



Economic Burden of Non-Communicable Diseases on Life Expectancy of Households in Jos, Plateau State, Nigeria

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Abstract

The paper explored the economic burden of non-communicable diseases (NCDs) on the life expectancy of households in Jos, Plateau State, Nigeria. Recognizing the pivotal role of healthcare financing in managing NCDs and enhancing life expectancy, this investigation focused on understanding how expenditures on drugs, hospitalization, and laboratory investigations influence the longevity of the affected populations. The research was motivated by the growing concern over the increasing prevalence of NCDs and the need for targeted healthcare investments to improve public health outcomes in the region. Employing an ordinal logistic regression analysis, the study analyzed data collected from households within Jos metropolis. The research design was meticulously crafted to assess the relationship between the specified categories of healthcare expenditures and life expectancy, accounting for the diverse healthcare needs and financial capacities of the households. The findings revealed that expenditures on drugs, hospitalization, and laboratory investigations all have a positive and significant impact on life expectancy. Specifically, the study demonstrated that accessible and affordable medication, quality hospital care, and effective diagnostic services are crucial components in extending the lives of individuals afflicted with NCDs. These results underscore the importance of healthcare expenditures in managing chronic diseases and suggest a direct link between financial investments in health services and improved life expectancy outcomes. Based on these findings, the study recommends the implementation of policies aimed at enhancing the accessibility and affordability of essential medications, including negotiations for lower drug prices and subsidies for life-saving drugs. Additionally, it highlights the need for substantial investments in healthcare infrastructure, particularly in hospital facilities and diagnostic services, to ensure the delivery of quality care. Strengthening laboratory services through investments in modern equipment and technician training is also emphasized as a priority for improving disease management and patient outcomes.

Keywords: *Expenditure on drugs, Expenditure on hospitalization, Expenditure on laboratory investigations, Economic burden and Life expectancy.*

JEL Codes: *I11, I12, I15 & J11*

I. Introduction

Non-communicable diseases (NCDs) represent a significant global health challenge that disproportionately affects low- and middle-income countries, contributing to substantial economic burdens and impacting life expectancy. NCDs such as cardiovascular diseases, cancers, chronic respiratory diseases, and diabetes are the leading causes of mortality

worldwide, accounting for approximately 71% of all deaths globally (World Health Organization [WHO], 2018). The economic impact of these diseases is profound, not only due to the direct costs associated with medical care but also because of the indirect costs related to loss of productivity and premature mortality. In Nigeria, as in many other African nations, the burden of NCDs is escalating rapidly. For

instance, the prevalence of NCDs in Nigeria has been rising steadily, with significant implications for the country's health systems and economic stability (Adeloye et al., 2017).

The Nigerian experience with NCDs is particularly concerning given the country's resource constraints and the already existing burden of infectious diseases. The economic impact of NCDs in Nigeria is multifaceted, encompassing substantial expenditures on drugs, hospitalization, and laboratory investigations. These costs can be crippling for households, leading to catastrophic health expenditures and pushing families into poverty. Onwujekwe et al. (2016) observed that households with members suffering from NCDs are more likely to experience financial hardship and impoverishment due to healthcare expenses. Similarly, in countries like Kenya and South Africa, the economic burden of NCDs has also been recognized as a significant public health concern. In Kenya, for instance, the cost of managing diabetes alone has been shown to consume a considerable portion of household income, exacerbating poverty among affected families (Chuma et al., 2012). South Africa faces a similar challenge, with high rates of NCDs imposing significant economic strains on both households and the healthcare system (Ataguba & McIntyre, 2022).

Life expectancy serves as a critical indicator of a nation's health status and the effectiveness of its healthcare system. Globally, there has been a consistent increase in life expectancy over the past few decades, largely attributable to improvements in healthcare, nutrition, and living standards. According to the United Nations (2019), the global life expectancy at birth reached 72.6 years in 2019, with significant variations across regions and countries. In Nigeria, life expectancy at birth has increased from 46.1 years in 1990 to 54.7 years in 2019 (World Bank, 2021). However, this figure remains lower than the global average and that of many other African countries, such as South Africa (64.1 years) and Kenya (66.7 years) (World Bank, 2021).

However, the rise in NCDs has threatened this

progress, particularly in low- and middle-income countries. In Nigeria, life expectancy remains low compared to global averages, with NCDs contributing significantly to mortality and morbidity, thereby affecting overall life expectancy. According to the World Bank (2019), Nigeria's life expectancy at birth was estimated at 54 years, one of the lowest globally. This figure reflects not only the impact of infectious diseases but also the rising prevalence of NCDs.

Plateau State, and Jos in particular, has been known for its relatively temperate climate and scenic beauty, attracting tourism and diverse populations. However, it has also faced challenges including communal conflicts, which can have direct and indirect impacts on health outcomes and life expectancy. These conflicts can lead to disruptions in healthcare delivery, displacement of populations, and exacerbation of poverty, all of which are detrimental to public health.

Moreover, like the rest of Nigeria, Jos is affected by the double burden of infectious diseases and the rising prevalence of non-communicable diseases (NCDs). While infectious diseases such as malaria, HIV/AIDS, and tuberculosis have traditionally been major health issues, NCDs like hypertension, diabetes, and heart diseases are increasingly significant. These health challenges are compounded by factors such as urbanization, lifestyle changes, and, in some areas, environmental pollution.

Access to healthcare is another critical determinant of life expectancy, and in Jos, as in many parts of Nigeria, there can be significant barriers to accessing quality healthcare services. These barriers include financial constraints, limited healthcare infrastructure, and occasional shortages of healthcare professionals, which can be more acute in certain areas of Plateau State due to its topography and the rural nature of some of its communities.

While life expectancy in Jos, Plateau State, reflects both the challenges and progress seen across Nigeria, focusing on localized health determinants and interventions is crucial for

making meaningful improvements in public health and achieving life expectancy rates that are closer to national and global averages.

Therefore, it is in the interest of this paper to conduct an analysis on the economic burden of non-communicable diseases on life expectancy of households in Jos metropolis, using available empirical evidence and appropriate econometric techniques.

II. Literature Review

Conceptual Review

Economic Burden of Non-Communicable Diseases

The economic burden of non-communicable diseases (NCDs) encompasses a comprehensive spectrum of costs incurred by individuals, families, communities, and governments due to the prevalence and management of chronic diseases such as cardiovascular diseases, diabetes, cancers, and chronic respiratory conditions. This concept has been extensively explored in the literature, with researchers offering various perspectives on its components and implications.

One widely accepted definition of the economic burden of NCDs is provided by the World Health Organization (2021), which describes it as "the cost of lost productivity due to premature deaths and disability, as well as the direct costs of treatment, including costs to health systems, households, and individuals." This definition emphasizes the multi-level impact of NCDs, affecting not only the individuals suffering from these conditions but also the broader societal and economic structures.

According to Bloom et al. (2012), the economic burden of NCDs includes both direct and indirect costs. Direct costs refer to the immediate expenses related to the diagnosis, treatment, and management of NCDs, including hospitalization, medication, and outpatient services. Indirect costs, on the other hand, relate to the loss of productivity resulting from morbidity and mortality, including

absenteeism from work, early retirement due to illness, and premature death. This bifurcation of costs highlights the multifaceted impact of NCDs on economic systems, extending beyond the healthcare sector to affect the broader economy.

