



University of
Southern
Queensland

**INEQUALITY IN MATERNAL AND CHILD HEALTH AND
HEALTHCARE IN NIGERIA: AN ECONOMETRIC
ANALYSIS**

A Thesis submitted by

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Economics

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ABSTRACT

Globally, thousands of women die annually from complications during pregnancy, childbirth, or the postpartum period. Most of these deaths occur in developing countries, especially in sub-Saharan Africa. The situation is critical in Nigeria, with a maternal mortality ratio of 512 deaths per 100,000 live births. For neonates, infants and children under five, their mortalities are 39, 67, and 132 deaths per 1,000 live births, respectively. Evidently, the maternal mortality ratio in Nigeria is the highest in Africa and much higher than the global average of 290 per 100,000 live births.

Improving maternal and child health is an important global health priority. This study seeks to investigate the inequality in maternal and child health and healthcare, particularly geographic and socioeconomic inequality, in the six geopolitical zones of Nigeria using decomposition and survival analyses.

This is a PhD thesis by publication. It includes four cross-sectional studies and one scoping review study. The cross-sectional studies used 2003, 2008, 2013 and 2018 datasets from the Nigeria Demographic Health Survey (NDHS). The NDHS is a nationally representative dataset with similar variables that are comparable over time. A specific method for a specific objective approach was deployed in each of the research papers.

Research paper 1 examines the geographic and socioeconomic inequalities in maternal healthcare utilisation in Nigeria between 2003 and 2017. The finding from the rate difference shows that the gap in the utilisation of facility-based delivery between urban and rural areas increased significantly by 0.3% per year over the study period. The Theil index suggests a decline in relative inequalities in antenatal care and facility-based delivery across the six geopolitical zones by 7% and 1.8% per year, respectively. Further, the results indicate a persistently higher concentration of maternal healthcare use among well-educated and wealthier mothers in Nigeria over the study period.

Research paper 2 measures and identifies factors explaining socioeconomic inequality in the uptake of intermittent preventive treatment in pregnancy with sulfadoxine-pyrimethamine (IPTp-SP). The study showed a higher concentration of the adequate uptake of IPTp-SP among socioeconomically advantaged women in Nigeria. The result of the decomposition analysis

indicates that geographic zones of residence and antenatal visits were the two main drivers for the concentration of the uptake of IPTp-SP among wealthier pregnant women in Nigeria.

Research paper 3 focuses on measuring inequality and identifying factors explaining socioeconomic inequality in teenage pregnancy in Nigeria. The results suggest that pregnancy is concentrated among poor teenagers. The decomposition analysis identifies that the marital status, wealth index of households, exposure to information and communication technology, and religion were the most important predictors contributing to the observed concentration of teenage pregnancy in Nigeria.

Research paper 4 investigates inequalities in geographic and socioeconomic factors influencing the survival time of children under five in Nigeria. The Kaplan-Meier survival estimates show that most under-five mortality occurs within 12 months after birth, with the poorest households most at risk of under-five mortality. The richest households are the least affected across the geographic zones and household wealth index quintiles. Of the six geopolitical zones, children born to mothers living in the North-West region of Nigeria had a 63.4% higher risk of under-five mortality compared to children born to mothers in the South-West.

Research paper 5 conducts a scoping review to ascertain the implications of outbound medical tourism on maternal and child mortality in Nigeria. The 32 articles included out of 2,957; 23 (74.2%) indicate that a lack of confidence and/or trust in the nation's health sector motivates Nigerians to embark on medical tourism. Outbound medical tourism affects the development of the health system and, by implication, contributes to increases in maternal and child mortality rates in the country. The review, therefore, calls for the regulation of sponsored medical treatment for government officials abroad to strengthen the public healthcare system. Strong political will, accountability, transparency and leadership by example are required to revamp the Nigerian health system.

Keywords: Maternal and child mortality; maternal and child healthcare; teen-pregnancy; inequality; socioeconomic status; concentration index; decomposition analysis; survival analysis; malaria; intermittent preventive treatment in pregnancy; medical tourism; scoping review; Nigeria.

CERTIFICATION OF THESIS

I, Chijioke Ifeanyi Okoli, declare that the PhD Thesis entitled ‘Inequality in Maternal and Child Health and Healthcare in Nigeria: An Econometric Analysis’ is not more than 100,000 words in length including quotes and exclusive of tables, figures, appendices, bibliography, references and footnotes.

This thesis is entirely the work of Chijioke Ifeanyi Okoli except where otherwise acknowledged, with the majority of the contribution to the papers presented as a Thesis by Publication undertaken by the student.

The work is original and has not previously been submitted for any other award, except where acknowledged.

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STATEMENT OF CONTRIBUTION

Paper 1:

Chijioke Okoli*, Mohammad Hajizadeh, Mohammad Mafizur Rahman and Rasheda Khanam (2020). Geographical and socioeconomic inequalities in the utilization of maternal healthcare services in Nigeria: 2003–2017. *BMC Health Services Research*, 20:849. DOI: <https://doi.org/10.1186/s12913-020-05700-w> [Quartile 1 (Q1) ranked].

Chijioke Okoli contributed 70% to this paper. Collectively Mohammad Hajizadeh, Mohammad Mafizur Rahman and Rasheda Khanam contributed the remainder.

Paper 2:

Chijioke Ifeanyi Okoli*, Mohammad Hajizadeh, Mohammad Mafizur Rahman and Rasheda Khanam (2021). Decomposition of socioeconomic inequalities in the uptake of intermittent preventive treatment of malaria in pregnancy in Nigeria: evidence from Demographic Health Survey. *BMC Malaria Journal*, 20:300.

DOI: <https://doi.org/10.1186/s12936-021-03834-8> [Quartile 1 ranked].

Chijioke Ifeanyi Okoli contributed 75% to this paper. Collectively Mohammad Hajizadeh, Mohammad Mafizur Rahman and Rasheda Khanam contributed the remainder.

Paper 3:

Chijioke Ifeanyi Okoli* Mohammad Hajizadeh, Mohammad Mafizur Rahman, and Rasheda Khanam (2022). Geographic and socioeconomic inequalities in the survival of children under-five in Nigeria. *Scientific Reports*, 12: 8389. DOI: <https://doi.org/10.1038/s41598-022-12621-7> [Quartile 1 ranked].

Chijioke Ifeanyi Okoli contributed 70% to this paper. Collectively Mohammad Hajizadeh, Mohammad Mafizur Rahman and Rasheda Khanam contributed the remainder.

Paper 4:

Chijioke Ifeanyi Okoli*, Mohammad Hajizadeh, Mohammad Mafizur Rahman, Eswaran Velayutham and Rasheda Khanam (2022). Socioeconomic inequalities in teenage pregnancy in Nigeria: evidence from Demographic Health Survey. *BMC Public Health*, 22:1729. DOI: <https://doi.org/10.1186/s12889-022-14146-0>, [Quartile 1 ranked].

Chijioke Ifeanyi Okoli contributed 70% to this paper. Collectively Mohammad Hajizadeh, Mohammad Mafizur Rahman, Eswaran Velayutham and Rasheda Khanam contributed the remainder.

Paper 5:

Chijioke Ifeanyi Okoli*· Mohammad Hajizadeh, Mohammad Mafizur Rahman, Adewuyi Ayodele Adeyinka and Rasheda Khanam. Outbound medical tourism from Nigeria: a scoping review of implications on maternal and child mortality. *Public Health* manuscript #: PUHE-D-22-02108 (under review) [Quartile 1 ranked].

Chijioke Ifeanyi Okoli contributed 70% to this paper. Collectively Mohammad Hajizadeh, Mohammad Mafizur Rahman, Adewuyi Ayodele Adeyinka and Rasheda Khanam contributed the remainder.

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ABBREVIATIONS

AC	Absolute Concentration index
ANC	Antenatal Care
BGV	Between-Group Variance
CBN	Central Bank of Nigeria
CEM	Continuing Medical Education
CI	Concentration Index
DHS	Demographic Health Survey
FBD	Facility-Based Delivery
HR	Hazard Ratio
IPTp-SP	Intermittent Preventive Treatment with Sulfadoxine-Pyrimethamine
LMICs	Low-and-Middle-Income Countries
MCH	Maternal and Child Health
MiP	Malaria in Pregnancy
MMR	Maternal Mortality Ratio
MT	Medical tourism
PCA	Principal Component Analysis
PHC	Primary Health Care
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
PRISMA-ScR:	PRISMA extension for Scoping Review
RC	Relative Concentration index
RD	Rate Difference
RR	Rate Ratio
SBA	Skilled Birth Attendance
SDGs	Sustainable Development Goals
SEG	Socioeconomic Group
SES	Socioeconomic Status
SSA	Sub-Saharan Africa
T	Theil index
U5MR	Under-Five Mortality Rate
WHO	World Health Organization

CHAPTER 1: INTRODUCTION

1.1. Background

Globally, thousands of women die annually from complications during pregnancy, childbirth and the postpartum period, with most deaths occurring in developing countries (Olonade et al. 2019; Sageer et al. 2019). The lifetime risk of maternal death is more than 200 times greater for women in developing countries compared to women in developed countries (Piane 2019). In the same vein, most mortalities for children under-5 occur in developing countries, especially in sub-Saharan Africa (Akinyemi et al. 2018; Akinyemi et al. 2019). These trends over the past decades have been judged unacceptable, and it remains a problem of public health importance, necessitating the attention of all stakeholders in maternal and child healthcare (Sageer et al. 2019).

Improving maternal and child health is an important global health priority (United Nations 2015). Thus, the principal aim of maternal healthcare is early recognition and management for women at risk of a complicated pregnancy (Aseweh Abor et al. 2011). Consequently, the United Nations Sustainable Development Goals (SDGs)—having replaced the Millennium Development Goals (MDGs)—include maternal health and healthcare as all-embracing goals (WHO 2016; United Nations 2015). This requires concerted and sustainable efforts to remove the various barriers to healthcare access and utilisation, particularly in developing countries (Novignon et al. 2019). However, what continues to be worrying is the lack of attention being paid to the large and growing inequities (unfair inequality) in the provision of and access to services within low- and middle-income countries (Thomsen et al. 2011).

In sub-Saharan Africa, poor living conditions, inadequate nutrition and healthcare, coupled with high fertility rates, often expose women of all ages, especially teenage girls (Finlay et al. 2011; Huda et al. 2021; Ujah et al. 2005), to a high risk of pregnancy-related illness and death (Aseweh Abor et al. 2011). The situation is critical in Nigeria, with a maternal mortality ratio of 512 deaths per 100,000 live births. Neonates, infants and children under five have mortality rates of 39, 67, and 132 deaths per 1,000 live births, respectively, in 2018 (National Population Commission & ICF International 2019). In addition, Nigeria has the highest global incidence of malaria, which remains the top cause of maternal and childhood death (USAID 2017). The maternal mortality ratio in Nigeria is the highest in Africa and much higher than the global

average of 290 per 100,000 live births (Piane 2019). This situation is especially exacerbated when there is poor access to healthcare services and poor utilisation rates (Aseweh Abor et al. 2011). Partly because health care workers are not only in short supply, but also lack the skills for basic standard of care (Bryan et al. 2010). Hence, the poor infant and maternal mortality statistics in sub-Saharan Africa due to the deplorable state of health infrastructure (Abubakar et al. 2018; Abubakar et al. 2022), reflect the quality of the region's healthcare system (Makinde 2016; Oleribe et al. 2019). As a result, many people from the region have become medical tourists to seek better quality healthcare (Makinde 2016).

Though some progress has been made in the last decade, mortality and other child health indicators are still below the desired levels (Akinyemi et al. 2018). Conspicuous variations in maternal mortality are reflected through inequities in access to maternal healthcare, such as antenatal care, skilled birth attendance and postnatal care on various economic, geographic and social scales (Pathak et al. 2010).

Monitoring the progress towards a reduction in maternal mortality, particularly in low-middle-income countries (LMICs), is difficult due to the paucity of reliable health information (Pathak et al. 2010). Where information is available, the success or failure of policymakers depends on their ability to develop the right interventions targeted at the vulnerable (Aseweh Abor et al. 2011), especially if the stakeholders have an appreciable knowledge of the factors that influence access to maternal and child healthcare services. Against this backdrop, this thesis investigates inequalities in the utilisation of maternal and child health and healthcare in the six geopolitical zones of Nigeria using the following econometric analyses: concentration index, decomposition analysis, survival analysis, Theil index, between-group variance (BGV), rate ratio and rate difference. Health inequalities are those differences that reflect consequences of an underprivileged position, thus we focus on socioeconomic differences in health and healthcare (Coburn and Coburn 2007). This thesis adds to the literature by measuring and explaining socioeconomic inequalities in maternal and child health and healthcare in Nigeria. In addition, this thesis includes a study that conducted a scoping review of implications of outbound medical tourism on maternal and child mortality in Nigeria. The findings may serve as a policy perspective pivot point upon which policymakers could improve maternal and child health and healthcare in Nigeria.

1.2. Research gap

A body of literature and anecdotal evidence indicates that maternal and child mortality in Nigeria is one of the highest in the world, with a rate of 512 per 100,000 live births and the highest under-five child mortality rate of any LMIC (Federal Ministry of Health Nigeria 2018; National Population Commission & ICF International 2019). This runs contrary to the SDG's three targets¹ (United Nations 2015) and the 'leave no one behind' agenda (Llop-Girones et al. 2019), as the mortality occurs mainly among the socioeconomically and geographically disadvantaged women.

For an ethnically diverse country such as Nigeria, a one-size-fits-all intervention cannot be effective in reducing maternal and child mortality. Context-specific evidence-based information is required within and across the geopolitical zones of Nigeria to match a unique response to a unique problem. Indeed, effective evidence-based interventions may exist, but context may change their effectiveness (Serbanescu et al. 2022). The findings of this thesis will complement most reviews on the causes and contributory factors affecting maternal-cum-teenage and child deaths in Nigeria that were hitherto based on reports from a single health facility that may not be generalizable to large populations (Sageer et al. 2019; Ujah et al. 2005).

The available evidence indicates that about 74% of maternal and child mortality could be prevented if all women received appropriate emergency obstetric care (Calvello et al. 2015), but fewer than 20% of the healthcare facilities in the country offer emergency obstetric care (Federal Ministry of Health Nigeria 2018). Thus, the prevailing poor healthcare delivery system in Nigeria encourages outbound medical tourism and negatively affects maternal/teenage and child health outcomes (Abubakar et al. 2018; Epundu et al. 2017; Igwegbe & Udigwe 2001; Orekoya & Oduyoye 2018). Nevertheless, the problems relating to the implications of outbound medical tourism on maternal and healthcare have received little or no attention.

¹ Goal three of the SDG is to ensure healthy lives and promote well-being for all at all ages with targets to:

1. reduce the global maternal mortality ratio to less than 70 per 100,000 live births by 2030
2. end preventable deaths of new-borns and children under five years of age, with all countries aiming to reduce neonatal mortality to as low as 12 per 1,000 live births and under-5 mortality to as low as 25 per 1,000 live births by 2030.

1.3. Aim and research questions

1.3.1. Aim: To investigate inequality in maternal and child health and healthcare in Nigeria and across its six geopolitical zones.

1.3.2. Research questions

1. What are the geographic and socioeconomic inequalities in the utilisation of maternal healthcare in Nigeria from 2003 to 2018?
2. What are the socio-demographic and geopolitical inequalities in the utilisation of intermittent preventive treatment of malaria in pregnancy?
3. Are there socioeconomic inequalities in teenage pregnancy in Nigeria?
4. Is there inequality in under-five mortality in Nigeria?
5. What are the implications of outbound medical tourism on maternal and child mortality in Nigeria?

1.4. Theoretical and conceptual framework

1.4.1. Three-delay model

An array of theoretical perspectives has been used to help understand and explain poor maternal and child health outcomes, one of which is the three-delay model (Thaddeus & Maine 1994). This is important as it is impossible to separate infant death from maternal morbidity and mortality because maternal well-being largely determines children's well-being (Akinyemi et al. 2018). Thus, according to the World Health Organization (WHO), about 98% of maternal and child deaths could be prevented with timely access to obstetric intervention (Sumankuuro 2018). This implies that delays in deciding, reaching and receiving appropriate and timely maternal and neonatal health services lead to poor maternal and child health outcomes (Thaddeus & Maine 1994). Consequently, Thaddeus and Maine (1994) proposed the three-delay model (see Figure 1) that identifies different barriers that women face in receiving the timely and efficient medical care they need to prevent death from occurring during pregnancy and childbirth (Thaddeus & Maine 1994; Sumankuuro 2018).

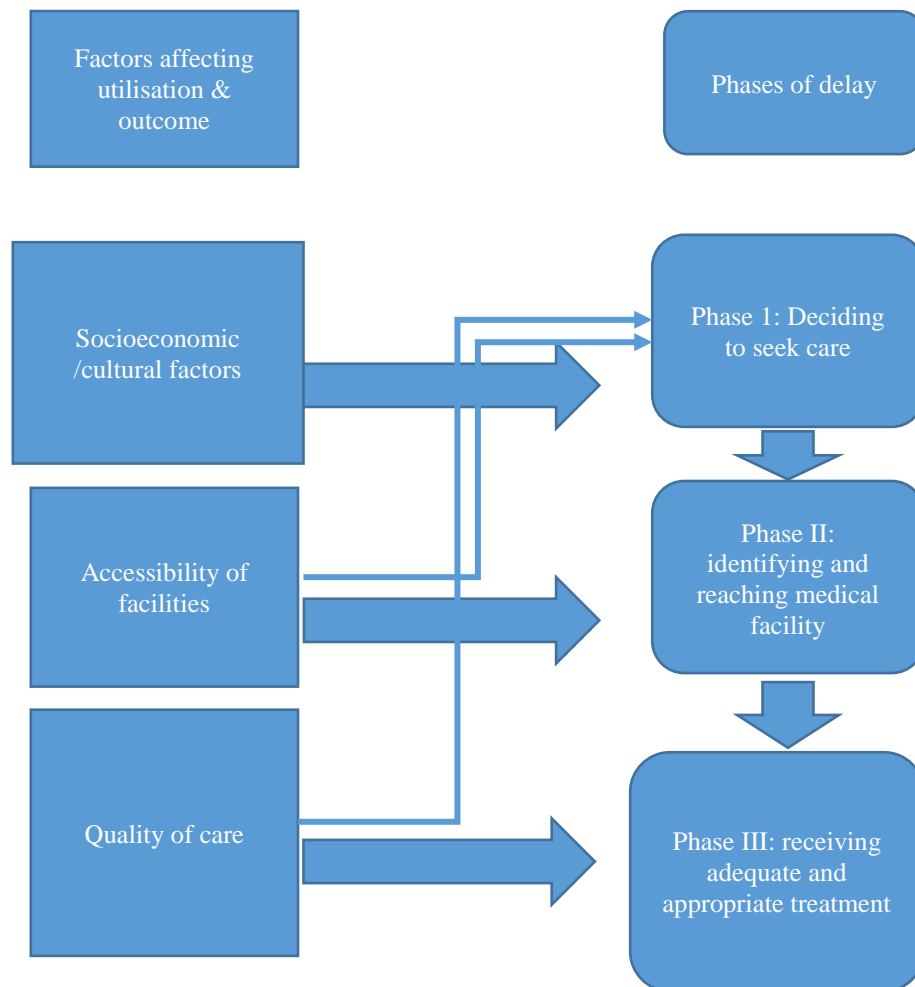


Figure 1: Three-delay model [Source: Thaddeus & Maine (1994)]

The model describes the interlinking nature of the different factors that prevent the populace, especially women, from accessing maternal and perinatal healthcare (Thaddeus & Maine 1994). Barriers such as low economic status, illiteracy, inadequate health education, sociocultural beliefs, poor road infrastructure and difficulty accessing transport services during an emergency, alongside inadequate health facilities, cause delays among patients, often resulting in maternal and infant deaths, particularly in sub-Saharan Africa (Sumankuuro 2018).

The model identifies 1) a delay in the decision to seek care on the part of the individual, the family, or both; 2) a delay in reaching an adequate healthcare facility and 3) a delay in receiving appropriate care at the facility (Thaddeus & Maine 1994; Yaya et al. 2018; Zere et al. 2010). The first two delays are demand-side barriers (Knight et al. 2013), which may be affected by a mother's education, household wealth, and community-level factors such as the levels of poverty (Zere et al. 2010). The third delay is the supply-side barriers (e.g., lack of requisite personnel and difficulties in procuring essential drugs). These are major factors contributing to maternal and child deaths in developing countries (Knight et al. 2013).

In practice, demand-side and supply-side issues are interwoven. For the demand side to function effectively, a portion of the supply-side mechanism must be present (Aremu 2011). There is evidence that demand reacts to quality (O'Donnell 2007), and the proof of access is in the use of service, not simply the presence of a facility (Gulliford et al. 2002). Upgrading health facilities, training health personnel and ensuring the availability and quality of life-saving interventions are key requirements for access to skilled care (Hounton et al. 2009). Therefore, policy interventions on both the demand and supply sides must progress simultaneously for optimal healthcare outcomes for the populace, especially for maternal and child health (O'Donnell 2007).

1.4.2. Access framework

Access has been described as the opportunity or freedom to use health services (Thiede et al. 2007). Effective maternal and child health require the combination of a number of theoretical models and frameworks to address the health needs of women, children and families (Fraser 2013). The three-delay model and access framework re-enforce each other.

Access is a multi-dimensional concept, with the three key access dimensions of availability (referred to as physical access), affordability (referred to as financial access) and acceptability (sometimes referred to as cultural access) (Gulliford et al. 2002; Thiede et al. 2007), as shown in Figure 2 below. Access encompasses healthcare service use, as there are a set of circumstances that allow for the use of appropriate healthcare services (Goddard & Smith 2001; Gulliford et al. 2002; Thaddeus & Maine 1994).

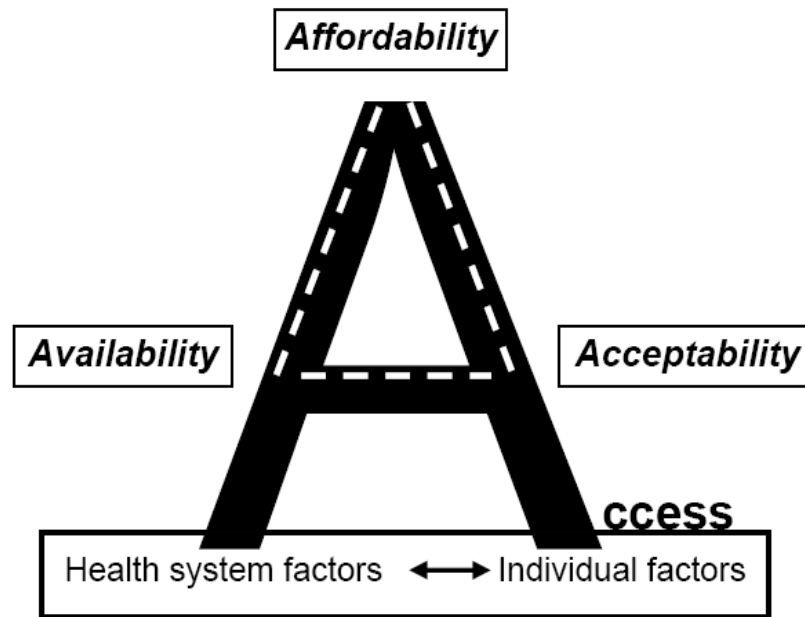


Figure 2: Access framework [Source: Thiede et al. (2007)]

The triangle shows that the dimensions are interrelated yet distinct issues. Addressing problems of availability requires completely different policy tools from those for improving the acceptability of a specific type of service (Thiede et al. 2007). In trying to address acceptability barriers, evidence suggests that the first step is to recognise the socialised nature of healthcare, and in particular, the frequent cultural mismatches between lay and professional health beliefs (Gilson 2007). Therefore, instead of blaming patients for their poor healthcare-seeking behaviours, health professionals need to understand the cultural beliefs and motivations of the public they seek to serve and tailor service delivery to their perceptions and needs (Gilson 2007). For instance, it would not be sufficient to ensure access to care if service providers were mainly male in communities where populations believed it is inappropriate for women to be examined by male physicians (McIntyre et al. 2009). The acceptability dimension could be improved if providers were aware of cultural beliefs in the local community and adapted services accordingly (McIntyre et al. 2009). Only when there is adequate information on health, information on appropriate healthcare responses and on the opportunities to use health services are effectively communicated across communities can equitable access to health services be established (Gulliford et al. 2002; Thiede et al. 2007).

1.5. Nigeria's healthcare system in brief

Nigeria's healthcare system is based on a three-tier system: Primary Health Care (PHC) as the entry point, secondary care as the first referral level and tertiary care (teaching hospitals) (Yaya et al. 2018). PHC is the most accessible and affordable form of care that serves most of the population. Presently, the country has about 34,000 PHC facilities covering all the health wards (each ward comprising population areas of 10,000 to 30,000 persons) and most rural and hard-to-reach communities (Yaya et al. 2018). There are fewer secondary health centres and teaching hospitals, most of which are located in state capitals and urban areas (Yaya et al. 2018; Yaya et al. 2019).

Most public health facilities in Nigeria lack essential medicines, an adequate workforce and quality equipment, and are often staffed by unmotivated providers (Haruna et al. 2019; Izugbara & Wekesah 2018). The services of maternity care providers in Nigeria are generally poor, characterised by pervasive abuse, quackery, a lack of commitment and irresponsibility on the part of many providers (Izugbara & Wekesah 2018). Over 72% of the total health expenses of Nigerians are out-of-pocket (Elebesunu et al. 2021). The Nigerian government has shown great disregard for the state of healthcare in the country despite the fact that governance (accountability and strong political will) is one of the most important factors for strengthening health systems (Elebesunu et al. 2021).

1.6. Study design and data source

A cross-sectional quantitative design was employed using the Nigeria Demographic and Health Surveys (NDHS) datasets² of 2003, 2008, 2013 and 2018 collected from the six geopolitical zones of Nigeria (North-Central, North-East, North-West, South-East, South-West and South-South). A specific method for a specific objective approach was deployed to address each research question.

The NDHS is a nationally representative survey that provides information on the reproductive health of women aged 15 to 49, maternal health for children (neonatal, infant and under-5), household characteristics, household members, and many others (NPC & ICF 2019). The NDHS uses trained and experienced interviewers, standardised measurement techniques and

² The dataset is available at https://www.dhsprogram.com/data/dataset_admin/login_main.cfm.

tools. It has an identical core set of questions to ensure the standardisation and comparability of surveys across time and countries (NPC & ICF 2019).

1.7. Thesis structure

This is a PhD thesis by publication comprising five research papers, among which four papers have already been published in peer-reviewed Q1 journals, and one paper is under review as at the time of submission. The five journal articles were derived from the five specific objectives of this thesis (see Figure 3). The remaining content of this thesis consists of the following chapters.

Chapter 2: This chapter consists of research question 1, but is transformed into a peer-review journal article titled ‘Geographical and socioeconomic inequalities in the utilisation of maternal healthcare services in Nigeria: 2003–2017’. This article is published in the *BMC Health Services Research* (2020) 20:849. DOI: <https://doi.org/10.1186/s12913-020-05700-w>.

Chapter 3: This chapter comprises research question 2, now converted to a peer-reviewed journal article titled ‘Decomposition of socioeconomic inequalities in the uptake of intermittent preventive treatment of malaria in pregnancy in Nigeria: evidence from Demographic Health Survey’. The article is published in the *BMC Malaria Journal* (2021) 20:300. DOI: <https://doi.org/10.1186/s12936-021-03834-8>. This study achieved third place in the ‘Three Minute Thesis Competition’ organised by the Centre for Health Research, USQ, 2021. Further, the article won the third-place prize in the School of Business HDR Student publication excellence awards for journal articles, 2022.

Chapter 4: This chapter investigates research question 3 and contains the research article titled ‘Socioeconomic inequalities in teenage pregnancy in Nigeria: evidence from Demographic Health Survey’. The article is published in the *BMC Public Health* (2022) 22:1729. DOI: <https://doi.org/10.1186/s12889-022-14146-0>.

Chapter 5: This chapter consists of research question 4, now converted into a peer-reviewed journal article titled ‘Geographic and socioeconomic inequalities in the survival of children under-five in Nigeria’. The article has been published in the *Scientific Reports* (2022) 12:8389. DOI: <https://doi.org/10.1038/s41598-022-12621-7>. In addition, the study was presented at the School of Business virtual High Degree Research seminar, University of Southern Queensland, on 20 September 2021.

Chapter 6: This chapter contains research objective 5, converted to a peer-reviewed journal article titled ‘ Outbound of medical tourism from Nigeria: a scoping review of implication on maternal and child mortality’. The article (at the time of submission) is under peer-review for the *Public Health* journal, manuscript ID PUHE-D-22-02108. Publisher: ELSEVIER

Chapter 7: This chapter contains an overall conclusion comprising the contribution of the thesis, policy implications, limitations and future research directions.

