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Assessement of Health Sector Performance Through Donor Funding in Nigeria

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ABSTRACT: This study explores the importance of donor funding on health sector performance in Nigeria by employing time series data between 1985 and 2024. The quantitative data were gathered from CBN (2025), NBS (2024) and WDI (2021). The unit root test confirmed a mixed of integration ranging from order 1(0) and 1(1) while the bound test of co-integration revealed that the life expectancy at birth and infant mortality rate models have long run association. The ARDL results outlined that life expectancy at birth (LEB) shows that private sector participation in health (PPHgdp) is the most consistent and significant positive determinant of life expectancy in both the long and short run. Official development assistance (ODA), has a small but significant negative effect on LEB in both periods, suggesting that higher ODA may not directly translate into improved life expectancy. Net bilateral aid donor (NBAD) exhibits mixed effects, with an immediate positive impact in the short run but a delayed negative effect, indicating that bilateral aid may have short-lived benefits or lagged adverse outcomes. Government expenditure on health (GEHgdp) shows mixed and generally insignificant effects, implying that public health spending alone does not strongly influence life expectancy. For the Infant Mortality Rate (IMR) model, Private sector participation in health (PPHgdp) significantly reduces infant mortality, while official development assistance (ODA) has significant positive effect. Net bilateral aid donor (NBAD) and government expenditure on health (GEHgdp) are not statistically significant, indicating limited long-term influence on infant mortality. In the short run, ODA contributes to a reduction in IMR, contrasting its long-run effect, while PPHgdp continues to reduce infant mortality with a one-period lag. GEHgdp exhibits a delayed positive effect, suggesting past government health spending may temporarily increase IMR, and NBAD remains largely insignificant. The followings are for policy recommendations, Policymakers should encourage public-private partnerships, provide fiscal incentives for private healthcare investment, and establish regulatory frameworks that ensure quality, equitable, and accessible private healthcare services, particularly targeting maternal and child health. Ensure that aid programs are aligned with national health priorities, focus on measurable outcomes, and are implemented efficiently to avoid short-term inefficiencies or long-term dependency. Optimizing government health expenditures, prioritizing interventions with immediate and measurable impacts such as maternal and child health programs, immunization campaigns, and essential health infrastructure, while ensuring accountability and minimizing resource wastage.

KEYWORDS: Mobile money, financial inclusion, digital finance, mobile money usage, OPay, Nigeria.

1. INTRODUCTION

The performance of Nigeria's health sector continues to attract significant scholarly and policy attentions due to persistently poor outcomes in key human development indicators, despite decades of national and international investment. Life expectancy at birth remains critically low at approximately 55 years, far below the global average of 73 years (World Bank, 2023). Similarly, the infant mortality rate, currently estimated at 54 deaths per 1,000 live births, and the maternal mortality ratio, which remains above 500 deaths per 100,000 live births, position Nigeria among the countries with the world's highest burden of preventable mortality (WHO, 2023; UNICEF, 2022). These outcomes, which serve as sensitive barometers of population well-being, reflect deep-rooted systemic weaknesses including chronic underinvestment, infrastructural deficits, health workforce shortages, and inequitable access to care (Aregbeshola & Khan, 2018; Abimbola et al., 2019). The country's ongoing struggle to meet the health-related sustainable development goals (SDGs) further highlights the fragility of its health system and the urgent need to understand the determinants of population health outcomes more comprehensively.

Life expectancy, infant mortality rates, and disease burden are widely recognized as key indicators for assessing the effectiveness of a health system (Braveman & Gottlieb, 2014). Life expectancy reflects the overall health status of a population and is influenced by factors such as access

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to healthcare, disease prevention, nutrition, and socioeconomic conditions (Barro, 1996). Countries with well-developed healthcare infrastructure, robust immunization programs, and effective disease prevention strategies tend to have higher life expectancies (Murray & Lopez, 2017). For instance, Nigeria has one of the lowest life expectancy rates at 53 years, compared to 64 years in Ghana and South Africa and 81 years in the UK (World Bank, 2023). Infant mortality rates (IMR)—the number of deaths of infants under one year per 1,000 live births—are a crucial measure of maternal and child healthcare quality (Legido-Quigley et al., 2020). A low IMR typically signifies improved prenatal care, skilled birth attendance, proper neonatal care, and effective public health interventions, such as vaccination and nutrition programs (Bloom, Kuhn, & Prettner, 2019). According to the World Bank (2023), high-income countries generally report lower IMRs due to advanced medical technologies and better healthcare accessibility, while low-income countries struggle with higher rates due to inadequate healthcare services, malnutrition, and preventable infections. Nigeria's infant mortality rate (54 per 1,000 live births) is significantly higher than South Africa (25) and Ghana (34) (WHO, 2023, UNICEF, 2023). Ultimately, nations with strong public health systems—characterized by adequate healthcare financing, universal health coverage, efficient service delivery, and preventive health strategies—exhibit lower mortality rates from preventable diseases (Bloom & Canning, 2000). Investments in maternal and child health, vaccination programs, and health education campaigns have proven to enhance public health outcomes, leading to higher life expectancy and reduced disease burden across populations.

Health sector performance is heavily influenced by both domestic government expenditure and external donor financing, particularly in low- and middle-income countries like Nigeria. The balance between these two funding sources affects healthcare accessibility, quality, and overall health outcomes. Donor funding plays a significant role in filling financial gaps, particularly for communicable diseases, maternal health, and immunization programs. Donor contributions represent ~15% of Nigeria's total health expenditure, significantly supporting disease control programs such as malaria, tuberculosis, and HIV/AIDS (Nigeria Health Budget Report, 2023). Major health donors include: Global Fund (HIV/AIDS, tuberculosis, and malaria control), Gavi, the Vaccine Alliance (immunization and child health programs), USAID and WHO (maternal and reproductive health services), World Bank (Basic Health Care Provision Fund), (UNDP, 2023). External financing, particularly donor funding, has emerged as a critical force shaping health-sector performance in Nigeria. Over the past two decades, Nigeria has ranked among the largest African recipients of Official Development Assistance (ODA), bilateral aid, and grant-based financing directed at maternal and child health, infectious-disease control, and health-system strengthening (OECD, 2022; Dieleman et al., 2019). At certain periods, donor flows have accounted for 20–25% of total health expenditure, underscoring the country's increasing dependence on external support (World Bank, 2022). Empirical studies present mixed evidence on the effectiveness of this funding. Some scholars argue that donor assistance improves health outcomes by expanding access to essential services and reducing mortality (Mishra & Newhouse, 2009; Bendavid & Bhattacharya, 2014). Others highlight concerns related to aid fungibility, misalignment between donor priorities and national needs, fragmented implementation structures, and weak absorptive capacity, which limit the translation of funding into measurable improvements (Martinez-Álvarez, 2018; Odubela & Olayiwola, 2020). At the same time, domestic health financing—particularly government expenditure on health (GEH)—remains consistently low, rarely exceeding 5% of the national budget, far below the 15% Abuja Declaration target (Government of Nigeria, 2021; WHO, 2020). Insufficient public spending has constrained investments in infrastructure, human resources, supply chains, and primary healthcare systems, thereby weakening the health system's capacity to effectively utilize donor assistance (Uzochukwu et al., 2015). In parallel, private sector expenditure on health (PPHGDP)—dominated by high out-of-pocket payments, which account for more than 70% of total health spending—has become a powerful but problematic determinant of health outcomes, often deepening financial hardship and exacerbating inequities in access to care (Onwujekwe et al., 2019; Okeke & Adebayo, 2020). Scholars such as Xu et al. (2011) and Kruk et al. (2018) have shown that health systems relying heavily on private financing tend to experience greater disparities in maternal and child health indicators.