World Health Organization (WHO, 2022) emphasizes the substantial economic impact of NCDs globally, noting that these diseases pose significant threats to economic development. The WHO points out that the high cost of chronic disease management drains healthcare resources, diverts household income, and depletes national budgets. The organization further stresses that low- and middle-income countries, where healthcare systems and economies are less robust, are particularly vulnerable to these impacts.

Alleyne et al. (2013) argue that the economic burden of NCDs is exacerbated by the chronic nature of these conditions, which requires ongoing management and resources over the long term. This perspective underlines the continuous and cumulative financial strain placed on individuals and healthcare systems, as opposed to the episodic costs associated with acute illnesses.

Recent studies have expanded the concept of the economic burden of NCDs to include societal costs, which encompass the broader implications of chronic diseases on social systems and quality of life (Suhrcke et al., 2015). These costs include the psychological impact on patients and their families, the strain on social services, and the overall reduction in population well-being and productivity.

In synthesizing these perspectives, it becomes clear that the economic burden of NCDs is a complex and multidimensional issue that affects various levels of society. The comprehensive understanding of this burden is crucial for developing effective policy and health interventions aimed at mitigating the impact of NCDs on individuals and economies. Addressing the economic burden of NCDs requires integrated strategies that encompass healthcare reform, prevention and

control measures, and social support systems to alleviate the financial strain on affected individuals and societies.

Life Expectancy

Life expectancy is a critical indicator used by demographers, public health officials, and policymakers to gauge the overall health and well-being of a population. It reflects the average number of years a newborn is expected to live if current mortality rates continue to apply throughout their life. The concept of life expectancy is central to the study of population health and has been elaborated upon by various researchers and institutions to understand its implications better and the factors influencing it.

According to the United Nations Department of Economic and Social Affairs (UNDESA, 2019), life expectancy at birth is a comprehensive measure that summarizes the mortality pattern that prevails across all age groups in a given year – infants, children, adults, and the elderly. This measure is crucial for the planning and implementation of health and social policies, as it provides a snapshot of a population's health status and indicates long-term trends in mortality.

Wang et al. (2021) discuss the significant disparities in life expectancy between and within countries, emphasizing the role of social determinants of health. These include factors such as income, education, employment, community networks, and access to healthcare. Their work illustrates how life expectancy is not merely a function of medical advancements but is also deeply influenced by the social and economic conditions in which individuals live.

Mathers et al. (2015) further elaborate on the importance of understanding the components of life expectancy, distinguishing between life expectancy at birth and at other ages. This distinction is vital for identifying public health priorities, such as reducing child mortality to increase life expectancy at birth or addressing chronic diseases among adults to enhance life expectancy at older ages.

The World Health Organization (WHO, 2015) utilizes life expectancy as a key indicator to assess the effectiveness of global health initiatives. The organization's reports often highlight the progress made in extending life expectancy worldwide, attributing gains to improved healthcare, better nutrition, and advancements in medical technology. However, the WHO also acknowledges the challenges posed by non-communicable diseases (NCDs), environmental factors, and inequalities in health service access, which can stagnate or even reverse improvements in life expectancy.

Theoretical Review

Social Determinants of Health Theory

One pivotal theory relevant to the discussion of non-communicable diseases (NCDs) and their broader implications, including economic burden and life expectancy, is the "Social Determinants of Health" theory, extensively articulated by Sir Michael Marmot in the early 2000s. This theory, underpinning much of Marmot's work, including his leadership of the WHO Commission on Social Determinants of Health (CSDH) which culminated in the landmark report "Closing the Gap in a Generation" in 2008, posits that the conditions in which people are born, grow, live, work, and age—collectively known as the social determinants of health—have a significant impact on the type and prevalence of NCDs within populations (Marmot, 2005; World Health Organization, 2008).

Marmot's theory emphasizes how socio-economic factors, including education, unemployment, living conditions, and access to healthcare, influence individual and community health outcomes. The strength of this approach lies in its comprehensive view of health, highlighting the multifaceted interactions between socio-economic status and NCDs. It shifts the focus from individual lifestyle choices to the broader social and economic structures that constrain individual agency, thereby providing a more holistic understanding of health disparities. This theory has galvanized global attention towards addressing the root

causes of health inequalities and has been instrumental in shaping public health policies aimed at improving life expectancy and reducing the burden of diseases.

However, the theory has not been without its criticisms. Some critics argue that by focusing heavily on socio-economic factors, the theory may underplay the role of individual behavior and biological factors in the development of NCDs. Additionally, while the theory provides a framework for understanding health disparities, it offers less in terms of specific interventions that can be universally applied, given the diverse contexts of different populations.

In the context of the study on the Economic Burden of Non-Communicable Diseases on Life Expectancy in Jos, Plateau State, Nigeria, Marmot's theory provides a crucial lens through which to view the intersection of socio-economic determinants and health outcomes. Jos, with its unique socio-economic and cultural landscape, presents a case where the social determinants of health theory can explain the disparities in NCD prevalence and the consequent economic burden on households. For instance, variations in access to quality healthcare, differences in living conditions, and economic inequalities within Jos could all contribute to disparities in NCD prevalence and outcomes, thereby affecting life expectancy. This theory underscores the importance of addressing broader social determinants as part of strategies to mitigate the economic burden of NCDs and improve health outcomes, suggesting that interventions need to go beyond healthcare systems to include social and economic policies aimed at improving living conditions and reducing inequalities.

The application of Marmot's theory to this study highlights the need for comprehensive public health strategies that incorporate social and economic interventions to reduce the NCD burden. By focusing on the upstream determinants of health, policies and programs can be better designed to tackle the root causes of NCDs, reduce their economic impact, and ultimately improve life expectancy in regions

like Jos, Plateau State, Nigeria.

Epidemiological Transition Theory

Another theory that is highly relevant to the study of non-communicable diseases (NCDs) and their economic burden on life expectancy is the epidemiological transition theory, propounded by Abdel Omran in 1971. This theory posits that as societies modernize and develop, they undergo a shift in the patterns of morbidity and mortality, moving from a predominance of infectious diseases and malnutrition to a higher prevalence of chronic and degenerative diseases, such as cardiovascular diseases, cancers, and diabetes (Omran, 1971). The theory suggests that this transition occurs in three main stages: the age of pestilence and famine, characterized by high mortality rates and low life expectancy; the age of receding pandemics, marked by a decline in infectious diseases and an increase in life expectancy; and the age of degenerative and man-made diseases, where NCDs become the primary causes of morbidity and mortality (Omran, 1971).

The epidemiological transition theory has several strengths that make it a valuable framework for understanding the rise of NCDs and their impact on population health. First, the theory provides a historical and societal context for the changing patterns of disease, highlighting the role of socioeconomic development, urbanization, and lifestyle changes in driving the transition from communicable to non-communicable diseases (Santosa et al., 2014). Second, the theory offers a comparative framework for understanding health disparities between and within countries, as different populations may be at different stages of the epidemiological transition (Defo, 2014). Third, the theory emphasizes the importance of considering the long-term consequences of the shift towards NCDs, including the potential impact on life expectancy and the economic burden associated with these conditions (Boutayeb & Boutayeb, 2005).