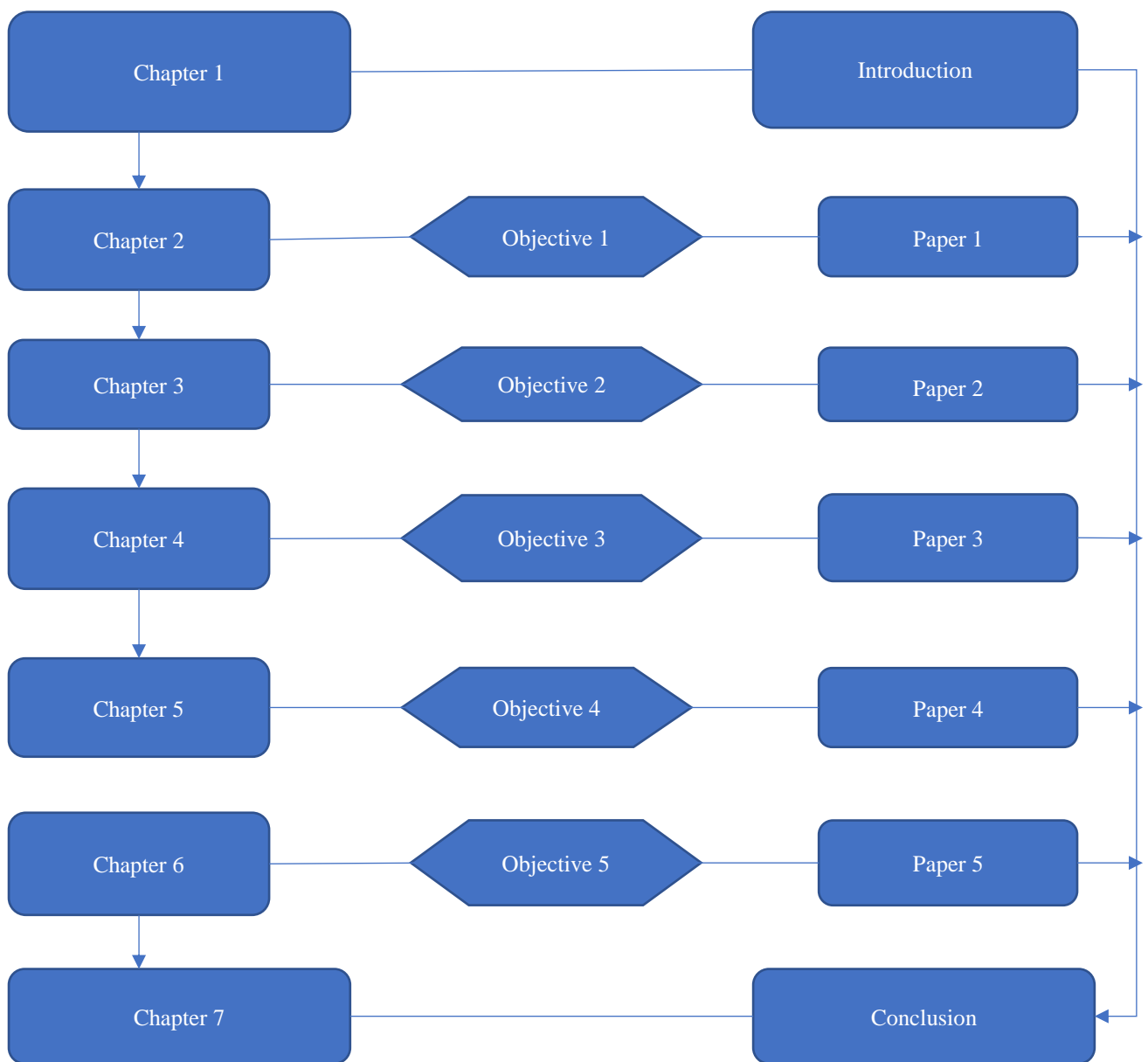


Figure 3: Flow chart of thesis outline

CHAPTER 2: PAPER 1 – GEOGRAPHICAL AND SOCIOECONOMIC INEQUALITIES IN THE UTILIZATION OF MATERNAL HEALTHCARE SERVICES IN NIGERIA: 2003–2017

2.1. Introductory paragraph

Chapter 2 addresses one of the gaps in the literature and one of the research questions from Chapter 1 that provides an overall background of this thesis. The objective of this paper was to examine the geographic and socioeconomic inequalities in maternal healthcare utilisation in Nigeria in the period between 2003 and 2017. Results show that the utilisation of maternal healthcare is lower among poorer and less-educated women, as well as those living in rural areas in the North-West and North-East geopolitical zones of Nigeria. The output of the research objective was published in a *BMC Health Services Research*.

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RESEARCH ARTICLE

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Geographical and socioeconomic inequalities in the utilization of maternal healthcare services in Nigeria: 2003–2017



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Abstract

Background: Maternal mortality has remained a challenge in many low-income countries, especially in Africa and in Nigeria in particular. This study examines the geographical and socioeconomic inequalities in maternal healthcare utilization in Nigeria over the period between 2003 and 2017.

Methods: The study used four rounds of Nigeria Demographic Health Surveys (DHS, 2003, 2008, 2013, and 2018) for women aged 15–49 years old. The rate ratios and differences (RR and RD) were used to measure differences between urban and rural areas in terms of the utilization of the three maternal healthcare services including antenatal care (ANC), facility-based delivery (FBD), and skilled-birth attendance (SBA). The Theil index (T), between-group variance (BGV) were used to measure relative and absolute inequalities in the utilization of maternal healthcare across the six geopolitical zones in Nigeria. The relative and absolute concentration index (RC and AC) were used to measure education- and wealth-related inequalities in the utilization of maternal healthcare services.

Results: The RD shows that the gap in the utilization of FBD between urban and rural areas significantly increased by 0.3% per year over the study period. The Theil index suggests a decline in relative inequalities in ANC and FBD across the six geopolitical zones by 7, and 1.8% per year, respectively. The BGV results do not suggest any changes in absolute inequalities in ANC, FBD, and SBA utilization across the geopolitical zones over time. The results of the RC and the AC suggest a persistently higher concentration of maternal healthcare use among well-educated and wealthier mothers in Nigeria over the study period.

Conclusion: We found that the utilization of maternal healthcare is lower among poorer and less-educated women, as well as those living in rural areas and North West and North East geopolitical zones. Thus, the focus should be on implementing strategies that increase the uptake of maternal healthcare services among these groups.

Keywords: Geographical inequalities; socioeconomic inequalities; Maternal healthcare, Nigeria

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Background

Despite continual efforts to reduce maternal mortality burden globally, it has remained an ongoing tragedy in many low-income countries, especially in Africa [1–4], which has the highest rate of maternal deaths in the world and sub-Saharan Africa as a primary contributor has a maternal death of 1 in every 16 pregnant women compared with 1 in 2800 in the developed countries [5]. This substantial difference is one of the largest inequalities of any public health statistics [6].

Social inequalities that prevail in the health sector especially between the poor and the rich continue to be a cause for concern, particularly in the developing worlds [7]. These inequalities are manifested in health outcomes as studies in developing countries show that maternal health service utilization is higher among wealthier women than their poorer counterparts [7–9], mostly residing in rural areas [10]. Living in rural areas in developing countries mean residing in deprived communities in terms of social amenities and infrastructure [8].

The rural-urban place of residence accounts for differences in the use of health services, especially as this relates to the level of maternal education and socioeconomic status [5, 8]. Studies show a positive association between education level and the use of antenatal care (ANC), delivery in health facilities (FBD), and skilled birth assistance (SBA) [8]. Of equal importance, is socioeconomic status, which influences the use of health services as the wealthier urban women access healthcare more compared to their poorer rural counterparts.

In Nigeria, there has been some decline in maternal mortality from 576 per 100,000 live births in 2013 to 512 per 100,000 live births in 2018 [11]. The pace of reduction and geographical inequalities in the distribution remains a huge concern. There are inequities in maternal mortality rate across the six geopolitical zones in Nigeria with North-East and North-West zones of the country having almost 10 and 6 times, respectively, higher mortality rates than that of the South-West zone of the country [11]. Women from northern Nigeria, especially in rural areas, are at higher risk of maternal death compared to those from the southern part of the country [11]. Lower access to health care services is most common in the Northern zones of the country, particularly in rural areas, among low socioeconomic status (SES) individuals [11]. This is due to distance to facility, limited means of transportation, poor staffing of the health facilities, poor attitude/unprofessional conduct of healthcare providers, and lower levels of education [12–15].

To date, most studies in Nigeria focus mainly on socioeconomic inequalities in maternal mortality rates [5, 16]. There is a paucity of studies in the literature assessing geographical and socioeconomic inequalities in

maternal healthcare use in Nigeria. Using information collected from the four cycles of the Nigeria Demographic Health Surveys (DHS, 2003, 2008, 2013 and 2018), this study examines trends in the geographical and socioeconomic inequalities in maternal healthcare services utilization over the period between 2003 and 2017. The results of this study will provide useful information for policymakers to address geopolitical socioeconomic inequalities in maternal healthcare services that determine health outcomes in the country.

Methods

Study setting

The study setting is in Nigeria, with an estimated population of 198 million as of 2018 [11]. The country comprises 36 states and a Federal Capital Territory, Abuja. The country is divided into six geopolitical zones for administrative and political purposes (North-Central, North-East, North-West, South-East, South-West, and South-South). These geopolitical zones comprise states with a similar culture, ethnic groups, and common history [1, 11].

The country has a three-tiered health system; primary, secondary, and tertiary based on the three tiers of government – local, state, and federal. More health services providers are located in the southern than in the northern states of Nigeria, [17], owing to widespread poverty in the North than in the South [18], but there are some other significant issues: for example, fewer than 20% of healthcare facilities in the country offer emergency obstetric care [11]. In terms of levels of socioeconomic development, wide differences exist between the northern and the southern parts of the country and across the geopolitical zones [10]. Approximately 62% of Nigerians live below the poverty line [10], with northern geopolitical zones having the highest poverty rates in the country [19].

Data

Of the available five rounds of the Nigeria demographic and health survey (1990, 2003, 2008, 2013 and 2018), this study used the latest four. The 1990 DHS was not included because the survey was limited to four (North-East, North-West, South-East, and South-West) of the six geopolitical zones of Nigeria. The Nigerian DHS is part of the DHS program designed to collect nationally representative information using three types of structured questionnaires: household questionnaire, women's questionnaire, and, men's questionnaire [10, 20]. The survey used a three-stage cluster sampling design and covered all the six geopolitical zones of the country. The sampling frame was based on the list of enumeration areas prepared for the 1991 and 2006 Population Census of the Federal Republic of Nigeria. Details of the survey

have been provided elsewhere [21]. This study utilizes the information collected through the women's questionnaire on issues related to maternal and child health, fertility, and family planning for women aged 15–49.

Variables

Outcome measures

The outcome variables of the study are three key aspects of maternal healthcare ANC, FBD, and SBA. Based on the recommendations of the World Health Organization (WHO), an ANC visit is defined as a pregnant woman having at least four antenatal assessments by or under the supervision of a skilled attendant [22]. Although the 2016 WHO guideline stipulates eight ANC visits [23], we used the old guidelines as data came mostly from the period with four ANC visits.

The FBD is defined as giving birth at a permanent health-facility such as primary health centers, hospitals, or a private clinic. The SBA is defined as delivery assisted by an accredited health professional such as a doctor, nurse, midwife, or an auxiliary nurse/midwife [20, 21].

Socioeconomic variables

Maternal education and household wealth index (WI) were used as socioeconomic variables in the study. The WI was measured using household asset ownership, household characteristics, household source of drinking water, and household sanitary facilities as contained in DHS datasets [21, 24]. The WI is generally used as an indicator for household SES when income or expenditure data is unavailable [25]. The WI is constructed using principal components analysis (PCA) technique that assigns a score to each household based on selected household assets. The first principal component of a set of variables captures the largest amount of information that is common to all the variables [26, 27]. The mother's education level (in years) was used as another measure of SES in the study [20].

Statistical analysis

Our statistical analysis involved measuring geographic, education, and wealth-related inequalities. We calculated geographic inequalities in the utilization of maternal healthcare services (ANC, FBD, and SBA) between urban and rural areas and across the six geopolitical zones of Nigeria. Education and wealth-related inequalities in access to maternal healthcare were also estimated for the study period. The chi-square test was set at 0.05% level of significance. Weights were applied to ensure the representativeness of the actual population.

Measuring inequalities between urban and rural and across geopolitical zones

Absolute and relative inequalities between urban and rural areas were calculated using rate ratio (RR) and rate

difference (RD). The Theil index (T) was employed to estimate relative inequalities in maternal healthcare utilization between the six geopolitical zones [20, 28]. The T can be estimated as follows:

$$T = \sum_{i=1}^j GZ_{i\#} \left[\ln \left(\frac{GZ_{i\#}}{GZ_{ip}} \right) \right], \quad (1)$$

where $GZ_{i\#}$ is the geopolitical zone's share of the population's health and GZ_{ip} is the i th zone's population share. The T ranges from zero, indicating an equal distribution, while a higher value suggests a more unequal distribution. Moreover, the between-group variance (BGV) was used to summarize absolute inequality across the geopolitical zones [20, 28]. The BGV was calculated as:

$$BGV = \sum_{i=1}^j GZP_i (GZH_i - \mu)^2 \quad (2)$$

Where GZP_i is geopolitical zone 's population size (i.e., number of women who gave birth in each year), GZH_i is geopolitical zone i 's average health outcome, μ is the average health outcome across all the geopolitical zones.

Measuring socioeconomic inequalities

The concentration index (C index) approach was used to calculate socioeconomic related inequalities in the utilization of maternal healthcare services. The index is a widely used measure of socio-economic health inequalities as it fulfills three qualities for a valid socioeconomic inequality index. The index should: a) reflect the health inequalities that arise from the socioeconomic characteristics; b) be representative of the whole population; and c) be sensitive to the subpopulation group sizes [29, 30]. The C index quantifies the extent of socioeconomic inequality in health, which is useful in tracing inequalities over time across different groups [29].

The relative concentration index (RC) is based on the relative concentration curve which graphs the cumulative share of maternal healthcare use (e.g., ANC), on its y-axis, against the cumulative share of the population, ranked in ascending order of an SES indicator (e.g. the WI) on its x-axis. The RC is calculated as twice the area between the relative concentration curve and the perfect equality line. The RC is negative (positive) if the concentration curve lies above (below) the line of equality, indicating that the utilization of maternal healthcare service is concentrated among poorer (richer) women [31, 32]. The RC ranges from -1 to 1, with a value of zero signifying "perfect equality" [29]. The convenient regression method can be used to compute the RC index as follows [32]:

$$2\sigma_r^2 \left(\frac{y_i}{\mu} \right) = \alpha + \phi r_i + \varepsilon_i, \quad (3)$$

where y_i is the healthcare variable of interest (e.g. ANC)

for women i , μ is the mean of the healthcare utilization variable for the whole sample, $r_i = i/N$, is the fractional rank of individual i in the distribution from the lowest SES woman ($i = 1$) to the highest SES woman ($i = N$), and σ_r^2 is the variance of fractional rank. The RC is calculated as the ordinary least squares (OLS) estimate of ϕ [33].

Since our outcome variable of interest is binary, the minimum and maximum values of the RC are not -1 and $+1$, thus, the RC was normalized by multiplying the estimated index by $1/1-\mu$, where μ indicates the mean of outcome variable of interest [34, 35]. The generalized concentration index ($RC \times \mu$) can be used to calculate absolute socioeconomic inequality in healthcare utilization [31]. Since the generalized concentration index does not satisfy this condition, the Erreygers modified the generalized/absolute concentration index (hereafter the $=RC \times 4\mu$) [34, 36] was used to calculate absolute socioeconomic inequality in healthcare utilization. The AC ranges from -1 to $+1$, with zero suggesting perfect equality [34]. All analyses were weighted to account for individual survey sample designs. All analyses were conducted using version 13 of the STATA software package (Stata Corp, College Station, Tex).

Results

Descriptive statistics

Table 1 shows maternal healthcare utilization by the sample characteristics. Of the three age groups, women aged 25–34 years, on average use more maternal ANC, FBD, and SBA over the four-year survey periods. Those with secondary education levels on average utilizes more maternal healthcare services than those with no formal education, or education at primary or tertiary education levels. Expectedly, married women use more ANC, FBD, and SBA than the never married and others (divorced, living together, not living together, and widowed). In the same vein, those employed or working on average use more maternal healthcare than their employed counterparts.

The results show Christians utilize more maternal healthcare services compared to Muslims and other religions. For the place of residence, urban residents used more maternal care services than rural residents. However, the wealth index shows a positive relationship in maternal healthcare utilization. Of the six geopolitical zones, the average utilization of maternal care use was higher in South-West followed by North-Central zones while it was lower in North-West and North-East zones.

Table 2 reports the survey year, sample size, and average utilization rates for ANC, FBD, and SBA for the total population (the six geopolitical zones) and urban and rural areas for each year within the survey periods. The total measures of maternal healthcare utilization increased for ANC, FBD, and SBA among women who

gave birth between 1998 and 2017. The results show that only 58, 32 and 14% of women who gave birth in 1998 used ANC, FBD, and SBA respectively, while these figures increased to 58, 42, and 45%, respectively in 2017. The utilization of maternal healthcare services also increased in urban and rural areas in Nigeria.

Figure 1a shows that all the southern geopolitical zones use ANC services more than their northern counterpart. Within the northern zone, the utilization of maternal care is lowest in the North-West zone. As shown in Fig. 1b, South-East and South-West zones use more FBD over the four survey years than the other geopolitical zones. As reported in Fig. 1c the South West, South-East, and North-Central zones have higher utilization of the SBA rate, while the North-West and North-East zones make less use of SBA.

Figure 2 shows the proportion of maternal healthcare use across the six geopolitical zones by four survey periods. The results indicate a pronounced increase in ANC use from 49 to 59 over the survey periods. However, this was not the case for SBA and FBD, which increased marginally from 31 to 35% and 33 to 40%, respectively, over the study period.

Geographical inequalities in maternal healthcare utilization

Table 3 reports geographical inequalities in maternal healthcare use between rural and urban and across the geopolitical zones of Nigeria. The urban-rural rate ratios (RR) increased for ANC while it decreased for FBD and SBA over the study period. The relative advantage of urban women compared to rural women in ANC increased from 1998 (RR = 1.552) to 2017 (RR = 1.635). The relative inequality in FBD and SBA decreased from 1998 (RR = 2.980) to 2017 (RR = 2.371) and from 1998 (RR = 3.717) to 2017 (RR = 2.478), respectively. The magnitude of these changes was not statistically significant.

The urban-rural rate differences (RD) indicate that women in urban areas use more maternal healthcare compared to their rural counterparts. In contrast to the RR results, the RDs show that absolute inequalities in maternal healthcare use between urban-rural areas increased for the whole study period. The increasing time trend coefficients of rate difference was significant for FBD. The estimated coefficient shows that the absolute gap in the utilization of FBD between urban and rural areas increased by 0.3% per year, over the period between 1998 and 2017 (Table 3). Both the T and BGV suggest that inequalities exist in maternal healthcare use across geopolitical zones in Nigeria. The T shows that relative inequalities in ANC, FBD across geopolitical zones declined by 7, and 1.8% per year, respectively. The BGV results do not suggest any changes in absolute inequalities in ANC, FBD, and SBA utilization across the geopolitical zones over time.

Table 1 Maternal healthcare utilization in Nigeria by mother's characteristics and geographic regions (2003–2018)

	2003			2008			2013			2018		
	ANC	FBD	SBA	ANC	FBD	SBA	ANC	FBD	SBA	ANC	FBD	SBA
Age of women												
15–24	458(25.7)	436(22.8)	483(23.2)	1712(21.4)	1783(193)	1974(19.6)	2339(22.7)	2292(20.9)	2427(20.6)	2708(22.3)	2570(19.6)	2785(19.3)
25–34	852(47.9)	1052(55.1)	1120(53.8)	4167(52.1)	5203(56.2)	5645(56.0)	5116(49.7)	5881(53.7)	6360(54.1)	6047(49.8)	7138(53.4)	7896(54.7)
35–49	469(26.4)	421(22.1)	481(23.1)	2123(26.5)	2264(24.5)	2457(24.4)	2838(27.6)	2778(25.4)	2978(25.3)	3394(27.9)	3421(26.0)	3743(26.0)
Education level												
No formal education	477(27.0)	312(16.4)	390(18.7)	1820(22.8)	1229(13.3)	1452(14.4)	2660(25.8)	1702(15.4)	17,794(15.3)	3346(27.5)	2171(16.5)	2282(15.8)
Primary	522(29.5)	564(30.0)	618(29.6)	2178(27.2)	2405(26.0)	2655(26.4)	2344(22.8)	2454(22.4)	2639(22.4)	1994(16.4)	2019(15.4)	2289(15.9)
Secondary	648(36.6)	853(44.7)	898(42.9)	3126(39.1)	4345(47.0)	4660(46.3)	4164(40.5)	5196(47.4)	5686(48.3)	5125(42.2)	6543(49.8)	7311(50.7)
Tertiary	123(7.0)	180(9.4)	183(8.8)	878(11.0)	1270(13.7)	1309(13.0)	1125(10.9)	1599(14.6)	1647(14.0)	1683(13.9)	2395(18.3)	2543(17.6)
Marital status												
Never married	63(3.6)	75(3.9)	75(3.6)	198(2.5)	172(1.9)	193(1.9)	299(2.9)	241(2.2)	262(2.2)	290(2.4)	299(2.3)	337(2.3)
Married	1553(87.7)	1663(87.1)	1827(87.7)	7364(92.0)	8614(93.1)	9342(92.7)	9276(90.1)	9988(91.2)	10,702(91.0)	10,956(90.2)	11,872(90.4)	12,998(90.1)
Others	154(8.7)	171(9.0)	181(8.7)	440(5.5)	464(5.0)	540(5.4)	718(7.0)	723(6.6)	802(6.8)	902(7.4)	958(7.3)	1089(7.6)
Work status												
Not working	505(28.6)	550(28.9)	606(29.2)	2092(26.3)	2191(23.8)	2292(25.5)	2542(24.8)	2533(23.3)	2756(23.6)	3081(25.4)	3022(23.0)	3322(23.0)
working	1262(71.4)	1352(71.1)	1470(70.8)	5870(73.7)	7009(76.2)	6688(74.5)	7705(75.2)	8356(76.7)	8944(76.4)	9067(74.6)	10,107(77.0)	11,103(77.0)
Religion												
Christian	933(52.7)	1227(64.3)	1301(62.5)	4679(58.8)	6308(68.6)	6818(68.0)	5409(53.0)	6921(63.9)	7447(64.0)	6013(49.7)	7878(60.3)	8734(60.8)
Muslim	817(46.2)	663(34.8)	764(36.7)	3183(40.0)	2827(30.7)	3132(31.2)	4726(46.3)	3850(35.5)	4128(35.5)	6055(50.1)	5174(39.6)	5613(39.1)
Other	19(1.1)	18(0.9)	17(0.8)	89(1.1)	67(0.7)	75(0.8)	70(0.7)	63(0.6)	59(0.5)	29(0.2)	24(0.2)	27(0.2)
Place of residence												
Urban	774(43.7)	920(48.2)	1003(48.1)	3672(46.0)	4756(51.5)	5087(50.6)	5295(51.9)	6521(60.1)	7140(61.4)	6184(51.1)	7756(59.3)	8562(59.6)
Rural	996(56.3)	988(51.8)	1080(51.9)	4318(54.0)	4477(48.5)	4970(49.4)	4909(48.1)	4313(39.8)	4495(38.6)	5913(48.9)	5320(40.7)	5813(40.4)
Wealth index												
poorest	191(10.8)	153(8.0)	155(7.4)	653(8.2)	469(5.1)	531(5.3)	829(8.1)	422(3.9)	406(3.5)	1430(11.8)	868(6.6)	880(6.1)
Poorer	255(12.7)	208(10.9)	233(11.2)	1147(14.4)	916(9.9)	1052(10.5)	1565(15.3)	1212(11.2)	1238(10.6)	2039(16.9)	1616(12.4)	1694(11.8)
Middle	345(19.5)	297(15.5)	315(15.1)	1637(20.5)	1653(17.9)	1837(18.3)	2185(21.4)	2127(19.6)	2312(19.9)	2632(21.8)	2783(21.3)	3151(21.9)
Richer	450(25.5)	482(25.2)	560(26.9)	2078(26.0)	2596(28.1)	2869(28.5)	2620(25.7)	3066(28.3)	3364(28.9)	2882(23.8)	3586(27.4)	4040(28.1)
Richest	559(31.6)	769(40.3)	821(39.4)	2474(31.0)	3600(39.0)	3769(37.5)	3006(29.5)	4007(37.0)	4315(37.1)	3114(25.7)	4223(32.3)	4611(32.1)

Table 1 Maternal healthcare utilization in Nigeria by mother's characteristics and geographic regions (2003–2018) (Continued)

	2003			2008			2013			2018		
	ANC	FBD	SBA	ANC	FBD	SBA	ANC	FBD	SBA	ANC	FBD	SBA
Geopolitical zones												
North-central	307(17.4)	388(20.3)	423(20.3)	1270(15.9)	1560(16.9)	1614(16.1)	1553(15.2)	1882(17.4)	1938(16.7)	1620(13.4)	2244(17.2)	2352(16.4)
North-east	268(15.2)	239(12.5)	281(13.5)	932(11.7)	596(6.5)	718(7.1)	1305(12.8)	1045(9.7)	1074(9.2)	1690(14.0)	1562(12.0)	1547(10.8)
North-west	367(20.7)	215(11.2)	257(12.3)	1154(14.5)	679(7.4)	786(7.8)	2214(21.7)	1322(12.2)	1430(12.3)	3213(26.6)	1936(14.8)	2301(16.0)
South-east	153(8.6)	276(14.5)	289(13.9)	985(12.3)	1789(19.4)	1924(19.1)	1381(13.5)	2104(19.4)	2237(19.2)	1752(14.5)	2758(21.1)	2898(20.2)
South-south	354(20.0)	402(21.0)	425(20.4)	1250(15.7)	1545(16.7)	1780(17.7)	1216(11.9)	1333(12.3)	1670(12.6)	1299(10.7)	1406(10.8)	1807(12.6)
South-west	321(18.1)	390(20.4)	409(19.6)	2398(30.0)	3064(33.2)	3235(32.2)	2537(24.9)	3147(29.1)	3487(30.0)	2524(20.9)	3170(24.2)	3470(24.1)

ANC Antenatal care, FBD Facility based delivery, SBA Skilled birth attendance

Table 2 Survey year, sample size, and maternal care use (mean) in Nigeria, 2003–2018

Survey year	Survey year	Sample size	ANC			FBD			SBA		
			Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural
2003	1998	1120	0.58	0.76	0.49	0.32	0.58	0.19	0.14	0.30	0.08
	1999	1194	0.52	0.67	0.46	0.28	0.51	0.20	0.31	0.55	0.23
	2000	1246	0.51	0.78	0.41	0.36	0.57	0.27	0.38	0.60	0.30
	2001	1129	0.50	0.73	0.39	0.36	0.54	0.26	0.37	0.58	0.27
	2002	1368	0.47	0.72	0.37	0.34	0.52	0.26	0.36	0.58	0.27
2008	2003	4933	0.66	0.83	0.57	0.44	0.69	0.33	0.11	0.18	0.08
	2004	5701	0.57	0.78	0.45	0.35	0.62	0.24	0.36	0.64	0.25
	2005	5827	0.51	0.82	0.38	0.33	0.59	0.23	0.36	0.64	0.25
	2006	5640	0.48	0.76	0.37	0.34	0.61	0.23	0.37	0.65	0.26
	2007	6032	0.49	0.77	0.37	0.34	0.62	0.23	0.37	0.66	0.26
2013	2008	6561	0.57	0.82	0.39	0.39	0.64	0.23	0.23	0.42	0.13
	2009	6094	0.55	0.81	0.38	0.33	0.60	0.19	0.36	0.65	0.20
	2010	6356	0.51	0.76	0.37	0.35	0.60	0.21	0.37	0.65	0.22
	2011	6054	0.55	0.79	0.42	0.38	0.64	0.23	0.40	0.70	0.24
	2012	7167	0.52	0.77	0.39	0.37	0.62	0.23	0.39	0.68	0.24
2018	2013	6756	0.71	0.80	0.58	0.50	0.70	0.33	0.07	0.12	0.04
	2014	7068	0.65	0.82	0.51	0.38	0.60	0.24	0.41	0.65	0.26
	2015	6997	0.61	0.78	0.47	0.38	0.62	0.24	0.41	0.66	0.26
	2016	6612	0.56	0.75	0.45	0.40	0.62	0.27	0.44	0.68	0.29
	2017	6704	0.58	0.76	0.47	0.42	0.65	0.28	0.45	0.71	0.28

ANC Antenatal care, FBD Facility based delivery, SBA Skilled birth attendance

Socio-economic inequalities in maternal care

Table 4 reports the relative and absolute education-related inequalities in maternal healthcare utilization among women of childbearing age for the survey period in Nigeria. The positive values of the RC and AC suggest a consistent concentration of all the three maternal healthcare services among well-educated women over the study period of 2003–2017. The extent of relative and absolute education-related inequalities in maternal healthcare utilization did not change over time.

Table 5 reports the relative and absolute measure of wealth-related inequalities in maternal healthcare utilization in Nigeria. The positive values of the RC and AC indicate consistent pro-rich inequality in the utilization of ANC, FBD, and SBA in Nigeria over the survey period. Similar to the results of education-related inequalities, we did not find any change in the magnitude of wealth-related inequalities in maternal healthcare use in Nigeria.

Discussion

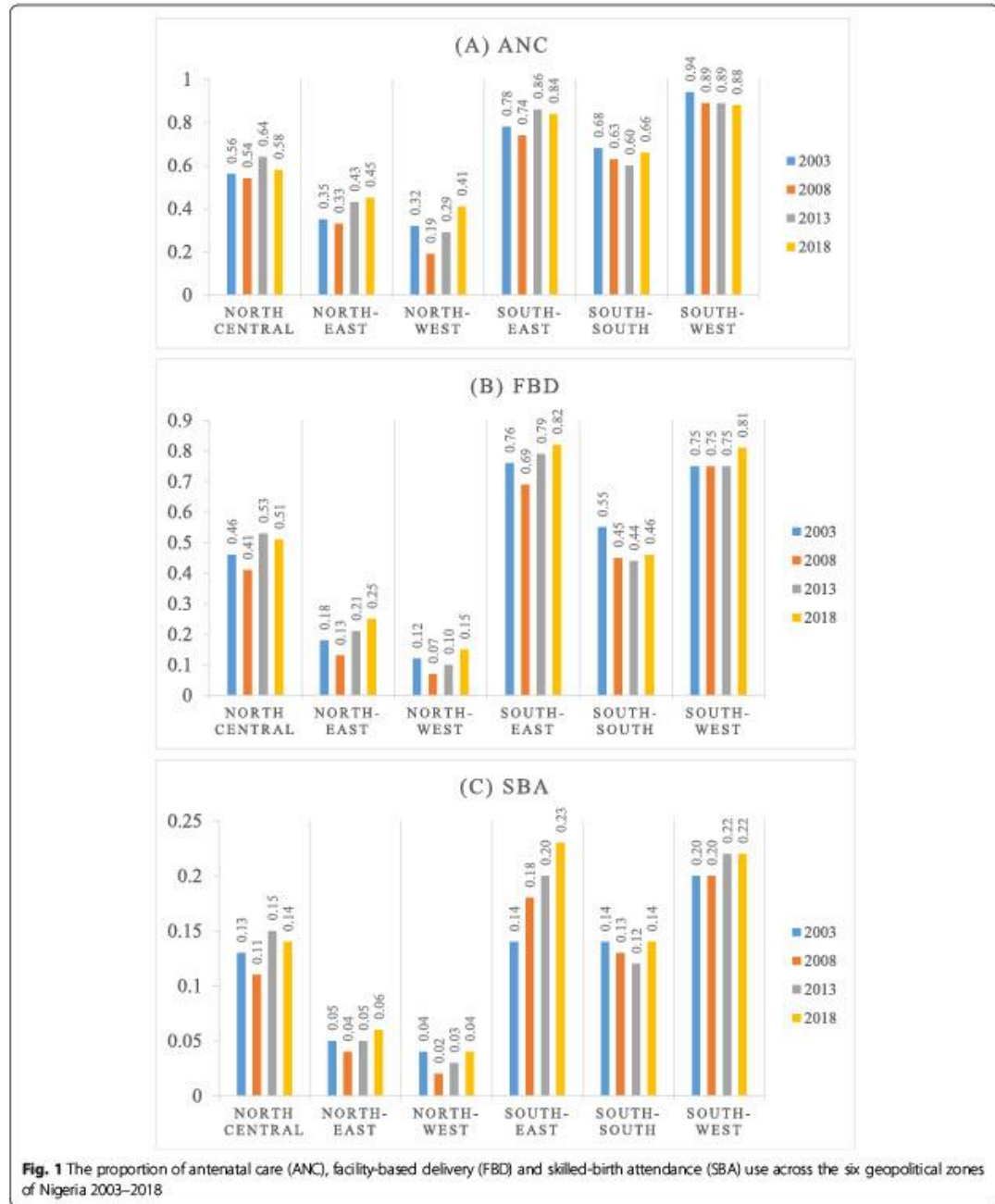
This study examined the geographical and socioeconomic inequalities in maternal healthcare services in Nigeria over the past twenty years. The results highlighted geographical inequalities in maternal healthcare services, especially for

SBA and FBD across the six geopolitical zones in Nigeria. The results also suggest that women living in urban areas use more maternal healthcare compared to their rural counterparts. Essentially, the gap in the utilization of FBD between urban and rural areas increased/widened per year.

