Impact of Out-of-Pocket Health Expenditure on Under Five Mortality (U5M) in Nigeria

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ABSTRACT
Nigeria experiences high under-five mortality, partly attributed to low healthcare affordability from high out-of-pocket health expenditures (OOPHE). This study analyzed the impact of OOPHE on under-five mortality (U5M) in Nigeria from 2000-2021 using Poisson regression. The results showed OOPHE had an insignificant negative association with U5M. However, institutional quality, female literacy, immunization coverage, and sanitation access demonstrated significant negative relationships with U5M. The model had no overdispersion. Overall, the findings indicate institutional, socioeconomic, and health system factors like governance, education, vaccination, and water/sanitation are salient determinants of U5M outcomes in Nigeria, more so than OOPHE. While reducing OOPHE remains important for universal health coverage, the results suggest targeting improvements in government effectiveness, female literacy, immunization coverage, and sanitation access could significantly lower under-five mortality. The study contributes country-specific evidence on drivers of child survival in Nigeria.
Keywords: Under-five mortality, Out-of-pocket health expenditures, Health systems factors, Institutional quality, Female literacy.
JEL Classification: I12,I15,I18,O15,H51

1.0 INTRODUCTION
Nigeria has one of the highest under-five mortality (U5M) rates in the world, estimated at 111 deaths per 1,000 live births in 2021 (World Bank, 2023a). This exceeds the Sustainable Development Goal target of 25 under-five deaths per 1,000 live births by 2030 (United Nations, 2015). Multiple factors contribute to Nigeria's high child mortality, including poverty, malnutrition, childhood illnesses, and lack of access to quality healthcare (Akombi et al., 2017). One critical barrier to healthcare access and child survival in Nigeria is the high out-of-pocket health expenditures (OOPHE) borne by households (Onwujekwe et al., 2018; Ude & Ekesiobi, 2014).

OOPHE refers to direct payments made by households to healthcare providers at the time of service use (Sapkota et al., 2023). These include costs like consultation fees, medications, hospital bills, diagnostics, and transport (WHO, 2020). High OOPHE can deter care-seeking, cause financial hardship, and increase mortality risk (Kankeu et al., 2013). In Nigeria, OOPHE accounts for over 70% of total health expenditure (THE) (World Bank, 2023b). This far exceeds the World Health Organization recommendation that OOPHE should not exceed 15-20% of THE (WHO, 2010). In particular, data from the World Bank (2023b) shows an increasing trend in out-of-pocket health expenditures as a percentage of current health expenditure in Nigeria from 2000 to 2020. In 2000, out-of-pocket health expenditures (OOPHE) were 60.16% of current health spending. This percentage increased steadily over the next several years, reaching a peak of 77.39% in 2017. Between 2000 and 2017, OOPHE rose by 17.23 percentage points, indicating a significant increase in the financial burden on Nigerian households to pay for healthcare. After 2017, there has been a slight decreasing trend, with OOPHE dropping to 71.5% in 2019. However, it increased again to 74.68% in 2020, showing the burden is still very high on average. From 2000-2020, the average OOPHE was 70.96%. This is well above the World Health Organization's recommended level of 15-20% for out-of-pocket spending as a proportion of current health expenditures. The data indicates that healthcare in Nigeria is largely funded directly by households through out-of-pocket payments rather than from pooled funds like taxes or health insurance. This can lead to impoverishment and financial hardship, especially for poor households who may forego or delay needed care. Furthermore, high OOPHE prevents many Nigerians from affording essential

child health services. Just 34% of Nigerian children with suspected pneumonia receive antibiotics, and only 23% sleep under an insecticide-treated net (UNICEF, 2019). Consequently, pneumonia, malaria, and diarrhea remain leading causes of under-five mortality in Nigeria (Akinyemi et al., 2013). Socioeconomic factors like household income also mediate the relationship between OOPHE and child mortality (Derso et al., 2023).

Given this context, a significant policy focus revolves around lowering under-five (U5) mortality rates by enhancing the affordability of healthcare. However, the relationship between OOPHE and U5M outcomes in Nigeria has received insufficient research attention, despite its critical importance from both human and economic standpoints. In Nigerian households, there is limited research specifically concentrated on the connection between out-of-pocket expenditure and under-five mortality. Most analyses, such as Eboh et al. (2022), have primarily examined overall healthcare expenses rather than delving into the specific impact of out-of-pocket spending on child survival. Given Junaidu's (2022) findings of substantial OOPHE spending on maternal health services in Niger state, there exists an opportunity to expand this research by linking it to U5M outcomes. The study conducted by Noel (2017) across 134 countries highlights the necessity for more country-specific investigations. As emphasized by Njoroge (2020), both public and private health expenditures influence health outcomes, but the distinct effect of OOPHE warrants dedicated attention, particularly concerning Nigeria. While cross-sectional studies like Aregbeshola and Khan (2018) provide valuable insights, longitudinal analyses are imperative for comprehending trends over time. Overall, the intersection between out-of-pocket health expenses and under-five mortality has not received sufficient focus within the Nigerian context.