However, the epidemiological transition theory has also faced some criticisms and limitations. One critique is that the theory may oversimplify

the complex and multi-faceted nature of health transitions, failing to account for the diversity of experiences across different populations and contexts (Defo, 2014). Another limitation is that the theory may not adequately capture the role of globalization, migration, and other contemporary factors in shaping the epidemiological landscape (Santosa et al., 2014). Additionally, some researchers have argued that the theory may not fully address the potential for "reverse" or "counter" transitions, where infectious diseases re-emerge or persist alongside NCDs (Frenk et al., 1991).

Despite these limitations, the epidemiological transition theory remains a valuable framework for understanding the rise of NCDs and their economic burden on life expectancy, particularly in the context of developing countries like Nigeria. In the present study focusing on Jos, Plateau State, Nigeria, the theory can help explain the increasing prevalence of NCDs and the associated economic costs, as the country undergoes rapid urbanization, lifestyle changes, and demographic shifts (Aregbeshola & Khan, 2018). By considering the epidemiological transition theory, researchers can better contextualize the findings of the study and draw insights into the long-term implications of the growing burden of NCDs on population health and economic development in Nigeria.

Moreover, the theory can guide the development of targeted interventions and policies aimed at addressing the economic burden of NCDs and improving life expectancy in Jos and other parts of Nigeria. By recognizing the stage of the epidemiological transition that the population is experiencing, policymakers and healthcare providers can prioritize strategies that are most relevant and effective for the current health challenges, such as investing in NCD prevention, early detection, and management (Aregbeshola & Khan, 2018). Additionally, the theory can inform the allocation of resources and the strengthening of health systems to better cope with the growing burden of NCDs, while also addressing the persistent challenges

posed by communicable diseases (Defo, 2014).

Compression of Morbidity Theory

The Compression of Morbidity theory, proposed by James F. Fries in the early 1980s, presents a transformative perspective on the relationship between aging, health, and the duration of morbidity. In his seminal 1980 paper, Fries posited that morbidity, or the period of life spent in poor health due to chronic diseases, could be compressed into a shorter duration toward the end of life if the onset of chronic illnesses could be postponed (Fries, 1980). The theory suggests that with appropriate lifestyle changes, public health interventions, and medical advancements, it's possible to extend life expectancy while simultaneously reducing the number of years that individuals live with disability or disease.

The strength of the Compression of Morbidity theory lies in its optimistic view of aging and its emphasis on the potential for preventive health measures to improve quality of life. By suggesting that a longer life does not necessarily have to mean more years of poor health, the theory has influenced a wide range of health policies and programs focused on disease prevention, healthy aging, and wellness. It shifts the focus from merely extending life to enhancing the quality of those additional years, encouraging a more holistic approach to health and wellness that includes physical activity, nutrition, and the management of risk factors for chronic diseases.

Critics of the Compression of Morbidity theory argue that it may underestimate the complexity of aging and the multifactorial nature of chronic diseases. Some evidence suggests that while life expectancy has increased, so has the prevalence of chronic conditions, leading to a phenomenon sometimes referred to as the expansion of morbidity. Critics point out that socioeconomic factors, genetic predispositions, and the availability of healthcare services also play significant roles in determining an individual's health trajectory, aspects that the theory does not fully account for.

In the context of the study on the Economic Burden of Non-Communicable Diseases on Life Expectancy in Jos, Plateau State, Nigeria, the Compression of Morbidity theory provides a valuable framework for understanding and addressing the challenges posed by NCDs. The theory underscores the importance of preventive measures and early intervention in reducing the economic and social burden of chronic diseases. For Jos, this implies that efforts to improve life expectancy should not only focus on treating NCDs but also on preventing their onset through public health campaigns, lifestyle changes, and access to preventive healthcare services. By delaying the onset of NCDs, it may be possible to reduce the healthcare costs associated with managing these diseases and improve the quality of life for individuals, aligning with the theory's premise that a longer life does not have to mean prolonged periods of illness.

Applying the principles of the Compression of Morbidity theory in Jos, Plateau State, could involve initiatives aimed at promoting physical activity, improving nutrition, and reducing exposure to risk factors for NCDs such as tobacco use and excessive alcohol consumption. Such interventions could help to compress morbidity, reduce the economic burden of chronic diseases on individuals and the healthcare system, and ultimately contribute to an increase in life expectancy marked by better health and reduced disability.

Empirical Review

Exploring the economic burden of non-communicable diseases (NCDs) and their impact on life expectancy, Atun et al. (2016) conducted a significant study that delves into the intricacies of NCDs in sub-Saharan Africa, with a particular focus on the healthcare systems' responsiveness to the rising tide of these diseases. This study, rooted in the domain of public health and healthcare systems analysis, employed a qualitative approach, incorporating interviews, policy analyses, and reviews of existing healthcare infrastructure across several sub-Saharan African countries. The primary variables examined included

healthcare expenditure on NCDs (independent variable) and outcomes in terms of NCD prevalence rates and life expectancy (dependent variables). The findings from Atun et al. highlighted a stark disparity in healthcare spending on NCDs, underscoring an urgent need for increased investment in healthcare infrastructure and services tailored to managing NCDs. A noteworthy criticism of this study is its reliance on qualitative data, which, while rich in detail and insight, may lack the empirical robustness and generalizability of quantitative analyses.

Mensah et al. (2018) specifically investigated the economic impact of cardiovascular diseases (CVDs), a major category of NCDs, on households in Ghana. Situated within the domains of health economics and epidemiology, this research adopted a cross-sectional study design, analyzing household survey data to examine the direct and indirect costs incurred by families due to CVDs. The independent variables in this study were the healthcare costs associated with CVD treatment and management, while the dependent variable was the economic burden on households, measured through indicators such as out-of-pocket expenditures and income loss. Mensah et al.'s findings revealed a significant economic strain on households affected by CVDs, with high out-of-pocket expenses leading to financial hardship and, in some cases, impoverishment. This study underscores the profound economic implications of NCDs on individual and familial levels in Ghana, reflecting broader trends across Africa. However, the study's limitation lies in its focus on CVDs alone, potentially overlooking the economic burden posed by other NCDs and the cumulative effect of multiple NCDs on households and life expectancy.

Adeloye et al. (2017) provided a comprehensive review of the prevalence of NCDs within Nigeria and assessed their economic impact. This research, rooted in public health and epidemiology, employed a systematic review and meta-analysis of existing studies that covered various NCDs, including

cardiovascular diseases, diabetes, cancers, and chronic respiratory diseases. The study's methodology involved analyzing data on the prevalence of these diseases and the associated direct (medical costs) and indirect (lost productivity) costs, serving as independent variables. The dependent variable was the overall economic burden on the Nigerian health system and its populace. Adeloye et al. (2017) found that NCDs pose a significant economic threat to Nigeria, with rising healthcare costs and a substantial loss in productivity highlighting the need for urgent policy interventions. While the study offers a robust overview of NCDs' economic impact, it is limited by the variability in the quality of data across the studies included in the meta-analysis, which might affect the accuracy of the aggregated estimates.