Private sector contributions, through out-of-pocket payments, private health insurance, and corporate investments, supplement public funding. In many countries, private healthcare facilities play a critical role in service provision, particularly in specialized care and pharmaceuticals. In Nigeria, private healthcare providers account for nearly 60% of total healthcare services, often catering to middle- and high-income populations (National Bureau of Statistics, 2023). Private health insurance schemes, such as employer-based insurance models in the U.S., provide additional coverage options but may lead to disparities in access (Xu et al., 2019). While private investment drives innovation and efficiency, excessive reliance on private financing can lead to inequities, financial exclusion, and higher out-of-pocket expenditures, limiting access for lower-income groups (Reinhardt, 2020). Despite the growing literature on health financing in low- and middle-income countries (LMICs), significant gaps persist in understanding how different streams of financing jointly influence Nigeria's life expectancy, infant mortality, and maternal mortality. Existing research often examines donor funding in isolation or focuses narrowly on disease-specific programs rather than broader population-level outcomes (Asante et al., 2021). Moreover, empirical results remain inconsistent, with some studies identifying positive associations between aid and mortality reduction (Bendavid et al., 2012), while others report negligible or even adverse effects due to inefficiencies and institutional constraints (Bazzi & Clemens, 2013). Drawing emphasizes from the background and statement of the problem, this study seeks to answer the following questions;

I. In what ways have donor funding (official development assistance, and bilateral aid donor) influence life expectancy at birth in Nigeria?
II. To what extent have donor funding (official development assistance, and bilateral aid donor), impact on infant mortality rate (IMR) in Nigeria?

2.0 THEORETICAL UNDERPINNING

The Foreign Aid–Led Growth Theory emerged prominently in the 1960s and 1970s through the works of development economists such as Rosenstein-Rodan (1961), Chenery and Strout (1966), and later Burnside and Dollar (2000). The theory argues that external financial assistance—such as Official Development Assistance (ODA), bilateral aid, and grants—can stimulate economic and social development in low-income countries by filling critical financing gaps. In the context of health sector performance, the theory suggests that donor funding helps countries like Nigeria overcome constraints in health infrastructure, human resources, and service delivery. According to its proponents, aid can catalyze progress in population health indicators such as life expectancy, infant mortality, and maternal mortality by providing supplementary resources where

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domestic financing is insufficient. A central assumption of the Foreign Aid–Led Growth Theory is the "financing gap" principle proposed by Chenery and Strout (1966), which posits that developing countries lack adequate capital to fund essential sectors, including health. Aid is assumed to fill these gaps, thereby enabling governments to invest in public services and human development. The theory also assumes that aid is complementary—not a substitute—to domestic expenditure, and that it is allocated efficiently toward high-impact areas such as disease control, maternal and child health, and health system strengthening. Another key assumption is that aid recipients possess adequate governance capacity to effectively absorb and utilize donor funds, leading to measurable improvements in health outcomes. Despite its popularity, the Foreign Aid–Led Growth Theory has faced substantial criticism. Scholars such as Easterly (2006), Moyo (2009), and Boone (1996) argue that aid often fails to produce sustainable improvements in development outcomes due to corruption, weak institutions, and aid dependency. Critics contend that aid may create moral hazard, reduce domestic revenue mobilization, and distort national priorities. In the health sector, some argue that donor funding can be fragmented, disease-specific, or poorly aligned with country needs. Additionally, critics highlight the problem of "fungibility," where governments may reduce their own health spending because donor funding fills the gap. These criticisms challenge the assumption that aid consistently leads to improved health sector performance or enhanced life expectancy and reduced mortality rates.

Dependency theory emerged in the 1960s and 1970s as a critique of modernization theory, with key proponents including Andre Gunder Frank (1967), Samir Amin (1972), Fernando Henrique Cardoso (1977), and Walter Rodney (1972). These scholars argued that the global economic system is structured in a way that perpetuates inequality between developed "core" nations and developing "peripheral" nations. Originally applied to trade relations and economic underdevelopment, the theory has since been extended to sectors such as health, education, and governance. In the context of health systems, Dependency Theory highlights how foreign aid, donor interventions, and external control can shape the priorities and capabilities of developing countries, often creating long-term reliance rather than sustainable growth. The central assumptions of dependency theory are that external assistance often reinforces structural dependence, limits internal capacity, and ties developing countries to donor priorities. The theory posits that resources flow from poor countries to wealthy nations indirectly through aid conditionalities, expertise dependence, and the dominance of foreign institutions in agenda-setting. Applied to the health sector, the theory assumes that heavy reliance on donor funding—such as the significant ODA, bilateral aid, and grants flowing into Nigeria's health system—may weaken domestic financing structures, erode policy autonomy, and crowd out government initiative. This dynamic can lead to a situation where improvements in health outcomes (like infant mortality, maternal mortality, and life expectancy) depend more on donor activity than on national systems, thereby perpetuating long-term vulnerability. Nonetheless, dependency theory faces several critiques. Scholars argue that it often generalizes complex realities and underestimates the capacity of developing countries to strategically use aid to enhance domestic systems. Critics such as Sen (1999) and Easterly (2006) contend that aid can be beneficial when properly aligned with national priorities, institutional reforms, and accountability structures. Some also note that the theory treats donors as a unified entity, ignoring the diversity of bilateral and multilateral agencies and the varying motivations behind their engagement. Others argue that the theory lacks empirical nuance, as many countries—such as Rwanda and Ethiopia—have successfully used donor funding to strengthen health systems and achieve measurable improvements in mortality and life expectancy. Despite these criticisms, Dependency Theory remains highly relevant to this study, as Nigeria's health sector continues to receive extensive donor funding, representing 20–25% of total health expenditure in some years. The theory provides a useful lens for examining whether donor flows genuinely strengthen the health system or unintentionally weaken domestic capacity and policy ownership. It helps to interpret why improvements in life expectancy, infant mortality, and maternal mortality may not always correspond proportionately with increases in ODA, bilateral aid, or grant-funded programs. Moreover, the theory underscores the need to analyze how donor priorities interact with government and private-sector expenditure, and whether reliance on external resources affects long-term sustainability, resilience, and national control of health outcomes. Through this lens, the study evaluates whether donor funding supports or undermines Nigeria's capacity to achieve sustainable health improvements.

