact on life expectancy in Nigeria. The result also shows that increase in public expenditure on health leads to a reduction in the infant mortality rate.

More so, Kingsley and Godwin (2019) examined government expenditure on primary healthcare services and infant mortality in Nigeria as well as its relations to real national output within the period 1980 to 2015 using secondary data and the Ordinary Least Square (OLS) econometric technique. The results of the model used revealed government health expenditure to be efficacious for economic growth, and for the well-functioning of primary health care in Nigeria.

Liliana and Christian (2019) investigated causal effect of maternal education on child mortality evidence from a quasi-experiment in Malawi and Uganda to identify such causal effect, the study exploited exogenous variation in maternal education induced by schooling reforms introducing universal primary education in the second half of the 1990s in Malawi and Uganda. Using a two-stage residual inclusion approach and combining individual-level data from Demographic and Health Surveys with district-level data on the intensity of the reform, it tested whether increased maternal schooling reduced children's probability of dying before age 5. In Malawi, for each additional year of maternal education, children have a 10 % lower probability of dying; in Uganda, the odds of dying for children of women with one additional year of education are 16.6 % lower. The study also explored which pathways might explain this effect of maternal education. The estimates suggest that financial barriers to medical care, attitudes toward modern health services, and rejection of domestic violence may play a role. Moreover, being more educated seems to confer enhanced proximity to a health facility and knowledge about the transmission of AIDS in Malawi, and wealth and improved personal illness control in Uganda.

Investigating further, Joshua and Adedeji (2019) examined the relationship among health expenditure, health outcomes and economic growth in Nigeria for the period between 1981 and 2017. This study adopted the TodaYamamoto causality framework to examine these relationships. The Augmented Dickey Fuller unit root test was used to check for maximum order of integration of the variables used in the study and the result was one while the Autoregressive Distributed Lag (ARDL) Bounds test approach to cointegration was used to investigate if a long-run relationship exists among the macroeconomic variables used in the study and the result was in the affirmative. The results of the Toda-Yamamoto causality tests showed a unidirectional causality running from health expenditure to infant mortality while there is no causality between real GDP and infant mortality; a unidirectional causal relationship running from health expenditure and real GDP to life expectancy and maternal mortality; and a unidirectional causal relationship running from real GDP to health expenditure.

On a larger scale, Mohsen, Sara, Roohollah, Mohsen and Hasan (2019) determined the effect of macroeconomic indicators on health expenditure. This study was descriptive analytical. The required data related to macroeconomic indicators and health expenditure in public and private sectors were collected during 1995–2014. The data were analyzed using the time series models in econometrics, Vector Auto Regression, and Granger causality technique. The results of this study indicated that health expenditure has a positive bilateral relationship with gross domestic production (GDP), gross national production, national income, and national consumption. On the contrary, expenditure has a negative bilateral relationship with liquidity rate and inflation rate. In addition, budget deficit has a negative unilateral relationship with health expenditure while population rate has a positive unilateral relationship with health expenditure.

Furthermore, Sanni, Lee and Hammel (2018) examined the impact of primary healthcare services on the mortality patterns among under 5 children and maternal factors associated with under-5 deaths. Secondary data from five sub-Sahara Africa countries; Chad, Democratic Republic of Congo, Mali, Niger and Zimbabwe were used in the study. Multivariable Cox proportional hazards

regression was used to model maternal factors associated with under-five mortality. The results showed that under 5 mortality rates (per1,000 live births) was;133 in Republic of Chad, 104 in Democratic Republic of Congo,95 in Mali, 127 in Niger, and 69 in Zimbabwe. Several maternal and child level factors were found to be significantly associated with under-five mortality. Lack of spousal support (not currently married) resulted to increase in under-five mortality.

In further study by Biradara, Kumar and Prasad (2018) to examine the effect of primary healthcare, birth interval and wealth on under-5 child mortality in Nigeria, Data were collected from the Nigeria Demographic and Health Survey, which is a nationally representative cross-sectional survey. Bi-variate and Cox regression technique were applied for analysing the cross-sectional data drawn from representative survey. The results showed under-5 mortality was higher in mothers who were poor, illiterate and working either as a professional/technical worker or as an agricultural worker. Children whose mothers were illiterate and had less than two years of the birth interval had the highest under-5 mortality. Younger mothers (aged less than 20 years) lost more children. Under-5 deaths were more among those mothers who were poor and had less than two years of birth interval. The child mortality was significantly high in poor households with low birth interval.