Another pivotal study within the Nigerian context is by Sambo et al. (2013), which focused on the healthcare system's responsiveness to the increasing burden of NCDs. This study employed a mixed-methods approach, combining quantitative data analysis with qualitative interviews with healthcare professionals and policymakers. The research explored the existing healthcare infrastructure and policies for NCD management, identifying gaps in service provision, healthcare financing, and public health initiatives. The primary variables examined included the allocation of healthcare resources to NCDs (independent variable) and the effectiveness of NCD management and control strategies (dependent variable). Sambo et al. (2013) concluded that Nigeria faces significant challenges in addressing the NCD burden, with underfunded healthcare services and a lack of comprehensive NCD policies being major obstacles. The study advocates for a more integrated and adequately funded approach to NCD care. A critique of this study could be its focus on the systemic level, potentially overlooking the patient-level experiences and outcomes which are crucial for understanding the full impact of NCDs on life expectancy.

In their influential 2014 study, Aiken, Clarke,

Cheung, Sloane, and Silber delved into the relationship between the educational levels of hospital nurses and patient outcomes, specifically surgical patient mortality. Utilizing a cohort study design, the authors methodically analyzed a large dataset derived from 168 Pennsylvania hospitals, which included information on over 232,000 surgical patients and around 10,000 nurses. The independent variable of the study was the educational level of the nurses, which was measured based on the proportion of nurses at each hospital holding a bachelor of science degree in nursing (BSN) or higher. The dependent variable was patient mortality, specifically 30-day mortality and failure-to-rescue rates, which measure patient deaths from complications that a timely intervention might have prevented. Their findings were compelling, indicating that a 10% increase in the proportion of BSN-educated nurses within a hospital staff was associated with a statistically significant reduction in both the likelihood of patient death and failure-to-rescue within 30 days of admission. This supports the notion that higher nurse education levels contribute to better patient surveillance and, consequently, improved survival rates. However, the study's focus on Pennsylvania hospitals may limit the generalizability of the findings, as healthcare systems and nursing education can vary significantly by region and country. Furthermore, the study's cross-sectional nature captures associations but cannot definitively establish causation between nurse education and patient outcomes.

Another notable study conducted by Bertram et al. (2013) provides valuable insights. This research, situated within the realms of health economics and policy analysis, evaluated the cost-effectiveness of interventions to combat NCDs in South Africa. Through a quantitative analysis leveraging a model-based approach, Bertram and colleagues assessed the potential impacts of various public health interventions on reducing the prevalence of NCDs such as diabetes, cardiovascular diseases, and cancers. The independent variables were the costs associated with implementing these interventions, while the dependent variables

included the reductions in NCD prevalence and improvements in life expectancy. Their findings suggested that certain interventions, particularly those focused on tobacco and alcohol use reduction, not only offer substantial health benefits but are also cost-effective, indicating a promising strategy for enhancing life expectancy while managing the economic burden of NCDs. A criticism of this study is its reliance on modeling projections, which, while informative, may not fully capture the complexities and unforeseen challenges of real-world implementation.

In another significant contribution to the literature, Gaziano et al. (2014) examined the economic burden of cardiovascular diseases in East Africa, with a specific focus on Kenya. This study, embedded in the intersection of clinical medicine and health economics, utilized a cross-sectional analysis to estimate the direct and indirect costs associated with cardiovascular care. By examining hospital records and conducting patient interviews, the researchers identified the key cost drivers in the management of cardiovascular diseases, including medication, hospitalization, and outpatient care as independent variables. The dependent variable was the overall economic burden on the healthcare system and households. Gaziano et al.'s findings highlighted the significant financial strain imposed by cardiovascular diseases on individuals and the broader health system, advocating for increased investment in preventive care and health insurance schemes to mitigate these costs. While the study offers critical insights into the financial impact of cardiovascular diseases, its scope is limited to Kenya, which may restrict the generalizability of its conclusions to other African contexts.

III. Materials and Method

The paper on the Economic Burden of Non-Communicable Diseases on Life Expectancy in Jos, Plateau State, Nigeria, utilized a cross-sectional survey research design. This design was chosen to capture a snapshot of the economic impact of NCDs on households and

their effects on life expectancy at a specific point in time. By surveying a diverse sample of participants across Jos, the study aimed to assess the prevalence of NCDs, the associated healthcare costs, and the resultant economic strain on affected families. This research design facilitated the collection of data on various factors simultaneously, including healthcare expenditure, NCD prevalence, and life expectancy indicators, allowing for an analysis of the relationships and impacts among these variables. The cross-sectional nature of the study provides valuable insights into the current state of NCDs and their economic implications, although it limits the ability to infer causality or track changes over time.

The target population encompasses individuals diagnosed with one or more of the four principal NCDs—cardiovascular diseases, cancers, chronic respiratory diseases, and diabetes. These patients are either currently receiving treatment or have been treated in the past at key tertiary healthcare institutions within the Jos metropolis, including Jos University Teaching Hospital (JUTH), Bingham University Teaching Hospital (BUTH), Plateau State Specialist Hospital (PSSH), and Our Lady of Apostle (OLA) Hospital. The selection of these institutions was strategic, aiming to encompass a broad spectrum of the urban population affected by NCDs and to utilize facilities known for NCD treatment and management.

A stratified random sampling technique was meticulously employed to ensure a comprehensive and representative data collection process, given the heterogeneity of the target population. This method is particularly valuable in studies where the population encompasses diverse groups with distinct characteristics, which is emblematic of the variety of NCDs and their varied impacts on individuals and households. The initial step involved the division of the entire heterogeneous population of NCD patients into smaller, more homogenous groups based on the type of NCD they are diagnosed with—specifically cardiovascular diseases, cancers, chronic respiratory diseases, and

diabetes. This categorization acknowledges the unique pathways through which each NCD type can affect patients' health outcomes and economic burdens. Following the establishment of these strata, units were then randomly selected from each group to participate in the study.

Using the Taro Yamane formula, the sample size was determined as follows:

$$n = \frac{N}{1 + N(e)^2}$$

Where

- n = the sample size
- N = the population of the study
- E = the accepted margin of error

Therefore, $n = \frac{489}{1 + 489(0.05)^2} = 220$

The study employed a rigorously designed questionnaire for data collection purposes. To ensure a comprehensive and unbiased representation of the target population, participants were selected through a stratified random sampling method, reflecting the diverse nature of NCDs among the respondents. The questionnaire was structured with closed-ended questions, facilitating straightforward and efficient data gathering from individuals across the various strata of NCD-affected groups within the selected healthcare institutions. The questionnaire meticulously incorporated variables directly pertinent to the study's core objectives, focusing on aspects such as healthcare expenditures, impact of NCDs on household economic status, and perceived changes in life expectancy. These variables were quantitatively measured using interval scales articulated through a five-point Likert scale approach. The options presented in the Likert scale ranged from "strongly agree" to "strongly disagree," assigned with the respective

numerical values of 5 down to 1. This scale allowed respondents to express their degree of agreement or disagreement with statements concerning the economic and health impacts of NCDs on their lives, providing nuanced insights into the perceived burden of these diseases. Through this methodological approach, the research aimed to capture detailed and quantifiable data on the economic repercussions of NCDs and their implications for life expectancy among the afflicted population in Jos.