The results suggest inequalities in maternal care across the geopolitical zones in Nigeria. The finding highlights the perennial entrenchment of North-South differences despite maternal healthcare interventions [37]. The intermittent geographic inequalities in the SBA and FBD could be because of the perennial poor socioeconomic development of the northern part of Nigeria [10, 19] which may result in lower utilization of maternal care in northern zones.

Results also indicate consistent socioeconomic inequalities in ANC, FBD, and SBA. Both relative and absolute measure of inequalities indicated higher concentration of maternal healthcare services among the better-off and well-educated women over the four survey years despite the concerted efforts of government interventions such as the introduction of free maternal and child health [38] to contain the abysmal maternal mortality ratio in the country.

The later findings are similar to earlier studies that show pro-rich inequalities in maternal healthcare utilization in



Ghana [39] and Nigeria [40]. These results provide important evidence that may assist the health stakeholders to redouble their efforts toward achieving the Sustainable Development Goals (SDGs) three targets of reducing the

global maternal mortality ratio to less than 70 per 100,000 live births by 2030 [41]. With the government Free Maternal and Child Health Program aimed at decreasing the high maternal mortality by increasing access to maternal

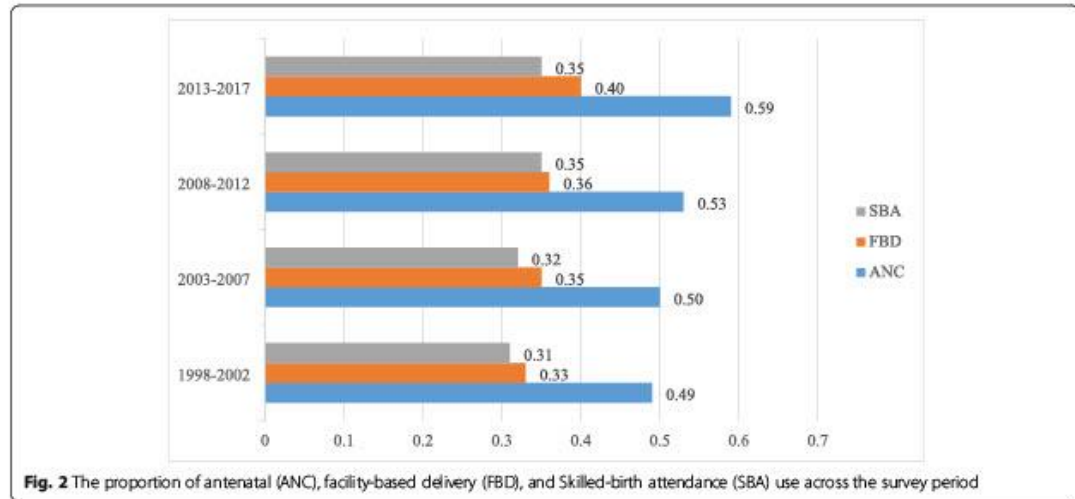


Fig. 2 The proportion of antenatal (ANC), facility-based delivery (FBD), and Skilled-birth attendance (SBA) use across the survey period

Table 3 Geographic inequalities in maternal healthcare use between the rural and urban area and across the six geopolitical zones of Nigeria: 2003–2018

Year	Inequalities between urban and rural areas						Inequalities across geopolitical zones					
	RR			RD			T			BGV		
	ANC	FBD	SBA	ANC	FBD	SBA	ANC	FBD	SBA	ANC	FBD	SBA
1998	1.552	2.980	3.717	0.271	0.385	0.218	0.356	1.053	3.041	0.024	0.158	0.240
1999	1.449	2.521	2.439	0.209	0.307	0.324	0.475	1.274	1.116	0.016	0.114	0.106
2000	1.902	2.433	2.003	0.368	0.296	0.298	0.489	0.907	0.815	0.052	0.069	0.062
2001	1.872	2.174	2.267	0.339	0.294	0.323	0.500	0.938	0.884	0.051	0.079	0.088
2002	1.952	2.060	2.155	0.352	0.269	0.308	0.558	1.006	0.902	0.057	0.068	0.077
2003	1.444	2.093	2.278	0.254	0.358	0.103	0.253	0.626	4.001	0.017	0.071	0.090
2004	1.740	2.602	2.545	0.333	0.381	0.388	0.384	0.941	0.879	0.039	0.123	0.117
2005	2.149	2.572	2.495	0.439	0.363	0.381	0.472	0.996	0.877	0.077	0.120	0.112
2006	2.058	2.613	2.539	0.393	0.375	0.395	0.535	0.961	0.840	0.067	0.124	0.117
2007	2.078	2.746	2.536	0.399	0.393	0.398	0.529	0.986	0.846	0.069	0.139	0.116
2008	2.104	2.751	3.286	0.431	0.408	0.293	0.379	0.795	1.681	0.070	0.131	0.185
2009	2.100	3.098	3.176	0.422	0.406	0.445	0.410	1.012	0.908	0.070	0.169	0.176
2010	2.021	2.790	2.970	0.382	0.384	0.431	0.487	0.944	0.864	0.064	0.139	0.156
2011	1.888	2.779	2.915	0.374	0.411	0.458	0.408	0.825	0.745	0.052	0.136	0.149
2012	1.979	2.679	2.825	0.380	0.392	0.437	0.462	0.859	0.783	0.060	0.128	0.142
2013	1.375	2.125	2.951	0.218	0.369	0.079	0.203	0.493	6.430	0.011	0.067	0.145
2014	1.627	2.468	2.521	0.317	0.359	0.394	0.267	0.815	0.723	0.029	0.105	0.109
2015	1.652	2.552	2.569	0.309	0.375	0.405	0.326	0.813	0.725	0.032	0.113	0.115
2016	1.676	2.334	2.351	0.302	0.357	0.391	0.391	0.736	0.639	0.034	0.092	0.094
2017	1.635	2.371	2.478	0.296	0.377	0.421	0.361	0.692	0.620	0.031	0.095	0.105
Time trend coefficients (P-value)	-0.002 (0.852)	0.000 (0.967)	0.006 (0.719)	0.001 (0.853)	0.003 (0.024)	0.007 (0.109)	-0.007 (0.072)	-0.018 (0.004)	-0.019 (0.743)	0.000 (0.836)	0.000 (0.883)	0.000 (0.927)

RR Rate Ratio, RD Rate Difference, T Theil Index, BGV Between Group Variance, ANC Antenatal care, FBD Facility based delivery, SBA Skilled birth attendance

Table 4 Education-related inequalities in maternal healthcare utilization among women aged 15–49 years in Nigeria: 2003–2018

Year	ANC		FBD		SBA	
	RC	AC	RC	AC	RC	AC
1998	0.508(0.298 to 0.717)	0.493(0.290 to 0.697)	0.674(0.561 to 0.786)	0.586(0.488 to 0.684)	0.542(0.418 to 0.665)	0.261(0.202 to 0.320)
1999	0.413(0.264 to 0.563)	0.412(0.263 to 0.562)	0.617(0.526 to 0.708)	0.497(0.424 to 0.570)	0.579(0.496 to 0.662)	0.493(0.423 to 0.564)
2000	0.578(0.492 to 0.664)	0.578(0.492 to 0.664)	0.663(0.590 to 0.736)	0.607(0.540 to 0.674)	0.646(0.569 to 0.723)	0.609(0.536 to 0.681)
2001	0.561(0.496 to 0.626)	0.561(0.496 to 0.626)	0.631(0.539 to 0.723)	0.571(0.488 to 0.654)	0.631(0.531 to 0.731)	0.581(0.489 to 0.673)
2002	0.529(0.469 to 0.589)	0.528(0.468 to 0.587)	0.617(0.545 to 0.688)	0.547(0.483 to 0.610)	0.600(0.532 to 0.667)	0.550(0.488 to 0.611)
2003	0.525(0.386 to 0.664)	0.469(0.345 to 0.593)	0.653(0.602 to 0.703)	0.644(0.595 to 0.694)	0.512(0.445 to 0.579)	0.202(0.176 to 0.229)
2004	0.565(0.501 to 0.629)	0.556(0.493 to 0.618)	0.660(0.624 to 0.695)	0.598(0.566 to 0.630)	0.669(0.635 to 0.703)	0.619(0.587 to 0.650)
2005	0.595(0.550 to 0.639)	0.594(0.550 to 0.638)	0.681(0.648 to 0.714)	0.606(0.577 to 0.636)	0.683(0.651 to 0.715)	0.632(0.602 to 0.662)
2006	0.577(0.543 to 0.612)	0.576(0.542 to 0.610)	0.660(0.624 to 0.696)	0.594(0.562 to 0.626)	0.664(0.630 to 0.698)	0.621(0.589 to 0.653)
2007	0.578(0.543 to 0.613)	0.578(0.543 to 0.612)	0.671(0.636 to 0.707)	0.600(0.568 to 0.631)	0.666(0.633 to 0.699)	0.622(0.591 to 0.653)
2008	0.619(0.542 to 0.695)	0.607(0.532 to 0.682)	0.636(0.598 to 0.675)	0.603(0.567 to 0.640)	0.566(0.521 to 0.611)	0.400(0.368 to 0.432)
2009	0.650(0.599 to 0.701)	0.643(0.593 to 0.694)	0.676(0.641 to 0.711)	0.598(0.567 to 0.629)	0.694(0.659 to 0.729)	0.636(0.604 to 0.668)
2010	0.534(0.491 to 0.578)	0.534(0.491 to 0.578)	0.625(0.588 to 0.661)	0.566(0.533 to 0.598)	0.655(0.620 to 0.690)	0.608(0.576 to 0.641)
2011	0.555(0.517 to 0.592)	0.549(0.512 to 0.586)	0.626(0.591 to 0.660)	0.588(0.556 to 0.620)	0.657(0.623 to 0.691)	0.631(0.599 to 0.664)
2012	0.525(0.487 to 0.562)	0.524(0.486 to 0.561)	0.640(0.607 to 0.673)	0.595(0.565 to 0.626)	0.662(0.630 to 0.695)	0.630(0.599 to 0.661)
2013	0.542(0.360 to 0.724)	0.446(0.296 to 0.595)	0.614(0.549 to 0.678)	0.613(0.549 to 0.678)	0.487(0.418 to 0.555)	0.130(0.112 to 0.149)
2014	0.573(0.520 to 0.626)	0.521(0.472 to 0.569)	0.635(0.604 to 0.665)	0.598(0.569 to 0.627)	0.672(0.644 to 0.700)	0.650(0.623 to 0.676)
2015	0.525(0.482 to 0.568)	0.502(0.460 to 0.543)	0.650(0.621 to 0.680)	0.613(0.585 to 0.641)	0.681(0.653 to 0.709)	0.658(0.630 to 0.685)
2016	0.488(0.452 to 0.525)	0.481(0.445 to 0.517)	0.633(0.605 to 0.662)	0.610(0.583 to 0.637)	0.675(0.649 to 0.701)	0.665(0.639 to 0.691)
2017	0.496(0.464 to 0.527)	0.483(0.452 to 0.513)	0.608(0.576 to 0.640)	0.592(0.561 to 0.624)	0.658(0.629 to 0.687)	0.650(0.622 to 0.679)
Time trend coefficient (P-value)	0.0003(−0.004 to 0.005) (0.874)	−0.001(−0.006 to 0.004) (0.697)	−0.001(−0.003 to 0.0004) (0.132)	0.002(−0.0004 to 0.004) (0.104)	0.004(−0.001 to 0.008) (0.132)	0.008(−0.005 to 0.021) (0.198)

RC, normalized relative concentration index, AC, modified absolute concentration index, ANC Antenatal care, FBD Facility based delivery, SBA Skilled birth attendance

Table 5 Wealth-related inequalities in maternal healthcare services among women aged 15–49 years in Nigeria: 2003–2018

Year	ANC		FBD		SBA	
	RC	AC	RC	AC	RC	AC
1998	0.560(0.329 to 0.790)	0.544(0.320 to 0.768)	0.636(0.507 to 0.765)	0.555(0.443 to 0.668)	0.540(0.417 to 0.664)	0.262(0.202 to 0.322)
1999	0.521(0.375 to 0.666)	0.519(0.375 to 0.664)	0.502(0.398 to 0.605)	0.406(0.323 to 0.490)	0.546(0.454 to 0.638)	0.467(0.388 to 0.545)
2000	0.510(0.416 to 0.605)	0.510(0.416 to 0.605)	0.623(0.534 to 0.712)	0.571(0.489 to 0.652)	0.638(0.549 to 0.726)	0.601(0.517 to 0.685)
2001	0.573(0.502 to 0.645)	0.573(0.502 to 0.645)	0.594(0.494 to 0.694)	0.539(0.448 to 0.630)	0.615(0.528 to 0.703)	0.568(0.487 to 0.649)
2002	0.509(0.434 to 0.585)	0.508(0.433 to 0.583)	0.522(0.422 to 0.621)	0.463(0.375 to 0.551)	0.559(0.463 to 0.654)	0.513(0.425 to 0.600)
2003	0.592(0.461 to 0.723)	0.529(0.412 to 0.646)	0.687(0.635 to 0.740)	0.679(0.627 to 0.731)	0.527(0.455 to 0.598)	0.208(0.180 to 0.236)
2004	0.641(0.582 to 0.700)	0.630(0.572 to 0.688)	0.682(0.642 to 0.722)	0.618(0.582 to 0.655)	0.687(0.647 to 0.726)	0.635(0.598 to 0.671)
2005	0.657(0.616 to 0.697)	0.656(0.616 to 0.697)	0.678(0.640 to 0.716)	0.603(0.569 to 0.637)	0.681(0.644 to 0.718)	0.630(0.596 to 0.664)
2006	0.627(0.593 to 0.662)	0.627(0.592 to 0.661)	0.660(0.620 to 0.700)	0.594(0.558 to 0.631)	0.680(0.642 to 0.718)	0.636(0.600 to 0.672)
2007	0.649(0.618 to 0.680)	0.648(0.618 to 0.679)	0.691(0.650 to 0.732)	0.617(0.581 to 0.654)	0.691(0.652 to 0.730)	0.646(0.609 to 0.682)
2008	0.716(0.655 to 0.777)	0.703(0.643 to 0.762)	0.667(0.625 to 0.709)	0.633(0.593 to 0.673)	0.606(0.555 to 0.657)	0.428(0.392 to 0.464)
2009	0.693(0.647 to 0.740)	0.686(0.641 to 0.732)	0.691(0.653 to 0.730)	0.612(0.578 to 0.647)	0.729(0.693 to 0.765)	0.668(0.635 to 0.701)
2010	0.633(0.594 to 0.672)	0.633(0.594 to 0.672)	0.668(0.629 to 0.707)	0.605(0.569 to 0.640)	0.700(0.661 to 0.738)	0.650(0.614 to 0.685)
2011	0.598(0.557 to 0.639)	0.592(0.551 to 0.632)	0.651(0.613 to 0.688)	0.611(0.576 to 0.647)	0.692(0.658 to 0.727)	0.666(0.633 to 0.698)
2012	0.605(0.571 to 0.639)	0.604(0.570 to 0.638)	0.667(0.630 to 0.704)	0.621(0.586 to 0.655)	0.699(0.665 to 0.734)	0.665(0.633 to 0.698)
2013	0.541(0.366 to 0.716)	0.445(0.301 to 0.588)	0.601(0.536 to 0.666)	0.601(0.536 to 0.666)	0.480(0.408 to 0.551)	0.128(0.109 to 0.148)
2014	0.598(0.544 to 0.651)	0.543(0.494 to 0.591)	0.606(0.569 to 0.643)	0.572(0.537 to 0.607)	0.659(0.626 to 0.692)	0.637(0.605 to 0.669)
2015	0.557(0.511 to 0.603)	0.532(0.489 to 0.576)	0.624(0.591 to 0.656)	0.588(0.558 to 0.619)	0.654(0.621 to 0.686)	0.632(0.600 to 0.663)
2016	0.483(0.443 to 0.524)	0.476(0.436 to 0.516)	0.596(0.564 to 0.629)	0.575(0.543 to 0.606)	0.647(0.618 to 0.675)	0.637(0.609 to 0.665)
2017	0.505(0.472 to 0.539)	0.492(0.459 to 0.525)	0.591(0.557 to 0.624)	0.575(0.543 to 0.608)	0.649(0.618 to 0.681)	0.642(0.611 to 0.673)
Time trend coefficient (P-value)	-0.0003(-0.006 to 0.005) (0.921)	-0.001(-0.008 to 0.005) (0.620)	0.001(-0.003 to 0.006) (0.625)	0.004(-0.0009 to 0.008) (0.107)	0.004(-0.001 to 0.010) (0.129)	0.009(-0.004 to 0.022) (0.181)

RC, normalized relative concentration index, AC, modified absolute concentration index, ANC Antenatal care, FBD Facility based delivery, SBA Skilled birth attendance

health services, evidence indicates that such intervention leads to an increased percentage of access to SBA thereby reducing maternal mortality [38, 42].

Further, findings show that the northern geopolitical zones especially the North-West zone compared with their southern counterparts lag in the utilization of maternal healthcare services. This is not surprising because of the wide gap in socio-economic development between the northern and southern parts of the country [10]. Studies by Obiyan and Kumar [5] and Nghargbu and Olaniyan [40] also emphasized that wealth status and education were the major factors driving inequality in maternal healthcare utilization in Nigeria. Nghargbu and Olaniyan [40], shows that SES rather than the need for healthcare mainly determine demand for maternal healthcare.

The pronounced inequalities in maternal healthcare services in the northern geopolitical zone are exacerbated by several supply-side factors (lack of accessibility, availability, quality, and comprehensiveness of health services) and demand-side factors (social, economic, and cultural) as confirmed by Obiyan and Kumar [5]. As healthcare costs, transportation, and quality of services were identified as barriers for women seeking maternal health services in Nigeria [37], addressing supply-side barriers alongside demand-side factors may lead to an improvement in the maternal care use in Nigeria, especially among low SES women [6].

To address inequalities in maternal care in Nigeria, the political will of both sub-national and national governments is needed for context-specific interventions. National health systems are key in addressing health inequalities and no state or geopolitical zone should face levels of health inequalities that are avoidable [43]. The northern geopolitical zone should give special attention to the upgrade of hospitals for the uptake of obstetric care [44, 45] so that during an emergency, pregnant women should have access to an appropriately equipped health service. As distance is an important barrier to seeking healthcare, especially in rural areas [46], obstetric care must be located within reasonable reach of the people who should benefit from it [46, 47].

This study shows a positive education gradient in the utilization of maternal healthcare services. The education level of women has been found to affect their use of healthcare facilities in other studies [45]. Thaddeus and Maine [48] also found a significant positive association between the use of prenatal care services and the level of women's education. This is important, especially for the North-West and North-East geo-political zones where the female literacy rate is as low as 38% [19], which calls for action to address the trend and increase maternal healthcare services uptake.

Our descriptive results indicate that women of the Christian religion utilize more key maternal healthcare

services compare with their Muslim counterparts. The higher use of maternal healthcare services by the Christian women in the South could be due to their higher level of education compared with the Muslim women in the North [49]. This may explain the lower utilization of the maternal healthcare services in the North-East and North-West geopolitical zones where Islam is the main religion. Evidence shows that most husbands practicing Islam discourage their wives from going out without their permission [50]. This presents a barrier to use maternal healthcare for Muslim women, especially when the husband is away from home [48].

One of the strengths of this paper is that the study used nationally representative data that allows the generalization of findings to the entire country. The use of several measures of inequality to assess geographical and socioeconomic inequalities in maternal healthcare is another strength of the study. This study, however, is subject to some limitations. First, the self-reported maternal healthcare use in DHS may be subject to recall bias. Second, although information on maternal healthcare utilization is obtained from pregnancy and delivery occurred between two to four years before the survey year, the WI as one of SES indicators is constructed from information collected for the survey year. As changes in household wealth occur in the long-run, we considered the WI for the survey year to be a reasonable proxy for recent years.

Conclusion

Geographical and socioeconomic inequalities in maternal healthcare utilization prevail in Nigeria. Specifically, the results of this study demonstrated that the utilization of maternal healthcare is lower among poorer and less-educated women, as well as those living in rural areas and North-West and North-East geopolitical zones. Thus, priority focus should be on implementing strategies that increase the uptake of maternal healthcare services among these groups in Nigeria.

Abbreviations

ANC: Antenatal Care; DHS: Demographic Health Survey; FBD: Facility-based delivery; SBA: Skilled birth attendance; RR: Rate ratio; RD: Rate difference; RC: Relative concentration index; AC: Absolute concentration index; T: Theil index; BGV: Between-group variance; SES: Socioeconomic status; PCA: Principal component analysis; SSA: Sub-Saharan Africa; WHO: World Health Organization

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Authors' contributions

CO designed the study, conducted the statistical analysis, and prepared the first draft of the manuscript. MH and RK assisted in designing the study, supervised data analysis, and writing of the manuscript. MMR reviewed data analysis and the article. All the authors read and approved the final manuscript.

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Availability of data and materials

Data for this study is publicly accessible at the DHS website: <https://www.dhsprogram.com/data/available-datasets.cfm>

Ethics approval and consent to participate

Approval letter to use the DHS dataset for this study was obtained from the Demographic and Health Surveys (DHS) Program. The DHS dataset is a secondary data, hence, this study did not require a formal ethics approval. However, we observed anonymity and confidentiality under the data terms of use.

Consent for publication

Not applicable.

Competing interests

There is no conflict of interest.

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CHAPTER 3: PAPER 2 – DECOMPOSITION OF SOCIOECONOMIC INEQUALITIES IN THE UPTAKE OF INTERMITTENT PREVENTIVE TREATMENT OF MALARIA IN PREGNANCY IN NIGERIA: EVIDENCE FROM DEMOGRAPHIC HEALTH SURVEY

3.1. Introductory paragraph

Chapter 3 contains a decomposition analysis that measures and identifies factors explaining the socioeconomic inequality in the uptake of IPTp-SP in Nigeria. The decomposition analysis helps to uncover specific factors that are modifiable by policymakers. It acts as a follow-up to Chapter 2, which identified that the utilisation of maternal healthcare is lower among poorer and less-educated women, as well as those living in rural areas. The study constitutes paper 2 of this thesis, as published in *BMC Malaria Journal*.

3.2. Paper 2: *BMC Malaria Journal*, (2021) 20:300


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RESEARCH

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Decomposition of socioeconomic inequalities in the uptake of intermittent preventive treatment of malaria in pregnancy in Nigeria: evidence from Demographic Health Survey

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Abstract

Background: Although malaria in pregnancy is preventable with the use of intermittent preventive treatment with sulfadoxine–pyrimethamine (IPTp-SP), it still causes maternal morbidity and mortality, in sub-Saharan Africa and Nigeria in particular. Socioeconomic inequality leads to limited uptake of IPTp-SP by pregnant women and is, therefore, a public health challenge in Nigeria. This study aimed to measure and identify factors explaining socioeconomic inequality in the uptake of IPTp-SP in Nigeria.

Methods: The study re-analysed dataset of 12,294 women aged 15–49 years from 2018 Nigeria Demographic Health Survey (DHS). The normalized concentration index (C_n) and concentration curve were used to quantify and graphically present socioeconomic inequalities in the uptake of IPTp-SP among pregnant women in Nigeria. The C_n was decomposed to identify key factors contributing to the observed socioeconomic inequality in the uptake of adequate (≥ 3) IPTp-SP.

Results: The study showed a higher concentration of the adequate uptake of IPTp-SP among socioeconomically advantaged women ($C_n = 0.062$; 95% confidence interval [CI] 0.048 to 0.076) in Nigeria. There is a pro-rich inequality in the uptake of IPTp-SP in urban areas ($C_n = 0.283$; 95%CI 0.279 to 0.288). In contrast, a pro-poor inequality in the uptake of IPTp-SP was observed in rural areas ($C_n = -0.238$; 95%CI -0.242 to -0.235). The result of the decomposition analysis indicated that geographic zone of residence and antenatal visits were the two main drivers for the concentration of the uptake of IPTp-SP among wealthier pregnant women in Nigeria.

Conclusion: The pro-rich inequalities in the uptake of IPTp-SP among pregnant women in Nigeria, particularly in urban areas, warrant further attention. Strategies to improve the uptake of IPTp-SP among women residing in socioeconomically disadvantaged geographic zones (North-East and North-West) and improving antenatal visits among the poor women may reduce pro-rich inequality in the uptake of IPTp-SP among pregnant women in Nigeria.

Keywords: Socioeconomic, Inequalities, Concentration index, Decomposition analysis, Malaria, Intermittent preventive treatment in pregnancy, Nigeria

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Background

Malaria in pregnancy (MiP) is a global public health concern with severe consequences for the mother, the foetus, and the newborn child [1–3]. In 2018, an estimated 219 million cases and 435,000 deaths from malaria were recorded globally and about 80% of these deaths were reported by the World Health Organization (WHO) African Region and India [1, 4]. MiP is an obstetric, medical, social, and economic, emergency that is preventable and/or treatable but still causes maternal morbidity and mortality in sub-Saharan Africa [5–7]. Despite this evidence and the ongoing efforts to eliminate malaria, the use of intermittent preventive treatment in pregnancy (IPTp) is still insufficient [3, 6, 8].

IPTp with sulfadoxine–pyrimethamine (IPTp-SP) has proven to be efficacious in reducing the amount of MiP [9]. However, although, the WHO recommends that all pregnant women living in malaria-endemic regions take at least 3 doses of IPTp-SP during their pregnancy, studies have shown poor uptake among pregnant women in many areas [10]. For many countries in sub-Saharan Africa, access to and use of these interventions by pregnant women is low and achievement of high coverage among pregnant women remains elusive [11].

In 2001, Nigeria instituted IPTp-SP for pregnant women in the second and third trimesters of pregnancy. However, twenty years later both first and second dose coverage remains low being 8.0% and 4.6%, respectively [12, 13]. The use of IPTp in Nigeria involves the administration of at least two curative doses of SP during pregnancy, regardless of whether the woman is infected [12, 13]. Previous studies in Nigeria show variations in uptake of IPTp-SP across the states in Nigeria [1, 6]. Low uptake of IPTp-SP can lead to high malaria cases among pregnant women, which could culminate in low birth weights, a higher number of stillbirths, spontaneous abortion, asymptomatic infection, with potential results being maternal anaemia and placental parasitaemia, premature delivery, and maternal and infant deaths [5].

Several studies indicate that socioeconomic inequalities prevail in the IPTp-SP uptake in Nigeria [1, 6, 9, 12, 14, 15]. For example, Akpa and colleagues in their work in select communities of Ebonyi State in Nigeria found that women whose husbands had secondary and tertiary education were more likely to have IPTp-SP uptake than those whose husbands had below secondary education [1]. As the study by Alawode and colleagues asserts, there are significant differences in access to some of the malaria interventions that favour the better off in society as a whole and some geopolitical regions in particular [15].

This study aim to measure socioeconomic inequality in the uptake of IPTp-SP in Nigeria. As a way of measuring

this, a decomposition analysis is used to identify factors that contribute to the socioeconomic inequality in the uptake of IPTp-SP in Nigeria. The results of this study provide evidence for intervention to reduce socioeconomic inequality in the uptake of IPTp-SP in Nigeria. The study is in tandem with the Sustainable Development Goal 3 targets to reduce the global maternal mortality ratio to less than 70 per 100,000 live births and reduce neonatal mortality to as low as 12 per 1000 live births by 2030 [16].

Methods

Study setting

The study focuses on Nigeria. Nigeria, with an estimated population of 198 million in 2018, is the most populous country in Africa [17]. The population is predominantly young, with about 45% aged under 15 years and 20% under 5 years, while women of childbearing age (15–49 years) account for about 22% of the total population [18]. The country is divided into six geopolitical zones: North-Central, North-East, North-West, South-East, South-South, and South-West with each geopolitical zone comprising about six states [19]. Of the six zones, the northern geopolitical zones especially the North West and North East have the highest poverty rates in the country [20]. The health care system in Nigeria is largely public sector driven, with substantial private sector involvement in service provision. Most secondary- and tertiary-level health facilities are in urban areas, whereas rural areas are predominantly served by primary health care (PHC) facilities. There is a shortage of PHC facilities in some states [18] and less than 20% of health facilities in the country offer emergency obstetric care, despite that Nigeria accounts for one-quarter of all malaria cases in Africa [17]. Malaria accounts for 60% of outpatient visits and 30% of hospitalizations among children under five years of age in Nigeria. The malaria prevalence among children 6–59 months in the six geopolitical zones was as follows, South West (50.3%), North Central (49.4%), North West (48.2%), South-South (32.2%), North East (30.9%) and South East (27.6%) [21].