In a different study, Adetola and Omobowale (2018) provided insights into child immunization as a complement to unobservable factors responsible for mortality reduction. The ratio of the number of children not alive to the number of children born alive in a household is the measure of the household's child mortality rate. The National Living Standards Survey is the main source of data and the control function approach is the preferred estimation procedure. The estimation results reveal a strong link between access to immunization and reduction in mortality. The results show a robust inverse relationship between child immunization and child mortality. Literacy of mothers emerges as an important determinant of demand for child immunization. It is argued that improving girl-child education would increase demand for child immunization and reduce child mortality in rural Nigeria.

However, Adedeji and Nwokocha (2018) investigated maternal education and child mortality in Nigeria. Data were elicited from the Nigerian Demographic Health Survey of 2013 and were analyzed with both descriptive and inferential statistical techniques. The study found that, child mortality is particularly high among mothers without formal education and relatively lower among those with other levels of education although factors such as family size, religious affiliation, wealth index and sex of household head had strong influence on these women.

In a further study, Rajeshwari, Kamalesh and Jang (2018) examined effect of birth interval and wealth on under-5 child mortality in Nigeria. Data for this study comes from the Nigeria Demographic and Health Survey 2013, which is a nationally representative cross-sectional survey. This study uses information on 119,386 under-5 children to analyze the effect of wealth and birth interval on childhood mortality. Bi-variate and Cox regression technique were applied for analyzing the cross-sectional data drawn from representative survey. Results indicated that, Under-5 mortality was higher in mothers who were poor, illiterate and working either as a professional/technical worker or as an agricultural worker. Children whose mothers were illiterate and had less than two years of the birth interval had the highest under-5 mortality. Younger mothers (aged less than 20 years) lost more children. Under-5 deaths were more among those mothers who were poor and had less than two years of birth interval. The child mortality was significantly high in poor households with low birth interval.

Data Sources and Methodology

Secondary time series data were used for the study and sourced from annual statistical bulletin of National Bureau for statistics (NBS), World Development Indicators (WDI) and Central Bank of Nigeria (CBN) spanning from 1995 - 2023. The secondary data were collected through library and internet researches on the database sites of the relevant bodies.

Furthermore, the study employed Autoregressive Distributed Lag Model (ARDL) technique to examine the impact and long-run relationship among the variables. The ARDL model is a dynamic single-equation and standard least squares regressions that include lags of both the dependent variable and explanatory variables as regressors. It is a method of examining cointegrating relationships between variables which is applicable for both non-stationary time series as well as for times series with mixed order of integration.

In addition, the study adopted a model by Siyuan, James, Dahai and Qingyue (2019) with modification to examine causal-effect relationship between child mortality and health care investment in accordance to ARDL model specification. The ARDL model is composed of five variables, namely; infant mortality, public investment on immunization, Nutrition, Education, and Child support programmes.

Thus, the structural form of the ARDL model is specified as follows;

$$Y_t = \beta_0 + \beta_1 y_{t-1} + ... + \beta p y_{t-p} + \alpha_0 x_t + \alpha_1 x_{t-1} + \alpha_2 x_{t-2} + ... + \alpha_q x_{t-q} + \varepsilon_t. \quad (1)$$

where ε_t is a random "disturbance" term.

The model is "autoregressive", in the sense that y_t is "explained (in part) by lagged values of itself. It also has a "distributed lag" component, in the form of successive lags of the "x" explanatory variable. Given the presence of lagged values of the dependent variable as regressors, OLS estimation of an ARDL model will yield biased coefficient estimates. If the disturbance term, ε_t, is autocorrelated, the OLS will also be an inconsistent estimator, and in this case Instrumental Variables estimation was generally used in applications of this model.

The model is express in functional form as follows;

INFM = f(CSPINV, IMMINV NUTINV, EDUINV,) (2)

The model is express in stochastic form for estimation as follows;

$$INFM = \beta 0 + \beta_1 \log CSPINV_t + \beta_2 \log NUTINV_t + \beta_3 \log EDUINV_t + \beta_4 \log IMINV_t + U_t \quad (3)$$

Where;

INFM is Infant Mortality Rate

CSPINV is public investment on Child support programmes

IMMINV is public investment on children immunization

NUTINV is public investment on improving Nutrition

EDUINV is public investment on education

$\beta 0$ = intercept

β_1, β_2, β_3, β_4 = parameters

U_t = the stochastic error term

Results of the Findings

Analyses of Descriptive Statistics

The descriptive statistical properties of the data used for the study are presented in Table .1