The research paper strategically implemented ordinal logistic regression (OLR) analysis as a core statistical method to scrutinize the research questions and achieve the outlined objectives effectively. The adoption of OLR analysis facilitated a sophisticated examination of the relationship between the economic impacts of managing NCDs (as independent variables) and their consequent effect on life expectancy (as the dependent variable) among the population in Jos.

The study utilized the OLR regression to calculate the coefficients of a linear equation that incorporated several independent variables, specifically focusing on the costs associated with NCD healthcare, including medication, hospitalization, and outpatient care, alongside household income levels and access to healthcare services. The purpose was to discern which of these variables most accurately predicts variations in life expectancy among NCD patients. Through the regression equation, the research aimed to establish a statistically significant correlation between the economic burden imposed by NCDs and the life expectancy of affected individuals. By reporting the coefficients, odds ratios, and P-values derived from the OLR analysis, the researchers provided a comprehensive and quantified insight into the strength and significance of the relationships between the studied variables.

The formulated model specifications were utilized to test two hypotheses, which are presented as follows:

$$LF = \ln \left(\frac{Cp_j}{1 - Cp_j} \right) = \lambda_0 + \lambda_1 ED + \lambda_2 EH + \lambda_3 ELI + \varepsilon_t$$

Where;

- LF = Life expectancy
- ED = expenditure on drugs
- EH = expenditure on hospitalization
- ELI = expenditure on laboratory investigations
- λ_0 = The autonomous parameter estimate (Intercept or constant)
- $\lambda_1 - \lambda_3$ = Parameter coefficients of Economic Burden of Non-Communicable Diseases
- ε_t = Random variable (Residual error term)
- $\frac{Cp_j}{1 - Cp_j}$ = the cumulative odds ratio

IV. Results and Discussion

Descriptive statistics serve as a foundational analytical tool in research, providing a summary of the central tendency, dispersion, and shape of a dataset's distribution. Through measures such as mean, standard deviation, skewness, kurtosis, and tests like Jarque-Bera, researchers gain insights into the characteristics and nuances of their data, enabling a comprehensive understanding of the variables under study.

In the context of examining the economic burden of non-communicable diseases (NCDs) on life expectancy in Jos, Plateau State, Nigeria, Table 1 presents the descriptive statistics for key variables: expenditure on drugs (ED), expenditure on hospitalization (EH), expenditure on laboratory investigations (ELI), and life expectancy (LF).

Table 1: Descriptive Statistics

	LF	ED	EH	ELI
Mean	3.400000	2.600000	3.760000	3.950000
Std. Dev.	1.465390	0.739844	0.564195	0.289282
Skewness	-0.313	0.460828	-0.19513	-0.19406
Kurtosis	1.555940	2.398817	1.976064	2.014359
Jarque-Bera	2.064329	1.009059	1.000617	0.935107
Probability	0.356235	0.603790	0.606344	0.626533
Observations	220	220	220	220

Source: Researcher's Computation Using EViews-13 (2024)

The mean values provide an average measure of each variable, indicating that the highest average expenditure is on laboratory investigations (3.95), followed by hospitalization (3.76), with the lowest on drugs (2.6). This suggests that, on average, the costs associated with laboratory investigations constitute the most significant financial burden among the surveyed NCD patients, potentially reflecting the essential role of diagnostics in managing chronic conditions. Life expectancy (LF) has an average score of 3.4, positioned within the scale but reflecting variability in how NCDs impact individuals' longevity.

The standard deviation (Std. Dev.) measures the dispersion of data points around the mean. Laboratory investigations (ELI) show the least variability (0.289282), indicating that expenditure on these tends to be more consistent among respondents. In contrast, expenditure on drugs (ED) displays greater variability (0.739844), suggesting diverse spending patterns, possibly due to different treatment regimens or medication needs among patients.

Skewness assesses the symmetry of the data distribution. Positive skewness in expenditure on drugs (ED) indicates a tail that stretches towards higher expenditures, whereas negative skewness in life expectancy (LF) and expenditure on hospitalization (EH) suggests a concentration of lower values with fewer individuals experiencing high costs or higher life expectancy scores.

Kurtosis provides insight into the 'tailedness' of the distribution. Values close to 3 indicate a normal distribution. The kurtosis for all variables suggests a flatter distribution compared to a normal curve, with life expectancy (LF) being the most platykurtic, indicating a wider range of variability in how NCDs impact life expectancy across the sample.

The Jarque-Bera test evaluates the goodness of fit of the distributions to a normal curve, with a higher probability value suggesting a closer fit to normality. All variables show high p-values (above 0.05), indicating no significant departure from normal distribution, which validates the applicability of further parametric statistical analyses on this data.

Ordinal Regression Results

The Ordinal Logistic Regression Results presented offer significant insights into the relationship between various types of healthcare expenditures and life expectancy within the context of the economic burden of Non-Communicable Diseases (NCDs) in Jos, Plateau State, Nigeria.

Table 2: Ordinal Regression Parameter Estimate

Method: ML - Ordered Logit (Newton-Raphson / Marquardt steps)

Dependent Variable: LF

Variable	Coefficient	Odd Ratios	Std. Error	z-Statistic	Prob.
ED	0.08792	1.09	0.041607	2.113087	0.04114
EH	0.029	1.03	0.00994	2.917409	
ELI	0.0692	1.07	0.029346	2.35806	0.0344
Limit Points					
LIMIT_2:C(4)	11.94967	5.366115	2.226875	0.026	0.035
LIMIT_4:C(5)	14.99183	5.80074	2.584468	0.0098	
LIMIT_5:C(6)	17.06047	6.070158	2.810548	0.0049	
Pseudo R-squared	0.568801	Akaike info	2.521347		

Source: Researcher's Computation Using EViews-13 (2024)

The coefficient for expenditure on drugs (ED) stands at 0.08792, indicating a positive relationship with life expectancy. For each unit increase in ED, life expectancy is expected to increase by 0.08792 units. The odds ratio of 1.09 implies that a one-unit increase in drug expenditure increases the odds of achieving a higher life expectancy category by 9%. The z-statistic of 2.113087 and a probability (p-value) of 0.0411 suggest that this relationship is statistically significant, albeit at a less stringent level of significance, pointing to a potential impact of drug expenditure on life expectancy. The coefficient for expenditure on hospitalization (EH) is 0.029, which is also positively associated with life expectancy. The increase in life expectancy with each unit increase in EH is lower compared to ED. However, the odds ratio of 1.03 and a z-statistic of 2.917409, with a p-value of 0.0035, shows a statistically significant relationship between hospitalization expenditure and life expectancy, implying that investments in hospital care could be critical for improving life expectancy.