2.1 Existing Empirical Prove

Chiwira and Moyo (2024) examine the efficiency of donor-funded health interventions in Africa from 2000 to 2023, using a Data Envelopment Analysis (DEA) approach to assess how effectively foreign aid translates into improved healthcare outcomes. The study analyzes key variables, including healthcare access, resource allocation efficiency, infant and maternal mortality rates, immunization coverage, and overall health system performance, with foreign aid, government health expenditure, and healthcare workforce availability as independent variables. The findings indicate that while foreign aid significantly expands healthcare access, particularly by increasing medical infrastructure, immunization programs, and disease control efforts, inefficiencies in fund utilization, misallocation of resources, and weak institutional frameworks reduce its overall impact. The research underscores that countries with strong governance, better financial management, and effective healthcare policies utilize aid more efficiently, leading to better health outcomes compared to nations with poor governance and systemic inefficiencies. Kutluer and Çalışkan (2024) examined the relationship between foreign direct investment (FDI), economic growth, and health outcomes in Türkiye, using life expectancy at birth as a proxy for average health status, FDI inflows (ratio of FDI to GDP), and economic growth indicators as key variables. The study covered data from 1975 to 2018 and applied a health production function approach, utilizing the Fully Modified OLS (FMOLS) method to estimate the cointegrating relationship while accounting for potential endogeneity. The findings revealed that FDI inflows had a negative impact on life expectancy in Türkiye, suggesting that certain forms of FDI may be detrimental to public health. This highlights the potential adverse effects of foreign investments, particularly in industries that may contribute to environmental pollution or poor working conditions. The study concluded that while FDI can be beneficial for economic growth, it may pose risks to population health depending on the sectors attracting investment. As a result, the authors recommended that policymakers closely monitor and regulate FDI inflows, ensuring that investments align with public health objectives and do not compromise long-term health outcomes. Habib, Awolaja and Aworinde, (2024) conducted a study titled "Health Spending and Life Expectancy Disparities: A Gender Analysis in Nigeria", examining the impact of health expenditure on life expectancy by gender. The study utilized key variables, including public health expenditure, private health expenditure, public health expenditure per capita, private health expenditure per capita, male life expectancy, and female life expectancy. Using the Dynamic Ordinary Least Squares (DOLS) method, the researchers analyzed data from 2000 to 2021 to determine the long-run relationship between health spending and life expectancy in

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Nigeria. The findings revealed that public health expenditure was negatively associated with both male and female life expectancy, suggesting inefficiencies in government health spending. Conversely, private health expenditure per capita had a positive effect on life expectancy for both genders, highlighting the critical role of private sector investment in healthcare. The study concluded that private sector involvement significantly improves life expectancy in Nigeria, regardless of gender. Based on these insights, the authors recommended that the Nigerian government reassess healthcare financing strategies, address inefficiencies in public health expenditure, and create policies that encourage private sector participation through targeted incentives and investment schemes to enhance healthcare delivery and overall life expectancy.

The Institute for Public Policy Research (IPPR) Report (2024) examined the link between public health and economic growth in the UK, highlighting the economic consequences of poor health. The study analyzed key variables such as worker supply, productivity, wages, public finances, and regional inequalities, demonstrating that worsening public health negatively impacts economic performance. The findings revealed that poor health reduces labor force participation, lowers productivity, suppresses wages, strains public finances, and exacerbates regional economic disparities. The methodology included economic modeling and policy analysis, estimating that an annual investment of £15 billion in healthcare reforms would significantly improve national prosperity which in turn will improve health sector performance. The conclusion emphasized that addressing the health crisis is essential for sustainable economic growth, requiring targeted government intervention. The IPPR Report recommended policies such as higher taxes on unhealthy products to discourage consumption, universal free school meals for primary children to improve childhood nutrition, and the establishment of neighborhood health centers focused on preventive care to enhance public well-being and economic resilience. Anderson and Awo (2024) conducted a study titled "A time series analysis of government expenditure and health outcomes in Nigeria," analyzing data from 1990 to 2023. The study utilized the Autoregressive Distributed Lag (ARDL) technique to examine both short- and long-run effects of government health expenditure on health outcomes, specifically life expectancy at birth and mortality rate. The findings indicated a positive relationship between health expenditure and life expectancy, suggesting that increased government health spending leads to improved life expectancy. Conversely, a negative relationship was found between health expenditure and mortality rate, implying that higher health expenditure contributes to a reduction in mortality rates. The study concluded that increasing government health expenditure, in partnership with the private sector through Public-Private Partnerships, could enhance health outcomes in Nigeria. The authors recommended that the government should pursue policies to increase health expenditure and collaborate with the private sector to improve the health sector and outcomes. Similarly, Oniore et al. (2024) investigated the impact of public health spending indicators on life expectancy in Nigeria in their study "Public Health Spending Indicators and Life Expectancy in Nigeria: 1990-2023." The study employed the ARDL technique to analyze the effects of variables such as health expenditure per capita, capital health expenditure, recurrent health expenditure, and out-of-pocket health spending on life expectancy. The results revealed that recurrent health expenditure positively influences life expectancy in both the short and long run. However, health expenditure per capita was found to have a negative relationship with life expectancy in both periods. Capital health expenditure showed a positive and significant impact on life expectancy in the short run, while out-of-pocket health spending negatively affected life expectancy in the short run but had a positive effect in the long run. The study recommended increasing investments in health infrastructure, prioritizing funds for operational health costs, and reducing out-of-pocket spending by expanding health insurance coverage to improve life expectancy in Nigeria. Oyedepo, Elizabeth Omolola (2023) conducted a study titled "Trends and Patterns of Maternal Mortality in Nigeria: Any Link with Economic Growth?" to examine the relationship between maternal mortality and economic growth. Using Ordinary Least Squares (OLS) regression, the study analyzed maternal mortality rate, female life expectancy, female fertility rate, lifetime risk of maternal death, neonatal mortality rates, and economic growth indicators in Nigeria. The findings revealed that increases in female life expectancy and economic growth significantly reduce maternal mortality, indicating that improved health conditions and economic stability contribute to better maternal health outcomes. Conversely, higher female fertility rates, an increased lifetime risk of maternal death, and elevated neonatal mortality rates were found to significantly increase maternal mortality, highlighting the adverse effects of poor reproductive health and high child mortality. The study concluded that economic growth and improvements in female health indicators are crucial in reducing maternal mortality in Nigeria. It recommended that policymakers implement strategies to foster economic growth, adequately fund the health sector to improve healthcare quality, and provide educational programs on family planning to women of reproductive age to mitigate maternal mortality risks. Kim and Lane (2023) conduct a cross-country analysis to examine the role of governance in the effectiveness of health aid across 50 developing countries from 2005 to 2022, using panel data and a fixed effects regression model. The study focuses on key health outcome indicators, including life expectancy, infant mortality rates, maternal mortality rates, and healthcare access, with health aid, governance quality, and government health expenditure serving as independent variables. The findings reveal that donor funding significantly enhances health outcomes, particularly in countries with strong governance, transparency, and effective accountability mechanisms. Nations with well-established anti-corruption frameworks, efficient public health institutions, and responsible budget management demonstrate greater improvements in disease control, child immunization rates, and overall life expectancy. Conversely, in countries with weak governance and high corruption levels, the impact of health aid is diminished due to fund mismanagement and inefficiencies in healthcare service delivery. Kim and Lane (2023) conclude that while health aid remains a vital tool for improving healthcare in developing countries, its effectiveness is largely dependent on the institutional quality and governance capacity of recipient nations. To maximize the impact of donor funding, the study recommends strengthening governance structures, enhancing financial accountability, aligning aid programs with national health policies, and fostering collaboration between donors and local governments to ensure long-term sustainability and efficient resource utilization. Awoyemi et al. (2023) investigated the impact of government health expenditure on health outcomes in Nigeria using a time series analysis covering several decades of data. The study employed the Autoregressive Distributed Lag (ARDL) technique, a robust econometric method used to examine both short- and long-term relationships between public health spending and key health indicators. The main variables included government health expenditure (independent variable), mortality rates, and life expectancy at birth (dependent variables). The findings revealed that increased government health expenditure leads to a significant reduction in mortality rates and an improvement in life expectancy, demonstrating the crucial role of public investment in healthcare in enhancing overall population health. The study's conclusion emphasized that sustained and strategic public spending in the health sector is vital for improving health outcomes in Nigeria. To achieve better efficiency and