Data

Data for the analyses were obtained from the latest Nigeria Demographic Health Survey (DHS) 2018, conducted between August 14, 2018 to December 29, 2018 [22]. The choice of the dataset is to ensure that the research finding represents current reality, which is nationally representative, and generalizable. The dataset contains survey information elicited from the women of reproductive age of 15–49 years in the six geopolitical zones in the country. The study used an Individual (women) Recode file that collected information on women's and husband's

background characteristics, reproductive history, antenatal care, malaria prevention and treatment, household asset ownership, and type of toilet facilities among other information. The DHS survey uses a multistage sampling procedure, standardized tools and well-trained interviewers to collect comparable and reliable data on maternal and child health. The 2018 Nigeria DHS had a response rate of 99%. Further information about the survey has been provided elsewhere [17, 22]. The analysis of this study was restricted to all pregnant women age 15–49 in the women sample ($n=13,705$). After dropping 227 and 1184 observations with missing information in the outcome and independent variables respectively, the final sample size for the study comprised 12,294 pregnant women.

Variables

Outcome variable

The dependent variable is the uptake of adequate (≥ 3) IPTp-SP, categorized following the WHO recommendation of IPTp-SP doses, women took during pregnancy in the year preceding the surveys. The variable was categorized as less than three doses of IPTp-SP, as inadequate uptake (i.e. < 3 doses = 0), and at least three doses or more ≥ 3 doses = 1, as adequate uptake [1, 6, 23].

Socioeconomic status

The wealth index variable was used as a proxy for socioeconomic status. It was constructed using household ownership of selected assets (e.g. televisions and bicycles), materials used in housing construction, type of water access, and sanitation facilities data via a principal component analysis (PCA) [24].

Independent variables

Based on the current literature [6, 9, 23, 25, 26], the following variables were used as determinants of the uptake of IPTp-SP among pregnant women: age groups, the level of education, marital status, religion, occupation, place of residence (rural and urban), geopolitical zone, wealth index quintiles, husband/spouse level of education, distance to a health facility, and a requirement to obtain permission for self-medical help (defined as either a big problem or not a big problem) to access IPTp-SP [6, 23]. Additional file 1: Table S1 reports description of variables used in the analysis.

Statistical analysis

Measuring socioeconomic inequalities in the uptake of IPTp-SP

This study used the concentration index (C) approach, an appropriate and most widely used measure of socioeconomic-related inequality [27–29], to quantify

socioeconomic inequalities in IPTp-SP. The C is based on the concentration curve which graphs the cumulative share of the population on the x-axis and the cumulative share of the health outcome on the y-axis. The C index is defined as twice the area between the concentration curve and the line of perfect equality (45-degree diagonal) [29, 30]. The C can be computed using the convenient regression method as follows:

$$2\sigma_r^2 \left(\frac{h_i}{\mu} \right) = \alpha + \beta r_i + \varepsilon_i, \quad (1)$$

where σ_r^2 is the variance of the fractional rank, h is the healthcare variable of interest (i.e. IPTp-SP uptake) of i th woman, μ is the mean of the variable of interest, h , for the whole population, and $r_i = \frac{i}{N}$ is the fractional rank of the i th woman in the distribution of socio-economic position, with $i = 1$ for the poorest and $i = N$ for the richest. The C is calculated as the ordinary least squares (OLS) estimate of β [29, 31].

The C ranges from -1 to $+1$, for continuous health outcomes. Since the outcome variable (IPTp-SP) of interest is binary, the minimum and maximum of the C are not between -1 and $+1$ but depend on μ [32]. Hence, the index can be normalized by multiplying the estimated C by $\frac{1}{1-\mu}$. The normalized concentration (C_n) index is used to quantify socioeconomic-related inequalities in uptake of adequate (≥ 3) IPTp-SP. If the value of the C_n is zero, it suggests that there is no socioeconomic-related inequality in health outcomes. A negative (positive) value of the C_n when the curve lies above (below) the line of equality indicates a disproportionate concentration of the health variable (i.e. IPTp-SP) among the poor (rich) [28, 29]. A higher value of the C_n corresponds to high socioeconomic inequalities [27].

Decomposition analysis

The C_n is decomposed to quantify factors (demographic, geographic, and socioeconomic) that contribute to the observed socioeconomic inequalities in the uptake of adequate IPTp-SP following the Wagstaff, Van Doorslaer [33] approach. If there is a linear regression model to link the outcome variable (i.e. uptake of adequate IPTp-SP) h , to a set of k explanatory factors, x_k such as:

$$h = \alpha + \sum_k \beta_k x_k + \varepsilon, \quad (2)$$

where α and β are parameters that measure the relationship between each explanatory factor x and the uptake of adequate IPTp-SP and ε error term.

Wagstaff, Van Doorslaer [33] showed that the C of h , can be decomposed into the contribution of determinants

that explain the uptake of IPTp-SP during pregnancy as follows:

$$C = \sum_k \left(\frac{\beta_k \bar{x}_k}{\mu} \right) C_k + \frac{GC_\varepsilon}{\mu} \tag{3}$$

where \bar{x}_k is the mean of x_k , and C_k denotes the concentration index for x_k , a contributing factor. The GC_ε denotes the generalized concentration index of the error term, ε_i .

Equation 3 shows that the overall inequality in the uptake of IPTp-SP has two components. The first term $\left(\frac{\beta_k \bar{x}_k}{\mu} \right) C_k$ denotes the contribution of factor k to socioeconomic inequality in the uptake of adequate IPTp-SP. It constitutes the deterministic or explained component of the IPTp-SP uptake of the concentration index. The second term $\frac{GC_\varepsilon}{\mu}$ represents the unexplained component or the residual of the IPTp-SP uptake [31, 34]. Based on Eq. 3, the product of the elasticity of each factor and its C_k gives the contribution of that factor to the inequality. The negative (positive) contribution of a predictor to the C_n suggests that the socioeconomic distribution of the predictor and the association between the predictor and the adequate uptake of IPTp-SP leads to an increase in the concentration of uptake of IPTp-SP among the poor (rich). A zero value of either elasticity or the C_k leads to the zero contribution of the factor to C [29, 35].

Applying the Wagstaff [32] normalization approach to the decomposition of the C can yield:

$$C_n = \frac{C}{1 - \mu} = \frac{\sum_k \left(\frac{\beta_k \bar{x}_k}{\mu} \right) C_k}{1 - \mu} + \frac{GC_\varepsilon}{1 - \mu} \tag{4}$$

The dataset was weighted using the primary sampling weight provided in the DHS to obtain estimates that are representative of all pregnant women in Nigeria. A survey logistic estimation on samples was conducted to check for collinearity before the decomposition analysis. Chi-square was used to test associations between socio-demographic characteristics and IPTp-SP uptake. The predictors of IPTp-SP uptake were considered statistically significant at $p < 0.05$. All data analyses were conducted using Stata/SE-13 software [36].

Results

Descriptive statistics

Table 1 reports descriptive statistics of variables used in the study. The average age of women in the sample was 29.2 years old. Just over a quarter of pregnant women (27.3%) had adequate (i.e. ≥ 3) uptake of IPTp-SP during pregnancy. Approximately 67% of women in the sample were married. When education was measured, 35% of both women and spouses had no formal education, while

Table 1 Descriptive statistics of variables used in the study

Variable	Mean or percentage
Adequate uptake (≥ 3) of IPTp-SP during pregnancy	27.3%
Demographic variables	
Woman's age	29.2
Marital status	
Married	66.5%
Others	33.5%
Socioeconomic variables	
Woman education level	
No formal education	34.6%
Primary education	15.3%
Secondary education	40.0%
Higher education	10.4%
Spouse education level	
No formal education	34.6%
Primary education	15.6%
Secondary education	34.1%
Higher education	15.7%
Wealth index	
Poorest (1)	18.6%
Poorer (2)	20.0%
Middle (3)	21.1%
Richer (4)	21.1%
Richest (5)	19.2%
Employment status	
Woman is employed	64.6%
Religion	
Christian	49.1%
Muslim	50.0%
Others	0.9%
Ecological variable	
Place of residence	
Urban residence	40.6%
Geopolitical zone	
North-Central	18.7%
North-East	18.4%
North-West	24.2%
South-East	13.3%
South-South	12.1%
South-West	13.3%
Distance to a health facility	
Distance to a clinic is a big problem	27.5%
Getting medical help for self	
Permission for self-medical help (big problem)	11.7%
Antenatal care variable	
Number of ANC visits	
≥ 4 times	57.2%
Sample size	12,294

IPTp-SP intermittent preventive treatment in pregnancy with sulfadoxine-pyrimethamine, *ANC* antenatal care

40% and 34% of the women and spouse had a secondary education level, respectively. Moreover, about 65% of the women were employed and 59.4% of them resided in rural areas. Interestingly, over half (57%) of the women received at least four ANC visits.

Socioeconomic inequality in adequate (≥ 3) uptake of IPTp-SP during pregnancy

Figure 1 reports the concentration curve for adequate (≥ 3) uptake of IPTp-SP by pregnant women in Nigeria, in urban and rural areas. The concentration curve for adequate (≥ 3) uptake of IPTp-SP for Nigeria as a whole and urban areas lies below the 45-degree diagonal line indicating that adequate uptake of IPTp-SP is concentrated among the wealthier women. However, the concentration curve of rural areas lies above the line of equality, suggesting that adequate uptake of IPTp-SP is concentrated among the poorer women.

Table 2 reports the C_n values for an adequate (≥ 3) uptake of IPTp-SP. Similar to the concentration curves, the C_n results suggested that adequate uptake of IPTp-SP is concentrated among socioeconomically advantaged women ($C_n = 0.062$; 95%CI 0.048 to 0.076) in the country, as well as in urban areas ($C_n = 0.283$; 95%CI 0.279 to 0.288). In contrast, pro-poor (favours the poor) inequality in uptake of IPTp-SP was found in the rural areas ($C_n = -0.238$; 95%CI = -0.242 to -0.235).

Decomposition of the socio-economic inequality in adequate (≥ 3) uptake of IPTp-SP

Table 3 reports the decomposition results of the socio-economic inequalities of adequate (≥ 3) uptake of IPTp-SP among pregnant women in 2018 in Nigeria. The table contains the estimated marginal effects of the predictor variables obtained from the logit model, the elasticities, the concentration index of the predictor variables (C_k), and the contribution of each predictor variable to the C_n . The elasticity column denotes the change in the outcome variable (i.e. adequate uptake of IPTp-SP) associated with a one-unit change in the independent variables. It represents the responsiveness of the health outcome i.e. adequate uptake of IPTp-SP to a change in the predictor variable. A negative (positive) sign in elasticity shows a decreasing (increasing) change of adequate uptake of IPTp-SP in association with a change in the predictor.

The negative (positive) sign of the C_k for a certain variable suggests that the predictor concentrated among the poor (rich) individuals. For instance, as reported in the table, the marital status of the married, primary educated women of the Muslim religion, was concentrated among the poor, whereas secondary and tertiary education, urban residence, and the number of antenatal care visits (≥ 4) were more concentrated among the rich.

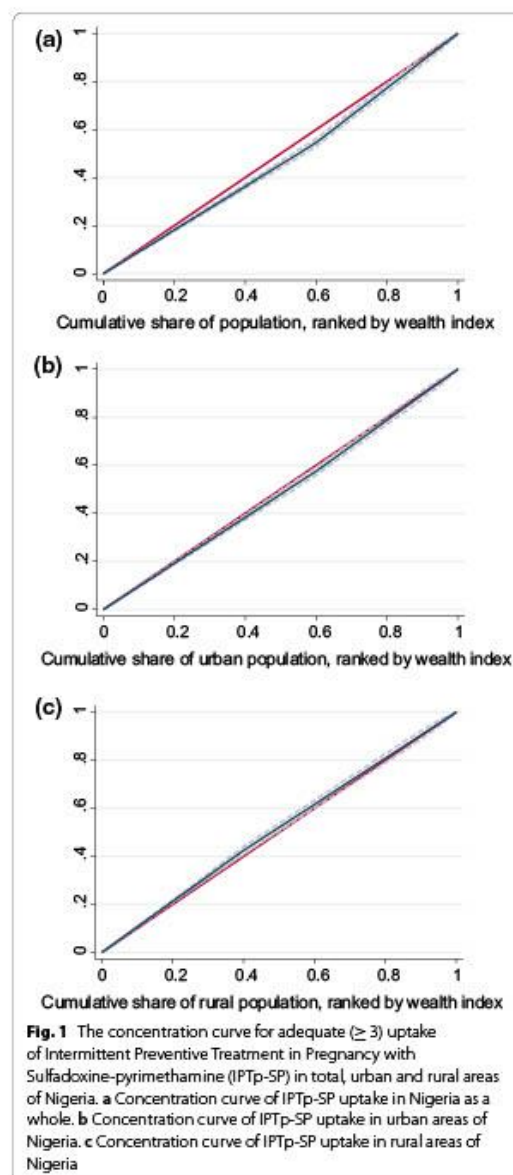


Fig. 1 The concentration curve for adequate (≥ 3) uptake of Intermittent Preventive Treatment in Pregnancy with Sulfadoxine-pyrimethamine (IPTp-SP) in total, urban and rural areas of Nigeria. **a** Concentration curve of IPTp-SP uptake in Nigeria as a whole. **b** Concentration curve of IPTp-SP uptake in urban areas of Nigeria. **c** Concentration curve of IPTp-SP uptake in rural areas of Nigeria

Table 2 Socioeconomic inequalities for adequate (≥ 3) uptake of IPTp-SP in pregnancy in Nigeria

The C_n Index		
Total	Urban	Rural
0.062 (0.048 to 0.076)	0.283 (0.279 to 0.288)	-0.238 (-0.242 to -0.235)

95% confidence intervals in parentheses

Table 3 Decomposition of the socioeconomic inequality in adequate (≥ 3) uptake of IPTp-SP among pregnant women in Nigeria, 2018

Variables	Marginal effect	Elasticities	Ck	Contribution to C_n		Percentage contribution (%)
				Absolute	Summed	
Age group						
	15–24 (ref)					
	25–34 0.007***	0.009	0.017	0.000		
	35–49 0.010***	0.012	0.007	0.000		
Marital status						
	Married 0.012***	0.031	-0.059	-0.001	-0.001	-1.90
	Others (ref)					
Level of education (women)						
	No formal education (ref)					
	Primary -0.017***	-0.009	-0.096	0.001		
	Secondary -0.015***	-0.023	0.197	-0.003		
	Tertiary -0.021***	-0.009	0.459	-0.003		
Level of education (husband)						
	No formal education (ref)					
	Primary 0.003***	0.002	-0.097	0.000		
	Secondary 0.052**	0.067	0.173	0.008		
	Tertiary 0.054**	0.033	0.395	0.010	0.018	20.01
Wealth index of households						
	Poorest (ref)					
	Poorer -0.075*	-0.056	-0.437	0.018		
	Middle -0.091*	-0.068	-0.437	0.022		
	Richer -0.078*	-0.064	0.563	-0.026		
	Richest -0.083*	-0.070	0.563	-0.029	-0.016	-25.90
Employment status						
	Unemployed (ref)					
	Employed -0.015***	-0.038	0.018	-0.001	-0.001	-0.84
Religion						
	Christian (ref)					
	Muslim 0.035***	0.072	-0.129	-0.007		
	Others -0.139	-0.003	-0.147	0.000	-0.006	-10.57
Place of residence						
	Urban -0.024***	-0.042	0.282	-0.009	-0.009	-14.28
	Rural (ref)					
Geopolitical zone						
	North-Central (ref)					
	North-East -0.073*	-0.045	-0.235	0.008		
	North-West -0.091*	-0.102	-0.206	0.016		
	South-East 0.249	0.113	0.180	0.015		
	South-South 0.070*	0.031	0.228	0.005		
	South-West -0.014***	-0.009	0.351	-0.002	0.041	67.38
	Distance to health facility (big problem) -0.029**	-0.029	-0.175	0.004	0.004	6.17
	Permission for self-medical help (big problem) 0.005***	0.002	-0.106	0.000	0.000	-0.31
	Number of ANC visits (≥ 4 times) 0.068*	0.151	0.148	0.016	0.016	26.92
	Sum				0.041	66.67
	Residual				0.020	33.33
	Total C_n				0.061	100.00

The percentage of contributions was calculated by dividing the specific "summed" contribution by the absolute values of C_n and multiplying by 100. The sum of all the percentage contributions should add up to 100 percent. The value 0.00 is not zero but due to rounding; Marginal effects were calculated at the means of the predictor

Table 3 (continued)

variables

IPTp-SP intermittent preventive treatment in pregnancy with sulfadoxine-pyrimethamine, ANC antenatal care

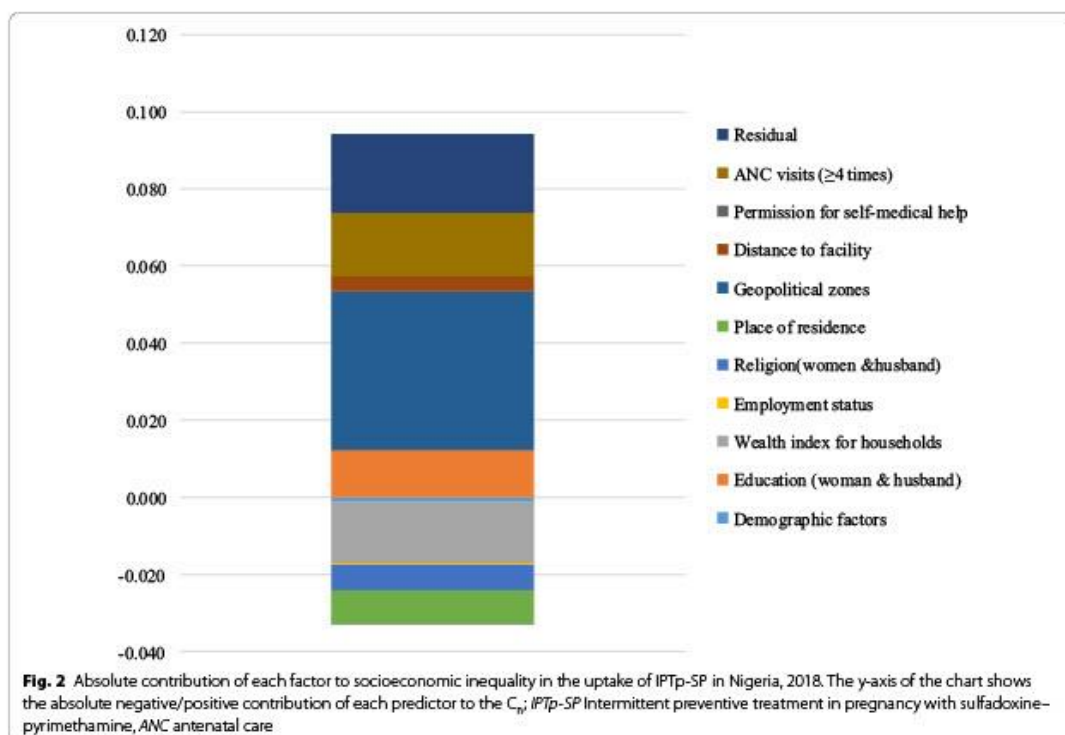
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

The estimated contribution of predictors to the C_N suggested that demographic factors, level of education for women, wealth index, employment status, religion, and urban place of residence contributed negatively to socioeconomic inequality in the uptake of IPTp-SP in 2018 in Nigeria. In contrast, the level of education for husbands, the geopolitical zones, distance to a health facility, and the number of antenatal visits of four and above positively contributed to socioeconomic inequality for adequate uptake of IPTp-SP in 2018 in the country.

Figure 2 illustrates the absolute contribution of a predictor to the socioeconomic inequalities for adequate uptake of IPTp-SP in 2018 in Nigeria. As reported in Table 3 and shown in Fig. 2, geopolitical zone (67.4%), education (20.01%), antenatal care visits of four and above (26.9%), and distance to health facility (6.2%) were the most important predictors contributing to

and/or explained the observed pro-rich (favours the rich) inequalities in uptake of IPTp-SP in the country. However, the wealth index (-25.9%), place of residence (-14.3%), and religion (-10.6%), amongst others contributed negatively to the socioeconomic inequality for adequate uptake of IPTp-SP.

The results suggested the independent variables included in the model explained a sum of 66.7% of the observed socioeconomic inequality for adequate uptake of IPTp-SP among pregnant women in 2018. A substantial contribution of the unexplained or residual component 33.3% implies that there are predictors other than the variables in the model that affect adequate uptake of IPTp-SP in pregnancy in Nigeria, which could be not observed, or controlled in the this study.



Discussion

This study sought to measure and decompose socioeconomic inequality in the uptake of IPTp-SP in Nigeria. Monitoring health inequalities helps countries to track their progress towards the Sustainable Development Goals and ensures that vulnerable populations are not overlooked [37]. Decomposing socioeconomic inequalities in health helps to uncover specific factors that are modifiable by policymakers [38].

The descriptive results demonstrated a low uptake of IPTp-SP (27.3%) in Nigeria, notwithstanding that over half (57%) of the women attended at least four ANC visits and above. This indicates that high ANC attendance alone is not sufficient to ensure high uptake of IPTp-SP due to operational challenges of service delivery (staff shortages, drug stock-out, and poor health worker attitude/remuneration) [25], and lack of knowledge of prophylaxis for malaria prevention [25]. Thus, there is a need to launch a targeted promotional campaign to reach the vulnerable population of pregnant women [11].

Moreover, our findings indicated pro-rich inequalities in the uptake of IPTp-SP among pregnant women in Nigeria, especially in the urban area. There are substantial socioeconomic inequalities across urban settings in Nigeria. The existence of such inequalities indicates that many urban dwellers (especially the urban-poor and urban-middle) do not have access to key resources and services, unlike the urban-rich [39]. The inequality reduces opportunities among the urban-poor, underserved, and vulnerable groups due to fierce competition for available resources, which only the 'fittest' so to say wins [39]. However, this seems not to be the case in rural areas as the poor use more IPTp-SP than the rich, contrary to expectation. As maternal health services in Nigeria were considered of poor quality [40], the better off compared to the less well-off women may use fewer IPTp-SP in rural areas because health care demand of the poor is less sensitive to quality than that of the better off [41]. Hence, there is a need to improve provider practices for IPTp-SP delivery in Nigeria [13], especially in rural settings. The higher uptake of IPTp-SP among the poor women in rural areas may also be due to differences in the assessment of malaria exposure risk between the rich and the poor women in Nigeria. In other words, poor pregnant women in rural areas may consider themselves at higher risk of contracting malaria; thus, they use more IPTp-SP than the rich.

The geopolitical zone of residence, an education level (spouse), antenatal care visits of four and above, and distance to health facilities were found to be the main drivers' of pro-rich inequalities in the uptake of IPTp-SP in Nigeria. Education level (spouse) and antenatal care visit contributed to the concentration of the uptake of

IPTp-SP in Nigeria among the rich because these factors, on the one hand, are positively associated with the uptake of IPTp-SP among pregnant women, and on the other hand, they are more concentrated among wealthier women. The positive impacts of the level of education (spouse) and ANC visits on adequate uptake of IPTp-SP were also found in the previous studies [23, 27]. Geopolitical zone of residence contributed to the pro-rich inequalities in the uptake of IPTp-SP because pregnant women in the two socioeconomically disadvantaged geographic zones of North-East and North-West consumed fewer IPTp-SP compared to other geographic zones. It is interesting to note that the household wealth index contributed negatively to socioeconomic inequality in the uptake of IPTp-SP in Nigeria. This could be explained by the fact that IPTp-SP is administered free at health facilities in Nigeria and, therefore, poor women do not have a financial barrier of access to IPTp-SP.

The decomposition analysis also showed a significant contribution of the residual (i.e., the unexplained portion of the model) to the observed pro-rich inequality in the uptake of IPTp-SP in Nigeria. The distribution of some of the omitted health systems factors (supply-side) from the model might have contributed to the pro-rich inequalities in the uptake of IPTp-SP among pregnant women. In other words, poor service delivery for low socioeconomic status (SES) pregnant women in the country may have reduced the uptake of IPTp-SP in these groups, as the quality of service is one of the greatest barriers to utilizing maternal healthcare [18, 27].

This study is subject to some limitations. Firstly owing to the unavailability of some data in the DHS, we could not include supply-side factors such as patient satisfaction/quality of service delivery variables in the decomposition analysis. In the same vein, other confounding factors such as pregnancy mortality, preterm delivery, parity and HIV infection that could influence IPTp-SP uptake were unaccounted for due to unavailability of data. Thus, further research should be undertaken to examine, especially the influence of supply-side factors on socioeconomic inequality and adequate uptake of IPTp-SP using a mixed-method. Secondly, the DHS data on IPTp-SP uptake was based on self-report elicited from pregnant women and as such may introduce a systematic error like recall bias.

Conclusion

This study demonstrated pro-rich inequalities in the uptake of IPTp-SP among pregnant women in Nigeria. The concentration of the uptake of IPTp-SP among wealthier pregnant women in urban areas is particularly concerning. Thus, there is a need to improve the uptake of IPTp-SP among women residing in

socioeconomically disadvantaged geographic zones (especially in the North-East and North-West) and increased access to ANC among poor women to mitigate pro-rich inequality in the uptake of IPTp-SP in Nigeria.

Abbreviations

ANC: Antenatal care; CI: Concentration index; DHS: Demographic Health Survey; IPTp-SP: Intermittent preventive treatment with sulfadoxine-pyrimethamine (IPTp-SP); MIP: Malaria in pregnancy; PHC: Primary health care; PCA: Principal component analysis; SSA: Sub-Saharan Africa; WHO: World Health Organization.

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12936-021-03834-8>.

Additional file 1: Table S1. Description of variables used in the study.

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Authors' contributions

CJO conceptualized the study, performed the statistical analysis, and prepared the first draft of the manuscript. MH and RH supervised the statistical analysis. MH, RH, MMR, and CJO reviewed the final version of the manuscript. All authors read and approved the final manuscript.

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Availability of data and materials

Data for this study is publicly accessible at the DHS website: <https://www.dhsprogram.com/data/available-datasets.cfm>

Declarations

Ethics approval and consent to participate

Approval letter to use the DHS dataset for this study was obtained from the Demographic and Health Surveys (DHS) Program. The DHS dataset is secondary data, therefore, this study did not require formal ethics approval. However, we observed anonymity and confidentiality under the data terms of use.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no conflict of interest.

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CHAPTER 4: PAPER 3 – SOCIOECONOMIC INEQUALITIES IN TEENAGE PREGNANCY IN NIGERIA: EVIDENCE FROM DEMOGRAPHIC HEALTH SURVEY

4.1. Introductory paragraph

Chapter 4 focuses on measuring inequality and identifying factors explaining socioeconomic inequality in teenage pregnancy in Nigeria. The key finding shows that teenage pregnancy is concentrated among poor teenagers. The study sheds more light on why infants born to teenagers are at a higher risk of mortality than those born to adults vis-a-vis the pro-rich inequalities in the uptake of maternal healthcare services contained in Chapter 3. The research article is published in *BMC Public Health*.

4.2. Paper 3: *BMC Public Health*, (2022) 22:1729.

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RESEARCH

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Socioeconomic inequalities in teenage pregnancy in Nigeria: evidence from Demographic Health Survey

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Abstract

Background: Despite the high rate of teenage pregnancy in Nigeria and host of negative medical, social and economic consequences that are associated with the problem, relatively few studies have examined socioeconomic inequality in teenage pregnancy. Understanding the key factors associated with socioeconomic inequality in teenage pregnancy is essential in designing effective policies for teenage pregnancy reduction. This study focuses on measuring inequality and identifying factors explaining socioeconomic inequality in teenage pregnancy in Nigeria.

Methods: This is a cross-sectional study using individual recode (data) file from the 2018 Nigeria Demographic Health Survey. The dataset comprises a representative sample of 8,423 women of reproductive age 15–19 years in Nigeria. The normalized Concentration Index (C_n) was used to determine the magnitude of inequalities in teenage pregnancy. The C_n was decomposed to determine the contribution of explanatory factors to socioeconomic inequalities in teenage pregnancy in Nigeria.

Results: The negative value of the C_n (-0.354; 95% confidence interval [CI] = -0.400 to -0.308) suggests that pregnancy is more concentrated among the poor teenagers. The decomposition analysis identified marital status, wealth index of households, exposure to information and communication technology, and religion as the most important predictors contributing to observed concentration of teenage pregnancy in Nigeria.

Conclusion: There is a need for targeted intervention to reduce teenage pregnancy among low socioeconomic status women in Nigeria. The intervention should break the intergenerational cycle of low socioeconomic status that make teenagers' susceptible to unintended pregnancy. Economic empowerment is recommended, as empowered girls are better prepared to handle reproductive health issues. Moreover, religious bodies, parents and schools should provide counselling, and guidance that will promote positive reproductive and sexual health behaviours to teenagers.

Keywords: Teenage pregnancy, Socioeconomic inequalities, Concentration curve, Concentration Index, Decomposition analysis, Nigeria

Plain language summary

Teenage pregnancy is a global public health concern. It is an undesirable occurrence and seems to be one of the social problems facing several countries, including Nigeria. Previous studies suggest socioeconomic differences in teenage pregnancy in Nigeria. However, relatively few studies have examined the socioeconomic inequality in

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teenage pregnancy in the country. This study focuses on measuring and explaining predictors of socioeconomic inequality in teenage pregnancy in Nigeria using the Nigeria Demographic Health Survey conducted in 2018. Findings suggest that teenage pregnancy is more concentrated among poor teenagers, while the most important factor contributing to the teenage pregnancy in Nigeria were marital status, wealth index of households, exposure to information and communication technology, and religion. These findings emphasise the need for targeted intervention to reduce teenage pregnancy among low socioeconomic status women in Nigeria to break the intergenerational cycle that expose teenagers to unwanted pregnancy. Since, empowered girls are better prepared to handle reproductive health issues. In addition, religious bodies, parents and schools should give teenagers counselling, and guidance that will promote positive reproductive and sexual health behaviours.