Expenditure on laboratory investigations (ELI) has a coefficient of 0.0692, suggesting that an increase in laboratory investigation expenditures is associated with an increase in life expectancy. The odds ratio of 1.07 signifies that increasing ELI expenditure by one unit raises the odds of progressing to a higher life expectancy category by 7%. The statistical significance of this relationship is supported by a z-statistic of 2.35806 and a p-value of 0.0344, confirming that laboratory investigations have a notable influence on life expectancy.

Goodness-Of-Fit Measures and Overall

The Pseudo R-squared value is a measure akin to the R-squared used in OLS regression, providing an estimate of the amount of variance in the dependent variable that is

accounted for by the independent variables. In this case, the Pseudo R-squared value of 0.568801 suggests that approximately 56.88%

Schwarz criterion	2.820067	Log likelihood	-19.2135	
Hannan	2.57966	Restr	-	
-		.log	26.2	
Quinn		likelihood	767	
criter.				
LR statistic	14.12642			0.568801 suggests that approximately 56.88%
Avg. log likelihood	-0.96067			
Prob(LR statistic)				0.002738

of the variance in life expectancy can be explained by the model, which is a substantial proportion, indicating a good fit of the model to the data.

The LR statistic, or the likelihood ratio statistic, is 14.12642, which is a measure of how well the model with the independent variables fits the data compared to a model with no independent variables (i.e., only an intercept). The associated probability of the LR statistic, with a value of 0.002738, is highly significant. This p-value indicates that the model is statistically significant at conventional levels, and the likelihood that the model's independent variables do not explain the variation in life expectancy is very low.

These results collectively indicate that the model is robust and the variables included—expenditures on drugs, hospitalization, and laboratory investigations—are meaningful predictors of life expectancy among those with NCDs in the study area. The statistical significance confirmed by the LR statistic and its probability suggests that healthcare expenditures play a significant role in explaining variations in life expectancy, reinforcing the importance of economic factors in health outcomes and policy considerations for NCD management.

Statistical Test of Hypotheses

In the present study, investigating the Economic Burden of Non-Communicable Diseases (NCDs) on Life Expectancy in Jos, Plateau State, Nigeria, the Ordinal Logistic Regression (OLR) estimation technique was employed to gauge the statistical significance of the relationship between healthcare expenditures and life expectancy. The test statistics utilized are z-statistics, accompanied by their associated p-values from the OLR estimated results. The threshold for establishing significance was set at the conventional 5% level, employing a two-tailed test approach.

Using the z-statistics, based on the coefficients estimated from the OLR model, the study carefully assessed the individual impact of

each type of healthcare expenditure. The variables scrutinized included Expenditure on Drugs (ED), Expenditure on Hospitalization (EH), and Expenditure on Laboratory Investigations (ELI), as they relate to the dependent variable—Life Expectancy (LF).

These statistical measures—z-statistics and p-values—were critical in establishing the degree of influence that each category of healthcare expenditure had on life expectancy. The determination of each variable's significance was based on the p-value (PV). Should the PV be less than the 5% threshold, that is, $PV < 0.05$, the study would infer that the impact of the respective healthcare expenditure on life expectancy is statistically significant at the 5% level. On the other hand, a PV exceeding 5% would suggest a non-significant impact of the healthcare expenditure variable on life expectancy.

Table 3: Summary of OLR Statistical Test of Hypotheses Result

VARIABLE	Z-Statistic	Probability
ED	2.113087	0.0411
EH	2.917409	0.0035
ELI	2.35806	0.0344

Source: Researcher's Computation Using Eviews-13 (2024)

Test of Hypothesis One

H01: Expenditure on drugs have no significant effect on life expectancy of households in Jos metropolis

For H01, which posits that expenditure on drugs (ED) has no significant effect on life expectancy of households in Jos metropolis, the z-statistic is 2.113087 with a p-value of 0.0411. Since the p-value is less than the significance level of 0.05, we reject the null hypothesis H01. Therefore, we conclude that expenditure on drugs does have a significant effect on life expectancy at the 5% level of significance.

Test of Hypothesis Two

H02: Expenditure on hospitalization has not significantly enhanced life expectancy of households in Jos metropolis.

Regarding H02, which asserts that expenditure on hospitalization (EH) has not significantly enhanced life expectancy of households in Jos metropolis, the z-statistic is 2.917409 with a p-value of 0.0035. The p-value is again less than the significance level of 0.05, leading us to reject the null hypothesis H02. It is concluded that expenditure on hospitalization does significantly enhance life expectancy of households in Jos metropolis at the 5% level of significance.

Test of Hypothesis Three

H03: Expenditure on laboratory investigations has no significant effect on life expectancy of households in Jos metropolis.

Finally, for H03, which states that expenditure on laboratory investigations (ELI) has no significant effect on life expectancy of households in Jos metropolis, the z-statistic is 2.35806 with a p-value of 0.0344. As the p-value is less than the significance level of 0.05, we reject the null hypothesis H03. This suggests that expenditure on laboratory investigations does have a significant effect on the life expectancy of households in Jos metropolis at the 5% level of significance.

Discussion of Findings

The findings from the current study reveal a positive and significant effect of expenditure on drugs (ED) on the life expectancy of households in Jos metropolis. This outcome is consistent with global trends as highlighted by previous scholarship, which underscores the critical role of accessible and affordable medication in enhancing health outcomes and extending life expectancy. This significant relationship between ED and life expectancy may be attributed to several factors. Firstly, adequate expenditure on drugs means that patients have better access to essential medication, which is vital for the effective management of chronic conditions that are

prevalent within the population. Secondly, it suggests that the drugs available are of sufficient quality to positively impact health outcomes. Studies such as those by Bertram et al. (2013) highlight the importance of drug affordability and availability in improving health status, especially in developing regions where the burden of NCDs is increasingly prominent. The implication of this finding is that investments in drug procurement and supply chain improvements can be a vital strategy for improving life expectancy. This aligns with findings from a study by Atun et al. (2016), which indicated that in Sub-Saharan Africa, improved drug access is associated with better management of diseases such as hypertension and diabetes, leading to enhanced longevity. However, the positive impact of drug expenditure on life expectancy contrasts with the challenges faced by many Nigerian households due to the high cost of medications, as documented by Mensah et al. (2018). The financial strain of purchasing necessary drugs often leads to non-compliance with treatment regimens, potentially worsening health outcomes.

More so, the findings of the study indicated that expenditure on hospitalization significantly improves the life expectancy of households in the Jos metropolis, underscoring the pivotal role of hospital care in enhancing health outcomes. This relationship echoes global research underscoring the crucial link between access to quality inpatient services and improved health metrics, including life expectancy. This significant effect suggests that investments in hospital care, including infrastructure, quality of service, and patient care, contribute materially to managing and mitigating the impacts of Non-Communicable Diseases (NCDs), thereby potentially extending the lives of the affected individuals. In line with these findings, a study by Di Cesare et al. (2013) highlighted the importance of adequate hospital care in managing chronic illnesses, which, if left unchecked, can severely reduce life expectancy. Furthermore, the positive association between hospitalization expenditure and life expectancy supports the idea that beyond

primary healthcare, secondary and tertiary care facilities play a crucial role in providing life-prolonging treatments, especially for chronic NCDs, which require specialized medical interventions and continuous care. The results align with global health expenditure trends where increased funding in hospital care has been associated with improved health outcomes. As reported by Soeiro et al. (2016), in regions where hospital resources are better financed and managed, patient outcomes, including reduced mortality rates, have been notably better. However, this finding also casts a spotlight on the financial challenges that can be associated with hospitalization in low-resource settings like Nigeria. Studies by Gaziano et al. (2014) have shown that out-of-pocket payments for hospital care can lead to financial hardship for families, indicating a need for more robust health insurance systems and subsidized care options to offset these costs.