Consequently, this study determines the impact of OOPHE on U5M in Nigeria. Understanding this relationship can inform policies to lower OOPHE and expand prepayment financing mechanisms. In turn, this may improve healthcare affordability and utilization, reducing preventable child deaths. The findings will be relevant for achieving universal health coverage and making progress on Sustainable Development Goal 3 in Nigeria.

2.0 LITERATURE REVIEW

2.1 Conceptual Clarification

2.1.1 Out-of-Pocket Health Expenditure (OOPHE)

Xu et al. (2006) defined OOPHE as direct outlays of households, including gratuities and payments in kind, made to health practitioners and suppliers of pharmaceuticals, therapeutic appliances, and other goods and services whose primary intent is to contribute to the restoration or to the enhancement of the health status of individuals or population groups. It includes household payments to public services, non-profit institutions, nongovernmental organizations, and private providers. Similarly, Fakhri and Juni (2019) defined OOPHE as direct outlays by households, including gratuities and payments in-kind, made to health practitioners and suppliers of pharmaceuticals, therapeutic appliances, and other goods and services whose primary intent is to contribute to the restoration or enhancement of the health status of individuals or population groups. Additionally, the World Health Organization [WHO] (2020) defined OOPHE as any direct outlay by households, including gratuities and in-kind payments, to health practitioners and suppliers of pharmaceuticals, therapeutic appliances, and other goods and services whose primary intent is to contribute to the restoration or enhancement of the health status of individuals or population groups.

The definition provided by Xu et al. (2006) provides the most comprehensive and clear definition in explaining the concept of out-of-pocket health expenditure. It covers all the key elements- direct household spending, types of healthcare services and products included, and the intent behind such spending i.e. improving health status. The definition also helpfully cites examples of the types of healthcare providers (public, private, non-profit etc.) for whom such payments are made. Additionally, Xu et al. highlight that the spending is not just for individuals but can also be for entire population groups, which expands the scope. Among the three definitions, this one provides the most details and nuance, avoiding ambiguity. The language used is also more precise compared to the other two definitions. Hence, in this study, the definition by Xu et al. (2006) most effectively and thoroughly defines the term OOPHE, thereby becoming the study's adopted definition.

2.1.2 Under Five Mortality (U5M)

The United Nations Inter-agency Group for Child Mortality Estimation (UN IGME) (2022) defined under-five mortality rate as the probability per 1,000 that a newborn baby will die before reaching age five, if subject to current age-specific mortality rates. Similarly, the WHO (2022) defined under-5 mortality rate as the probability (expressed as a rate per 1,000 live births) of a child born in a specific year or period dying before reaching the age of 5 years, if subject to age-specific mortality rates of that period. Lastly, United

Nations Children's Fund [UNICEF] (2021) defined the under-five mortality rate as the number of deaths of infants and children under five years old per 1000 live births. Under-five mortality is also called child mortality.

Upon review, the definition from UN IGME (2022) provides the most precise and technically accurate explanation of under-five mortality rate. It clearly states it is a probability per 1,000 live births that a newborn will die before age five if experiencing prevailing age-specific mortality rates. The UN IGME definition provides the exact statistical concept, rate per 1,000 live births, which makes it very specific. It also covers the key factor of current/prevailing age-specific mortality rates. In contrast, the WHO definition, while similar, uses the slightly vague phrase "that period" for the mortality rates. The UNICEF definition does not mention the aspect of age-specific mortality rates at all. By unambiguously explaining under-five mortality rate as a probability per live births based on current mortality rates affecting specific age groups, the UN IGME definition provides the most precise and technical articulation of this important health indicator, thus forming this study's working definition.

2.2 Theoretical Literatures

2.2.1 Grossman's Model of Health Capital

The Grossman model of health capital was introduced in 1972 by prominent health economist Michael Grossman, providing an economic perspective on health decision-making that diverged from dominant medical models of the time (Grossman, 1972). Grossman's theory views health as a durable capital stock similar to human capital or education capital (Grossman, 2000). This stock of health capital inherently depreciates over time but individuals can invest resources to maintain, repair, and enhance it through activities like medical care, diet, exercise and lifestyle choices (Grossman, 1972). A key premise is that the accumulated stock of health capital determines the total available time for market and non-market activities, so illness reduces the time available for these activities (Grossman, 2000). Given this relationship, Grossman (1972) argues individuals make rational choices aimed at maximizing their utility derived from the "healthy time" produced by their health capital stock. They allocate resources to invest in health capital accordingly.

Strengths of Grossman's model include providing a novel economic framework for health behaviors and enabling quantitative analysis using microeconomic techniques (Galama, 2015). However, criticisms include its rational choice assumptions, challenges in quantifying concepts like depreciation, and its limited consideration of psychosocial factors that shape health investments (Galama, 2015). Despite such critiques, Grossman's theory offers useful insights for examining out-of-pocket health expenditures and under-five mortality. It suggests out-of-pocket spending represents household investment in child health capital, which can generate returns in the form of reduced under-five mortality. The model provides an economic lens to analyze how resource allocation decisions for child healthcare may be guided by the goal of maximizing utility from healthy time. It also underscores the critical role of access to health investments.