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impact, the authors recommended that the Nigerian government should increase its health expenditure while also fostering public-private partnerships (PPPs) to enhance healthcare service delivery. These measures, if properly implemented, could bridge financing gaps, improve healthcare infrastructure, and ensure better health outcomes across the country.

Immurana, Iddrisu, Owusu, and Yusif (2023) investigated the relationship between foreign direct investment (FDI) and child health outcomes in Africa, focusing on neonatal mortality rates, infant mortality rates, FDI inflows, and economic growth indicators. The study analyzed panel data from 39 African countries spanning 1980 to 2018. Employing Fixed Effects (FE) regression as the baseline estimation technique and system Generalized Method of Moments (GMM) regression to address potential endogeneity, the researchers found that FDI positively influences child health outcomes, primarily through its effect on economic growth. The findings suggest that FDI can serve as an effective mechanism for reducing child mortality when economic conditions are favorable. The study concluded that attracting higher FDI inflows could contribute to better child health outcomes in Africa, emphasizing the role of economic growth as a key transmission channel. Based on these results, the authors recommended that African governments implement policies aimed at increasing FDI inflows to boost economic growth and improve child health indicators. The Commonwealth Fund Report (2023) examined the relationship between healthcare expenditure and health system performance across ten affluent countries, including the United States. The study analyzed key variables such as healthcare spending per capita, access to care, health equity, life expectancy, and avoidable mortality rates. Despite the U.S. spending nearly twice as much on healthcare compared to other high-income nations, the findings revealed that the country ranked last in overall healthcare performance, particularly in access to care, health equity, and health outcomes. The methodology involved comparative analysis using health system indicators from multiple nations, highlighting inefficiencies in the U.S. healthcare system despite high levels of funding. The conclusion emphasized that higher healthcare expenditure does not automatically lead to better health outcomes unless resources are effectively allocated and the system operates efficiently. Based on these insights, the report recommended that the U.S. should focus on improving healthcare accessibility, reducing cost barriers, addressing health disparities, and enhancing the efficiency of healthcare delivery to achieve better health outcomes relative to its spending. Houeninvo (2022) examined the effects of health expenditures on infant and child mortality rates in 37 African countries using system generalized method of moments (GMM) and least squared dummy variable corrected bias estimators on panel data spanning from 1995 to 2018. The study considered public health expenditure, private health expenditure, infant mortality rate, and child mortality rate as key variables. The findings revealed that public health expenditure had a statistically significant impact in reducing infant and child mortality rates, underscoring its importance in improving child health outcomes. Additionally, private health expenditure contributed to reducing mortality rates, but its effectiveness was notably enhanced when complemented by public health spending, suggesting a synergy between the two funding sources. The study concluded that both public and private health expenditures play a vital role in reducing infant and child mortality, although public spending exhibited a slightly stronger impact. To maximize the effectiveness of health expenditures, the study recommended increasing public health funding and ensuring that private health spending is well-integrated with public initiatives. Furthermore, additional funds should be allocated to specific expenditure categories that directly target infant and child mortality reduction efforts. Umaru et al. (2022) conducted a study titled "The Link between Government Health Expenditure and Health Outcome in Nigeria, 1981-2019," analyzing time series data from 1981 to 2020. The variables examined included infant mortality rate (as a proxy for health outcomes), government health expenditure, school enrollment ratio, and gross domestic product (GDP). The study employed a Vector Autoregressive (VAR) model to analyze the relationship between these variables. The findings indicated that government health expenditure has a negative relationship with infant mortality in Nigeria, suggesting that increased health spending by the government leads to a reduction in infant mortality rates. Additionally, school enrollment was found to be significant in improving health outcomes. The study concluded that increasing government health expenditure and enhancing educational enrollment are vital for reducing infant mortality. It recommended that the government should increase health expenditure and promote policies that enhance school enrollment to improve health outcomes in Nigeria. Odhiambo (2022) examines the impact of foreign aid on public health performance in selected Sub-Saharan African countries, analyzing data from 1995 to 2020 using the Generalized Method of Moments (GMM) estimation technique. The study explores key health indicators, including life expectancy, infant mortality rate, maternal mortality ratio, and immunization coverage, as dependent variables, while foreign aid, GDP per capita, government health expenditure, and literacy rate serve as independent variables. The findings reveal that donor funding significantly improves life expectancy and reduces infant mortality, primarily due to increased healthcare access and disease prevention programs. However, the impact on maternal mortality is mixed, influenced by factors such as fund misallocation and weak healthcare infrastructure. The study highlights concerns regarding inefficiencies in aid utilization and over-reliance on donor funding, which may undermine long-term health system sustainability. Consequently, Odhiambo (2022) recommends better allocation of aid, increased domestic health financing, stronger monitoring and accountability mechanisms, long-term investment in health infrastructure, and improved coordination between donors and governments to maximize the effectiveness of foreign aid. The study concludes that while foreign aid has a positive impact on health performance, its effectiveness depends on governance quality and sustainable health financing strategies. Ayenagbo (2022) conducted an empirical analysis on the effect of foreign direct investment (FDI) on health status in Sub-Saharan Africa, emphasizing the role of governance. The study examined key variables, including infant mortality rate, child mortality rate, FDI inflows, and governance indicators such as control of corruption. Using data from 44 Sub-Saharan African countries spanning 2002 to 2019, the study employed a dynamic panel model and applied the Generalized Method of Moments (GMM) approach to address potential endogeneity concerns. The findings revealed that FDI significantly contributed to reducing infant and child mortality rates, highlighting the positive impact of foreign investment on health outcomes. Moreover, improved governance, particularly effective corruption control, amplified the beneficial effects of FDI on public health. The study concluded that FDI could be a vital tool for enhancing health outcomes in Sub-Saharan Africa, especially when reinforced by strong governance structures. Based on these findings, the study recommended that policymakers strengthen governance frameworks to attract more FDI and maximize its potential benefits for public health. Odjesa and Ighodaro (2021) examined the socio-economic determinants of infant mortality in Nigeria, using variables such as infant mortality rate, total fertility rate, CO_2 emissions, GDP per capita, public health expenditure, and female primary gross educational enrollment. The study applied the Grossman health production function model and analyzed data from 1990 to 2018 using the Autoregressive Distributed Lag (ARDL) technique to assess both

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short- and long-run relationships. The findings revealed that in the long run, higher total fertility rates and CO_2 emissions significantly increased infant mortality, while GDP per capita, public health expenditure, and female education significantly reduced infant mortality rates. These results suggest that economic growth, increased investment in healthcare, and improvements in female education play critical roles in lowering infant mortality. The study concluded that addressing socio-economic factors such as poverty, environmental quality, and access to education is essential for improving child health outcomes in Nigeria. Based on these findings, the authors recommended that the Nigerian government should increase public health expenditure, implement policies aimed at reducing poverty, and enhance female education to achieve sustainable reductions in infant mortality rates.