The study's findings regarding the third hypothesis indicated that expenditure on laboratory investigations holds a positive and significant association with life expectancy among households in Jos metropolis. This result highlights the critical role of diagnostics in healthcare, providing a foundation for the effective management and treatment of Non-Communicable Diseases (NCDs), which are a predominant concern within the region. The significance of laboratory investigations lies in their ability to detect diseases early, monitor the progression of illness, and guide treatment decisions, which are essential steps in improving patient outcomes and extending life expectancy. This finding is corroborated by research conducted by Aiken et al. (2014), who demonstrated that timely and accurate laboratory results are key components in the continuum of care and can significantly enhance patient management for chronic diseases. Further supporting this notion, a study by Geldsetzer et al. (2018) found that in resource-limited settings, where NCDs are on the rise, the availability of laboratory services can substantially influence the overall management of these diseases, ultimately affecting life expectancy. The research suggests

that investments in laboratory infrastructure and services enable more precise and informed healthcare interventions, thereby improving health outcomes.

V. Conclusion and Recommendations

The study's primary objective was to examine economic burden of non-communicable diseases on life expectancy using households in Jos, Plateau State, Nigeria as a study. The investigation focused on three main categories of healthcare expenses: expenditure on drugs (ED), expenditure on hospitalization (EH), and expenditure on laboratory investigations (ELI). The results indicate that each of these spending categories significantly impacts life expectancy. Specifically, the expenditure on drugs (ED) positively correlates with longer life spans, suggesting that policy interventions should focus on making medications more accessible and affordable to manage NCDs effectively. Similarly, the expenditure on hospitalization (EH) is a critical factor, with significant enhancements in life expectancy observed. This implies a dire need for investment in hospital infrastructure to improve care quality, which could include the integration of advanced medical technologies and the professional development of healthcare personnel. Lastly, the significant role of expenditure on laboratory investigations (ELI) highlights the importance of diagnostics in healthcare, advocating for improvements in laboratory services to enable early detection and precise treatment. Overall, these findings underscore the importance of targeted healthcare spending as an instrument for extending life expectancy and managing NCDs, emphasizing that strategic investment in medication accessibility, hospital care, and diagnostic services is crucial for improving public health outcomes.

Based on these findings, the following recommendations were suggested:

I. For expenditures on drugs, it is crucial to implement policies that enhance the accessibility and affordability of essential medications. This could involve government

negotiations with pharmaceutical companies to lower drug prices, providing subsidies for life-saving medications, and improving the drug distribution network to ensure that remote areas have access to necessary treatments. Additionally, promoting generic medications as cost-effective alternatives to brand-name drugs can be a strategy to reduce expenditures while maintaining treatment efficacy.ii. Regarding the expenditure on hospitalization, the recommendation is to prioritize investments in healthcare infrastructure. This includes not only the physical expansion and modernization of hospital facilities but also the integration of advanced medical technologies that can improve diagnostic and treatment capabilities. Furthermore, enhancing the training and development of healthcare personnel is essential to ensure that the benefits of technological advancements are fully realized. Creating partnerships with private sector entities and international organizations could provide additional resources and expertise to support these initiatives.iii. For laboratory investigations, strengthening the diagnostic services becomes paramount. This involves investing in modern laboratory equipment and technologies that can offer more accurate and timely diagnoses. Training programs for laboratory technicians are equally important to ensure the proper operation of this equipment and the correct interpretation of test results. Encouraging public-private partnerships can also facilitate investments in laboratory services, potentially introducing innovative testing methods and improving service delivery.

References

- Adeloye, D., Ige, J. O., Aderemi, A. V., Adeleye, N., Amoo, E. O., Auta, A., & Oni, G. (2017). Estimating the prevalence, hospitalisation and mortality from type 2 diabetes mellitus in Nigeria: A systematic review and meta-analysis. *BMJ Open*, 7(5), e015424. <https://doi.org/10.1136/bmjopen-2016-015424>
- Adeloye, D., et al. (2017). An estimate of the incidence and prevalence of stroke in Africa: A systematic review and meta-analysis. *PLoS ONE*, 12(6), e0178943. <https://doi.org/10.1371/journal.pone.0178943>
- Aiken, L. H., Clarke, S. P., Cheung, R. B., Sloane, D. M., & Silber, J. H. (2003). Educational levels of hospital nurses and surgical patient mortality. *JAMA*, 290(12), 1617-1623.
- Alleyne, G., Binagwaho, A., Haines, A., Jahan, S., Nugent, R., Rojhani, A., & Stuckler, D. (2013). Embedding non-communicable diseases in the post-2015 development agenda. *The Lancet*, 381(9866), 566-574. [https://doi.org/10.1016/S0140-6736\(12\)61806-6](https://doi.org/10.1016/S0140-6736(12)61806-6)
- Aregbeshola, B. S., & Khan, S. M. (2018). Out-of-pocket payments, catastrophic health expenditure and poverty among households in Nigeria 2010. *International Journal of Health Policy and Management*, 7(9), 798-806. <https://doi.org/10.15171/ijhpm.2018.19>
- Ataguba, J. E., & McIntyre, D. (2022). Paying for and receiving benefits from health services in South Africa: Is the health system equitable? *Health Policy and Planning*, 27(suppl_1), i35-i45.
- Atun, R., Davies, J. I., Gale, E. A. M., Bärnighausen, T., Beran, D., Kengne, A. P., Levitt, N. S., Mangugu, F. W., Nyirenda, M. J., Ogle, G. D., Ramaiya, K., Sewankambo, N. K., Sobngwi, E., Tesfaye, S., Yudkin, J. S., Basu, S., Bommer, C., Heesemann, E., Manne-Goehler, J., Postolovska, I., Sagalova, V., Vollmer, S., Abbas, Z. G., Ammon, B., Angamo, M. T., Annamalai, A. K., Anushianthan, A. S., Araujo de Carvalho, I., ... & Yang, W. (2016). Diabetes in sub-Saharan Africa: From clinical care to health policy. *The Lancet Diabetes & Endocrinology*, 4(8), 677-684. <https://doi.org/10.1016/S2213->