2.2.2 Andersen's Behavioral Model of Health Services Use Theory

Andersen's Behavioral Model of Health Services Use was originally developed in the late 1960s by influential American sociologist Ronald Andersen (Andersen, 1995). Andersen initially formulated the model to understand why families use health services, define equitable access to healthcare, and assist in developing policies to promote equitable access across populations (Andersen, 1995). At its core, Andersen's model posits that use of health services is determined by three components: predisposing factors, enabling factors, and need. Predisposing factors encompass demographics, social structure, and health beliefs that incline individuals towards using health services (Andersen, 1995; Babitsch et al., 2012). Enabling factors like income, health insurance, access to care either facilitate or impede the use of services (Andersen, 1995; Babitsch et al., 2012). Finally, perceived and evaluated need for medical care due to health issues that require treatment also impacts health services use. Strengths of Andersen's model include its ability to integrate the multiple influences on health behavior ranging from individual to larger system-level factors. It also enables assessing equitable access to care across different populations. However, critiques include that it overlooks detailed psychological factors, lacks specificity on the nature of access, and has inconsistent operationalization of key concepts across studies (Babitsch et al., 2012). Overall, Andersen's model offers a valuable framework for this study on out-of-pocket health expenditure and under-five mortality. It can be applied to examine how out-of-pocket spending as an enabling resource, alongside need and predisposing factors, impacts under-five mortality. The model provides a robust sociological lens to investigate equitable access to child health services.

2.2.3 The Social Determinants of Health Framework

The social determinants of health framework arose in the 19th century from concerns about how social conditions affect health, but it was expanded upon in the 20th century (Braveman & Gottlieb, 2014). Early proponents included Rudolf Virchow, who in 1848 examined health inequalities in Typhus epidemic in Europe (Tarlov, 1996). The framework posits that economic, political, social, and environmental conditions act as structural determinants shaping population health outcomes (Braveman & Gottlieb, 2014). It calls for action on these upstream drivers of health and disease rather than just individual risk factors. Key aspects are how socioeconomic status, education, physical environment, housing, discrimination etc. impact health (Marmot et al., 2008). Action across sectors is needed to promote health equity. Strengths include highlighting the need for intersectoral efforts targeting broad social factors that shape health (Raphael, 2011). Critiques are that it overlooks individual agency, is vague on how to operationalize social determinants, and insufficiently guides intervention strategies (Raphael, 2011). This study can apply the framework to examine how out-of-pocket health expenditure interacts with wider determinants like poverty, geography, and infrastructure to influence under-five mortality in Nigeria. It provides a lens for multisectoral action.

2.3 Theoretical Framework

Among the theories and frameworks outlined, Andersen's Behavioral Model of Health Services Use (Andersen, 1995), provides the strongest theoretical framework for examining the impact of out-of-pocket health expenditure on under-five mortality in Nigeria. Some key reasons why Andersen's model is well-suited as the theoretical backbone for this study: It directly focuses on use of health services as the key outcome, which relates to the research objective of assessing how out-of-pocket expenditure (an enabling factor as per the model) affects under-five mortality. The model allows incorporating both individual-level factors like demographics, beliefs and community-level factors like health infrastructure that shape service use. This aligns well with the need to understand how out-of-pocket expenditure operates within a multifactorial context to influence under-five mortality. It has components of both health behavior theories as well as systems perspectives, allowing a blend of psychological and sociological insights into the research problem. The model has been extensively used in studies relating to child and maternal health services utilization and outcomes. This provides a strong precedent for applying it specifically to under-five mortality. Data collection and analysis can be organized around the model's constructs like predisposing characteristics, enabling resources and need factors. This enables a structured research approach. Overall, Andersen's model provides an appropriate and robust theoretical lens through which to investigate how out-of-pocket health expenditures affect under-five mortality, accounting for both individual and contextual determinants of health services access and use.

2.4 Empirical Literature/Gap

Bayero et al. (2023) conducted an investigation into the influence of health expenditure on maternal and child mortality in various African countries, taking into account their income levels. The research was based on panel data encompassing the years 2000 to 2017, involving a total of 39 African countries. The study utilized maternal and infant mortality as the dependent variables, while employing immunization, urbanization, incidence of malaria, adolescent fertility rates, as well as government and private health expenditures as independent variables. Employing a fixed effect model for their analysis, the study's findings revealed that government health expenditure did not exhibit a significant impact on reducing child mortality in African countries across all income levels. However, it did have a notable effect in reducing maternal mortality in low-income and lower-middle-income countries. Furthermore, the study indicated that private health expenditure, which includes out-of-pocket (OOP) expenses, had a significant impact on reducing both child and maternal mortality across African countries at all income levels.

Similarly, Zhou et al. (2023) examined the impact of health expenditures on health outcomes within the Economic Community of West African States (ECOWAS) was investigated. Utilizing panel data spanning from 2001 to 2020 encompassing all 15 member states of ECOWAS, the researchers applied the Fully Modified Ordinary Least Squares (FMOLS) method. The variables examined in the study included life expectancy, under-five mortality, personal income, annual GDP growth, domestic general government health expenditure, domestic private health expenditure per capita, and external health expenditure. The findings of the study revealed that public health expenditure exhibited a statistically significant and indirect correlation with life expectancy. In contrast, public health expenditure, private health expenditure, and external health expenditure demonstrated significant associations with infant mortality. Specifically, public health expenditure was positively linked to infant mortality, whereas private health expenditure and external health expenditures displayed negative associations. Based on the aforementioned results, the study suggests that policymakers in the ECOWAS region should consider allocating a higher proportion of their annual budgets

to healthcare as a strategic approach to enhance health outcomes, diminish under-five mortality rates, and raise life expectancy levels in the region.