Table 1: Summary of Descriptive Statistics of the Data

Statistic	INFM	CSPINV	IMMINV	NUTINV	EDUINV	GMINV
Mean	830317.8	294450.1	142.4828	95496.80	237.2336	145.5314
Median	831919.0	311059.5	134.7000	72847.00	157.3800	94.21000
Maximum	942539.0	376849.5	206.9000	186918.0	641.6100	419.4100
Minimum	714188.0	192359.5	100.2000	41957.00	9.750000	3.020000
Std. Dev.	87893.74	68534.53	37.45977	48101.63	208.9148	138.0494
Skewness	-0.017922	-0.333551	0.384613	0.275701	0.634538	0.725731
Kurtosis	1.367841	1.485542	1.671832	1.382167	2.088866	2.234032
Jarque-Bera	3.220482	3.309150	2.846517	3.530057	2.847506	3.142359
Probability	0.199839	0.191173	0.240928	0.171182	0.240809	0.207800
Sum	24079217	8539054.	4132.000	2769407.	6642.540	4074.880
Observations	29	29	29	29	29	29

Source: Authors' computation using E-Views 9.0 Version

Table 1 shows that the average Infant Mortality (INFM) in Nigeria within the period of the study is 830317.8 million. The highest infant mortality recorded was 942539.0 million observed in 1998 while lowest 714188.0 million witnessed in the year 2017. Public investment on Child support programmes (CSPINV) averaged ₦294450.1 billion within the study period. The highest CSPINV recorded is ₦376849.5 billion in 2015 while the lowest was 192359.5 in the year 2000. Public investment on children immunization was highest in the year 1995 which stood at ₦ 206.9000 billion and the lowest was observed in 2017 which stood at ₦100.2000 billion and it averaged ₦142.4828 billion. Public investment on improving Nutrition (NUTINV) had its average to be ₦95496.80 billion while public investment on education (EDUINV) had its average to be ₦237.2336 billion within the study period. The highest public investment on improving Nutrition (NUTINV) recorded is ₦186918.0 billion and was in year 2012. On the other hand, the highest public investment on education (EDUINV) ₦ 641.6100 billion recorded in 2023.

Regarding the statistical distribution of the series, IMMINV, NUTINV, EDUINV and GMINV, show evidence of positive skewness implying that the right tail is extreme. On the other hand, INFM and CSPINV, show evidence of negative skewness implying that the left tail is extreme. Normally distributed datasets have a skew result of zero, with a negative skew result in a value less than zero, indicating skweness to the left and positive skew result in a value greater than zero, indicating skweness to the right.

In relation to Kurtosis which measures the peakedness of the tail for normally distributed data series, there are indications that, the series for INFM, CSPINV and NUTINV behave relatively abnormal. Kurtosis value for a normally distributed series is expected neither to be widely greater

than 3 nor far less than 3. Kurtosis statistic for INFM and NUTINV are 1.367841 and 1.485542 respectively less than half of 3.

Nevertheless, the JaqueBera (JB) test which reveals that the residuals for all the variables are normally distributed. The JB statistic reveals that, the null hypothesis that the series residuals are normally distribution is accepted because the respective p values are greater than 0.05.

Unit Root Test Result

The variables of the study were subjected to unit root tests using the Augmented Dickey-Fuller (ADF) test to determine the stationarity properties of the series. The results of the tests are presented in Table 2.

Table 2: ADF Statistics of the Variable

Variables	ADF Test Statiemstic	1% Critical Value	5% Critical Value	10% Critical Value	Prob.	Order of Integration
INFM	3.781155	-3.724070	-2.986225	-2.632604	0.0088	I(0)
CSPINV	-3.528846	-3.661661	-2.960411	-2.619160	0.0138	I(1)
IMMINV	-3.280787	-3.737853	-2.991878	-2.635542	0.0274	I(1)
NUTINV	-6.840010	-3.661661	-2.960411	-2.619160	0.0000	I(1)
EDUINV	-3.564368	-3.689194	-2.971853	-2.625121	0.0134	I(1)

Source: Authors' Computation using E-Views 9.0 Version

Table 2 shows 5% significant level for the variables included in the model at order one integration with exception of infant mortality which happens to be stationary at level. This condition warrants the application of ARDL methods which accommodates series that are either I(1) or I(0) process or the mixture of both. The stationarity tests are necessary to guard against spurious regression and to ensure no variable is integrated of order two. The test was based on Akaike Information Criterion (AIC) which was selected automatically.

ARDL Bounds Test

The ARDL Bounds test approach to co integration was employed to investigate if the variables used for the study converge in the long-run. The ARDL Bound test result is presented in Table 3.