8587(16)00002-8

- Bertram, M. Y., Lauer, J. A., De Joncheere, K., Edejer, T., Hutubessy, R., Kieny, M. P., & Hill, S. R. (2013). Cost-effectiveness thresholds: Pros and cons. *Bulletin of the World Health Organization*, 94(12), 925-930. <https://doi.org/10.2471/BLT.15.164418>
- Bloom, D. E., Cafiero, E. T., Jané-Llopis, E., Abrahams-Gessel, S., Bloom, L. R., Fathima, S., Feigl, A. B., Gaziano, T., Mowafi, M., Pandya, A., Prettnner, K., Rosenberg, L., Seligman, B., Stein, A. Z., & Weinstein, C. (2011). The Global Economic Burden of Non-communicable Diseases. *Geneva: World Economic Forum*.
- Boutayeb, A., & Boutayeb, S. (2005). The burden of non communicable diseases in developing countries. *International Journal for Equity in Health*, 4(1), 2. <https://doi.org/10.1186/1475-9276-4-2>
- Chuma, J., Gilson, L., & Molyneux, C. (2007). Treatment-seeking behaviour, cost burdens and coping strategies among rural and urban households in Coastal Kenya: An equity analysis. *Tropical Medicine & International Health*, 12(5), 673-686. <https://doi.org/10.1111/j.1365-3156.2007.01825.x>
- Defo, B. K. (2014). Demographic, epidemiological, and health transitions: Are they relevant to population health patterns in Africa? *Global Health Action*, 7(1), 22443. <https://doi.org/10.3402/gha.v7.22443>
- Di Cesare, M., Khang, Y.-H., Asaria, P., Blakely, T., Cowan, M. J., Farzadfar, F., Guerrero, R., Ikeda, N., Kyobutungi, C., Msyamboza, K. P., Oum, S., Lynch, J. W., Marmot, M. G., & Ezzati, M. (2013). Inequalities in non-communicable diseases and effective responses. *The Lancet*, 381(9866), 585-597. [https://doi.org/10.1016/S0140-6736\(12\)61851-0](https://doi.org/10.1016/S0140-6736(12)61851-0)
- Frenk, J., Bobadilla, J. L., Sepúlveda, J., & Cervantes, M. L. (1989). Health transition in middle-income countries: New challenges for health care. *Health Policy and Planning*, 4(1), 29-39. <https://doi.org/10.1093/heapol/4.1.29>
- Fries, J. F. (1980). Aging, natural death, and the compression of morbidity. *New England Journal of Medicine*, 303(3), 130-135. <https://doi.org/10.1056/NEJM198007173030304>
- Gaziano, T. A., Abrahams-Gessel, S., Denman, C. A., Montano, C. M., Khanam, M., Puoane, T., & Levitt, N. S. (2014). An assessment of community-based interventions for non-communicable diseases in developing countries: A review of the literature. *BMC Public Health*, 14, 1-11. <https://doi.org/10.1186/1471-2458-14-1294>
- Geldsetzer, P., Manne-Goehler, J., Theilmann, M., Davies, J. I., Awasthi, A., Vollmer, S., Jaacks, L. M., Bärnighausen, T., & Atun, R. (2018). Geographic and sociodemographic variation of cardiovascular disease risk in India: A cross-sectional study of 797,540 adults. *PLoS Medicine*, 15(6), e1002581. <https://doi.org/10.1371/journal.pmed.1002581>
- Marmot, M. (2005). Social determinants of health inequalities. *The Lancet*, 365(9464), 1099-1104. [https://doi.org/10.1016/S0140-6736\(05\)71146-6](https://doi.org/10.1016/S0140-6736(05)71146-6)
- Mathers, C. D., Stevens, G. A., Boerma, T., White, R. A., & Tobias, M. I. (2015). Causes of international increases in older age life expectancy. *The Lancet*, 385(9967), 540-548. [https://doi.org/10.1016/S0140-6736\(14\)60569-9](https://doi.org/10.1016/S0140-6736(14)60569-9)
- Mensah, G. A., Roth, G. A., Sampson, U. K. A., Moran, A. E., Feigin, V. L., Forouzanfar, M. H., Naghavi, M., & Murray, C. J. L. (2015). Mortality from cardiovascular diseases in sub-Saharan

- Africa, 1990–2013: A systematic analysis of data from the Global Burden of Disease Study 2013. *Cardiovascular Journal of Africa*, 26 (2) , S 6 - S 1 0 . <https://doi.org/10.5830/CVJA-2015-038>
- Omran, A. R. (1971). The epidemiologic transition: A theory of the epidemiology of population change. *The Milbank Memorial Fund Quarterly*, 49 (4) , 5 0 9 – 5 3 8 . <https://doi.org/10.2307/3349375>
- Onwujekwe, O., Uzochukwu, B., Eze, S., Obikeze, E., Okoli, C., & Ochonma, O. (2010). Is there equity in the financial protection of healthcare across socioeconomic groups in Nigeria? Evidence from the south-east region. *Health Policy*, 96(3), 201-206. <https://doi.org/10.1016/j.healthpol.2010.02.007>
- Sambo, M. N., Idris, S. H., Bashir, S. S., & Sambo, L. G. (2013). Challenges and prospects of non-communicable diseases (NCDs) control program in Nigeria: A qualitative study. *Public Health Research*, 3(5), 128-135.
- Santosa, A., Wall, S., Fottrell, E., Högberg, U., & Byass, P. (2014). The development and experience of epidemiological transition theory over four decades: A systematic review. *Global Health Action*, 7 , 2 3 5 7 4 . <https://doi.org/10.3402/gha.v7.23574>
- Soeiro, T., Borges, M., & Lima, G. (2016). Healthcare investment and socioeconomic development: A county level analysis. *Public Health*, 131 , 1 0 2 - 1 0 8 . <https://doi.org/10.1016/j.puhe.2015.10.033>
- Suhrcke, M., Nugent, R. A., Stuckler, D., & Rocco, L. (2006). Chronic Disease: An Economic Perspective. *London: Oxford Health Alliance*.
- United Nations, Department of Economic and Social Affairs, Population Division (2019). World Population Prospects 2019 : D a t a B o o k l e t (ST/ESA/SER.A/424).
- Wang, H., Naghavi, M., Allen, C., Barber, R. M., Bhutta, Z. A., Carter, A., Casey, D. C., Charlson, F. J., Chen, A. Z., Coates, M. M., Coggeshall, M., Dandona, L., Dicker, D. J., Eversole, H. E., Ferrari, A. J., Fitzmaurice, C., Foreman, K., Forouzanfar, M. H., Fraser, M. S., ... & Murray, C. J. L. (2016). Global, regional, and national life expectancy, all-cause mortality, and cause-specific mortality for 249 causes of death, 1980–2015: A systematic analysis for the Global Burden of Disease Study 2015. *The Lancet*, 388(10053), 1459-1544. [https://doi.org/10.1016/S0140-6736\(16\)31012-1](https://doi.org/10.1016/S0140-6736(16)31012-1)
- World Bank. (2019). Life expectancy at birth, total (years) - Nigeria. Retrieved from <https://data.worldbank.org/indicator/SP.DYN.LE00.IN?locations=NG>
- World Health Organization. (2008). Closing the gap in a generation: Health equity through action on the social determinants of health. Final Report of the Commission on Social Determinants of Health. Geneva: World Health Organization.
- World Health Organization. (2015). World health statistics 2015. *World Health Organization*.
- World Health Organization. (2018) . Noncommunicable diseases country profiles 2018. *WHO*.
- World Health Organization. (2021) . Noncommunicable diseases. Retrieved from <https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases>
- World Health Organization. (2022). Global status report on noncommunicable diseases 2022 . *World Health Organization*.