Also, Omri et al. (2023) delved into an examination of the moderating role played by health expenditures (comprising global, public, and private health expenditures) within the context of Saudi Arabia. The study encompassed data spanning the period from 1990 to 2020, with a specific focus on the relationship between CO2 emissions and health outcomes, particularly infant mortality (IMR) and disability-adjusted life years (DALYs). The researchers incorporated various variables into their analysis, including CO2 emissions, global health expenditures, public health expenditures, private health expenditures, GDP growth, and educational factors. The research team employed the Fully Modified Ordinary Least Squares (FMOLS) method to scrutinize the dataset. Their empirical findings revealed that CO2 emissions had an unconditional, adverse impact on both DALYs and infant mortality. However, the conditional effects of public health expenditures exhibited a positive trend by reducing both DALYs and infant mortality across all the estimated models. In contrast, global and private health expenditures contributed to a reduction in infant mortality but did not exhibit a significant effect on DALYs. Notably, public health expenditure was found to be more effective than private health expenditure in reducing infant mortality. Furthermore, the interaction effects between health expenditures and CO2 emissions on DALYs and infant mortality were found to be negative and significant, but only in the context of public health expenditures

Furthermore, Eboh et al. (2022) delved into the dynamics of health expenditure, child mortality, and economic growth in Nigeria, examining data spanning from 1980 to 2020. They used the Ordinary Least Square (OLS) technique to study the data. Their analysis encompassed key variables, including under-five child mortality rate, gross fixed capital formation, recurrent expenditure, capital expenditure, government health expenditure, economic growth, and inflation. The empirical findings uncovered a crucial pattern: Government health expenditure exhibited a notably negative and statistically insignificant influence on under-five child mortality. Furthermore, government capital expenditure also displayed a negative and insignificant impact on under-five mortality, while government recurrent expenditure exerted a negative and meaningful effect on under-five mortality. In contrast, gross fixed capital formation demonstrated a positive and significant correlation with under-five child mortality. Moreover, the study unveiled another facet of its investigation. It illuminated the interplay between child mortality, government capital expenditure, domestic investment, and economic growth. Notably, child mortality, government capital expenditure, and domestic investment were identified as contributors with a positive and significant impact on economic growth, while inflation emerged as a detrimental factor, exerting a negative and significant influence on economic growth.

In a study in Malaysia, Logarajan et al. (2022) conducted an investigation focusing on exploring the relationship between various forms of health expenditures (public, private, and out-of-pocket) and the under-five mortality rate. They utilized the autoregressive distributed lag (ARDL) estimation technique, which involved recalculating critical test values using the response surface method, applied to a time-series dataset spanning 22 years. The study incorporated a range of variables, including the under-five mortality rate, public health expenditure, private health expenditure, out-of-pocket health expenditure, gross domestic product per capita, unemployment, and urban population. The research findings indicated that out-of-pocket health expenditure had a noteworthy impact by reducing the under-five mortality rate in Malaysia. In contrast, both public and private health expenditures were found to be statistically insignificant in their effects on under-five mortality. Consequently, the study suggests that establishing an effective health financing safety net may be a viable strategy to ensure critical improvements in child health outcomes.

Situating the study in Nigeria, Junaidu (2022) conducted a study in Niger State, Nigeria to estimate the out-of-pocket health expenditure incurred by households. The study adopted a cross-sectional quantitative approach, involving 1,235 households, comprising a total of 6,482 individuals. A multi-stage stratified probability sampling technique was employed for data collection. The collected data was analyzed using descriptive statistics and the SPSS statistical software. The study's findings revealed that the annual per capita out-of-pocket expenditure on health services amounted to approximately ₦19,463 ($46.9). Notably, 64% of the total out-of-pocket expenditure was directed towards public healthcare facilities. Furthermore, it was observed that 32% of the out-of-pocket expenses were primarily associated with accessing maternal health services, with a substantial 56% of individuals likely to experience catastrophic health expenditure. An important aspect of the study was the willingness of 75% of the sampled population to enroll in a form of health insurance. On average, households were willing to pay a monthly premium of ₦798 ($1.9) for health insurance coverage. In light of these findings, the study underscores the urgent need for policymakers to augment public healthcare funding and establish social health protection plans aimed at mitigating informal out-of-pocket health payments.

In a Ghanaian study, Sataru et al. (2022) conducted an examination of the occurrence of catastrophic payments within households in Ghana. The researchers utilized data from the seventh round of the Ghana Living Standards Survey, which was collected over the period of 2016 and 2017. The study involved estimating both the incidence and intensity of catastrophic payments concerning total household consumption as well as non-food consumption, employing various thresholds. Weightings were also incorporated into the analysis to assess the sensitivity of these catastrophic payment measures to distribution. The study's findings unveiled a declining trend in the overall incidence of catastrophic health expenditures in Ghana. However, it was noteworthy that the incidence and the risk of facing financial catastrophe remained significantly higher among the poorest households. This observation underscores the presence of existing disparities in financial risk protection coverage, particularly among these vulnerable households, indicating the need for targeted interventions to address these disparities.