Background

Approximately 21 million teenage girls aged 15–19 years become pregnant each year and the prevalence of teenage pregnancies is 95% higher in low- and middle-income countries (LMICs) compared with high-income countries [1]. Globally teenage pregnancy poses a profound public health concern [2–5]. For instance, pregnancy and childbirth complications are the major cause of death in teenage girls and 99% of all teenage maternal death occurs in LMICs [1, 6].

Teenage pregnancy constitutes a significant economic, health, and social cost to the mothers and newborn children, their families, and the wider society [4]. Specifically, early motherhood has far-reaching consequences including an increased risk of antenatal complications and mortality, failure to complete schooling, socioeconomic disadvantage, welfare dependence, marital difficulties, maternal depression and less competent parenting [7, 8]. Children born to teenage mothers have higher rates of health problems (preterm birth, low birth weight, intrauterine growth retardation, neonatal death, etc.), physical injury, behavioural difficulties, cognitive problems, and educational underachievement compared to children born to the adult mothers [6, 8–10]. Indeed, teenage pregnancy is an undesirable phenomenon and seems to be one of the social problems facing several countries, including Nigeria [11].

In Nigeria, according to the National Population Commission, 23 percent of girls aged 15 to 19 years have started childbearing [12, 13]. About 400,000 unplanned births occur annually in Nigeria and half of these births are to teenage girls between the ages of 15 and 19 years [11]. Pregnant schoolchildren in Nigeria are often victims of ridicule in school, which forces them to drop out

of school even before school authorities expel them for being pregnant [14].

The high rate of teenage pregnancy rate (106 adolescent births per 1000 population) is a major concern for the government and other stakeholders [2]. To reduce the unintended pregnancies among schoolchildren, a curriculum for sex education was introduced in Nigerian schools in 2002 [15]. However, the poor attitude of the teachers and inadequate support from parents and religious leaders has led to the failure to implement this curriculum [15]. Specifically, many policymakers, government officials, religious leaders and parents fear that talking about sex with young people will only encourage promiscuous behaviour [16]. In fact, none of the sex education mandates had made any significant contribution to the decline of teenage pregnancy [17, 18].

Studies suggest that there are geographical differences in teenage pregnancy in Nigeria [2, 12]. While every three adolescent/teenage girls in Northern Nigeria get pregnant, the corresponding figure is one out of ten girls in the South [12]. Also, teenage girls with lower levels of education, lower-income households and living in rural areas are more likely to experience adolescent pregnancy compared with those from high socioeconomic status (SES) backgrounds [3, 5, 12, 19].

Despite the high rate of teenage pregnancy and host of negative medical and socioeconomic consequences that are associated with the problem in Nigeria and sub-Saharan Africa in general, relatively few studies have examined the socioeconomic inequality in teenage pregnancy in the region [2–5, 19]. This study focuses on measuring and explaining predictors of socioeconomic inequality in teenage pregnancy in Nigeria. Understanding the key factors associated with socioeconomic inequality in teenage pregnancy is essential in designing effective policies in reducing teenage pregnancy [9]. This is particularly crucial given that the high teenage pregnancy rate in Nigeria and other African countries portends danger to the actualization of the Sustainable Development Goal 5 (i.e., achieve gender equality and empower all women and girls) by 2030.

Methods

Study area

The study area is Nigeria, with an estimated population of 198 million in 2018 [20]. About 70 percent of the population resides in rural areas while only about 30 percent lives in urban areas [21]. With 32.4 percent of the population below the age of 18 years and over 23% adolescents/teenagers [22, 23], Nigeria has a large youth population. Administratively, the country is divided into six geopolitical zones viz., North-Central, North-East, North-West, South-East, South-West, and South-South. Of the

six geopolitical zones in Nigeria, southern states had the highest youth literacy rate while northern states had the least youth literacy rate [24]. Approximately 21.3 percent of youths, aged 15–19 had never been to school [24].

Data source

The dataset for the analysis comprises women of reproductive age of 15–19 years in the six geopolitical zones of Nigeria. Data were obtained from the latest Nigeria Demographic Health Survey (NDHS), conducted between August 14, 2018 and December 29, 2018. DHS is conducted every five years with common questionnaires and/or variables that are generalizable to over 90 low- and middle-income countries [13]. The NDHS data is a representative of Nigerian population with a response rate of 99%. The study used Individual (women's) Recode data file that collected information on women's background characteristics, reproductive history, household asset ownership, etc. The NDHS uses a multistage sampling procedure, standardized tools and well-trained interviewers to collect reliable data on maternal and child health. The details of the survey are explained elsewhere [13].

Sample

The sample size for the study was limited to 8,423 women (currently or ever pregnant) of reproductive age 15–19 years in Nigeria. As per DHS recommendation, sample weight was applied to get the representative sample size. The sample focused on the variable 'currently or ever pregnant' and 'teenage current age' rather than 'teenage age at first birth'.

Variables

Outcome variable

The outcome variable in the study is teenage pregnancy. The variable is a dummy variable coded 1 if a teenager (aged 15–19 years) currently or ever pregnant, 0 otherwise.

Socioeconomic status

The socioeconomic status of a teenager was measured using wealth index as an indicator of socioeconomic status. Since information on individuals' expenditure or income are often difficult to collect [25–27], the NDHS constructs a wealth index, as a measure of SES, using easy-to-collect data on a household ownership of selected assets (e.g., car, televisions and bicycles), materials used in housing construction, type of water access, and sanitation facilities [26]. A principal component analysis (PCA) technique was used to construct households' wealth index scores based on the aforementioned information collected in the survey [13]. The first

principal component of a set of variables captures the largest amount of information that is common to all the variables [25–27]. Households' wealth index scores were used to categorise individuals into five SES quintile, starting with the poorest to the richest.

Independent variables

In line with previous literature [2, 3, 6, 12], the following variables were used as predictors of teenage pregnancy, teenage education level, marital status, religion, occupation, place of residence, geopolitical zone, wealth index quintiles, and exposure to information and communication technology (ICT) (frequency of watching television and use of internet). Table 1 presents description of variables used in the study.

Statistical analysis

Measuring socioeconomic inequalities in the teenage pregnancy

We used the concentration index (C) to measure socioeconomic inequality in teenage pregnancy. The C is measured based on the Concentration curve, which plots the cumulative share of health variables in horizontal axis against the cumulative share of population in ascending order of SES in the vertical axis. Twice the area between the Concentration curve and line of perfect equality (i.e., 45-degree line) indicate the magnitude of the C. If the Concentration curve lies above (or below) the line of perfect equality, it suggests that health outcome is concentrated among the poor (or rich).

The C was calculated using a convenient regression method as follows [28, 29]:

$$2\sigma_r^2 \left(\frac{h_i}{\mu} \right) = \alpha + \beta r_i + \varepsilon_i \quad (1)$$

where σ_r^2 is the variance of the fractional rank, h is the healthcare variable of interest (i.e., teenage pregnancy) of i th teenage girl, μ is the mean of the health variable of interest, h_i for the whole population, and $r_i = \frac{i}{N}$ is the fractional rank of the i th teenage girl in the distribution of socioeconomic position, with $i = 1$ for the poorest and $i = N$ for the richest teenager. The C is calculated as the ordinary least squares (OLS) estimate of β [29, 30].

The C ranges from -1 to +1, for continuous health outcomes. Since our health outcome variable of interest is binary, the minimum and maximum of the C are not between -1 and +1 and depend on μ [31]. The C can be normalized by multiplying the estimated C by $\frac{1}{1-\mu}$ to overcome this issue. We used the normalized Concentration index (C_n) to quantify socioeconomic inequalities in teenage pregnancy. If the value of the C_n is zero, it suggests that there is no socioeconomic inequality in health

Table 1 Description of variables used in the study

Variable	Variable description
Currently or ever pregnant	
No	1 = if a teenager is not currently or have not been pregnant, 0 otherwise
Yes	1 = if a teenager is currently or have been pregnant, 0 otherwise
Sociodemographic variables	
Teenage current age	
Age 15	1 = if a teenager is 15 years old, 0 otherwise
Age 16	1 = if a teenager is 16 years old, 0 otherwise
Age 17	1 = if a teenager is 17 years old, 0 otherwise
Age 18	1 = if a teenager is 18 years old, 0 otherwise
Age 19	1 = if a teenager is 19 years old, 0 otherwise
Marital status	
Never married	1 = if a teenager is never married, 0 otherwise
Married	1 = if a teenager is married, 0 otherwise
Ethnic origin	
Hausa/Fulani/Kanuri	1 = if a teenager ethnic origin is Hausa/Fulani/Kanuri, 0 otherwise
Igbo	1 = if a teenager ethnic origin is Igbo, 0 otherwise
Yoruba	1 = if a teenager ethnic origin is Yoruba, 0 otherwise
Others	1 = if a teenager ethnic origin is not Hausa, Igbo or Yoruba, 0 otherwise
Socioeconomic variables	
Teenage highest education level	
No formal education	1 = if a teenager has no formal education, 0 otherwise
Primary education	1 = if a teenager has a primary education, 0 otherwise
Secondary education	1 = if a teenager has a secondary education, 0 otherwise
Higher	1 = if a teenager has a higher education, 0 otherwise
Wealth index	
Poorest	1 = if a teenager is in the poorest quintile, 0 otherwise
Poorer	1 = if a teenager is in poorer quintile, 0 otherwise
Middle	1 = if a teenager is in the middle quintile, 0 otherwise
Richer	1 = if a teenager is in richer quintile, 0 otherwise
Richest	1 = if a teenager is in the richest quintile, 0 otherwise
Employment status	
Unemployed	1 = if a teenager is not working, 0 otherwise
Employed	1 = if a teenager is working, 0 otherwise
Religion	
Christian	1 = if a teenager is a Christian, 0 otherwise
Muslim	1 = if a teenager is a Muslim, 0 otherwise
Others	1 = if a teenager is neither Christian nor Muslim, 0 otherwise
Geographic and geopolitical variables	
Place of residence	
Urban	1 = if a teenager lives in an urban area, 0 otherwise
Rural	1 = if a teenager lives in a rural area, 0 otherwise
Geopolitical zone	
North-Central	1 = if a teenager is from North-Central, 0 otherwise
North-East	1 = if a teenager is from North-East, 0 otherwise
North-West	1 = if a teenager is from North-East, 0 otherwise
South-East	1 = if a teenager is from South-East, 0 otherwise
South-South	1 = if a teenager is from South-South, 0 otherwise
South-West	1 = if a teenager is from South-West, 0 otherwise

Table 1 (continued)

Variable	Variable description
Exposure to information and communication technology (ICT)	
Frequency of watching television	
Not at all	1 = if a teenager does not watch TV, 0 otherwise
Less than once a week	1 = if a teenager watches TV less than once a week, 0 otherwise
At least once a week	1 = if a teenager watches TV at least once a week, 0 otherwise
Use of internet	
No	1 = if a teenager does not use internet, 0 otherwise
Yes	1 = if a teenager uses internet, 0 otherwise

outcomes. A negative (or positive) value of the C_x indicates a higher concentration of the health variable among the poor (or rich) [28]. A higher value of the C_x corresponds to higher socioeconomic inequality in health.

Decomposition analysis

In order to identify the contribution of each explanatory variable to socioeconomic inequality in teenage pregnancy, we decomposed the C_x using the Wagstaff, et al. approach [29]. Assume that we have a linear regression model to link our outcome variable (i.e., teenage pregnancy) h , to a set of k explanatory factors, x_k such as:

$$h = \alpha + \sum_k \beta_k x_k + \varepsilon \quad (2)$$

where α is the intercept and β denotes parameter that measure the relationship between each explanatory factor x and the teenage pregnancy, and ε is error term. A Wagstaff, E Van Doorslaer and N Watanabe [29] showed that the C of h can be decomposed into the contribution of determinants that explain the teenage pregnancy as follows:

$$C = \sum_k \left(\frac{\beta_k \bar{x}_k}{\mu} \right) C_k + \frac{GC_\varepsilon}{\mu}, \quad (3)$$

where, \bar{x}_k is the mean of x_k , and C_k denotes the C for x_k , a contributing factor. The GC_ε denotes the generalized C of the error term, ε .

Equation 3 shows that the overall inequality in the teenage pregnancy has two components. The first term $\left(\frac{\beta_k \bar{x}_k}{\mu} \right) C_k$ denotes the contribution of factor k to socioeconomic inequality in the teenage pregnancy. It constitutes the deterministic or explained component of the teenage pregnancy of the C . The second term $\frac{GC_\varepsilon}{\mu}$ represents the unexplained component [28]. Based on Eq. 3, the product of the elasticity of each factor and its C_k gives the contribution of that factor to the inequality. The negative (or positive) contribution of a predictor to the C_x suggests that the socioeconomic distribution of the

predictor and the association between the predictor and the teenage pregnancy leads to an increase in the concentration of teenage pregnancy among the poor (or rich). A zero value of either elasticity or the C_k leads to the zero contribution of the factor to C [28].

Applying the A Wagstaff [31] normalization approach to the decomposition of the C can yield:

$$C_x = \frac{C}{1-\mu} = \frac{\sum_k \left(\frac{\beta_k \bar{x}_k}{\mu} \right) C_k}{1-\mu} + \frac{GC_\varepsilon}{1-\mu} \quad (4)$$

The dataset was weighted using the sampling weight provided in the NDHS to obtain estimates that are representative of all teenagers in Nigeria. Logit model estimation and marginal effects were conducted before the decomposition analysis. Chi-square was used to test associations between explanatory factors and teenage pregnancy. The predictors of teenage pregnancy were considered statistically significant at $p < 0.05$. All data analyses were conducted using Stata/SE-13 software [32].

Results

Descriptive statistics

Table 2 reports descriptive statistics of variables used in the study. About 6.3% of the teenagers are currently or ever pregnant and majority of them were never married (75.2%). The married teenagers (23.4%) were mainly from the Hausa/Fulani/Kanuri (43.0%) ethnic origin. In addition, 25.8% of the teenagers had no formal education, while 61.1% had secondary education. Over half of teenagers were Muslims (57.8%) and reside in rural areas (54.9%), in North-West (32.4%), North-East (17.7%) and North-Central (14.2%) geopolitical zones. On exposure to ICT, most teenagers did not use internet (84.4%), nor watch television at all (48.1%).

Socioeconomic inequality in teenage pregnancy in Nigeria

Figure 1 presents the concentration curve of teenage pregnancy in Nigeria. The curve lies above the 45-degree diagonal line suggesting that teenage pregnancy in

Table 2 Descriptive statistics of variables used in the study

Variable	Mean/ percentage
Currently or ever pregnant (15–19yrs)	
No	93.7
Yes	6.3
Sociodemographic variables	
Teenage current age	
Age 15	24.6
Age 16	18.8
Age 17	18.7
Age 18	22.7
Age 19	15.2
Marital status	
Never married	75.2
Married	23.4
Others	1.4
Ethnic origin	
Hausa/Fulani/Kanuri	43.0
Igbo	13.9
Yoruba	13.2
Others	29.9
Socioeconomic variables	
Teenage highest education level	
No formal education	25.8
Primary education	10.4
Secondary education	61.1
Higher	2.7
Wealth index	
Poorest	16.9
Poorer	20.6
Middle	20.8
Richer	21.4
Richest	20.3
Employment status	
Unemployed	64.4
Employed	35.6
Religion	
Christian	41.7
Muslim	57.8
Others	0.5
Geographic and geopolitical variables	
Place of residence	
Urban	45.1
Rural	54.9
Geopolitical zone	
North-Central	14.2
North-East	17.7
North-West	32.4
South-East	10.9
South-South	10.5
South-West	14.3

Table 2 (continued)

Variable	Mean/ percentage
Exposure to Information and communication technology (ICT)	
Frequency of watching television	
Not at all	48.1
Less than once a week	19.4
At least once a week	32.5
Use of internet	
No	84.4
Yes	15.6

Nigeria is more concentrated among poor teenagers ($C_n = -0.354$; 95% CI = -0.400 to -0.308).

Decomposition of the socioeconomic inequality in teenage pregnancy in Nigeria

Table 3 presents the decomposition of the socioeconomic inequality in teenage pregnancy in Nigeria. The table contains the estimated marginal effects of the predictor variables derived from the logit model, the elasticities, the C of the predictor variables (C_k) and the contribution of each predictor variable to the C_n . The elasticity column shows the change in the outcome variable (i.e., teenage pregnancy) associated with a one-unit change in the independent variables. It indicates the responsiveness of the health outcome (teenage pregnancy) to a change in the predictor variables. A negative (or positive) sign in elasticity shows a decreasing (or increasing) change of teenage pregnancy in association with a change in the predictor.

The negative (or positive) sign of the C_k for a certain variable indicates that the predictor concentrated among the poor (or rich) teenagers. For instance, in Table 3, being married, primary education, employed, North-East and North-West geopolitical zones were concentrated among the poor, whereas, the teenage secondary and tertiary highest education levels, urban residence, southern geopolitical zones, exposure to ICT (frequency of watching TV, and use of internet) were more concentrated among the rich.

The estimated contribution of predictors to the C_n suggested that marital status, primary and tertiary education, wealth index of households, religion, geopolitical zones (North-East and South-East) and frequency of watching TV and use of internet contributed negatively to socioeconomic inequality in teenage pregnancy in 2018 in Nigeria. On the other hand, ethnicity, secondary education level, place of residence, and southern geopolitical zones positively contributed to the socioeconomic inequality of teenage pregnancy in the country.

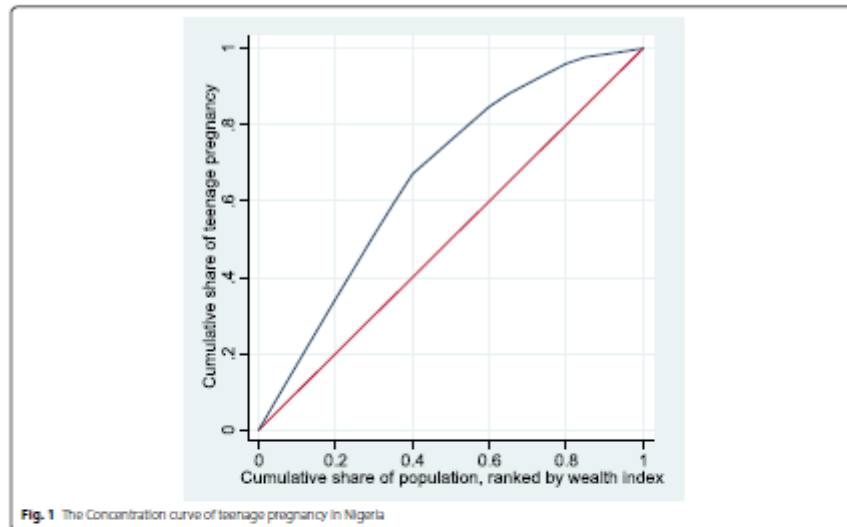


Fig. 1 The Concentration curve of teenage pregnancy in Nigeria

Figure 2 illustrates the absolute contribution of a predictor to the socioeconomic inequality of teenage pregnancy in 2018 in Nigeria. As reported in Table 3 and illustrated in Fig. 2, marital status (91.1%), wealth index of household (19.5%), frequency of watching TV (7.3%), use of internet (4.4%), and religion (4.2%) were the most important predictors contributing to or explained the observed socioeconomic inequality in teenage pregnancy in Nigeria. In contrast, ethnicity (-14.4%), teenage education level (-7.4%), geopolitical zones (-5.6%) and place of residence (-3.3%) contributed negatively to socioeconomic inequality in teenage pregnancy.

The results show that the independent variables included in the model explained a sum of 94.2% of the observed socioeconomic inequality in teenage pregnancy in Nigeria. A 5.8% lower contribution of residual component suggests that there are less significant predictors other than the variables in the model that affect teenage pregnancy in Nigeria, which could not be identified by this study.

Discussion

Understanding the predictors of the observed socioeconomic inequality in teenage pregnancy is vital in designing effective policies [3]. As the high teenage pregnancy rate in Nigeria portends danger to the actualization of

SDG 5.3 by 2030, this study aimed at measuring and identifying factors associated with socioeconomic inequality in teenage pregnancy in Nigeria using the Concentration index approach.

The key findings show teenage pregnancy in Nigeria is more concentrated among the poor teenagers. The finding is in tandem with studies in Malawi [3] and Tanzania [5] that teenage pregnancy and childbearing rate was higher among teenagers from poorer household than those from richer households. It also aligns with the finding, which states that teenagers from low SES background are twice more likely to get pregnant as a teenager when compared with those from high SES background [19].

Findings further indicate that the most important predictors contributing to observed concentration of teenage pregnancy among the low SES in Nigeria were marital status, wealth index of households, frequency of watching TV, use of internet, and religion. This finding suggests that low SES (high level of poverty) makes teenagers susceptible to early pregnancy [2]. It is also traceable to the prevailing cultural norms and religious practices that prohibit teenagers from accessing family planning services and having premarital sex [2]. More so, access to reproductive health products is constrained by social stigma [33], thereby leading to unintended pregnancies. Hence, interventions sensitive to religious beliefs

Table 3 Decomposition of the socioeconomic inequality in teenage pregnancy in Nigeria, 2018

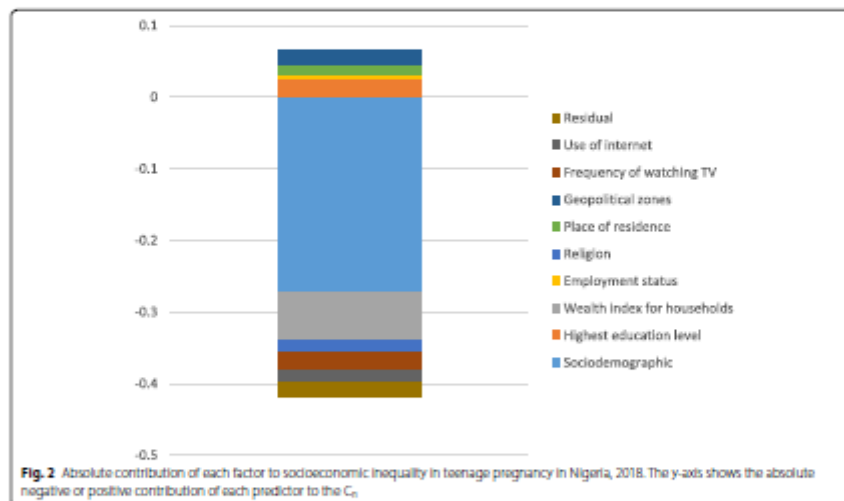
Variables	Marginal effect	\bar{X}	Elasticities	C_k	Contribution to C_k		Percentage contribution (%)
					Absolute	Summed	
Teenage current age							
Age 15	-0.007	0.246	-0.027	-0.019	0.000		
Age 16	-0.002	0.188	-0.006	0.025	0.000		
Age 17	-0.006	0.187	-0.018	-0.007	0.000		
Age 18	0.007	0.227	0.025	-0.046	-0.001	-0.001	0.18
Age 19 (ref)							
Marital status							
Married	0.248*	0.234	0.921	-0.374	-0.323	-0.323	91.12
Never married (ref)							
Ethnicity							
Hausa/Fulani/Kanuri (ref)							
Igbo	0.068**	0.139	0.150	0.288	0.040		
Yoruba	0.012	0.132	0.025	0.428	0.010		
Others	0.007	0.299	0.033	0.008	0.000	0.051	-14.35
Teenage highest education level							
No formal education (ref)							
Primary	0.010	0.104	0.016	-0.258	-0.004		
Secondary	0.016*	0.611	0.155	0.227	0.033		
Tertiary	-0.012	0.027	-0.005	0.599	-0.003	0.026	-7.38
Wealth index of households							
Poorest (ref)							
Poorer	0.006	0.206	0.020	-0.456	-0.008		
Middle	0.004	0.208	0.013	-0.042	-0.001		
Richer	-0.004	0.214	-0.014	0.38	-0.005		
Richest	-0.023*	0.203	-0.074	0.797	-0.055	-0.069	19.50
Employment status							
Unemployed (ref)							
Employed	-0.015*	0.356	-0.085	-0.088	0.007	0.007	
Religion							
Christian (ref)							
Muslim	0.012	0.578	0.110	-0.138	-0.014		
Others	0.041	0.005	0.003	-0.204	-0.001	-0.015	4.19
Place of residence							
Urban	0.005	0.451	0.036	0.345	0.012	0.012	-3.27
Rural (ref)							
Geopolitical zone							
North-Central (ref)							
North-East	-0.005	0.177	-0.014	-0.292	0.004		
North-West	0.001	0.324	0.005	-0.206	-0.001		
South-East	-0.027	0.110	-0.047	0.225	-0.010		
South-South	0.002	0.105	0.003	0.319	0.001		
South-West	0.027	0.144	0.062	0.447	0.026	0.020	-5.58
Frequency of watching television							
Not at all (ref)							
Less than once a week	-0.019*	0.194	-0.058	0.144	-0.008		
At least once a week	-0.009	0.325	-0.046	0.416	-0.018	-0.026	7.34

Table 3 (continued)

Variables	Marginal effect	\bar{X}	Elasticities	C_{β}	Contribution to C_{β}		Percentage contribution (%)
					Absolute	Summed	
Use of internet							
No (ref)							
Yes	-0.012	0.156	-0.030	0.564	-0.016	-0.016	4.43
Sum						-0.334	94.23
Residual						-0.020	5.77
Total C_{β}						-0.354	100.00

Marginal effects were calculated at the means of the predictors. The percentage of contributions was calculated by dividing the specific "summed" contribution by the absolute values of C_{β} and multiplying by 100. The sum of all the percentage contributions should add up to 100 percent. The value 0.00 is not zero, but due to rounding.

* $p < 0.005$, ** $p < 0.1$



and cultural peculiarities should be designed to tackle the challenges of teenage pregnancies among the poor [19]. Religious leaders may set the pace through moral instructions in churches and mosques [11], coupled with counselling and guidance on risk associated with teenage pregnancy.

Our findings show over half of the teenagers are Muslims residing in rural areas in the northern geopolitical zones of the country. Study indicates that girls in the poorest wealth quintile are 2.5 times more likely to get married in childhood than those living in the richest

quintile [34]. This is more prevalent among girls who live in rural areas than their urban counterparts due to economic, social, cultural, and religious factors [35]. Often marriage attracts a dowry for the bride's family and in Nigeria, there is a real economic incentive for early marriage owing to dismal economic circumstances and strong cultural traditions in the region [35]. Even, young girls residing in rural areas are forcefully married because parents believe that it would save their daughters from sexual abuse [6]. Early marriage is one of the main contributors to teenage pregnancy among the low SES.

Measures to delay age at marriage can help reduce early pregnancies. Therefore, eliminating child marriage needs to be part of family planning campaigns to facilitate the attainment of SDG 5.3 by 2030 [35]. This is important because teenagers who are at the risk of becoming pregnant is the relevant population from a policy viewpoint [36].

There is a need for formal education empowerment to address the high prevalence of teenage pregnancy among low SES girls in Nigeria. Empowered girls or women are more likely to delay marriage, and plan their pregnancies [34, 37]. Study shows that teenagers with higher education were 94% less likely to experience teenage pregnancy compared to those without education [12]. Also, it is a fact that teenagers who have higher education levels are protected from unwanted pregnancies due to the empowerment that accompany higher education [2]. Indeed, education plays a vital role given that those with low or no education tend to fall victim of early pregnancy compared to those who acquired higher education [12]. Given the high proportion of teenage pregnancy in the northern part of the country, due to low-level of education and high level of poverty, a targeted formal education intervention is warranted. It would help break the intergenerational cycle of poverty [37] and reduce the risk of early marriage, and teenage pregnancy [35].

The main strength of this paper is the use of the concentration index to identify key predictors of the observed socioeconomic inequality in teenage pregnancy in Nigeria. In addition, the paper used the latest NDHS 2018 dataset, which is nationally representative and generalizable to Nigeria as a whole. A major limitation of this paper is that, we cannot establish temporality between explanatory factors and socioeconomic inequality in teenage pregnancy given the cross-sectional design of the study. Thus, it precludes establishing causal inference. Further, since the survey data was self-reported, the issue of recall bias and social desirability may occur.

Conclusion

There is a need for targeted intervention (i.e. increased girls' enrolment and completion of high education), especially in the northern geopolitical zones of Nigeria. This may help break the intergenerational cycle of poverty that make teenagers' susceptible to unintended pregnancy and parents forcing the girl-child into early marriage. Economic and education empowerment is recommended, as empowered girls/women are better prepared to handle reproductive health issues. Moreover, religious bodies, parents and schools should provide counselling, and guidance that will promote positive reproductive and sexual health behaviours to teenagers.

Abbreviations

C: Concentration Index; FMOH: Federal ministry of health; ICT: Information and communication technology; LMICs: Low- and middle-income countries; NBS: National bureau of statistics; NDHS: Nigeria demographic health survey; NPC: National population commission; OLS: Ordinary least square; PCA: Principal component analysis; SDG: Sustainable development goal; SES: Socioeconomic status; WHO: World health organization.

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Authors' contributions

CJO wrote the first draft of the manuscript and performed the statistical analysis. MH supervised the statistical analysis. RH, MH, MMR, EV and CJO reviewed the manuscript. All authors read and approved the final version of the manuscript.

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Availability of data and materials

Data for this research is publicly accessible from the DHS program archive after due permission and can be downloaded from <https://www.dhsprogram.com/Data/available-datasets.cfm>.

Declarations

Ethics approval and consent to participate

The DHS dataset is a secondary data in the public domain and does not require ethical clearance. Details on DHS data and ethical standard are available at <https://dhsprogram.com/methodology/Protecting-the-Privacy-of-DHS-Survey-Respondents.cfm>.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no conflict of interests.

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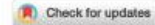
CHAPTER 5: PAPER 4 – GEOGRAPHIC AND SOCIOECONOMIC INEQUALITIES IN THE SURVIVAL OF CHILDREN UNDER-FIVE IN NIGERIA

5.1. Introductory paragraph

Given that maternal well-being largely determines a child's well-being, chapter 5 assesses the geographic and socioeconomic differences in the survival of children under five in Nigeria. The key finding from this paper shows that most under-five mortality occurs within 12 months after birth, with the poor most at risk. The study re-emphasises the importance of maternal healthcare services contained in chapters 3 and 4. The research article has been published in the *Scientific Reports* journal.