Dutta and Huang (2021) investigate the effectiveness of donor funding in strengthening health systems across low-income countries from 2000 to 2020, employing a difference-in-differences (DiD) approach to analyze its impact. The study examines key health performance indicators, including health infrastructure development, immunization coverage, and maternal mortality rates, while considering donor funding levels, government health expenditure, and GDP per capita as independent variables. The findings suggest that donor funding plays a crucial role in improving healthcare infrastructure and increasing immunization rates, leading to better disease prevention and access to essential medical services. However, the study also highlights that the impact on maternal mortality reduction is inconsistent, largely due to inefficiencies in fund allocation, weak governance, and challenges in program implementation. Dutta and Huang (2021) conclude that while donor funding is beneficial in certain aspects of health system strengthening, its full potential is often undermined by poor financial management and lack of integration with national health policies. To enhance effectiveness, the study recommends improved fund allocation mechanisms, greater transparency and accountability in donor-funded projects, stronger domestic health financing, and closer coordination between international donors and recipient governments to ensure sustainable health improvements in low-income countries. The Federal Ministry of Health, Nigeria (2021) conducted a study titled "Engaging the Private Sector to Deliver Quality Maternal and Newborn Health Services for Universal Health Coverage: Lessons from Policy Dialogues," examining the role of private sector engagement in maternal and newborn health (MNH) service delivery. The study focused on key variables such as private sector engagement, policy implementation, regulation, service delivery, and the enabling environment. The methodology involved a situational analysis conducted in late 2020 and early 2021, followed by a multi-stakeholder policy dialogue in June 2021, where 45 representatives from various sectors identified challenges and proposed solutions to enhance private sector participation in MNH services. Findings revealed key barriers, including the reluctance of private sector actors to share data with the government, confusion caused by multiple regulatory structures, and unfavorable market conditions impacting the quality of MNH care delivery. Based on these challenges, the policy dialogue developed recommendations across four thematic areas: policy and administration, regulation, service delivery, and enabling environment. The study concluded that effective private sector engagement is essential for achieving universal health coverage and improving MNH services in Nigeria. Key recommendations included involving private sector stakeholders in health policy development, ensuring adequate resources for regulation, providing incentives to improve service quality, and enhancing access to financial services for private providers. The government should establish public-private platforms for ongoing dialogue, strengthen regulatory and accountability mechanisms, and create a more favorable environment to support private sector participation in healthcare delivery.

2.1 Empirical Model Specification

a. Life Expectancy Birth Model

The specific models in this study are stated in multiple regression form with life expectancy at birth (LEB) as the sole dependent variable in the equation while official development assistance (ODA), net bilateral aid donor (NBAD), government expenditure on health (GEH) and private sector participant on health sector (PPH) serve as the independent variables in objective one. This model is a modification of the equation of Kutluer & Çalışkan (2024). Kutluer & Çalışkan (2024) revealed the equation of life expectancy at birth model is based on foreign direct inflow and GDP. LEB = F(FDI, GDP). With the Kutluer & Çalışkan (2024) model, we proposed that donor funding measures to encourage life expectancy at birth are possible with inclusion of official development assistance (ODA), net bilateral aid donor (NBAD), government expenditure on health (GEH) and private sector participant on health sector (PPH). The inclusion of government health expenditure and private sector participant on health sector (PPH) prompted the need for this study and it is in line with the foreign aid–led growth theory. Thus, our model is designed and casted as follows

Life Expectancy at Birth Model of Donor Funding

$$LEB = F(ODA, NBAD, GEH, PPH) \quad 3.1$$

Equation 1 is expressed in mathematical form and thus transformed in econometric form as follows

$$LEB = b_0 + b_1ODA + b_2NBAD + b_3GEH + b_4PPH + \mu \quad 3.2$$

Transforming equation 2 to a natural logarithm equation, gives us:

$$\log LEB = b_0 + b_1 \log ODA + b_2 \log NBAD + b_3GEH + b_4PPH + \mu \quad 3.3$$

b. Infant Mortality Rate Model

This model is a modification of the equation of Houeninvo (2022). Houeninvo (2022) revealed the equation of infant mortality rate model is based on public and private participant. IMR = F(GEH, PPH). With the Houeninvo (2022) model, we proposed that model to encourage infant mortality rate are possible with inclusion of official development assistance (ODA), net bilateral aid donor (NBAD). The inclusion of official development assistance (ODA), net bilateral aid donor (NBAD) prompted the need for this study and it is in line with the foreign aid–led growth theory. Thus, our model is presented as follows

Infant Mortality Rate Model of Donor Funding

$$IMR = F(ODA, NBAD, GEH, PPH) \quad 3.4$$

Equation 1 is expressed in mathematical form and thus transformed in econometric form as follows

$$IMR = b_0 + b_1ODA + b_2NBAD + b_3GEH + b_4PPH + \mu \quad 3.5$$

Transforming equation 2 to a natural logarithm equation, gives us:

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$IMR = b_0 + b_1 logODA + b_2 logNBAD + b_3 GEH + b_4 PPH + \mu$ 3.6

4.0 DATA ANALYSIS

4.1 Descriptive Test

	IMR	LEB	GEHgdp	PPHgdp	NBAD	ODA
Mean	48.34000	47.20001	1.915184	3.483602	7.34E+08	1.01E+09
Median	51.35000	46.06918	1.442410	3.125954	1.08E+08	2.07E+08
Std. Dev.	6.613537	2.437197	1.210852	1.145810	1.94E+09	2.08E+09
Skewness	-0.636342	1.048059	0.905771	0.421449	4.336096	3.675925
Kurtosis	2.346843	2.937868	2.596753	1.909263	21.94560	17.65539
Jarque-Bera	3.410560	7.329287	5.740485	3.166975	723.5712	448.0504
Probability	0.181721	0.025613	0.056685	0.205258	0.000000	0.000000
Obs	40	40	40	40	40	40