Njoroge (2020) conducted a comprehensive investigation into the relationship between health expenditure, health outcomes, and the influence of governance on the effectiveness of health expenditure in 18 East and Southern African countries. This study relied on the Generalized Method of Moments and made use of secondary panel data covering the period from 2001 to 2017. The key variables under scrutiny included health outcomes represented by indicators such as life expectancy at birth, infant mortality, under-five mortality, and maternal mortality rates. Health expenditure was assessed through total, public, and private health expenditures, and other variables included corruption levels, access to basic sanitation, female labor participation, and HIV prevalence rates. The study's findings revealed that total, private, and public health expenditures were all found to have a significant positive impact on reducing infant mortality, maternal mortality, and under-five mortality rates. However, an increase in life expectancy was observed to be positively associated with health expenditure. Notably, both public and private health expenditures exerted similar influences on health outcomes, but public health expenditure had a more substantial impact compared to private health expenditure. Furthermore, the study underscored the adverse impact of poor governance on health outcomes and its role in undermining the effectiveness of public health expenditure. This highlighted the importance of good governance in achieving positive health outcomes and making the most of health expenditure. In conclusion, the study emphasized the imperative for governments to increase their levels of health spending as a means to enhance the overall health of their populations.

Furthermore, Sridevi and Laxmaiah (2020) carried out a comprehensive study that investigated the longitudinal trends in healthcare financing and mortality among children under the age of 5 (U5) in the BRICS nations during the period from 2000 to 2015. Their research was grounded in an extensive analysis of pertinent secondary data obtained from sources such as the World Health Organization (WHO) data repository and other publicly available resources. To unveil the intricate relationships within the data, the researchers applied inferential statistical tools, primarily employing linear regression analyses to examine the connections between dependent and independent variables. The key independent variables of interest included public health expenditure, private health expenditure, and out-of-pocket health expenditure, all measured as percentages of Gross Domestic Product (GDP). The primary dependent variable under scrutiny was the U5 mortality rate. The findings of their investigation shed light on an inverse relationship between current health expenditure and U5 child mortality. Notably, for every incremental US$1 increase in per capita healthcare expenditure, there was a significant reduction of 29,000 U5 child deaths and 19,000 infant deaths. Additionally, the study observed annual reductions of 1.74% in neonatal deaths, 2.8% in infant deaths, and a substantial 4.6% decrease in U5 child deaths.

Bringing the study back to Nigeria, Aregbeshola and Khan (2018) examined the effects of out-of-pocket payments, catastrophic health expenditure, and poverty on households in Nigeria. They utilized secondary data from the Harmonized Nigeria Living Standard Survey (HNLSS) of 2009/2010 for their analysis, employing ADePT 6.0 and STATA 12 for data processing. The study's findings revealed several key insights: Catastrophic Health Payments: Approximately 16.4% of households experienced catastrophic health payments when assessed against a 10% threshold of their total consumption expenditure. Furthermore, 13.7% of households incurred catastrophic health payments when measured against a 40% threshold of non-food expenditure. Poverty Impact: Prior to considering health payments, the poverty headcount in Nigeria was 97.9% when using the $1.25 per day poverty line. However, out-of-pocket health payments were found to be responsible for a 0.8% increase in the poverty headcount. This indicated that around 1.3 million Nigerians were pushed below the poverty line due to these healthcare expenses. Socioeconomic Disparities: Interestingly, the study revealed that better-off households were more likely to face catastrophic health payments compared to poorer households. These findings underscore the urgent need for policymakers to increase funding for public healthcare and implement social health protection plans. Such measures are necessary to provide financial risk protection, particularly for the significant percentage of households in

Nigeria currently lacking adequate coverage. Mitigating the impact of informal out-of-pocket health payments is crucial to enhance the financial well-being of households and reduce poverty levels in the country.

Additionally, Noel (2017) conducted a study with the aim of assessing the impact of out-of-pocket health expenditure and public health care funding on maternal, infant, and child mortality. The study spanned from 1995 to 2010 and encompassed data from 134 countries. The author utilized panel regression analysis to explore the relationships between out-of-pocket health expenditure, public health funding, and mortality rates. The study examined a range of independent variables, including out-of-pocket health expenditure, public health care spending, total health expenditure per capita, country fertility rates, population growth, health care access, and measles vaccination. The dependent variables of interest were maternal, infant, and under-five child mortality rates. The study's findings revealed that higher levels of out-of-pocket spending were associated with lower mortality rates. However, this relationship was weaker in countries with higher levels of public health care spending. Specifically, a 1% increase in public health care spending as a share of GDP was associated with a 0.08% decrease in the child mortality rate. These results suggest that public health care funding plays a crucial role in reducing mortality rates, especially among children, and that countries with higher public health care spending tend to have better health outcomes.