5.2. Paper 4: *Scientific Reports*, (2022) 12:8389.

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OPEN

Geographic and socioeconomic inequalities in the survival of children under-five in Nigeria

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Despite a substantial decline in child mortality globally, the high rate of under-five mortality in Nigeria is still one of the main public health concerns. This study investigates inequalities in geographic and socioeconomic factors influencing survival time of children under-five in Nigeria. This is a retrospective cross-sectional quantitative study design that used the latest Nigeria Demographic Health Survey (2018). Kaplan–Meier survival estimates, Log-rank test statistics, and the Cox proportional hazards were used to assess the geographic and socioeconomic differences in the survival of children under-five in Nigeria. The Kaplan–Meier survival estimates show most under-five mortality occur within 12 months after birth with the poorest families most at risk of under-five mortality while the richest families are the least affected across the geographic zones and household wealth index quintiles. The Cox proportional hazard regression model results indicate that children born to fathers with no formal education (HR: 1.360; 95% CI 1.133–1.631), primary education (HR: 1.279; 95% CI 1.056–1.550) and secondary education (HR: 1.204; 95% CI 1.020–1.421) had higher risk of under-five mortality compared to children born to fathers with tertiary education. Moreover, under-five mortality was higher in children born to mothers' age ≤ 19 at first birth (HR: 1.144; 95% CI 1.041–1.258). Of the six geopolitical zones, children born to mothers living in the North-West region of Nigeria had 63.4% (HR 1.634; 95% CI 1.238–2.156) higher risk of under-five mortality than children born to mothers in the South West region of Nigeria. There is a need to focus intervention on the critical survival time of 12 months after birth for the under-five mortality reduction. Increased formal education and target interventions in geopolitical zones especially the North West, North East and North Central are vital towards achieving reduction of under-five mortality in Nigeria.

Abbreviations

CI	Confidence Interval
DHS	Demographic and Health Survey
HR	Hazard ratio
LMIC	Low-and-middle-income countries
SDGs	Sustainable development goals
USMR	Under-five mortality rate
WHO	World Health Organization

Globally, geographic and socioeconomic differences in childhood mortality are a major public health concern, especially in low- and middle-income countries (LMICs)^{1–3}. Geographic inequalities in mortality in LMICs are usually substantial and partly explain socioeconomic differences in childhood mortality⁴. According to the World Health Organization (WHO), children in developing countries are 10 times more likely to die before their fifth birthday compared with children in developed countries^{2,5}. In sub-Saharan Africa regions, 1 in 8 children dies before age five, which is nearly 20 times the average of 1 in 167 for developed regions⁶.

There has been a substantial decline in childhood mortality on the global stage⁷. The high rate of childhood mortality in Nigeria (132 deaths per 1000 births) is still one of the main public health concerns⁸. In Nigeria, every minute one child under-5 years dies i.e. 1440 deaths daily⁹. Given that the childhood mortality rate is a major

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indicator of the overall health of a population and level of economic development of any country^{10,11}, Nigeria requires a minimum target of 44% reduction in under-five mortality rates (U5MR) every 5 years to reach the target of < 25 U5MR of the Sustainable Development Goal (SDG) by the year 2030¹². This involves a concerted and sustainable effort in removing various barriers to healthcare access and utilization¹³. However, the public health concern is the lack of attention to the large and growing inequities in the provision of and access to services within low-middle-income countries¹⁴.

The issue of child mortality does not draw media attention because it is occurring amongst the poorest, most vulnerable, and voiceless communities¹². Differential distribution of child mortality also exists across different geographical regions in LMICs. In Nigeria, for example, U5MR varies across the six geopolitical zones (North Central, North East, North West, South East, South South, and South West), ranging from 89 deaths per 1000 births in the South West to 222 deaths per 1000 births in the North East⁶. The country loses far too many under-five children, making it one of the largest contributors to global under-five mortality rates¹⁵.

To date, some cross-sectional studies have analysed geographic and socioeconomic determinants of U5MR in Nigeria^{6,10,16,17}. However, these studies did not take into consideration the time-to-event censored data analysis. To address this gap in the literature, this study uses the Kaplan–Meier survival estimates and the Cox proportional-hazards regression model instead of the traditional regression model to assess socioeconomic and geographical differences in U5MR. The Kaplan–Meier and the Cox proportional-hazards regression models are robust and preferred over the logistic regression, which ignores survival time and censoring information^{18–21}. Since the major causes of child mortality are largely avoidable and/or preventable²², identifying the geographic and socioeconomic factors influencing U5MR in Nigeria helps policy and decision-makers to understand differences in U5MR between the most and least deprived social and geographic groups who may consequently benefit from focused interventions to prevent child mortality.

Methods

Study setting. The study setting is Nigeria, with an estimated population of around 200 million people and by implication the most populous sub-Saharan African country⁹. Administratively, the country is divided into six geopolitical zones, comprising 36 states and the Federal Capital Territory, Abuja. The country is culturally, ethnically, and geographically heterogeneous, with more than 250 identifiable ethnic groups¹⁶. Of the ethnic groups, the largest and politically dominant ethnic groups are the Hausa (North), the Igbo (South East), and the Yoruba (South West)²³. Cultural values and practices unique to ethnic groups influence child health outcomes. For example, Yoruba and Igbo girls tend to marry in the third decade of life, while early marriage, before age 16 years, is common among the Hausa/Fulani/Kanuri ethnic groups²³. The proportion of educated people is high among Igbo, Yoruba, and minority ethnic groups compared to the less-educated Hausa/Fulani/Kanuri tribes¹⁶. While more than 70% of the northern geopolitical zones live below the poverty line, this figure is less than 35% in the southern geopolitical zones²⁴. Due to the cultural differences among Nigerians, there are significant ethnic variations in health care utilization in the country²⁵. Nevertheless, many primary health facilities have fallen into disrepair and most public services are not trusted due to poor service delivery⁹.

Study design. This is a retrospective cross-sectional quantitative study using the latest 2018 Nigeria Demographic and Health Survey (2018 NDHS) conducted from August 14, 2018 to December 29, 2018⁸.

Data source. The NDHS is a nationally representative health survey conducted every 5 years using a multistage sampling procedure, standardized tools and well-trained interviewers⁸. It is the world's largest survey, eliciting information on infant and child mortality rates and demographic factors generated from birth histories obtained from the mothers interviewed². The DHS also contains information on socioeconomic and geographic characteristics including household ownership of assets, maternal education, and rural/urban residence^{6,26}. As measuring inequalities in childhood mortality requires information on age at death of under-five, and socioeconomic status, the 2018 NDHS Birth Recode data file was used. It contained 127,545 sample sizes with a response rate of 99%⁸. Analysis in this study was restricted to children aged 0–59 months ($n = 33,741$).

Variables. The dependent variable is descriptive binary (1 if a live-born child dying before its fifth birthday, 0 otherwise) plus time in months until the event (death) occurs. In line with previous studies^{19,21,25,27,28}, the independent variables comprise child gender, mother's age (at first birth), household wealth index, maternal and paternal education (as an indicator for socioeconomic status), ethnic origin, religion, place of residence, and geopolitical zone. Table 1 presents the description of variables used in the analysis.

Statistical analysis. We used a survival analysis method to examine survival time-to-event data. Of the three survival analysis techniques (parametric modelling, semiparametric modelling and nonparametric analysis), we adopted the later (nonparametric) for analysing censored data²¹ and for its capacity of letting the dataset speak for itself²⁹. We used the two most common nonparametric methods in survival analysis viz., Kaplan–Meier survival estimates and Log-rank test statistic to assess the survival function and pattern of under-five mortality^{30,31–32}.

The Kaplan–Meier survival estimates were used to present graphically a survival curve that plots survival probability against time²⁰. The conditional probability of a child's survival increases as he/she progresses in age³³. Kaplan–Meier provides a useful summary of the data that can be used to estimate measures such as median survival time³⁴.

Dependent variable	Variable description
Under-five mortality (event)	1 = if the child died, 0 otherwise
Age of child (in months)	
< 1 month (neonatal)	The child died before one month
1–11 months (post-neonatal)	The child died between 1–11 months
12–59 months (childhood)	The child died between 12 to 59 months
Independent variables	
Demographic variables	
Child's gender	
Male	1 = if the child is a male, 0 if a child is a female
Mother's age (at first birth)	
≤ 19	1 = if the mother's age at first birth is ≤ 19, 0 otherwise
20–39	1 = if the mother's age at first birth is between 20 and 39, 0 otherwise
≥ 40	1 = if the mother's age at first birth is ≥ 40, 0 otherwise
Ethnic origin	
Hausa/Fulani/Kanuri	1 = if the maternal ethnic origin is Hausa/Fulani/Kanuri, 0 otherwise
Igbo	1 = if the maternal ethnic origin is Igbo, 0 otherwise
Yoruba	1 = if the maternal ethnic origin is Yoruba, 0 otherwise
Others	1 = if the maternal ethnic origin is not Hausa, Igbo or Yoruba, 0 otherwise
Religion	
Christian	1 = if the mother is a Christian, 0 otherwise
Muslim	1 = if the mother is a Muslim and others, 0 otherwise
Socioeconomic variables	
Maternal education	
No formal education	1 = if the mother has no formal education, 0 otherwise
Primary education	1 = if the mother has a primary education, 0 otherwise
Secondary education	1 = if the mother has a secondary education, 0 otherwise
Higher education	1 = if the mother has higher education, 0 otherwise
Paternal education	
No formal education	1 = if the father has no formal education, 0 otherwise
Primary education	1 = if the father has a primary education, 0 otherwise
Secondary education	1 = if the father has a secondary education, 0 otherwise
Higher education	1 = if the father has higher education, 0 otherwise
Wealth index (household)	
Poorest (1)	1 = if the mother is in poorest quintile, 0 otherwise
Poorer (2)	1 = if the mother is in poorer quintile, 0 otherwise
Middle (3)	1 = if the mother is in middle quintile, 0 otherwise
Richer (4)	1 = if the mother is in richer quintile, 0 otherwise
Richest (5)	1 = if the mother is in richest quintile, 0 otherwise
Geographic and geopolitical variables	
Place of residence	
Urban residence	1 = if the mother lives in an urban area, 0 otherwise
Geopolitical zone	
North Central	1 = if the mother is from North Central, 0 otherwise
North East	1 = if the mother is from North East, 0 otherwise
North West	1 = if the mother is from North West, 0 otherwise
South East	1 = if the mother is from South East, 0 otherwise
South South	1 = if the mother is from South South, 0 otherwise
South West	1 = if the mother is from South West, 0 otherwise

Table 1. Description of variables used in the study.

Survival data are modelled in terms of two related functions: -, the survivor function and the hazard function³⁴. Assume T to be a random variable representing the survival time of subjects in the population, and t be the realization of T . The cumulative distribution function of T is expressed as:

$$F(t) = P(T < t). \tag{1}$$

where t denotes the actual survival time of a child, T indicates a random variable associated with the survival time, and $F(t)$ is the probability density function for the survival time.

The distribution function of T and survival function $S(t)$ show the proportion of children that survive longer than t from the first day of birth and is expressed as:

$$F(t) = P(T > t) = \int_0^t f(u) du \quad (2)$$

$$S(t) = P(T \geq t) = 1 - F(t) \quad (3)$$

The hazard function, $h(t)$, represents the probability that an individual dies at a time, conditional on having survived to that time. That is, the function represents the instantaneous death rate for an individual surviving to time t :

$$h(t) = \lim_{\Delta \rightarrow 0} \frac{P(t < T \leq t + \Delta t | T > t)}{\Delta t} = \frac{f(t)}{S(t)} \quad (4)$$

where $h(t)$ is the hazard function, T is the survival time, $S(t)$ is the survival function, and Δ is the instantaneous change^{19,21}.

The Cox proportional hazards regression model, the most widely used model in the analysis of survival data, was used to assess the influence of various covariates in the survival times of individuals through the hazard function¹⁹. It provides a hazard ratio to compare survival times of two or more population groups. The observation is right-censored, that is the survival status of the individual might not be known at the time of the survey^{19,25}. In the model, the exponentiated linear regression portion of the model explains the effects of explanatory variables on hazard ratio¹⁹.

The Cox hazard is modelled as follows:

$$h(t) = h_0(t) \exp.(b_1 X_1 + b_2 X_2 + b_3 X_3 + \dots + b_k X_k), \quad (5)$$

where X_1 to X_k are k explanatory variables and $h_0(t)$ is the baseline hazard at time t , representing the hazard for a person with the value 0 for all the explanatory variables. By dividing both sides of Eq. (5) by $h_0(t)$ and taking logarithms, we obtain:

$$\ln \frac{h(t)}{h_0(t)} = b_1 X_1 + b_2 X_2 + b_3 X_3 + \dots + b_k X_k. \quad (6)$$

where $\frac{h(t)}{h_0(t)}$ is the hazard ratio. The coefficients b_1 to b_k are estimated by the Cox regression²⁵.

Three models were fitted into the Cox proportional hazards model for analysis to investigate the influence of the predictor variables on the under-five mortality. Model 1 contained demographic factors as the only predictor variables while model 2 added socioeconomic variables. Model 3 included environmental and geopolitical variables along with the previous variables in models 1 and 2 for analysis²¹.

In the Cox proportional hazards model, the outcome is described in terms of the hazard ratio. The Cox regression model gives the hazard function as a product of a baseline hazard involving t and an exponential expression involving X 's without t . The exponential part of the equation ensures that the fitted model will always give estimated hazards that are non-negative²⁵.

The hazard ratio represents the instantaneous risk over the study time. The measures of association were expressed as hazard ratios (HR) with 95% confidence intervals (CI)²⁶. A hazard ratio of 1 means lack of association, a hazard ratio > 1 suggests an increased risk and a hazard ratio < 1 suggests a smaller risk. In general, the survivor function focuses on not having an event, while the hazard function focuses on the event occurring²⁴. All analyses were weighted to ensure representativeness of the survey sample. A p -value less than 0.05 is considered statistically significant. We conducted all the analysis using Stata version 13.1. More so, all methods were performed in accordance with the relevant guidelines and regulations.

Ethical approval and consent to participate. The Demographic and Health Surveys (DHS) Program has granted approval to use the Nigeria DHS dataset for this study. The DHS adhered to informed consent and we observed anonymity and confidentiality under the data terms of use.

Results

Table 2 presents the descriptive statistics of variables used in the study and distribution of under-five (0–59 months) deaths across the demographic, geographic and socioeconomic characteristics. The results show that the proportion of under-five mortality (U5M) is about 10%, and higher among the male (51.0%) than the female (49.0%) gender. Although the proportion of age of child (in months) is highest (82.2%) among the childhood (i.e. 12–59 months) group, the proportion from total U5M is the highest (39.5%) among the neonatal (<1 month) age bracket.

Further, the result indicates that the proportion of U5M is prevalent among children born to mothers' age ≤ 19 at first birth (58.0%), especially among the Hausa/Fulani/Kanuri ethnic origin (48.9%) and the Muslim groups (64.1%). Moreover, the socioeconomic variables show that the U5M was higher among children born to mother (46.5%) and father (37.5%) with no formal education compared to the children born to mother or father with primary, secondary, or tertiary education. In the same vein, of the household wealth index quintiles, 65.4% of

Variable	Proportion	Proportion from total under-five deaths
Under-five mortality (event)	9.7%	
Age of child (in months)		
< 1 month (neonatal)	0.9%	39.5%
1–11 months (post-neonatal)	16.9%	27.7%
12–59 months (childhood)	82.2%	32.8%
Demographic variables		
Child's gender		
Male	51.0%	53.5%
Female	49.0%	46.5%
Mother's age (at first birth)		
≤ 19	58.0%	67.2%
20–39	41.9%	32.7%
≥ 40	0.1%	0.1%
Ethnic origin		
Hausa/Fulani/Kamuri	48.9%	57.9%
Igbo	12.6%	9.2%
Yoruba	11.0%	5.8%
Others	27.5%	27.1%
Religion		
Christian	35.9%	28.0%
Muslim	64.1%	72.0%
Socioeconomic variables		
Maternal education		
No formal education	46.5%	58.1%
Primary	14.9%	15.4%
Secondary	30.4%	22.2%
Tertiary	8.2%	4.3%
Paternal education		
No formal education	37.5%	49.1%
Primary	14.1%	14.9%
Secondary	33.7%	27.5%
Tertiary	14.7%	8.5%
Wealth index (household)		
Poorest (1)	22.2%	30.7%
Poorer (2)	22.6%	28.0%
Middle (3)	20.6%	20.5%
Richer (4)	18.4%	13.2%
Richest (5)	16.2%	7.6%
Environmental variables		
Place of residence		
Urban	38.6%	26.5%
Rural	61.4%	73.5%
Geopolitical zones		
North Central	13.5%	14.8%
North East	18.3%	22.8%
North West	36.5%	42.4%
South East	10.1%	7.9%
South South	8.7%	5.7%
South West	12.9%	6.4%
Sample size	33,741	3194

Table 2. Descriptive statistics of variables used in the study and distribution of under-five (0–59 months) deaths across the demographic, geographic and socioeconomic characteristics.

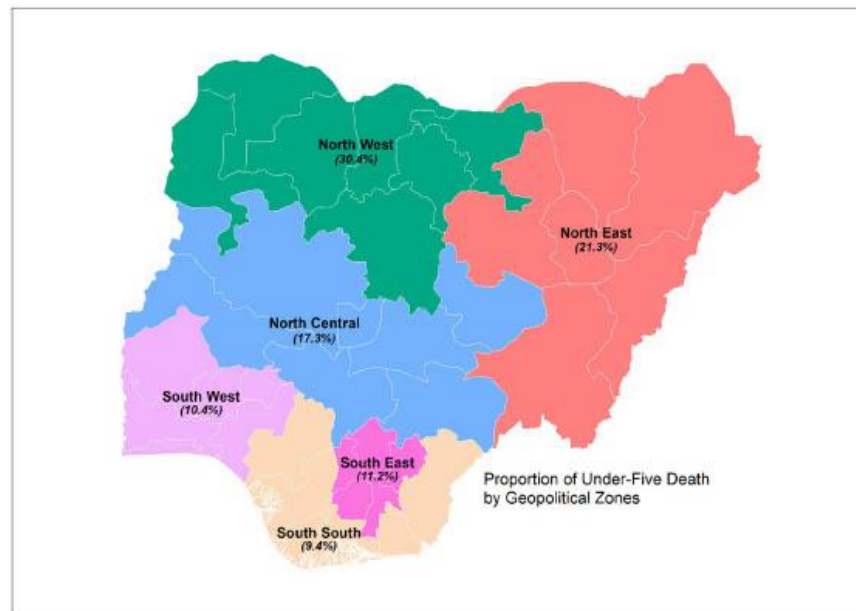


Figure 1. Proportion of under-five (U5) death by geopolitical zones of Nigeria (Source: <http://www.gadm.org> (data); software: ArcMap version 10.8.1 (Esri), <http://www.esri.com>).

the under-five death occurred among the three lowest wealth quintiles: poorest (22.2%), poorer (22.6%) and middle (20.6%).

About 61.4% of the U5M occurred in rural areas, while the remaining 38.6% occurred in urban areas in Nigeria. Of the six geopolitical zones, 68.3% of U5M occur in the three northern geopolitical zones: North West (36.5%), North East (18.3%), and North Central (13.5%) compared to their southern counterparts (31.7%). The majority of U5M occurs among those residing in rural areas (73.5%).

Figure 1 presents proportion of under-five death by geopolitical zones in a Nigeria map. Of the six geopolitical zones, North West (30.4%) followed by the North East (21.3%) and North Central (17.3%), had the highest under-five death compared to the South East (11.2%), South West (10.4%) and South South (9.4%).

Figure 2 shows the Kaplan–Meier estimates of the survival graph for all the under-five children. The horizontal axis indicates the time to event in months, while the vertical axis shows the survival probability or the proportion of under-five children surviving. At time 0, the survival probability is 1.00 (i.e. 100% of the participants are alive). Thus, the result indicates most under-five death occurs at earlier months after birth.

Figure 3 graphically presents Kaplan–Meier survival estimates of under-five mortality by household wealth index quintiles. The graph shows that the top wealth quintiles had higher under-five survival probability than the bottom quintiles. The survival probability is high for the richest but relatively low for the poorest. Even so, the survival probability of the poorer and the poorest were almost the same. The statistically significant value of the log-rank test for equality of survivor functions for household wealth index ($\chi^2 = 217.89$, $P < 0.001$) indicates differences in survival probability among different socioeconomic groups.

Figure 4 plots the Kaplan–Meier survival estimates of under-five mortality by geopolitical zones. The graph indicates that the North West followed by the North East and the North Central have the most at risk of survival among the six geopolitical zones while South South, South East and South West have a lower risk of survival. The geographic zones log-rank test for equality of survivor functions is statistically significant ($\chi^2 = 307.45$, $P < 0.001$).

Table 3 presents the results of the Cox proportional hazard regression analysis. It assesses the influence of different factors on the survival time of under-five children. The demographic variables included in Model 1 assessed the independent influence of demographic factors on the risk of under-five deaths. The result shows that U5M is 15.5% higher among male children (HR: 1.155; 95% CI 1.070–1.247, $p < 0.001$) than female children. Moreover, U5M is 25.4% higher in children born to mothers age ≤ 19 at first birth (HR: 1.254; 95% CI 1.148–1.369, $p < 0.000$) than children born to mothers age 20–39 at first birth. Further, the results show that mortality by ethnic origin is 47.8% (HR: 0.522; 95% CI 0.437–0.625, $p < 0.001$); 24.7% (HR: 0.753; 95% CI 0.625–0.907, $p < 0.003$) and 25.9% (HR: 0.741; 95% CI 0.661–0.830, $p < 0.000$) lower for children whose mothers are from the Yoruba, Igbo and other ethnic origin respectively, compared to the children whose mothers are of Hausa/Fulani/Kanuri origin. More so the U5M is 26.2% higher among children born to Muslim mothers (HR: 1.262; 95% CI 1.110–1.434, $p < 0.001$) than children born to Christian mothers.

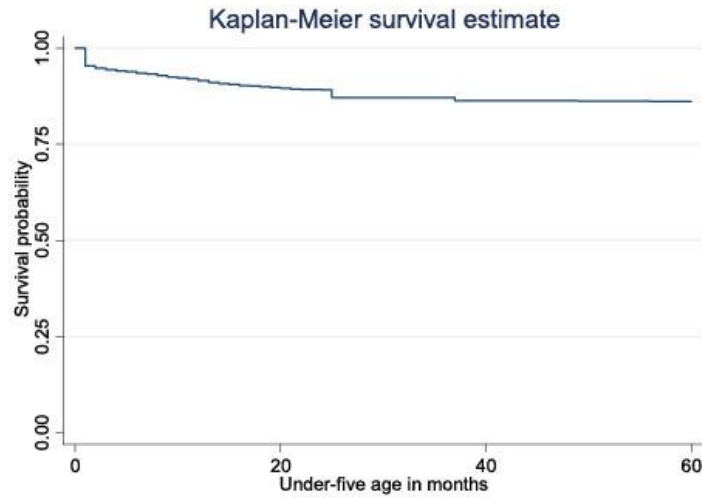


Figure 2. Plot of the overall estimate of the Kaplan–Meier survivor function of under-five mortality in Nigeria.

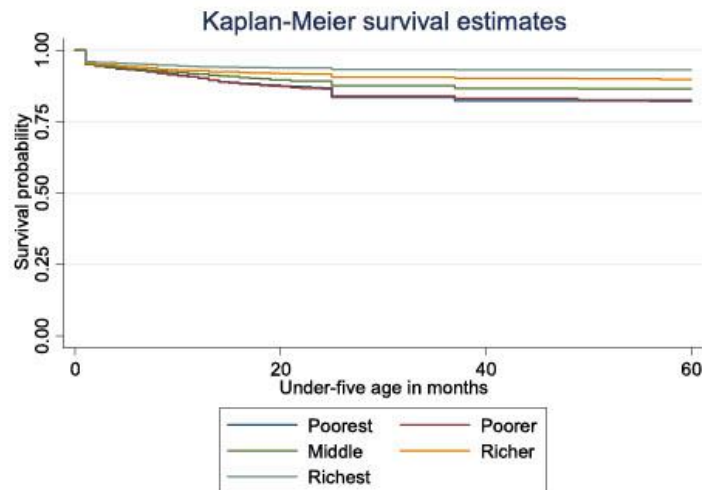


Figure 3. Plot of the Kaplan–Meier survival estimates of under-five mortality by household wealth index quintiles in Nigeria, 2018.

Model 2 examines the influence of demographic and socioeconomic variables on the risk of under-five deaths. Results indicate that U5M is 15.2% higher for male children (HR: 1.152; 95% CI 1.064–1.247, $p < 0.001$) than females. In addition, U5M is 15.7% higher in children born to mothers aged ≤ 19 at first birth (HR: 1.157; 95% CI 1.052–1.271, $p < 0.003$). Children of Yoruba (HR: 0.667; 95% CI 0.548–0.812, $p < 0.000$) and other ethnic origins (HR: 0.797; 95% CI 0.708–0.896, $p < 0.001$) had 33.3% and 20.3%, respectively lower U5M compared with the Hausa/Fulani/Kanuri ethnic origin. About 22.0% U5M occurs among children of Muslim mothers than children of Christian mothers. These findings show a significant association between U5M and paternal education. Results show that children born to fathers with no formal education (HR: 1.328; 95% CI 1.107–1.592, $p < 0.002$), primary education (HR: 1.252; 95% CI 1.035–1.515, $p < 0.021$) and secondary education (HR: 1.180; 95% CI 1.000–1.392, $p < 0.050$) had 32.8%, 25.2% and 18.0%, respectively, have a higher risk of U5M compared

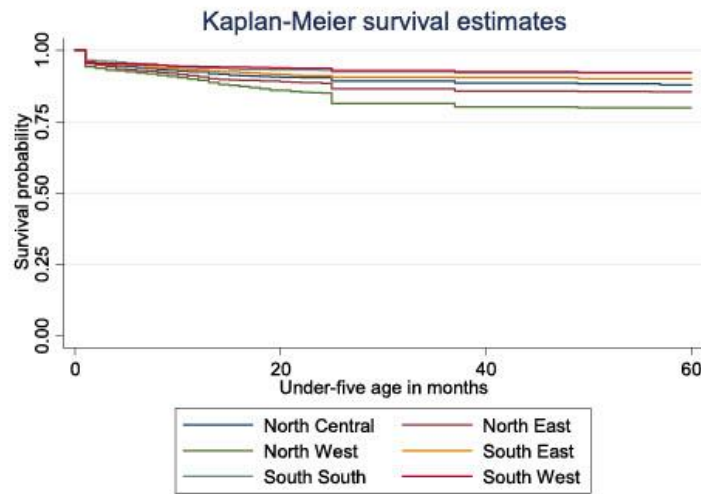


Figure 4. Plot of the Kaplan–Meier survival estimates of under-five mortality by geopolitical zones in Nigeria, 2018.

to children born to fathers with tertiary education. Of the household wealth index quintile, the richest (HR: 0.639; 95% CI 0.522–0.783, $p < 0.001$) and richer (HR: 0.804; 95% CI 0.689–0.937, $p < 0.005$) groups had 36.1% and 19.6%, respectively, lower risk of U5M compared with the poorest quintile group.

Finally, the results of Model 3 for demographic factors were consistent with Models 1 and 2 results. In the same vein, results indicate that children born to fathers with no formal education (HR: 1.360; 95% CI 1.133–1.631, $p < 0.001$), primary education (HR: 1.279; 95% CI 1.056–1.550, $p < 0.012$) and secondary education (HR: 1.204; 95% CI 1.020–1.421, $p < 0.028$) had 36.0%, 27.9% and 20.4%, respectively, higher risk of U5M compared to children born to fathers with tertiary education. Moreover, results suggest that the richest (HR: 0.703; 95% CI 0.567–0.872, $p < 0.001$) and richer (HR: 0.865; 95% CI 0.735–1.018, $p < 0.082$) wealth quintile groups had 29.7% and 13.5%, respectively, lower risk of U5M compared with the poorest quintile. Of all the geopolitical zones, children born to mothers living in the North West (HR 1.634; 95% CI 1.238–2.156, $p < 0.001$) had 63.4% higher risk of U5M than South West zone.

Discussion

Evidently, under-five mortality rate (U5MR) is the highest in sub-Saharan African countries and Nigeria in particular. Notwithstanding that, these deaths are preventable in part by addressing the associated demographic, geographic, and socioeconomic factors¹⁸. This study investigates the geographic and socioeconomic survival differences of under-five in Nigeria.

Findings from the Kaplan–Meier survival estimates show the most U5Ms occur within 12 months after birth with the poorest most at risk of U5M while the richest are the least affected across household wealth index quintiles. The findings are in tandem with the UNICEF report that under-five deaths are increasingly concentrated in the neonatal period^{5,36}. Besides, our finding is in line with the assertion by Larrey and colleagues that the probability of a child's survival increases as the child progresses in age and that the survival probability is lower for children from the poorest families but higher for the children from the richest families³³. Therefore, U5M reduction interventions may target children under 12 months of birth given their fragile immune systems. This is to protect them from the perennial environmental threats to child health such as malaria (from mosquito bites), lack of clean water, and poor sanitation^{2,17}.

Further, the finding shows that of the six geopolitical zones in Nigeria, the northern zones especially North West, North East and North Central are at the most risk of U5M. Earlier studies^{6,23,27} corroborate that the risk of under-five deaths is higher in the North West and North East regions owing to higher proportions of home delivery and complications during childbirth, younger age at birth of first child, and poor utilization of modern health facilities compared to the southern region. The finding establishes that geopolitical setting strongly influence the health and survival chances of children¹, thus, implying that U5M risks could be contained depending on the geopolitical environment children in which find themselves¹⁶.

As a corollary, our study shows that children born to mothers living in rural areas experience higher U5M compared to their urban counterparts. Often children born to poor mothers in rural areas are delivered at home³⁸. This is not surprising as modern health care is not easily available in rural areas as in the urban area, hence, urban areas are reported to have lower U5Ms than rural areas^{6,18,27}.