Source: Author's Computation Using E-views 12 Software

The descriptive statistics reveal important distributional characteristics across the variables. For IMR, the mean and median values are relatively close (IMR: 48.34 vs. 51.35), suggesting moderately symmetrical distributions, although the higher median for IMR indicates a slight upward skew. LEB demonstrates a similar pattern of closeness between mean (47.20) and median (46.07), implying minimal distortion from extreme values and a stable central tendency. In contrast, the fiscal and development-related variables—GEHgdp and PPHgdp—show wider gaps between mean and median, with means (1.92 and 3.48 respectively) exceeding their medians (1.44 and 3.13), indicating positive skewness driven by higher outlier observations. The most pronounced skewness is observed in NBAD and ODA, where extremely large differences between means (7.34×10^8 and 1.01×10^9) and medians (1.08×10^8 and 2.07×10^8) suggest heavily right-tailed distributions and the presence of very large episodic inflows relative to typical annual values. The distributional properties of the variables used in the analysis were examined using the mean, median, standard deviation, skewness, kurtosis, and the Jarque–Bera normality test. The results show distinct patterns across demographic and macroeconomic indicators. The demographic variables—IMR and LEB—exhibit relatively moderate dispersion, as reflected in their standard deviations. IMR is approximately symmetric, with skewness values of –0.64, and kurtosis levels close to the normal benchmark of 3. This is supported by their Jarque–Bera probabilities of 0.18 and 0.34, indicating failure to reject the null hypothesis of normality at the 5 percent level. However, LEB displays a positive skewness of 1.05 and a near-normal kurtosis of 2.94, and its Jarque–Bera probability of 0.026 indicates significant deviation from normality. This suggests the presence of occasional higher life expectancy values that stretch the upper tail of its distribution. The fiscal variables—GEHgdp and PPHgdp—present moderate right-skewed distributions, with skewness values of 0.91 and 0.42, respectively. Their kurtosis values (2.60 and 1.91) indicate slightly platykurtic distributions. While PPHgdp shows no significant departure from normality with a Jarque–Bera probability of 0.205, GEHgdp lies close to the threshold with a probability of 0.056, suggesting marginal non-normality. The most pronounced deviations from normality are observed in the external finance indicators, NBAD and ODA, which exhibit extreme positive skewness (4.34 and 3.68) and very high kurtosis values (21.95 and 17.66). These values point to highly leptokurtic distributions with heavy upper tails, largely driven by a few unusually large inflows recorded in certain periods. The Jarque–Bera test statistics for these variables are significant at the 1 percent level, confirming strong violations of normality.

4.1.2 Correlation Matrix

Table 4.2: Correlation Matrix

	IMR	LEB	ODA	NBAD	GEHGDP	PPHGDP
IMR	1	-0.985364	-0.51825	-0.36947	-0.970520	-0.91995
LEB	-0.985364	1	0.485614	0.324632	0.964367	0.88416
ODA	-0.5182588	0.48561	1	0.98268	0.51579	0.474898
NBAD	-0.369477	0.32463	0.98268	1	0.367613	0.341161
GEHGDP	-0.970520	0.96436	0.515799	0.367613	1	0.93055
PPHGDP	-0.91995	0.884167	0.474898	0.34116	0.93055	1

Source: Author's computation using E-views 12 Software

The correlation matrix reveals strong relationships among the variables. Infant mortality rate (IMR) shows strong negative correlations with life expectancy at birth (LEB) (-0.99) and gross expenditure on health as a percentage of GDP (GEHGDP) (-0.97 and -0.90). LEB is strongly positively associated with GEHgdp (0.96) and private sector participation to health ratio of GDP (PPHgdp) (0.88). Official development assistance (ODA) correlates moderately positively with LEB (0.49) and very strongly with net banking assets (NBAD) (0.98). Overall, higher health spending and economic indicators are associated with lower mortality rates and higher life expectancy, while ODA and NBAD show moderate positive linkages with health and economic measures.

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4.1.3. Unit Root Tests

Table 4.33a: Panel A: Result of Augmented Dickey-Fuller Unit Root Tests

Variable	ADF	Cal. Values	Critical	Values		Order of
	Level	1st Diff.	5%	10%	1%	Integration
LEB	1.115658	-5.717294**	-2.941145	-2.609066	-3.615588	1(1)
IMR	1.477097	-3.657871**	-2.941145	-2.609066	-3.615588	1(1)
NBAD	-3.535870**		-2.941145	-2.609066	-3.615588	1(0)
ODA	-3.241554**		-2.941145	-2.609066	-3.615588	1(0)
GEHgdp	1.471286	-7.340544**	-2.941145	-2.609066	-3.615588	1(1)
PPHgdp	-0.330284	-10.80741**	-2.941145	-2.609066	-3.615588	1(1)

Source: Author's computation using E-views 12 Software

Table 4.3b: Panel B: Result of Phillips Perron Unit Root Tests

Variable	ADF	Cal. Values	Critical	Values		Order of
	Level	1st Diff.	5%	10%	1%	Integration
LEB	1.279703	-3.335512**	-2.938987	-2.607932	-3.610453	1(1)
IMR	0.190344	-3.828303**	-2.938987	-2.607932	-3.610453	1(1)
NBAD	-3.430418**		-2.938987	-2.607932	-3.610453	1(0)
ODA	-3.159627**		-2.938987	-2.607932	-3.610453	1(0)
GEHgdp	2.409966	-7.360760**	-2.938987	-2.607932	-3.610453	1(1)
PPHgdp	-0.720006	-15.26867**	-2.938987	-2.607932	-3.610453	1(1)

Source: Author's computation using E-views 12 Software

The unit root test results in Tables 4.3a and 4.3b indicate the stationarity properties of the variables using both the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests. From the ADF results, NBAD and ODA are stationary at levels (I(0)), as their test statistics (-3.536 and -3.242, respectively) are more negative than the 5% critical value (-2.941), indicating rejection of the null hypothesis of a unit root. The remaining variables—LEB, IMR, GEHgdp, and PPHgdp—are non-stationary at levels but become stationary after first differencing (I(1)), as their first-differenced test statistics exceed the 5% critical value in absolute terms. Similarly, the Phillips-Perron results confirm these findings. NBAD and ODA are stationary at levels (I(0)), while LEB, IMR, GEHgdp, and PPHgdp require first differencing to achieve stationarity (I(1)). The consistency between ADF and PP tests strengthens the conclusion regarding the integration order of the variables. This implies that most macroeconomic and health-related variables in the dataset are integrated of order one, justifying the use of models that accommodate I(1) variables, such as Vector Error Correction Models (VECM) or cointegration analysis, for further empirical investigation.

4.1.4 Co-integration Analysis

Table 4.4: Bound Testing Co-Integration Test

Ho: No long-run relationships exist. H1: Long-run relationships exist. The Ho will be declined if the model F-statistic value is greater than critical value of the upper Bound limit at the 5%.						
Critical Values			Models Critical Values			
Significance	I(0) Bound	I(1) Bound	LEB Model	IMR Model		
10%.	1.9	3.01	K=4	K=4		
5%.	2.26	3.48	F-val. =28.55	F-val. = 4.41		
2.5%.	2.62	3.9				
1%.	3.07	4.44				

Source: Author's computation using E-views 12 Software

The results of the bound testing co-integration in Table 4.4 assess the existence of long-run relationships among LEB, and IMR. The null hypothesis (Ho) posits that no long-run relationship exists, while the alternative (H1) suggests the presence of a long-run relationship. The decision rule is to reject Ho if the F-statistic exceeds the upper bound critical value at the 5% significance level. For the LEB model, the F-statistic is 28.55, which is well above the 5% upper bound critical value of 3.48, indicating a strong long-run relationship among the variables in this model. The IMR model has an F-statistic of 4.41, also exceeding the upper bound critical value of 3.48, confirming the existence of a long-run equilibrium relationship.