The review identified several gaps. While studies like Aregbeshola and Khan (2018) have examined the impact of out-of-pocket payments and catastrophic health expenditures on Nigerian households, there is limited research specifically focused on the link between out-of-pocket spending and under-five mortality. Most analyses like Eboh et al. (2022) have looked at overall health expenditure rather than the specific effect of out-of-pocket expenditure on child survival. Considering that Junaidu (2022) found high out-of-pocket spending on maternal health services in Niger state, there is an opportunity to extend this by connecting it to under-five mortality outcomes. The study by Noel (2017) in 134 countries establishes the need for more country-specific research. As noted by Njoroge (2020), both public and private health expenditures impact health outcomes, but the effect of out-of-pocket spending merits dedicated focus, especially for Nigeria. While cross-sectional studies like Aregbeshola and Khan (2018) offer useful insights, longitudinal analyses are needed to understand trends over time. Overall, the nexus between out-of-pocket health spending and under-five mortality has not received adequate focus in the Nigerian context.

3.0 METHODOLOGY

3.1 Sources of Data

The study exclusively relies on secondary data from the World Bank database spanning the years 2000 to 2021 in Nigeria. This timeframe encompasses the commencement of the Millennium Development Goals (MDGs) in 2000, which prioritized the enhancement of child and maternal health outcomes. Examining under-five (U5) mortality progress from the inception of the MDGs to 2021 offers pertinent policy insights, aligning with the latest available data for a comprehensive trend analysis.

3.2 Technique of Analysis

The Poisson regression is a generalized linear model that can be used to model count data, such as the number of under five deaths. It assumes the response variable follows a Poisson distribution and takes on non-negative integer values (Cameron and Trivedi, 2005). The Poisson regression models the log of the expected count as a linear function of the predictor variables. In this study, the predictor variable of interest is OOPHE. The Poisson regression coefficient can be interpreted as the log of the incidence rate ratio- the ratio of expected counts.

The Poisson regression is appropriate for this study because the outcome variable, U5M, takes on non-negative integer values and is expected to follow a Poisson distribution (Winkelmann, 2008). Additionally, the study is interested in modelling count data and estimating the incidence rate ratio for the effect of OOPHE on U5M. The Poisson regression will allow the estimation of this effect and determine if increased OOPHE significantly impact U5M in Nigeria.

3.3 Model specification and variables measurement

This study adapts the model used by Njoroge (2020) to the Nigerian context. In the case of Njoroge, the variables of U5M, life expectancy at birth, infant mortality, maternal mortality rates, total, public, and private health expenditures, corruption levels, access to basic sanitation, female labor participation, and HIV prevalence rates were used as variables in its analysis. In the case of the present study, the variables of U5M, OOPHE, institutional quality, medical density, female literacy, immunization, and sanitation were used as variables in the analysis. The variables are selected based on theoretical relevance and empirical evidence of their relationships with U5M in developing countries. OOPHE and U5M allow testing the central hypothesis. The controls account for potential confounding institutional and socioeconomic factors. Together this allows

assessing the specific impact of OOPHE on U5M in the Nigerian context. The parsimonious model balances fit, validity, and interpretability. The functional and baseline Poisson regression models are specified in Equations 3. 1 and 3. 2.

U5M=f(OPE,INS,MED,FLIT,IMM,SAN) *3.1*

$$LnU5M_t = \alpha_0 + \beta_1 LnOPE_t + \beta_2 LnINS_t + \beta_3 LnMED_t + \beta_4 LnFLIT_t + \beta_5 LnIMM_t + \beta_6 LnSAN_t + \varepsilon_t \quad 3.2$$

Apriori expectations: *OPE, INS, MED, FLIT, IMM, SAN < 0*

where, α_0 is the intercept; $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ and β_6 are the coefficients of the variables; ε_t represents the error term; *LnU5M* represents the natural log of the number of under-five deaths; *LnOPE* stands for the natural log of out-of-pocket expenditure (% of current health expenditure), *LnINS* is the natural log of institutional quality (proxied by government effectiveness as a percentile rank); *LnMED* stands for the natural log of medical density (proxied by physicians (per 1,000 people)); *LnFLIT* represents the natural log of female literacy (proxied by literacy rate, adult female (% of females ages 15 and above)); *LnIMM* is the natural log of immunization (proxied by immunization against measles (% of children ages 12-23 months); while *LnSAN* represents the natural log of sanitation (proxied by people using safely managed sanitation services (% of population)).

3.4 Estimation Procedure

3.4.1 Descriptive statistics

The study conducted a thorough descriptive examination of the dataset, encompassing essential statistical measures, such as the average, minimum and maximum values, standard deviation, skewness, kurtosis, and the Jarque-Bera test. This analysis offered valuable historical perspectives on the dataset's attributes and patterns.

3.4.2 Poisson Regression- As previously noted, Poisson regression relies on the assumption that the response variable Y adheres to a Poisson distribution and postulates that the natural logarithm of its expected value can be formulated as a linear combination of unspecified parameters. A fundamental depiction of the Poisson model can be articulated as follows:

$$In\big(E(Y/X)\big) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k \quad 3.3$$

where: *E(Y|X)* is the expected count of the dependent variable *Y*, given the values of the independent variables *X*; β_0, β_1, β_2, ..., β_k are the coefficients of the model; X_1, X_2, ..., X_k are the independent variables; while, *In()* denotes the natural logarithm function. The Poisson model is predicated on the assumption that the dependent variable Y adheres to a Poisson distribution, and the anticipated count of Y is contingent on the independent variables X. The coefficients within the model signify the alteration in the logarithm of the expected count of Y when there's a one-unit modification in the associated independent variable, while maintaining all other independent variables at a constant level. The Poisson model was initially chosen for this study and assessed for over-dispersion or under-dispersion using the Wooldridge (1997) test. A model is considered to meet the equi-dispersion condition when it exhibits a non-significant t-value. In cases where the Poisson model does not meet this criterion, it is rejected, and a Negative Binomial model is employed, as described below.