Variables	Model 1	Model 2	Model 3
	HR (95% CI)	HR (95% CI)	HR (95% CI)
Demographic factors			
Child's gender			
Female (ref)	1	1	1
Male	1.155 (1.070–1.247)**	1.152 (1.064–1.247)**	1.154 (1.066–1.250)**
Mother's age (at first birth)			
≤ 19	1.254 (1.148–1.369)**	1.157 (1.052–1.271)**	1.144 (1.041–1.258)**
20–39 (ref)	1	1	1
≥ 40	1.604 (0.400–6.427)	1.785 (0.445–7.161)	1.836 (0.457–7.371)
Ethnic origin			
Hausa/Fulani/Kanuri (ref)	1	1	1
Igbo	0.753 (0.625–0.907)**	0.877 (0.716–1.075)	1.122 (0.789–1.596)
Yoruba	0.522 (0.437–0.625)**	0.667 (0.548–0.812)**	0.908 (0.684–1.205)
Others	0.741 (0.661–0.830)**	0.797 (0.708–0.896)**	0.957 (0.834–1.099)
Religion			
Christian	1	1	1
Muslim	1.262 (1.110–1.434)**	1.220 (1.061–1.403)**	1.147 (0.990–1.328)*
Socioeconomic factors			
Maternal education			
No formal education		0.971 (0.751–1.256)	0.962 (0.744–1.244)
Primary		1.000 (0.777–1.288)	1.011 (0.785–1.301)
Secondary		0.941 (0.750–1.182)	0.953 (0.759–1.196)
Tertiary (ref)		1	1
Paternal education			
No formal education		1.328 (1.107–1.592)**	1.360 (1.133–1.631)**
Primary		1.252 (1.035–1.515)**	1.279 (1.056–1.550)**
Secondary		1.180 (1.000–1.392)**	1.204 (1.020–1.421)**
Tertiary (ref)			
Wealth index (household)			
Poorest (1) (ref)		1	1
Poorer (2)		1.080 (0.971–1.201)	1.064 (0.956–1.184)
Middle (3)		0.956 (0.843–1.083)	0.987 (0.868–1.122)
Richer (4)		0.804 (0.689–0.937)**	0.865 (0.735–1.018)**
Richest (5)		0.639 (0.522–0.783)**	0.703 (0.567–0.872)**
Environmental factors			
Place of residence			
Urban (ref)			1
Rural			1.087 (0.974–1.212)
Geopolitical zones			
North Central			1.199 (0.927–1.552)
North East			1.221 (0.928–1.608)
North West			1.634 (1.238–2.156)**
South East			1.072 (0.726–1.581)
South South			0.946 (0.701–1.277)
South West (ref)			1
Log rank test (p-value)			$\chi^2 = 307.45$ (p < 0.001)

Table 3. The Cox's proportional hazard ratios (HR) with 95% confidence interval (CI) for factors affecting under-five mortality in Nigeria 2018. **p < 0.05, *p < 0.1.

The Cox proportional hazard regression models show that paternal education is negatively related to U5M: increased paternal education leads to a reduction in U5M and vice versa. This is in tandem with the assertion that parental education increases a child's survival probability³⁰. However, contrary to expectations the maternal education was not statistically significant although mothers' education has a relatively higher impact on child mortality than fathers' education and many other socioeconomic factors^{27,33,38,39}. This could be due to the finding that mothers in northern Nigeria have a higher proportion of no education or primary education³⁷ due to early

marriage (before age 16 years)²³ and combined with the fact that culturally, husbands are the overall decision-makers and breadwinner, especially in the regions⁴⁰.

Moreover, the Cox regression model of the household wealth index shows that the rich had lower risk of U5M compared to the poor as shown in Cox models 2 and 3. A study in India affirms that the risk of child mortality is the highest among the poor⁴¹. It presupposes that a targeted intervention to the poor is necessary to close the gap.

This study also shows that children from Hausa/Fulani/Kanuri ethnic origin (northern region) experience more under-five mortality compared to the southern region. Earlier studies in Nigeria, indicates that a child born in the North West has a 2.5 times higher probability of dying before age five than one born in the South East⁴². This could be due to the preponderance of early marriage commonly practiced in northern Nigeria. Thus, given that education is a fundamental factor to consider in terms of child survival irrespective of region, formal education sensitization particularly in northern Nigeria would help alleviate childhood mortality in the country⁶.

The results consistently indicate that male children have higher mortality compared with female children. This is supported by literature that males have a higher mortality in infancy in both Nigeria and globally⁴³. It brings to fore the findings of Wegbom and colleagues that U5M in Nigeria is diversely affected by health-related factors and non-health sector factors such as demographic, economic, environmental, social, and security²¹. Therefore, it requires a health equity-in-all policies approach to tackle under-five mortality⁴⁴.

The strength of this work is the use of the Kaplan–Meier survival estimates and Cox proportional hazard model for analysing time-to-event data and censored observations. Nevertheless, this study is subject to some limitations. Firstly, although DHS is a renowned reliable data source on child mortality^{2,36}, we acknowledge the inherent data collection challenges that could manifest through misreporting of age of child or age at death in months. Secondly, our analyses focused on U5M over the last 5 years, and the household wealth index constructed for the survey year was used as one of the proxies for socioeconomic status. Since, changes in household wealth often occur in the long-run, the current measures of wealth index can be a valid proxy for past values⁴⁵. Notwithstanding this, the current measure of both dependent and independent variables would have been ideal for the analysis. Lastly, as our analyses were based on retrospective cross-sectional data, temporality could not be established between explanatory variables and geographic or socioeconomic inequality in U5M; thus, impeding causal inference.

Conclusion

Achieving a reduction in U5M is a public health concern that requires a multi-dimensional approach. There is a need to tailor U5M reduction interventions to the critical survival time of 12 months after birth. A target intervention in geopolitical zones especially the North West, North East and North Central will be of utmost importance to increase access to needed health care services. In addition, increased formal education particularly in northern Nigeria is vital for U5M reduction in the country, given that education is a fundamental factor to consider in terms of child survival irrespective of region.

Data availability

Data for this study is publicly accessible upon request from the DHS website: <https://www.dhsprogram.com/data/available-datasets.cfm>.

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Author contributions

C.I.O. conceptualized the study, performed the statistical analysis, and prepared the first draft of the manuscript. M.H. and R.K. supervised the statistical analysis. M.H., R.K., M.M.R., and C.I.O. reviewed the final version of the manuscript. All authors read and approved the final manuscript.

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Competing interests

The authors declare no competing interests.

Additional information

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CHAPTER 6: PAPER 5 – OUTBOUND MEDICAL TOURISM FROM NIGERIA: A SCOPING REVIEW OF IMPLICATIONS ON MATERNAL AND CHILD MORTALITY

6.1. Introductory paragraph

The common denominator of the four previous papers in Chapters 2 to 5 centres on the issue of access (availability, accessibility, affordability and acceptability) to healthcare services, especially among women of a child-bearing age residing in socioeconomically disadvantaged geopolitical zones, leading to higher maternal and child mortality. It re-echoes that the SDGs, especially goals three and five, cannot be attained without increasing availability, access, demand for, and utilisation of existing health services (Serbanescu et al. 2022). Evidently, access to effective healthcare is a major challenge in Nigeria due to perennial neglect, underfunding and indifference by government officials that frequently seek medical treatment abroad. Therefore, paper 4 examines the implications of outbound medical tourism on maternal and child mortality in Nigeria. The paper as at the time of writing is being peer-reviewed for *Public Health* journal.

6.2. Paper 5: *Public Health* manuscript number: PUHE-D-22-02108.

Outbound medical tourism from Nigeria: a scoping review of implications on maternal and child mortality

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Abstract

Objective: This study aimed to examine the implications of outbound medical tourism on maternal and child mortality in Nigeria.

Study design: This was a scoping review study

Methods: The review followed the Arksey & O'Malley's methodological framework and PRISMA-Scoping Review guidelines. The Web of Science, PubMed, Ebscohost, Science Direct, and Google Scholar databases were searched for relevant articles. Grey literature and snowball approaches were engaged to complement the database searches. Literature searches were limited to articles published in English from 2000 – 2021. Data were descriptively synthesised using the WHO healthcare delivery building blocks.

Results: Of the 32 articles included out of the 2,957 articles, 23(74.2%) indicated lack of confidence in the country's healthcare system due to inadequate infrastructure, poor human resources management, poor remuneration, improper medical treatment, corruption, poor healthcare financing, shortage of essential drugs/supplies, and incessant industrial disharmony. All of which motivate Nigerians to embark on medical tourism. The reviews show that over 5,000 citizens 'fly out' monthly for various forms of medical treatment abroad. Approximately, US\$ 1.2 billion is lost to capital flight from medical tourism yearly. Medical tourism affects the development of the health system thereby contributing to increase in maternal and child mortality rates in the country. The review calls for ban on sponsored government official's medical care overseas.

Conclusions:

The Nigeria healthcare system needs to be overhauled to restore confidence and trust in the provision of public healthcare. The government should regulate public servants funded medical treatment overseas to control the prevalent outbound medical tourism.

Keywords: Outbound medical tourism, maternal mortality, child mortality, scoping review, Nigeria.

Introduction

The main goal of a health system is to ensure delivery of accessible, affordable, equitable and safe health services to the population ^{1, 2}, partly because if access to health services were distributed according to need, the poor would come first. But they do not ³. Therefore, it is the responsibility of the government of any country to take adequate measures to ensure that the best healthcare system is available to its population ⁴. Access to high-quality health care is a human right and moral obligation for every country ⁵

Although the delivery of high-quality healthcare service is critical for population health, many healthcare facilities in Nigeria, especially government-owned hospitals are in a deplorable state ^{6, 7}. In most of the states, health systems are facing several challenges due to perennial neglect ⁸. Besides, some government officials unconscionably have contributed to the ailing health system by embarking on outbound medical tourism (i.e., travel from less developed to developed countries to seek better medical treatment) ^{9, 10}

Outbound medical tourism is fast becoming a culture among many Nigerians due to the weak healthcare system in the country ^{6, 11}. In Nigeria and other sub-Saharan African countries, a woman's lifetime risk of dying in pregnancy or childbirth is about 1 in 36 compared with 1 in 4 900 in high-income countries ¹². It is estimated that 75 percent of maternal deaths might be prevented through timely access to essential emergency childbirth-related care ¹³. All of these problems have made people lose confidence in the health sector ^{14, 15}. Thus, providing healthcare services without guaranteeing a minimum level of quality is ineffective, wasteful, and unethical ⁵.

Consequently, the average Nigerian, especially pregnant women and the underprivileged bear the brunt of the poor healthcare system ¹⁶. While the Nigerian political class and the wealthy seek medical care abroad, leaving behind underfunded government hospitals characterized by

dilapidated infrastructure, a dearth of state of the art equipment and incessant healthcare worker strikes ¹⁷.

In Nigeria, 1 in 13 women die in childbirth, with 145 women dying daily ¹⁸. Nigeria's maternal mortality ratio (MMR) exceeds the average for the African continent, with the country accounting for significant 10 percent of the global burden ¹⁹. The high maternal (512 per 100,000 live births in 2018) and child (132 deaths per 1,000 birth) mortality rate in Nigeria is a result of multi-faceted causes amongst which is the spate of outbound medical tourism ^{4, 15, 20, 21}.

Against this background, there is a need to examine the implications of outbound medical tourism on maternal and child mortality in Nigeria. Previous studies had explored effects of medical tourism in Africa ²², implications of medical tourism on public healthcare development in a developing nation ⁷ and consequences of medical tourism on the Nigeria healthcare system ²³, but none had examined the implication of outbound medical tourism on maternal and child mortality in Nigeria. This is vital, if Nigeria hopes to achieve the United Nations Sustainable Development Goals (SDG) 3 target to reduce maternal mortality ratio to 70 per 100,000 live birth and new-born mortality ratio to <12 per1000 live birth by 2030.

Methods

The study method was developed in line with the methodological guidelines on scoping reviews²⁴⁻²⁸. The following steps for the scoping review were adopted.

Step 1: Specifying objectives and research questions

The aim of the review is to examine the implications of outbound medical tourism on maternal and child mortality in Nigeria. This has been informed by the fact that a significant number of Nigerians, especially government officials/political classes travel abroad using public funds each year to seek medical treatment mainly because the healthcare system is poorly funded and dysfunctional²⁹⁻³¹. This problem is more apparent in government hospitals where many believed that they would get the best care, but cases of negligence abound such that maternal and child healthcare issues are rarely investigated¹⁸. This review is conducted using the following research questions:

1. What are the issues that motivate people to opt for medical tourism outside Nigeria?
2. Which socioeconomic group and/or social class in Nigeria takes advantage of outbound medical tourism?
3. What do we know from the existing and/or grey literature about the implications of outbound medical tourism on maternal and child mortality in Nigeria?

Step 2: Identifying relevant studies

The following databases were searched between 9th August and October 2021: Ebscohost Megafire Ultimate, Science Direct, Wiley online library, Google Scholar, Scopus and PubMed, and Web of Science. In addition, a snowball search in Google was conducted to retrieve relevant references from the included articles. Grey literature such as reports and newspaper articles and magazines were also identified and retrieved. In line with a scoping review, the search strategy was not limited to any study design. The review, however, was

limited to articles published in the English language because Nigeria's language is English. In order to ensure the literature search was thorough, the university's library support officer provided necessary assistance to the authors. Several keywords based on the study aim and research questions guided our literature search (see Appendix 1 for the search strategy used).

Step 3: Study selection

We included articles published from 2000 to 2021 (i.e., over 20 years) to ensure they covered more than two civilian administrations in Nigeria, which gives a clearer trajectory of the country's healthcare system. After a review of the title and abstract, the research questions formed the basis to select the final articles. Full texts of selected articles were retrieved for the scoping review. The flow diagram in Figure 1 in the results section presents the inclusion and exclusion criteria of the articles.

Step 4: Charting the data

A data charting form was developed in line with research questions using a 2016 Excel spreadsheet. It was further refined with inputs from co-authors (see supplementary data file). The following information was extracted from the charting form: Author(s), Type of evidence, Aim/purpose, What motivates people to opt for medical tourism outside Nigeria? Which socioeconomic group/social class in Nigeria uses outbound medical tourism? What do we know from the existing and/or grey literature about the implications of outbound medical tourism on maternal and child mortality in Nigeria?, and Key findings.

Step 5: Collating, summarizing and reporting the results

We collated and thematically organized the chart data based on the research questions. Evidently, the Nigerian healthcare system suffers from neglect, underfunding and incessant health worker strikes¹⁰ and leading to loss of confidence in public health facilities. Hence, the attendant medical tourism and the themes were discussed in line with the six World

Health Organization (WHO) healthcare delivery building blocks ¹⁰: (1) Service delivery; (2) Healthcare workforce; (3) Healthcare information systems; (4) Medicines and technologies; (5) Financing; and (6) Leadership/governance. Report of findings followed the systematic reviews and meta-analyses extension for scoping reviews (PRISMA-ScR). However, the optional stakeholder consultation and quality assessment were not conducted.

Patient and Public Involvement:

No patients or public participated in any stage of this review.

Results

The literature search resulted in the total number of 2,957 identified articles. Of these articles, 2,889 were excluded because they fell beyond the scope of the topic. Thirty-six (36) full-text articles were excluded because they did not focus on the research questions. The final 32 articles were included for the scoping review (Figure 1)

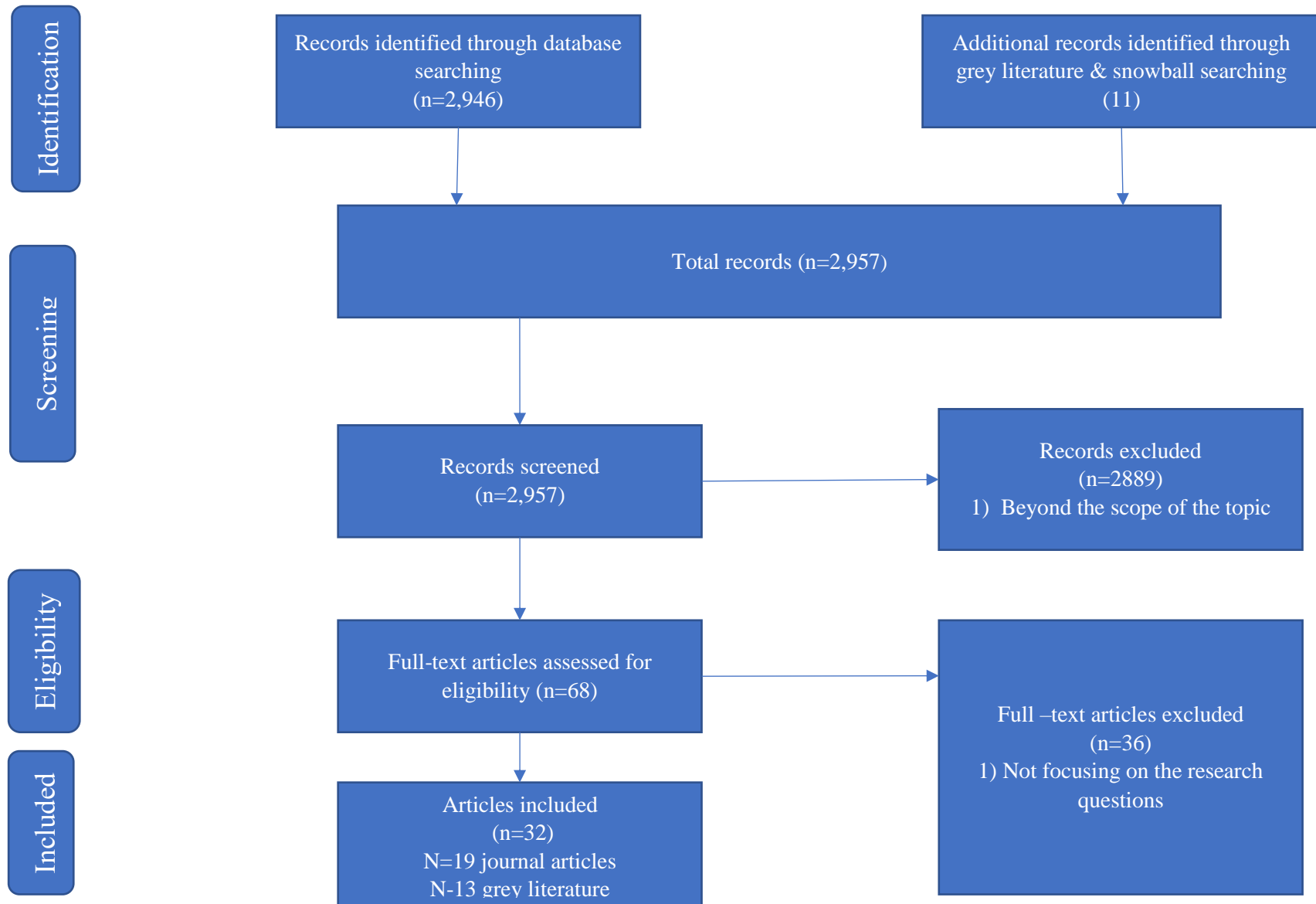


Figure 1: Adapted PRISMA-ScR flow diagram for study selection

Summary of chart data from the included articles

The findings of this scoping review have been summarized as follows (see supplementary data file for detailed chart data of included articles):

1. What motivates people to opt for medical tourism outside Nigeria?

About 23 (74.2%) of the 32 articles reviewed suggest that Nigerians' decision to travel abroad for medical treatment was motivated by their lack of trust in the country's healthcare system. This was due to a variety of factors, including inadequate infrastructure, inadequate human resource management, low pay, improper medical care, corruption, inadequate health care financing, a lack of necessary drugs and supplies, and recurring industrial unrest, among others ^{4, 6, 8, 11, 14, 15, 21, 22, 31-37}.

2. Which socioeconomic group or social class in Nigeria takes advantage of outbound medical tourism?

Literature shows that most elites, starting from Nigerian Presidents, Governors, Ministers and other wealthy individuals since the democratic dispensation represent the largest proportion of individuals who have gone outside the country for medical attention ^{7, 21, 29, 30, 38}. Some elites, public and political office holders see it as a status symbol, even when such medical conditions or medical care needs can be satisfactorily attended to in Nigeria ^{11, 15, 22, 30, 36}.

Many of the hospitals, especially government-owned hospitals in and around the country, are not leaving up to expectations ¹⁵. The quality of healthcare has drastically diminished owing to the indifferent attitude of health caregivers, infrastructural inadequacies, and improper medical procedures.

3. What do we know from the existing and/or grey literature about the implications of outbound medical tourism on maternal and child health mortality in Nigeria?

Literature reveals outbound medical tourism by Nigerians affect several sectors of the country, one of which is a reduction in the revenue for sustaining local health sector ^{4, 36, 39}. For instance, about US\$ 1.2 billion is lost to medical tourism annually in Nigeria, which could have been invested in the development of the country's health care system ^{6, 21, 31, 32, 38}. It seems that the health sector in Nigeria is being denied the much-needed funding which is affecting its development ³⁹, thereby culminating in lack of trust in medical practitioners and high mortality rate. The maternal mortality rate (about one mother's death in 100 deliveries) is one of the highest in the world. Some other health status indicators such as under-5 mortality rate and adult mortality rate are higher than the average for Sub-Saharan Africa ⁷.

If the President, Vice President, Senate President, House of Representatives Speaker, Federal Executive Council members, Governors and Deputy Governors and other political office holders were to seek medical care and conduct health checks in public hospitals in Nigeria, public health facilities would be given necessary attention ⁴⁰. In other words, since Nigerian politicians generally do not use healthcare services in the country, but rather seek medical treatment abroad, the ambition for a better health infrastructure will remain an illusion. For example, Lagos University Teaching Hospital was once one of the best on the continent, but is now criticised for degeneration ³⁰. When people entrusted with leadership responsibility ignore public health systems because they can afford private health care at home or abroad, ordinary citizens, especially the pregnant women and vulnerable, bear the brunt.

A complete overhaul of the healthcare sector is overdue to contain perennial maternal and child mortality in the health sector ³⁵. There is a need for significant investment in the healthcare industry in Nigeria by investing in infrastructure, human resources for health,

technology, hospital/medical supplies, and drugs for higher coverage of a number of conditions, as well as improved public health services ⁸.

Key findings

The reviews showed that Nigerians undertake outbound medical tourism due to improper medical treatment in the home country, infrastructure inadequacies, and availability of qualified health service providers abroad ²¹. Over 5,000 citizens ‘fly out’ on a monthly basis, seeking medical treatment in China, Dubai, India, Saudi Arabia, United Kingdom, United States and other countries ^{37, 40, 41}. If the money spent by some Nigerian government officials and the Nigerian elites on medical tourism abroad is invested in infrastructural development and they seek medical treatments in Nigeria, the health system of Nigeria would be much better ³⁹.

Most of the government owned hospitals in the country are ill-equipped and in a dilapidated state ^{6, 21}, owing to poor funding, shortage of medical facilities and personnel, and poor medical service delivery ^{4, 37}. Indeed, poor healthcare services in the country have contributed to increase in mortality rates in the country ¹⁵.

Funding of healthcare from the general health budget is still poor. The current allocation is almost four percent of the budgets, with erratic and none release of the allocated budgets. The budgetary allocation for the sector hardly achieves the target envisaged during budget implementation. Corrupt officials and their collaborating suppliers and contractors embezzle most of these funds ¹⁵. Corruption in the health sector can be a matter of life and death, especially for the poor, as it restricts access to quality health care, which in turn contributes to significant morbidity and mortality ⁴².

Discussion

This scoping review examined the implications of outbound medical tourism on maternal and child mortality in Nigeria. Available evidence established that Nigeria is undoubtedly one of the countries that incurs a high economic cost burden from medical tourism³⁹. It loses enormous amounts of foreign exchange that could have been deployed to refurbish hospitals and create jobs⁴³. The review findings collaborate Snyder, Byambaa⁴⁴ assertion that medical tourism have potential negative consequences for the economies and health systems of countries with significant numbers of outbound medical tourists.

Against this backdrop and coupled with the SDG mandate to achieve access to quality essential healthcare services by 2030, we assessed the implications from the viewpoint of the six WHO's healthcare delivery building blocks²:

Service delivery

Although a good service delivery comprises quality, access, safety and adequate coverage², the scoping review shows that Nigeria's health system faces the problems of poor quality of service delivery, poor funding, inadequate human resources for health capacity, poor infrastructure, and inadequate specialist services, among other flaws. Since the quality of care offered to clients influence where they seek or receive care³⁸ outbound medical tourism has become a norm in Nigeria^{8, 41, 45}. There would be less need for outbound medical tourism if people could access equivalent quality of care in the home countries⁴⁶.

In Nigeria, health services (supportive care) that are basic and essential for women in other parts of the world remain unavailable to millions of women⁴⁷, especially to the poor in rural areas and city slums^{48, 49}. Fewer than 20% of healthcare facilities in the country offer emergency obstetric care²⁰. For instance, Oxytocin is an affordable and effective drug recommended to prevent postpartum haemorrhage. However, Oxytocin requires cold chain

supply from the point of manufacture to the point of use for it to maintain its effectiveness. However, most health facilities in Nigeria, especially those at the primary healthcare level, have no refrigerators or reliable electricity supply. Evidence shows that when poor-quality oxytocin is used, it fails to prevent post-partum haemorrhage, thereby leading to high maternal mortality⁵⁰. High quality of health systems could prevent half of all maternal deaths each year⁵.

In Nigeria, the leading contributory factors of maternal deaths include inadequate equipment, lack of ambulance transportation, delay in referrals services and inadequate human resources for health⁵¹. All the above point to weak health system, which perhaps could not have been if the health system is well funded and the government officials/political class access healthcare treatment in the country. If the public officials do not trust the health system under their watch then who is going to trust it⁴⁴. Thus, government needs to invest in improved health service delivery to limit demand for outbound medical travel from own citizens⁴⁶.

Health workforce

The scoping review records spate of strikes by doctors and other healthcare professionals, owing to the neglect of their welfare and inadequate working environment⁸. The poor staff welfare and salaries, occasioned by the government inability to implement agreements have been the common causes of healthcare worker strikes in Nigeria. This has resulted in disruption to service delivery and training programmes, leading to increased morbidity and mortality of patients and loss of confidence in the hospitals¹⁰. Nigerians are leaving the country for medical tourism because tertiary care is not living up to expectations⁴¹. A well performing workforce consists of a well-remunerated and trained workforce, and sufficient and well-maintained facilities^{1,2} and Nigeria's health system is lacking in these qualities¹.

Health information system

Better information is an essential requirement for better health because without quality information on where, when, and why maternal deaths occur, we cannot effectively tackle the real causes of maternal and child mortality⁵². Nigeria's Health Information System is not only weak, but also fragmented with numerous vertical programmes, which are mostly donor-driven²⁰. There is a dearth of robust population-level health and mortality data⁵³. Given the scenario, preventing maternal and child deaths is challenging and can only be contained if timely and reliable data is available to support targeted interventions^{2, 52}.

Medical products, vaccines and technologies

The review shows that Nigeria largely depends on importation to meet its local needs for medicines, vaccines, and health technologies²⁰. However, studies indicate that medicines and other supplies from public facilities are available for resale at private facilities, resulting in unnecessary shortages of medications and supplies in public facilities⁴². Consequently, women, especially in hard-to-reach areas are hardest hit when it comes to accessing quality healthcare and life-saving maternal medicines (such as Uterotonic, Oxytocin) used to manage complications⁵⁴. This is in contrast with the WHO's guideline that procurement and supply programs need to ensure equitable access, assured quality and cost-effective use².

Financing

A good health financing system raises adequate funds for health, protects vulnerable people from financial catastrophe, allocates resources, and purchases goods and services in ways that improve quality, equity, and efficiency². In Nigeria, healthcare budget spending is about 3.75 percent of the national budget⁴¹. The budget allocations also encounter delays and non-

release of the allocated budgets ⁸. The budgetary allocation for the sector hardly gets to the target layers envisaged during budget implementations due to corruption ¹⁵.

The paucity of funding of healthcare services by the various tiers of government (Local, State and Federal) in Nigeria leads to increased out of pocket payments and many poor and vulnerable Nigerians cannot pay for these services ⁸. Over 40% of the citizens are living below the poverty line of <\$1.90 per day ⁹. Data show that the level of out-of-pocket payments as a share of total health expenditure in Nigeria is still placed at 72%, the highest on the continent and one of the highest in the world ⁸.

Leadership and Governance

Effective leadership and governance ensure effective oversight, regulation, and accountability ². In Nigeria, weak governance undermines the functioning of health systems ⁴⁸. It manifests through political interference in the management of health institutions: poor human resource management, including recruitment, training, promotions and transfers; and poor allocation of resources resulting in low professional standards in the delivery of health services ⁴⁸, embezzlement and/or heavy pilfering of public funds by government officials ¹⁵.

In addition, most governments in Nigeria ‘play politics’ with healthcare such that communities that support incumbent governments receive health services over those that do not ⁵⁵. Studies show that countries such as Nigeria with widespread corruption in the health sector ^{55, 56} are associated with higher maternal and child mortality ⁴². The performance of a health system is more effective when there is strong governance and effective institutions, which may entail transparent funding mechanism ^{45, 57}. If the country tackles its most difficult obstacles of poor accountability, inefficiency and corruption, it has enormous potential to transform the health sector ⁵³.

Nevertheless, public satisfaction is a goal for the politicians and policymakers of every government⁵⁸. The dismal trends in maternal and child mortality are important markers of the general performance of the Nation's health sector²⁰. Therefore, it is important to collect satisfaction assessment survey from patients for every healthcare service delivery. It would help to ensure effective oversight and regulation of the health system performance.

Strengths and limitations

This scoping review followed the PRISMA-ScR guideline, using research questions as benchmarks for inclusion and exclusion criteria. Also, the non-appraisal of quality of included articles affords this review the opportunity of including articles from a range of different study designs and methodologies unlike in a systematic review that focuses on specific study design in advance. However, access to grey literature especially government reports on medical tourism was limited to digitally available articles. Although the optional stakeholder consultation was not conducted, but would be recommended in future research.

Conclusion

There is a need for a complete overhaul of the Nigeria health sector to restore confidence and trust on public healthcare delivery. In addition, it is vital to regulate government-sponsored outbound medical treatment for public officers. There is a need for strong political will, accountability, transparency and leadership by example to revamp Nigeria's health system. Otherwise, reversing the alarming outbound medical tourism, and containing the high maternal and child mortality in Nigeria will remain a mirage.

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Ethical approval

This research uses publicly available articles; therefore, ethical approval was not required.