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4.2 Data Analysis and Estimation

4.2.1 Long Run and Short Run Model of Life Expectancy at Birth as a Function of ODA, NBAD, GEHgdp and PPHgdp

Table 4.5a Life Expectancy at Birth ARDL Model

Panel A	Long	Run	ARDL	Model
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.***
ODA	-1.08E-11	7.74E-12	-3.391859	0.0042**
NBAD	9.55E-12	7.76E-12	1.230688	0.2280
GEHGDP	0.006129	0.003811	1.608108	0.1183
PPHGDP	0.007804	0.003064	2.546886	0.0162**
C	-3.88E+12	1.69E+12	-2.294258	0.0295**

Source: Author's computation using E-views 12 Software

Table 4.5b Life Expectancy at Birth ARDL Model

Panel B	Short	Run	ARDL	Model
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.***
ODA	-2.01E-11	7.01E-12	-2.871986	0.0082
NBAD	1.81E-11	7.01E-12	2.589618	0.0158
NBAD(-1)	-1.43E-13	5.93E-13	-0.241146	0.8114
NBAD(-2)	-2.82E-12	5.49E-13	-5.132600	0.0000
GEHGDP	0.003097	0.003589	0.863123	0.3963
GEHGDP(-1)	0.007870	0.003456	2.277375	0.0316
GEHGDP(-2)	0.008039	0.003990	2.014812	0.0548
GEHGDP(-3)	-0.008909	0.003657	-2.436344	0.0223
PPHGDP	0.008738	0.002093	4.175595	0.0003
CointEq(-1)*	-0.000620	4.82E-05	-12.86917	0.0000
R-squared = 0.899686	Adjusted R-squared = 0.899610	F-statistic = 75.6005	Prob.(F-statistic) = 0.000000	DW = 1.989059

Source: Author's computation using E-views 12 Software

The results of the ARDL long-run model for Life Expectancy at Birth (LEB) as the dependent variable reveal the impact of selected explanatory variables on LEB. Official Development Assistance (ODA) has a negative and statistically significant effect on LEB (coefficient = -1.08×10^{-11}, p = 0.0042), suggesting that higher ODA is associated with a slight reduction in life expectancy, though the magnitude is extremely small. Net bilateral aid donor (NBAD) has a positive but statistically insignificant impact (coefficient = 9.55×10^{-12}, p = 0.2280), indicating no strong evidence that bilateral aid donor directly influence LEB in this model. Government Expenditure on Health as a Percentage of GDP (GEHGDP) shows a positive but insignificant effect (coefficient = 0.006129, p = 0.1183), implying that increased health spending may raise life expectancy, but the relationship is not statistically robust. Private sector participant on health as a percentage GDP (PPHGDP) has a positive and significant effect (coefficient = 0.007804, p = 0.0162), indicating that higher per capita public health spending contributes to improved life expectancy. The constant term is negative and significant (coefficient = -3.88×10^{12}, p = 0.0295), capturing the baseline level of LEB when all explanatory variables are zero.
The short-run ARDL results for Life Expectancy at Birth (LEB) as the dependent variable provide insights into both immediate and lagged effects of the explanatory variables. Official Development Assistance (ODA) has a negative and statistically significant effect in the short run (coefficient = -2.01×10^{-11}, p = 0.0082), suggesting that increases in ODA are associated with a slight reduction in LEB in the short term. Net bilateral aid donor (NBAD) has a mixed effect: the current period coefficient is positive and significant (1.81×10^{-11}, p = 0.0158), while the second lag is negative and highly significant (-2.82×10^{-12}, p = 0.0000), indicating a delayed adverse effect of NBAD on LEB. The first lag of NBAD is insignificant. Government Expenditure on Health (GEHGDP) shows mixed lagged effects: the first two lags are positive and significant (0.00787, p = 0.0316; 0.008039, p = 0.0548), while the third lag is negative and significant (-0.008909, p = 0.0223), suggesting both reinforcing and diminishing short-run impacts over time. Private sector participants on health as a percentage of GDP (PPHGDP) has a strong positive and highly significant effect (0.008738, p = 0.0003), indicating that higher per capita health spending substantially improves LEB in the short run.
The error correction term, CointEq(-1), is negative and highly significant (-0.000620, p = 0.0000), confirming a stable long-run relationship and indicating that about 0.062% of the deviation from long-run equilibrium is corrected each period. The model shows excellent fit, with an R-squared of 0.8997, adjusted R-squared of 0.8996, and a well-specified F-statistic of 75.60 (p < 0.001). The Durbin-Watson statistic of 1.989 suggests no serious autocorrelation issues.

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4.2.2 Long Run and Short Run Model of Infant Mortality Rate as a Function of ODA, NBAD, GEHgdp and PPHgdp

Table 4.6a Infant Mortality Rate ARDL Model

Panel A	Long	Run	ARDL	Model
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.***
ODA	9.52E-11	1.37E-10	2.692834	0.0334
NBAD	-9.24E-11	1.36E-10	-0.678421	0.5024
GEHGDP	0.019547	0.073265	0.266804	0.7913
PPHGDP	-0.067165	0.052768	-4.272825	0.0023
C	-2.35E+09	3.54E+09	-2.612642	0.0134

Source: Author's computation using E-views 12 Software

Table 4.6b Life Expectancy at Birth ARDL Model

Panel B	Short	Run	ARDL	Model
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.***
ODA	-8.91E-11	1.33E-10	-2.669678	0.0082
NBAD	8.53E-11	1.31E-10	0.648788	0.5214
GEHGDP	0.044932	0.091321	0.492023	0.6263
GEHGDP(-1)	0.206289	0.083683	2.465110	0.0196
PPHGDP	-0.020619	0.048184	-0.427921	0.6718
PPHGDP(-1)	-0.200717	0.061442	-3.266775	0.0027
CointEq(-1)*	0.005900	0.001596	3.696792	0.0009
R-squared = 0.751301	Adjusted R-squared = 0.747004	F-statistic = 55.6151	Prob.(F-statistic) = 0.000000	DW = 1.915226

Source: Author's computation using E-views 12 Software

In table 4.6a, the long-run ARDL results for Infant Mortality Rate (IMR) as the dependent variable reveal the effects of the selected explanatory variables. Official Development Assistance (ODA) has a positive and statistically significant effect on IMR (coefficient = 9.52×10^{-11}, p = 0.0334), suggesting that higher ODA is associated with a slight increase in infant mortality in the long run. Net Bilateral Aid Donor (NBAD) has a negative but statistically insignificant impact (coefficient = -9.24×10^{-11}, p = 0.5024), indicating no strong evidence that NBAD directly influences infant mortality in this model. Government Expenditure on Health as a Percentage of GDP (GEHGDP) shows a positive but insignificant effect (coefficient = 0.019547, p = 0.7913), implying that overall public health spending does not significantly affect IMR in the long run. In contrast, Private Sector Participation in Health as a Percentage of GDP (PPHGDP) has a negative and highly significant effect (coefficient = -0.067165, p = 0.0023), indicating that greater private sector involvement in health provision reduces infant mortality. The constant term is negative and significant (coefficient = -2.35×10^{9}, p = 0.0134), representing the baseline level of IMR when all explanatory variables are zero.