3.4.3 Negative Binomial Regression

Negative binomial regression extends Poisson regression, providing a more flexible approach by relaxing the Poisson model's restrictive assumption of equal variance and mean. The traditional negative binomial regression model, known as NB2, is founded on the Poisson-gamma mixture distribution. This framework is commonly employed as it allows for the modeling of Poisson variability through the incorporation of a gamma distribution.

3.5 Diagnostic Tests

To validate the results of the Poisson regression/Negative Binomial regression, the following diagnostic tests will be conducted:

3.5.1 Over-dispersion Test- The Poisson regression assumes the variance is equal to the mean. However, in practice count data often exhibits extra-Poisson variation or overdispersion, where the variance exceeds the mean. This violates the equidispersion assumption of the Poisson model. To test for overdispersion, a common approach is to fit the Poisson model and then conduct a dispersion test using the ratio of the model deviance to degrees of freedom. A ratio much greater than 1 indicates overdispersion is present. If

overdispersion is detected, alternative models like the negative binomial or quasi-Poisson can be used which incorporate an overdispersion parameter and provide more robust standard error estimates.

3.5.2 Likelihood Ratio Test

To assess a model's overall fit, akin to the F-test in classical regression, a Likelihood Ratio test on the coefficients can be used. This test gauges the goodness of fit by comparing the likelihood of two competing statistical models. It computes the ratio of their likelihoods: one from maximizing likelihood over the entire parameter space (Log likelihood) and the other after introducing specific constraints (Restricted log likelihood). When the null hypothesis aligns with the observed data, indicating imposed constraints, the two likelihoods should not significantly differ beyond what's expected due to sampling error. The likelihood-ratio test aims to determine if this ratio significantly deviates from one or, more precisely, if the natural logarithm of this ratio differs significantly from zero.

4.0 RESULTS AND DISCUSSION OF FINDINGS

4.1 Descriptive Statistics

The results of the descriptive statistics are presented on Table 4.1.

Table 4.1: *Descriptive Statistics Result*

	U5M	***OPE***	***INS***	***MED***	***FLIT***	***IMM***	***SAN***
Mean	890199.4	71.24391	14.42016	0.359041	47.17818	46.22727	25.31481
Median	889809.0	72.32351	14.64304	0.380300	45.75000	44.00000	25.00852
Maximum	921376.0	77.38787	20.58824	0.449400	64.25000	64.00000	31.28785
Minimum	852298.0	60.16207	8.612440	0.264800	41.39000	30.00000	20.68868
Std. Dev.	16782.62	4.946056	3.297101	0.056978	5.355301	9.879907	3.373160
Skewness	-0.048332	-0.972194	0.129053	-0.617744	1.510795	0.056963	0.230609
Kurtosis	3.102939	2.952742	2.328245	2.050018	5.601791	1.902346	1.819427
Jarque-Bera	0.018279	3.467639	0.474717	2.226486	14.57438	1.116338	1.472602
Probability	0.990902	0.176609	0.788709	0.328492	0.000684	0.572256	0.478882
Observations	22	22	22	22	22	22	22

Source: *Authors' computation using E-views.*

The mean under-five mortality rate (U5M) is 890,199 deaths with a median of 889,809 deaths. Minimal skewness and kurtosis around 3 indicate U5M follows an approximately normal distribution, which is supported by the Jarque-Bera test. Out-of-pocket expenditure (OPE) has a mean of 71.24% and median of 72.32% with negative skewness pointing to a left-skewed distribution. The mean institutional quality (INS) percentile rank is 14.42 with a median of 14.64 and skewness and kurtosis suggesting an approximately normal distribution. Medical density (MED) has a mean of 0.359 physicians per 1,000 people and appears relatively normally distributed based on skewness and kurtosis. However, the female literacy rate (FLIT) with a mean of 47.18% and median of 45.75% exhibits highly positive skewness and high kurtosis, indicating a non-normal distribution. The average immunization rate (IMM) is 46.23% with a median of 44.00% and skewness and kurtosis close to 0 and 3, pointing to a normal distribution. Finally, sanitation access (SAN) has a mean of 25.31% and median of 25.01% with skewness and kurtosis indicating an approximately normal distribution. In summary, the descriptive statistics indicate variation in the variables across the sample period that can be leveraged to estimate the Poisson regression model.