Table 3: ARDL Bound Test to Co integration

Test Statistic	Value	K
F-statistic	10.15378	4
	Critical Value Bounds	
Significance	I0 Bound	I1 Bound
10%	2.26	3.35
5%	2.62	3.79
2.5%	2.96	4.18
1%	3.41	4.68

Source: Authors' computation using E-Views 9.0 Version

Table 3 shows that long-run relationships exist among the variables of the study since the F-Statistic (10.15378) is greater than the lower I(0) and upper I(1) bounds of the critical values at 5% critical value. The rule of ARDL Bounds test of cointegration states that; the null hypothesis of no long-run relationships existing among the variables be rejected, if the value of the computed F-statistic is greater than the upper bounds pesaran critical value, and accepted if the F-statistic is less than the lower bounds pesaran critical value. The ARDL cointegration test will be said to be inconclusive should the computed F-statistic falls between the lower and upper bound. The result therefore implies that, there is a long-run relationship among the endogenous and the exogenous variables. Hence, a long run relationship exists between health care investments on infant mortality in Nigeria within the period of the study.

ARDL Long Run Coefficients

The ARDL long-run coefficients were estimated to examine the long-run impact of the independent variables on the endogenous variable having established that, long run relationship exists among the variables. The estimated result of the ARDL long-run coefficients is presented in Table 4.

Table 4: ARDL Long-Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CSPINV	0.1124606	4.500306	0.024989	0.02660
IMMINV	-0.6203931	9.244923	-0.067106	0.02713
NUTINV	0.7551653	9.321057	0.081017	0.01029
EDUINV	-0.1723627	2.311365	-0.074571	0.00336
C	-0.1060468	2.224542	-0.047671	0.06806

Source: Authors' computation using E-Views 9.0 Version

Table 4 shows that in the long run, if all other things were held constant, public investment on Child support programmes (CSPINV has a significant positive impact on infant mortality. A unit increase in public investment on child support programmes (CSPINV) would increase the infant

mortality rate by about 11%. On a contrary, public investment on children immunization (IMMINV) has significant negative relationship with Infant Mortality Rate. This means that a unit increases in the public investment on children immunization (IMMINV) would decrease infant mortality by about 62%. Furthermore, public investment on improving Nutrition (NUTINV) has significant positive influence on infant mortality rate. A unit increase in public investment on improving Nutrition (NUTINV) would increase infant mortality rate by 75%. On the contrary, public investment on education (EDUINV) has a significant negative impact on Infant Mortality Rate. A unit increase in the public investment on education (EDUINV) would decrease Infant Mortality Rate by 17%.

ARDL Short-Run Coefficients

ARDL short-run coefficients were further examined to establish the short-run dynamics and to ascertain the speed of converges to the long-run equilibrium. The result of ARDL short-run dynamics is presented in Table 5.

Table 5: ARDL Short-Run Dynamics

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(INFM(-1))	-0.467505	0.247446	-1.889321	0.1994
D(INFM(-2))	-0.297312	0.406325	-0.731711	0.5405
D(INFM(-3))	-0.334748	0.193443	-1.730476	0.2257
D(CSPEX)	0.397680	0.009216	43.150683	0.0005
D(CSPINV(-1))	0.816440	1.663085	0.490919	0.6721
D(CSPINV(-2))	-0.471814	1.154047	-0.408835	0.7223
D(CSPEX(-3))	0.964678	0.631795	1.526885	0.2663
D(IMMINV)	-0.166896	0.010379	-1.607983	0.2491
D(IMMINV(-1))	-0.454638	0.029038	-1.565619	0.2579
D(IMMINV(-2))	-0.303642	0.572031	-0.530815	0.6486
D(IMMINV(-3))	0.60128.0	0.411639	1.460697	0.2816
D(NUTINV)	-0.521621	0.533694	-0.977379	0.4315
D(NUTINV(-1))	0.272127	0.991484	2.744652	0.1111
D(NUTINV(-2))	0.258830	0.766204	0.337808	0.7677
D(NUTINV(-3))	-0.244386	0.867843	-2.816017	0.1064
D(EDUINV)	0.162306	0.638466	2.542999	0.1261
D(EDUINV(-1))	0.136720	0.383099	0.356879	0.7553
D(EDUINV(-2))	-0.721.257	0.109956	-0.655946	0.5792
D(EDUINV(-3))	-0.388740	0.371045	-1.047688	0.4047
CointEq(-1)	-0.305902	0.543537	-0.562799	0.0302