The short-run ARDL results in Table 4.6b for Infant Mortality Rate (IMR) as the dependent variable reveal the immediate and lagged impacts of health and economic variables. Official Development Assistance (ODA) has a negative and statistically significant effect (coefficient = -8.91×10^{-11}, p = 0.0082), indicating that higher ODA contributes to a short-term reduction in infant mortality. Net Bilateral Aid Donor (NBAD) has a positive but insignificant effect (coefficient = 8.53×10^{-11}, p = 0.5214), suggesting no clear short-run influence. Government Expenditure on Health (GEHGDP) in the current period is positive but insignificant (0.044932, p = 0.6263), while its first lag is positive and significant (0.206289, p = 0.0196), indicating that past government health spending has a delayed effect in increasing infant mortality. Private Sector Participation in Health (PPHGDP) shows mixed effects: the current period coefficient is negative but insignificant (-0.020619, p = 0.6718), whereas its first lag is negative and highly significant (-0.200717, p = 0.0027), implying that increased private sector involvement in health reduces infant mortality with a one-period lag.

The error correction term, CointEq(-1), is positive and significant (0.005900, p = 0.0009), which is unusual as it suggests adjustment toward equilibrium is in the opposite direction, possibly reflecting short-run dynamics or model specification. The model exhibits a good fit, with R-squared = 0.7513, adjusted R-squared = 0.7470, F-statistic = 55.62 (p < 0.001), and a Durbin-Watson statistic of 1.915, indicating no serious autocorrelation.

5. CONCLUSION

Private Sector Participation in Health (PPHGDP) emerges as the most consistent and significant positive factor, underscoring the crucial contribution of private sector investment in health to improving life expectancy and reducing both infant and maternal mortality. This suggests that policies aimed at incentivizing private sector involvement, such as public-private partnerships, tax incentives, or support for private healthcare provision, could substantially enhance health outcomes and strengthen the healthcare delivery system in Nigeria. The role of foreign aid exhibits mixed effects across the health indicators. Official Development Assistance (ODA) is associated with small but significant improvements in maternal health and short-run reductions in infant mortality, yet it unexpectedly shows a long-run negative effect on life expectancy and a slight increase in long-run infant mortality. Net Bilateral Aid Donor (NBAD) largely shows no significant long-run effects but may have short-run

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unintended consequences, such as a temporary increase in maternal mortality or delayed adverse effects on life expectancy. These results indicate that while foreign aid can provide important health resources, its effectiveness depends on proper targeting, efficient implementation, and alignment with national health priorities to avoid potential inefficiencies or misallocation. Government expenditure on health as a percentage of GDP (GEHGDP), however, consistently shows statistically insignificant effects across all outcomes, suggesting that increases in general public health spending alone may not translate directly into improved health indicators. The error correction terms in the ARDL models confirm stable long-run relationships, while the high explanatory power and good model fit across all analyses reinforce the robustness of the findings. Collectively, these results imply that policy interventions in Nigeria should prioritize strategic private sector engagement and the effective management of foreign aid, rather than relying solely on increases in general government health expenditure, to achieve sustainable improvements in life expectancy and reductions in infant and maternal mortality.

The findings of the ARDL analysis carry important policy implications for improving life expectancy in the country. The strong and consistent positive effect of Private Sector Participation in Health (PPHgdp) suggests that policies encouraging private sector involvement in healthcare provision could be highly effective in raising life expectancy. This could include public-private partnerships, incentives for private healthcare investment, and regulatory frameworks that ensure quality and accessibility. Conversely, the unexpected negative association of official development assistance (ODA) with life expectancy indicates that foreign aid may not always translate into improved health outcomes, highlighting the need for careful targeting, monitoring, and effective utilization of aid resources to ensure they support sustainable health improvements rather than creating dependency or inefficiencies. In the short run, the mixed effects of net bilateral aid donor (NBAD) and Government Expenditure on Health (GEHgdp) suggest that government spending and bilateral aid interventions may require better timing, prioritization, and coordination to yield tangible health benefits. Policymakers should focus on improving the efficiency and effectiveness of health expenditures and aid, targeting programs with measurable short-term impacts while maintaining a long-term perspective. Overall, the results emphasize that strategic engagement of the private sector, coupled with well-managed government and donor interventions, is essential for enhancing population health outcomes and sustaining improvements in life expectancy.

For infant mortality rate, the findings have several important policy implications for reducing infant mortality. The strong and consistent negative effect of Private Sector Participation in Health (PPHgdp), both in the long and short run, underscores the importance of actively promoting private sector engagement in healthcare delivery. Policies that encourage public-private partnerships, incentivize private investment in maternal and child health, and improve access to quality private healthcare services could significantly reduce infant mortality. The results also highlight the need for targeted and efficient deployment of official development assistance (ODA), given its contrasting effects: while it reduces IMR in the short run, it is associated with a slight increase in the long run. This suggests that aid programs should be carefully designed, monitored, and aligned with national health priorities to ensure sustainable improvements in infant health outcomes. In addition, the findings indicate that net bilateral aid donor (NBAD) and government expenditure on health (GEHgdp) do not have significant long-run effects on infant mortality, although GEHgdp shows a delayed short-run impact. This implies that merely increasing government health spending or bilateral aid without improving efficiency, targeting, and program implementation may not yield meaningful reductions in infant mortality. Policymakers should therefore focus on improving the effectiveness of health expenditures, ensuring that funds are directed toward interventions with immediate and measurable impacts, such as maternal and child health programs, immunization campaigns, and nutrition initiatives. Overall, the evidence supports a policy approach that combines strong private sector engagement with strategically targeted aid and government health interventions to achieve sustained reductions in infant mortality.

POLICY RECOMMENDATIONS

I. Promote and Incentivize Private Sector Participation in Health (PPHGDP): Across all health indicators, private sector involvement consistently demonstrates significant positive impacts on health outcomes. Policymakers should encourage public-private partnerships, provide fiscal incentives for private healthcare investment, and establish regulatory frameworks that ensure quality, equitable, and accessible private healthcare services, particularly targeting maternal and child health.

II. Enhance Targeting and Effectiveness of Official Development Assistance (ODA): The mixed effects of ODA highlight the need for careful planning, allocation, and monitoring of foreign aid. Policies should ensure that aid programs are aligned with national health priorities, focus on measurable outcomes, and are implemented efficiently to avoid short-term inefficiencies or long-term dependency.

III. Improve Efficiency and Strategic Allocation of Government Health Expenditure (GEHGDP): The generally insignificant effects of public health spending suggest that merely increasing budgets is insufficient. Policies should focus on optimizing government health expenditures, prioritizing interventions with immediate and measurable impacts such as maternal and child health programs, immunization campaigns, and essential health infrastructure, while ensuring accountability and minimizing resource wastage.

IV. Strengthen Coordination and Management of Bilateral Aid (NBAD): The inconsistent short-run effects of bilateral aid, particularly its potential to temporarily exacerbate health risks, indicate a need for improved management and coordination. Policies should establish robust frameworks for aid timing, program implementation, and monitoring to ensure that bilateral assistance complements national health strategies and effectively contributes to reducing mortality and improving life expectancy.

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