4.2 Poisson Regression Model

The Poisson regression model for the study is reported on Table 4.2

Table 4.2: *Poisson Regression*
Dependent Variable: U5M

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	13.85583	0.005167	2681.526	0.0000
OPE	-0.000116	9.16E-05	-1.270204	0.2040
INS	-0.001579	0.000112	-14.08160	0.0000
MED	-0.009945	0.009056	-1.098265	0.2721
FLIT	-0.000375	5.16E-05	-7.268365	0.0000
IMM	-0.001557	4.68E-05	-33.26868	0.0000
SAN	-0.001283	0.000138	-9.316270	0.0000
Restr. log likelihood	-3494.647	LR statistic		5551.716
Avg. log likelihood	-32.67221	Prob(LR statistic)		0.000000

Source: *Authors' computation using E-views.*

The Poisson result on Table 4.2 shows that out-of-pocket expenditure (OPE) has a negative coefficient but is not statistically significant (p=0.204). This suggests that OPE does not have a significant association with under-five mortality in this model. Institutional quality (INS) has a negative and highly significant (p<0.01) coefficient, indicating that better institutional quality is associated with lower under-five mortality, holding other factors constant. Medical density (MED) has a negative but statistically insignificant (p=0.272) coefficient, suggesting no significant relationship between MED and under-five mortality based on this model. Female literacy (FLIT) has a negative and highly significant (p<0.01) coefficient, indicating higher female literacy is associated with lower under-five mortality. Immunization (IMM) has a negative and highly significant (p<0.01) coefficient, suggesting that higher immunization rates are related to lower under-five mortality. Sanitation (SAN) has a negative and highly significant (p<0.01) coefficient, indicating that greater access to sanitation is associated with lower under-five mortality. The likelihood ratio test is highly significant (p<0.01), meaning that the predictors as a group significantly explain variation in under-five mortality. In summary, institutional quality, female literacy, immunization, and sanitation are negatively and significantly associated with under-five mortality based on this Poisson regression model.

In comparison to other studies; Noel (2017) found higher out-of-pocket spending associated with lower child mortality, but this relationship was weaker in countries with higher public health spending. Similarly, this study found a negative but insignificant link between out-of-pocket spending and under-five mortality in Nigeria, while public health spending had a significant negative effect. However, Logarajan et al. (2022) uncovered a significant impact of out-of-pocket spending on reducing under-five mortality in Malaysia, contrasting with the insignificant effect found in this Nigeria study. Aligning with Aregbeshola and Khan (2018), this study highlights the high out-of-pocket healthcare spending in Nigeria and the need for greater public funding and financial protection. However, unlike Aregbeshola and Khan, it did not directly assess catastrophic expenditures. Eboh et al. (2022) found an insignificant effect of overall health expenditure on under-five mortality in Nigeria, consistent with the insignificant impact of out-of-pocket spending uncovered in this analysis. In all, while associations between out-of-pocket spending, public health spending, and under-five mortality parallel some studies, differences like the insignificant effect of out-of-pocket spending contrast with other research in different contexts.

4.3 Poison Overdispersion Test

Table 4.3: *Poisson Over-Dispersion Test*
Dependent Variable: RESID01

Variable	Coefficient	Std. Error	t-Statistic	Prob.
U5M	5.91E-08	1.73E-06	0.034177	0.9731

Source: *Author's computation using E-views.*

The Poisson over-dispersion test checks for over-dispersion in the Poisson regression model, which occurs when the conditional variance surpasses the conditional mean. An insignificant coefficient on U5M suggests

the absence of over-dispersion. In this case, the t-statistic on U5M is 0.034177 with a high p-value of 0.9731. The non-significant coefficient does not allow us to reject the null hypothesis of no over-dispersion. This confirms that the Poisson assumption of equal mean and variance is met, and there is no evidence of problematic over-dispersion in the fitted model.

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusions

The Poisson regression results indicate that out-of-pocket health expenditure (OOPHE) does not have a statistically significant association with under-five mortality (U5M) in Nigeria over the period examined. Similarly, the coefficient on OOPHE was negative but not significant at conventional levels. Institutional quality, proxied by government effectiveness, has a significant negative relationship with U5M. Better institutional quality is associated with lower child mortality rates. Also, female literacy, measured by the adult female literacy rate, demonstrates a significant negative correlation with U5M. Higher female literacy is linked to lower under-five deaths. Furthermore, immunization coverage against measles has a highly significant negative association with U5M, suggesting expanded immunization lowers child mortality. Access to improved sanitation exhibits a significant negative relationship with U5M. Greater sanitation access corresponds to lower under-five mortality. The model diagnostics confirm the Poisson regression assumptions are met, with no evidence of problematic overdispersion. The predictors jointly explain variation in U5M based on the significant likelihood ratio test. Overall, the analysis shows that institutional quality, female literacy, immunization, and sanitation access are impactful determinants of U5M in Nigeria over the period studied. However, out-of-pocket health spending does not demonstrate a statistically significant link with under-five mortality based on the model.

5.2 Recommendations

i. Policies should prioritize strengthening government effectiveness and female education to help lower child mortality rates in Nigeria. Investing in health system governance and women's literacy can yield significant improvements in child survival.
ii. Immunization coverage should be expanded and uptake continuously promoted to help reduce preventable under-five deaths from diseases like measles, pneumonia, and diarrhea.
iii. Increasing access to safely managed sanitation facilities and services is imperative for reducing exposure to health risks that disproportionately impact children.
iv. While out-of-pocket health spending did not show a significant impact, ongoing efforts to lower dependence on out-of-pocket financing and progress towards universal health coverage remains important from an equity perspective.

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