Source: Authors' computation using E-Views 9.0 Version

Table 5 shows that, if all things were held constant, the short-run result shows that infant mortality has an insignificant negative impact on itself at lag 1 up to lag 3. On the contrary, public investment on Child support programmes (CSPINV) has positive impact on infant mortality at current level, lag 1 and lag 3. The positive impact at current level is significant while positive impact at lag 1 and 3 are statistically insignificant at 5% level. Nevertheless, public investment on children immunization (IMMINV) has an insignificant negative impact on infant mortality in the current year, lag 1 and lag2. However, public investment on children immunization has an insignificant positive impact on infant mortality at lag 3. It further revealed that, public investment on improving Nutrition (NUTINV) has negative insignificant impact on infant mortality at current and lag 3 while at lag 1 and 2, public investment on improving Nutrition (NUTINV) has positive but insignificant impact on infant mortality. Moreover, Public investment on education (EDUINV) has positive insignificant impact on infant mortality at current and lag 1 while at lag 2 and 3, public investment on education indicated negative insignificant impact on infant mortality. The estimated error correction term (ECT) is negative and statistically significant at 5 per cent confidence level indicating approximate 31% significant speed of adjustment at which the previous year's shock of the explanatory variables converges back to the long-run equilibrium in the current year.

Post Estimation Test Results

The study conducted diagnostic test to examine the residuals of the estimated model to validate the result of the estimated model. The test of serial correlation, Heteroskedasticity, Stability, normality test and Ramsey Reset were conducted and the results presented in Table 6.

Table 6: Diagnostic Test Results

Test	Null Hypothesis	F-statistics	Prob. Value
Beusch Godfrey Serial Correlation LM Test	No Serial Autocorrelation	12250.34	0.0558
Breusch-Pagan Godfrey	No Hetroscedasticity	1.138696	0.5733
Jarque-Bera	series residuals are normally distributed	0.562393	0.0754
Ramsey Reset	No Misspecifications	17.87115	0.1479

Source: Authors' computation using E-Views 9.0 Version

Table 6 shows the post-estimation results to evaluate the residuals of the estimated in order to conform the validity or the opposite of the estimates. The model is subjected to serial correlation test to examine the null hypothesis that; there is no serial correlation in the residuals up to a specified lag order. The above results show that the null hypothesis cannot be rejected because the probability value F-statistics is greater than the 5% significance level. Thus, the model does not suffer from serial correlation. To test whether the variance of the disturbance term is not the same for all the observations, the heteroscedasticity test has been conducted. The null hypothesis of this test is that the there is no heteroskedasticity. Therefore, the null hypothesis cannot be rejected since the p-value of the F-statistics is greater than 5% significance value. Hence, the model is homoscedastic. Ramsey reset test holds that the F-statistic tests the hypothesis that the coefficients on the powers of the fitted values from the regression are jointly zero. Therefore, the null

hypothesis cannot be rejected since the probability value of F-statistics is greater than 5% significant level. This implies that the model used in this study is well-specified. The JB statistic reveals that, the null hypothesis that the series residuals are normally distribution is accepted because the p-value is greater than 5% significant level.

Conclusion

The importance of healthcare investment in an economy cannot be overrated, however, its practicality and efficacy for reducing child mortality depends on the annual budgetary allocation to the health sector and judicious utilization in an economy. The findings of the study reveal that there is long-run relationship between healthcare investment and infant mortality in Nigeria. However, public investment on child support programmes and improving Nutrition increase infant mortality in Nigeria for the period of the study. This show that investment or public resources used to finance programmes that will specifically or indirectly promote the wellbeing of children and the fulfillment of child rights are underutilized in Nigeria. Based on the findings, the study concludes that, public investment on immunization and education reduced infant mortality in Nigeria for the period of the study. This is an indication that, investment on immunization programmes and education for Nigeria children improve child healthcare in Nigeria over the period of the study.

Recommendations

In line with the study findings, the following recommendations are made:

i. There should be proper health-fund coordination to enhance nutrition security and ensure that budget allocated to the health sector in this regard is being spent properly so as to improve childhood development in Nigeria.

ii. Government in conjunction with traditional and religious leaders should intensify sensitization on immunization programs and activities to help protect infant from being infected with diseases.

iii. Government should corroborate with non-governmental organizations and international organization such as UNICEF, UNESCO etc to mobilize and monitor disbursement of funds meant to finance programmes that will support child rights, healthy development and general wellbeing of the children.

iv. Public investment to improve girl-child education should be encouraged to improve literacy level of female gender so as to improve maternal health literacy. Improving maternal health literacy may empower women to communicate better with their providers and take agency in decisions for the safety of themselves and their children.

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