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Appendix 1: Search strategy

Search strategy	Database	Number of results	Field search	Limits
("Infant mortality" OR "maternal mortality" OR "child mortality") AND ("medical tourism" OR "health tourism") AND ("health economics") AND politic*	Library search	42	All	2000-2021
("Infant mortality" OR "maternal mortality" OR "child mortality") AND ("medical tourism" OR "health tourism") AND ("health economics") AND politic*	Google scholar	287	All	
(medical tourism[MeSH Terms]) AND (nigeria)	PubMed	10	All	
(("Infant mortality" OR "maternal mortality" OR "child mortality") AND ("medical tourism" OR "health tourism"))	Scopus	130	Title, abstract, key, author's keyword.	
"health tourism" OR "medical tourism" OR "surgical tourism" OR "outbound medical travel" AND "Nigeria*" OR "Africa"	EBSCOHOST Megafire Ultimate	103	All	
"health tourism" OR "medical tourism" OR "surgical tourism" OR "outbound medical travel"	Science Direct	178	Review articles, research articles, social science & medicine, Int'l journal of Gynaecology & Obstetrics, Open access & Open archive	
"health tourism" OR "medical tourism" OR "nigeria" OR "maternal mortality" OR "infant mortality"	Web of Science	2,196	Health care sciences, tropical medicine, health policy services or literature, primary health care, critical care medicine, reproductive biology or nursing, plus citations	
Grey literature and snowball searching	Google	11	Based on references from selected articles	

Supplementary data (chart data of included articles)

Author(s)	Type of evidence	Aim/purpose	What motivates people to opt for MT outside Nigeria?	Which SES group/social class in Nigeria takes advantage of MT?	What do we know from the existing and/or grey lit. about the implications of MT on MCH services in Nigeria?	Key findings
Oleribe et al. 2019	Journal	To identify the principal challenges in the health sector in Africa and their solutions for evidence-based decisions, policy development and program prioritization.	Dilapidated healthcare systems have facilitated medical tourism, for example, leading to over 5000 people leaving Nigeria every month for various forms of treatment abroad and about 1.2 billion US dollars lost from the Nigerian economy to medical tourism yearly.		Healthcare systems in Africa suffer from neglect and underfunding, leading to severe challenges across the six World Health Organization (WHO) pillars of healthcare delivery.	Inadequate human resource and healthcare financing and poor leadership and management are the major challenges of healthcare systems in Africa. The major solutions outlined by the participants grouped into leadership and governance, healthcare workforce and healthcare financing.
Aiwerioghene et al. 2016	Journal	To do a critical analysis of the available literature comparing Indian and Nigeria healthcare system with regards to medical tourism.			Presently Nigeria is not a medical tourism destination. The huge amount spent on medical tourism annually in India by the Nigerian patients is a huge drain to the economy.	

Abubakar et al. Journal
2018

To examine the factors responsible for medical tourism in Nigeria and the measures that can be put in place to ensure that medical tourism can be curbed in the country.

Medical tourism is fast becoming a culture among many Nigerians due to the deplorable state of the health care system in Nigeria especially govt owned hospitals. Every month, almost 5,000 people leave the country for various forms of treatment abroad when such treatment should have been carried out in Nigeria. Recently, the Nigerian President travelled to a London hospital for ear infection which could have been treated at home

The social classes to which an individual belongs and personal beliefs of the beneficiaries of health services are what motivate individuals to seek medical help. More so, the negative attitude of health professionals to patients and medical negligence among health professionals in the country is also alarming.

About 1.2 billion dollars is lost to medical tourism yearly in Nigeria which could have been invested in the development of the country's health care system and the country as a whole. The Nigerian government should, as a matter of urgency, ban sponsored medical treatment for government officials abroad. It is therefore high time government officials started patronizing Nigerian hospitals. Leadership should be by example, when government imbibes this attitude, possibilities are that others will follow suit.

Most of the government owned hospitals in the country are ill equipped and in a dilapidated state. These facilities should be fully upgraded to meet the current health challenges of the teeming population. Government hospitals especially tertiary hospitals that attend to specialist cases should be adequately equipped with up-to-date medical facilities so that people can get adequate health services needed for their treatment and therefore discouraged from going abroad for medical treatment. Tackling the problem of medical tourism in Nigeria include: adequate funding, improved health care facilities, better remuneration and motivation for health workers, government intervention on the battle for supremacy among health workers, immediate ban of government sponsored medical treatment abroad, adequate training, enforcement of legal action against medical negligence, improved medical research and encouraging foreign investment.

Orekoya and Oduyoye 2018	Journal	To explore the implications of medical tourism on public health care development in a developing nation.	The key factors responsible for Nigerians to become medical tourists include inadequate health facilities and equipment, poor human resources management, lack of motivation and remuneration, corruption, poor health care financing, decreased expenditure on health by the government, political instability, shortage of essential drugs and supplies, inadequate access to health care, absence of integrated system for disease response, prevention, surveillance and treatment; high user fees and inadequate health care providers, and lack of confidence in the nation's health sector.	The wealthy prefer to travel to the United States or Europe for treatment while the Nigerian masses prefer to go to South Africa or even India for treatment due to reasons best known to them. This perception is increased by the fact that government officials and politicians are sponsored abroad for medical treatment on the nation's expense.	The maternal mortality rate (about one mother's death in one hundred deliveries) is one of the highest in the world. Some other health status indicators like the under-5 mortality rate and adult mortality rate are higher than the average for Sub-Saharan Africa. A viable health care system depends on the availability of capable human resources for health, adequate funding, ardent health research, standard framework and good govt that recognizes and addresses the health care needs of the people.	The unimpressive state of the health care system has led to inequities in the Nigerian society with the affluent possessing the means to seek for treatment overseas while the low-income citizens stay put with the health system that needs a total overhaul. Reversing outbound medical tourism entails investing heavily in the health sector and ensuring it is affordable to all Nigerians.
Orji et al. 2020	Journal	To assess the reasons behind Nigerian consumers' outbound medical tourism; determine the risk factors that give Nigerians concern over outbound medical tourism; and ascertain the effect of cost on Nigerian patients' outbound medical tourism.	There are four major reasons for Nigerians participation in outbound medical tourism. They include; improper medical treatment in home country, infrastructural inadequacies, commensurate cost of treatment in destination countries and availability of qualified health service providers abroad.	The rich Nigerians and officials at the top echelon jet out of the country to attain proper medical procedures. For instance, the wife of a past Nigerian President in 2005 lost her life as a consequence of having cosmetic surgery in Spain. The incumbent Nigerian President has also visited the UK health system in June 2016 to address "a persistent ear infection". Despite the existence of more than 250 ear, nose, and throat specialists and a national ear hospital in Nigerian.	More than ₦1billion is extracted per annum through medical trips to India, Germany, America, China and Dubai, thereby depleting the nation's foreign reserve. In economic terms, the demand for medical treatment abroad is inelastic because patients are willing to pay any cost to get a desired treatment.	The findings showed that Nigerians undertake outbound medical tourism due to improper medical treatment in home country, infrastructural inadequacies, commensurate cost of treatment in destination countries and availability of qualified health service providers abroad.

Abubakar and Adamu 2016	Journal	To high light some of the problems encountered by patients after treatment abroad such as been attended to by incompetent health personnel or having inappropriate treatment.	In developing countries such as Nigeria, the motivation to travel abroad is largely to access better health service due to the paucity of a super specialist. The incessant industrial disharmony with the health sector has eroded the confidence of the public on the quality of care in Nigerian Hospitals.		Nigeria loses about 46 billion Naira (\$255 million) to medical tourism annually. This amount does not reflect the man-hours involve in preparation, travel to and fro, and the stress involves in the whole process.	
PWC 2016	Report	Restoring trust to Nigeria's healthcare system	Lack of trust in the local healthcare system is a major factor that motivate patients to seek care abroad. There is absence of clear clinical protocols to ensure proper diagnosis of patients. Also there are no defined referral mechanisms vertically or horizontally.	The patients who travel abroad for healthcare are precisely the ones that can pay for services at market prices in Nigeria.	It could be tempting to think of this as just the loss of foreign exchange – allocating \$1Bn to medical care needs abroad means there is \$1Bn less available to other sectors of the economy. However, there is a more fundamental impact of external medical tourism – the loss of value from the local healthcare system.	The first thing to recognise is that addressing the problem will require some fundamental changes across a wide range of stakeholders and some of these changes will require a rethink of the roles of some of the organizations/players in the sector.
Mogaka et al. 2017	Journal	To determine the level of knowledge on the role, structure and effect of MT in Africa as it relates to healthcare systems in the region.	Patients may lack confidence in the ability of home health systems to meet their medical needs and move abroad in relatively large numbers	The wealthy middle class in Africa, for instance, regularly seek advanced medical care abroad.		MT services are primarily provided by the private sector and payments are mostly out of pocket.
Aiwerioghene et al. 2021	Journal	To identify the factors affecting Nigerian medical tourism sector.	The main reason people in Nigeria go abroad for treatment is the poor quality and poor standard of treatment in Nigeria. Nigerian healthcare sector lacks adequate infrastructure. Currently, only one hospital in Nigeria is recognized by JCI (international accreditation). A few hospitals have updated medical equipment making it difficult for proper diagnosis.			Nigerian Healthcare system has remained relatively weak despite the effort from the government over the years. Improvement in healthcare infrastructure is required for reaching the goals of high-quality care, better patient satisfaction, and effective utilization of resources.

Balogun 2019	Journal	To investigate the decision-making process of Nigerian medical tourists and why they prefer medical tourism to India to medical care locally.	Reasons and factors why they chose medical tourism to India rather than staying back in Nigeria for their medical needs: long waiting list, inadequate medical equipment (surgical and diagnostic) in hospitals, chaotic laboratory services, inadequately staffed hospitals, comparatively limited degree of expertise among Nigerian medical practitioners, nonchalance and negligence by available medical experts, non-collaboration among medical and allied staff, poor customer service from hospital workers, poor sanitary and environmental conditions, poor response to treatment, concerns about access to quality drugs, lack of trust and confidence in the system. Government hospitals have experts but it is the junior doctors that handle most of the cases. The consultants usually come when it may be too late			Nigerian MTs to India consider medical tourism as an enforced necessity rather than a desired first choice. Unmet needs resulting from service failure lead them to medical tourism.
Obuh et al. 2020	Journal	To evaluate the effects medical tourism has on Nigeria		All Nigerian presidents, Governors, Ministers and other wealthy individuals since the democratic dispensation represents the largest chunk of individuals who have gone outside this country seeking medical attention, an ugly trend that must be reversed.	Findings revealed that indeed, medical tourism by Nigerians has had some effects on several sectors of the country, one of which is a reduction in the revenue for sustaining local health sector and as a result, leads to poor performance on the medical officers, as they are short of logistics and facilities and in turn leads to lack of trust in medical practitioners and also high mortality rate.	The health sector is being denied the much needed funding which is affecting its development. In 2014 the Federal Ministry of Health, through its Director of planning, Research and Statistics, disclosed that public officers alone spent N198.95 billion on medical tourism.

Wapmuk et al. 2015	Journal	The paper examines the growing phenomenon of medical tourism in Nigeria-India relations.	The reasons for the increase of Nigerians going for medical tourism in India are many. First, years of systemic decay by a lack of political commitment, corruption and mismanagement of the national economy has also affected the health sector. The political leaders inclusive lack confidence in healthcare facilities established by them and prefer to go abroad for treatment.		There is no doubt that particularly, the public health infrastructure in Nigeria, is in shambles owing mainly to poor funding, shortage of medical facilities and personnel and poor medical service delivery. Over 5,000 citizens fly out on a monthly basis, seeking medical treatment in India and other countries.
Eme et al. 2014	Journal	To identify the indices of the Nigerian dying health system and suggest ways of building a solid healthcare system in Nigeria.	Primary healthcare, like most facets of our life, collapsed long ago and the evidence is the preference for foreign medical attention by Nigeria's elite who can afford it. They do not have confidence in our medical personnel to handle even basic ailments, from toothache to headache, not to talk of more serious medical conditions. At the hospital, patients on admission buy everything namely syringes, drugs and hand gloves for the nurses, disinfectant, detergent and even bulbs for the wards in many public hospitals across the country. The queues are long, the equipment outdated, the facilities understaffed, the necessary medication is often lacking, and most of the patients cannot even afford the drugs or treatment. Remote areas and rural communities are almost relegated to the background and have to fend for themselves.	Despite having some of the very best healthcare professionals in the world, the lack of development of the public healthcare system has eroded the little confidence the general population have in the Nigerian healthcare system. Even the leaders who ought to lead by example are most guilty of this lack of faith in the Nigerian healthcare system, which is why they excel at flying themselves and their cronies to other countries with highly developed healthcare systems at the slightest sign of any health issues.	Healthcare system in Nigeria began to deteriorate in the 1980s when our medical experts and other medical personnel left the country in droves in search of the proverbial greener pasture abroad. The absence of modern facilities in many public hospitals is linked to failure of successive governments to pay adequate attention to the health sector. Inadequate and obsolete equipment in Nigerian hospitals had over the years contributed to the exodus of Nigerian doctors and other health personnel abroad in search of better opportunities. Indeed, poor healthcare services in the country have contributed to increase in mortality rate in the country. The budgetary allocation for this sector hardly get to the target layers envisaged during budget implementation. Most of these funds get embezzled by corrupt officials and their collaborating suppliers and contractors.

Eze et al. 2020	Journal	Examined the demand factors responsible for outbound medical tourism to India, South Africa and Germany.	Thousands of Nigerians travel abroad each year to seek medical treatment mainly because the nation's health care system remains poorly funded. Factors like inadequate medical equipment, inadequate service personnel, and also inadequate infrastructures (to mention a few) have greatly contributed to the abysmal state of Nigeria's healthcare sector, and this has in turn made people lose confidence in the sector. This lack of confidence in the healthcare sector has further led to the increase of Nigerians with life threatening ailments travelling abroad in search of better medical treatment and care.		This study concludes that medical tourists are propelled to engage in medical tourism by certain demand factors, which include medical cost, medical service quality and destination competitiveness. These factors will continue to appeal to tourist who can obtain them abroad Nigeria is undoubtedly one of the biggest sufferers from medical tourism in the world.
Mathai et al. 2015	Journal				Without quality information on where, when, and why maternal deaths occur, we cannot begin to tackle the real causes of maternal mortality. Better information is an essential requirement for better health.
Makinde 2016	Journal	Physicians as medical tourism facilitators in Nigeria: examine issues of the practice.	The growth of medical tourism has been a result of the cost of service and lengthy waiting times in developed countries and the absence of specialist services, elitist ideas, and loss of faith in the quality of health care services rendered in developing countries.	The current president of the country travelled to the UK in June 2016 in order to attend to "a persistent ear infection". This was despite the availability of over 250 ear, nose, and throat specialists and a national ear hospital in the country. Several other prominent Nigerians have reportedly received health care services in various countries and for various ailments.	Nigerians with an estimated annual spending on medical tourism of between one and 20 billion US dollars are undoubtedly major contributors to this industry. Many Nigerians travel to countries such as India and the UK for various treatments including cardiac surgeries, neurosurgeries, cosmetic surgeries, orthopaedic surgeries, and renal transplant surgeries.

Makinde et al. 2014	Journal	Argues for the repeal or significant review of the code of medical ethics which bars healthcare providers and institutions from advertising the kind of services rendered at their medical practices.	The affluent population perceive as an elitist idea, travelling abroad for medical routine physical examinations and surgically amenable ailments. In addition, the perceived suboptimal quality of care and treatment options available at healthcare facilities in the country have resulted in low patronage by those that can afford the relatively expensive healthcare cost in more developed countries.	About 30, 000 Nigerians are estimated to spend about US\$1 Billion annually on medical tourism. Should these resources be committed to the local health market, it would boost local industry.	It is noteworthy that 33% of health facilities in Nigeria are private health facilities with majority of their clientele base paying for services out-of-pocket. Medical tourists are concerned about quality of care, and a transparent process, which demonstrates quality in health service delivery by in-country health facilities, is needed.
FMoH, Nigeria 2021	FMoH, Nigeria website	Launch of Cardio care multispeciality hospital in Abuja.	Specialist care is often the most inaccessible according to the Honourable Minister of Health. The lack of it, or distrust of its quality in our country, is often the reason citizens seek health care abroad.		It has been estimated that Nigeria loses between USD\$1 and 2 billion annually in foreign exchange to what has been branded as medical tourism.
Ejim 2014	PMNews	Building a solid healthcare system in Nigeria.	The queues are long, the equipment outdated, the facilities understaffed, the necessary medication is often lacking, and most of the patients cannot even afford the drugs or treatment.		Despite having some of the very best healthcare professionals in the world, the lack of development of the public healthcare system has eroded the little confidence the general population have in the Nigerian healthcare system. Even the leaders who ought to lead by example are most guilty of this lack of faith in the Nigerian healthcare system, which is why they excel at flying themselves and their cronies to other countries with highly developed healthcare systems at the slightest sign of any health issues. It is very shameful that Nigerians have to go to India for procedures like kidney transplants, when we have some of the best and brightest physicians in the world. Yet, the same physicians would be seriously hampered and handicapped in Nigeria due to the lack of basic framework and infrastructure to support a sustainable and meaningful health sector.

Onyemelukwe-Onuobia 2021	Blog	Engaging lawyers in the fight against maternal mortality in Nigeria.	Nigeria was the 169th most unsafe place out of 176 countries surveyed in which a woman could give birth. 1 in 13 women die in childbirth in Nigeria, with 145 women dying daily. Having only 2 percent of the world's population, Nigeria contributes 10 per cent of the world's maternal deaths, coming in as the second country with the highest absolute numbers of women (about 630 out of 100,000 live births) dying in childbirth.		The high maternal mortality rate in Nigeria is a result of multi-faceted causes. Some of these causes are socio-cultural in origin like lack of basic patient education and lack of basic awareness of patient rights, and cultural practices like teenage marriage, which lead to complications in pregnancy and childbirth. Others are systemic failures within our health care system including public and private facilities that do not meet basic international standards for obstetric care and maternal health, hostile attitudes of health professionals.	
Liedong 2017	Blog	African politicians seeking medical help abroad is shameful, and harms health care.	It's well documented that politicians from across the continent go abroad for medical treatment. The reasons for exercising this choice are obvious: they lack confidence in the health systems they oversee, and they can afford the trips given that the expenses are paid for by taxpayers.	Not only do the leaders travel with elaborate entourages, but they also travel in expensive chartered or presidential jets. For example, the cost of parking Buhari's plane during his three month medical treatment in London is estimated at £360,000. That's equivalent to about 0.07% of Nigeria's N304 billion budget allocation for health this year. And there would have been many other heavier costs incurred during his stay.	The effective health systems in western and Asian countries that are being patronised by African leaders only exist because they were developed, and are consistently maintained, through political commitment and visionary leadership, qualities that are clearly lacking in Africa. Taxpayer funded medical trips should be banned and criteria set detailing what sicknesses that can be covered by the public purse. Though a law to this effect exists in Nigeria, it appears to be ineffective.	There is an African idiom that if a man does not eat at home, he may never give his wife enough money to cook a good pot of soup. This might just be true when applied to politicians on the continent seeking medical help anywhere but home. Medical tourism by African leaders and politicians could therefore be one of the salient but overlooked causes of Africa's poor health systems and infrastructure. As long as Africa's leaders keep going abroad for medical reasons, the ambition for better health infrastructure will remain an illusion. For example, Lagos University Teaching Hospital was once deemed to be one of the best on the continent. Recently, it was criticised for decadence. Essentially, when people charged with responsibility feel they have no need for public health systems because they can afford private health care at home or abroad, ordinary citizens bear the brunt.

Kazeem 2018	Quartz Africa	Nigeria's lawmakers want to limit medical trips abroad for government officials.		
			<p>Over the years, public office holders in Nigeria have typically resorted to seeking medical treatment abroad. The most recent example came when president Muhammadu Buhari spent over 150 days in London receiving treatment for an ear infection.</p>	<p>The lawmakers are debating a bill to amend the national health act to “regulate international trips for medical treatment by public officers. The bill, which was introduced by an opposition party lawmaker, has now passed second reading. Local hospitals are not prioritized by government officials as they don’t depend on them to stay alive. Frequent strike actions by doctors at public hospitals protesting low wages and poor working conditions are a steady reminder of that reality.</p>
Continuing Medical Education (CME) 2012	News bites	Africa: Nigeria splurge on medical tourism	<p>If the President, Vice President, Senate President, House of Representatives Speaker, Federal Executive Council members, governors and deputy governors and other holders of political office make it a point of duty to stand in the same queue with ordinary Nigerians to seek medical care and conduct health checks in public hospitals in Nigeria, the confidence of ordinary Nigerians and foreigners in Nigeria's health care system will be reignited and bolstered’.</p>	<p>More than 5 000 Nigerians travel to India and other countries every month on medical tourism, spending about N78 billion every year, the Nigerian Medical Association (NMA) said. Briefing newsmen during Physicians' Week recently, NMA president Dr Osahon Enabulele said ‘India earns over US \$260 million (R1.82 billion) from medical tourism from Nigeria alone’. Each medical tourist is said to spend between \$20 000 (R140 000) and \$40 000 (R280 000) on average on each trip.</p>

VOA 2019	VOA news	Nigeria losing \$1B annually to medical tourism, Authorities say.	Nigerian authorities say the country is losing more than \$1 billion annually to medical tourism as tens of thousands of Nigerians travel abroad in search of the best treatment.	But even Nigerian President Muhammadu Buhari — with access to the best health care in Nigeria — made several trips to Britain for medical care in his first term.		Nigeria’s Health Ministry says it is building several world-class health centers to address the issue, but not even the country’s president seems to trust health care in Nigeria. A former Nigerian lawmaker from Kaduna state, lost both his parents to diabetes. He was afraid the disease might run in the family, so he went for a medical exam. Unhappy with the quality of care at home, Bello flew to India, like many of Nigeria’s well-to-do. “Comparative analysis between Nigerian case and where I passed through in India, honestly, I cannot do it here because the margin is so wide that every Nigerian who has any health issue - his prayer is how can he be moved to India," he said.
Enabulele undated	Journal	COVID-19: a possible reversal mechanism for outward medical tourism by African Political leaders.	There are various reasons for outward medical tourism (foreign medical travels) by individuals and groups. These include better quality of health infrastructure and healthcare services in the destination country.	Some elites, public and political office holders see it as a status symbol, even when such medical conditions or medical care needs can be satisfactorily attended to in Africa.		It is well known that rather than investing resources in the sustained development of their healthcare systems, some African political leaders and public office holders utilize public resources to undertake frequent travels abroad to receive medical care, sometimes for medical conditions that can be readily managed in their respective countries. For instance, in the year 2013, Nigeria alone, lost over \$1billion to capital flight from outward medical tourism.
Ayetoto 2021	Business Day	Private funds in fresh bid to reverse Nigeria's \$1.5bn medical tourism.	Owing to weak infrastructure, poor government spending and rising loss of medical professionals to improved working conditions elsewhere.		Infant mortality remains at 76 per 1000 as the country grapples with about 35,000 doctors when 237, 000 is needed, according to the World	India alone accounts for more than half of \$1.5 billion that Nigeria loses yearly to purchasing medical services overseas, according to the Nigeria Medical Association (NMA). Nigeria's healthcare spending hovers around 3.75

				Health Organization estimates.	percent instead of 15 percent. Nigeria could retain a substantial part of the capital flight that follow medical tourism as more multi-billion investments are made in the sector.
Moses-Ashike 2021	Business Day	CBN raises healthcare intervention fund to N200bn.			CBN Governor, Emeziele said medical tourism put a huge strain on the country's foreign reserves and more importantly, for every \$1 billion allocated to medical treatment abroad, there is less than \$1 billion that could be available to other critical sectors of the economy.
da Lilly-Tariah and Sule 2020	Journal	Will improve quality of health, affordability, and accessibility be a driver to reduce outward medical tourism (MT) in Nigeria?	The failure of Nigeria's health system is responsible for the thriving foreign MT because of poor quality and service delivery, poor funding, inadequate human resource for health capacity, poor infrastructure, and inadequate specialist services, among other flaws. The spate of strikes by doctors and other healthcare professionals is another disturbing phenomenon, often spurred by the perceived neglect of their welfare and inadequate working environment.	The Nigerian health indices are poor, for example, the neonatal mortality rate of 23/1000 live births and under-five mortality rate of 76/1000 were reported in 2018, while the maternal mortality ratio of 917/100,000 live births was reported in 2017. Improved quality of healthcare delivery, increased accessibility, affordability, and timeliness of access by the population can stem outward medical tourism.	A significant number of Nigerians travel abroad every year for MT, and estimates showed that Nigeria may be losing about \$1.3 billion yearly as a result which places a burden on the Nigerian economy. Funding of healthcare from the general health budget is still poor in Nigeria. The current allocations are in the region of 4% of the budgets, with erratic and none release of the allocated budgets.

Onyenucheya 2018	The Guardian	Reversing medical tourism in Nigeria.	The inadequacy of Nigeria's health system has been traced to the thriving foreign medical tourism due to poor service delivery, poor funding, unavailability of human capital, poor infrastructure and absence of specialist services, among other flaws. Failed primary healthcare, uncoordinated tertiary health care, corruption and mismanagement, of course some of the reasons.		Most of the countries in the world with the best human indices in healthcare have high standard of living, which has led to the lowest maternal and infant mortality and very high life expectancy.	Tens of thousands of Nigerians travel every year to the United States of America, (USA), United Kingdom, (UK), India, Thailand, Turkey, France, Canada, Germany Malaysia, Singapore, Saudi Arabia and China, among other countries for treatments ranging from kidney transplant, open heart or cardiac surgeries, neurosurgeries, cosmetic surgeries, orthopaedic surgeries, eye surgery and other health conditions, to the extent of delivering babies over there.
Ogunrinde 2021	The Guardian	Helping Nigeria overcome the medical tourism malady.	Over the years, the number of Nigerians travelling to the US, UK, India, China, Saudi Arabia, Dubai and other developed countries for the treatment of cancer, kidney or liver transplant, heart or cardiac surgeries, neurosurgeries, cosmetic surgeries, routine check-up and baby deliveries, has been on the rise.	The penchant for medical tourism by Nigerians, has somewhat, assumed a worrisome dimension.		Nigeria also loses huge foreign exchange that could have been deployed to revamp our ageing hospitals and create jobs.
Vanguard 2015	Vanguard News	Ministerial nominee decries Nigeria loss of about N3bn to medical tourism annually.				Nigeria lost between one and three billion naira to medical tourism. About 60 per cent of Nigerians go to private hospitals.

CHAPTER 7: CONCLUSION

7.1. Thesis summary

This chapter brings together the key findings of the thesis. It also discusses the contributions of the thesis, policy implications, the limitations of the study and future research directions.

7.1.1. Overview of thesis

This thesis by publication investigates inequality in maternal and child health and healthcare in Nigeria and across its six geopolitical zones. Given the three-delay theoretical model and access framework, the above study aim was unbundled into five research questions. Consequently, all the five research questions were transformed into five research papers. The findings show weak healthcare system and socioeconomic disadvantaged position as a hotbed of maternal and child mortality.

Thus, research paper 1 shows that geographic and socioeconomic inequalities in the utilisation of maternal healthcare are lower among poorer and less-educated women, especially those living in the rural areas of the North-West and North-East geopolitical zones of Nigeria (paper 1).

However, a decomposition of socioeconomic inequalities in the uptake of intermittent preventive treatment of malaria in pregnancy (IPTp-SP) in Nigeria indicates the presence of pro-rich inequalities in the uptake of IPTp-SP among women, particularly in urban areas (paper 2). Further, a decomposition of the socioeconomic inequalities in teenage pregnancy in Nigeria reports a negative value of the concentration index, which suggests that teenage pregnancy is concentrated among poor teenagers (paper 3).

Conversely, geographic and socioeconomic inequalities in the survival of children under five in Nigeria show that most under-five mortality occurs within 12 months after birth. The poorest families are the most at risk of under-five mortality, while the richest families are least affected across the geopolitical zones and household wealth quintile (paper 4).

From the foregoing, the common denominator of the key findings alluded to a weak healthcare system, which gives rise to outbound medical tourism. Thus, the scoping review shows that outbound medical tourism affects the development of local health systems and contributes to an increase in maternal and child mortality rates in the country (paper 5). These findings bring

to the fore the importance of the three-delay theoretical model and access framework in addressing the health needs of women, children and families for optimal health outcomes in Nigeria and global health in general.

7.2. Contributions of the thesis

7.2.1. Empirical and theoretical contributions

We deployed a specific method for a specific objective approach to address each research question. Specific econometric measures of inequality (e.g., decomposition analysis and survival analysis, Theil index, between-group variance [BGV], rate ratio and rate difference) were used to assess geographic and socioeconomic inequalities in maternal and child healthcare.

Findings of the decomposition analysis show that the geopolitical zone of residence contributed to the pro-rich inequalities in the uptake of IPTp-SP as pregnant women in the two socioeconomically disadvantaged geographic zones of the North-East and North-West consumed fewer IPTp-SP compared to southern geographic zones. In addition, the decomposition analysis showed a significant contribution of the residual (i.e., the unexplained portion of the model) to the observed pro-rich inequality in the uptake of IPTp-SP in Nigeria. The distribution of some of the omitted health system factors (supply-side) from the model might have contributed to the pro-rich inequalities in the uptake of IPTp-SP among pregnant women. In other words, poor service delivery for low socioeconomic status (SES) pregnant women in the country may have reduced the uptake of IPTp-SP in these groups, as the quality of service is one of the greatest barriers to utilising maternal healthcare (paper 2). Moreover, the decomposition of socioeconomic inequality in teenage pregnancy identified marital status, wealth index of households, exposure to ICT, and religion as the most significant factors contributing to the observed inequality (paper 3).

A further contribution of the thesis is the use of the Kaplan-Meier survival estimates and Cox proportional hazard model for analysing time-to-event data and censored observations. The Kaplan-Meier survival estimate findings show that most under-five mortality occurs within 12 months after birth, with the poorest families most at risk. The richest families are the least affected across the geographic zones and household wealth index quintiles (paper 4).

The study shows that functional obstetric care must be located within reasonable reach of the people who should benefit from it since distance is an important barrier to seeking healthcare, especially in rural areas. It reiterates the importance of the access framework (availability, affordability and acceptability) and the three-delay model concerning facility-based delivery or the use of a skilled birth attendant (paper 1).

The scoping review indicates the lack of confidence and trust in the nation's health sector due to infrastructure inadequacies, poor human resources management, lack of motivation and remuneration, improper medical treatment, corruption, poor healthcare financing, a shortage of essential drugs and supplies and incessant industrial disharmony, all of which motivate Nigerians to embark on outbound medical tourism. Hence, outbound medical tourism affects the development of the health system and the quality of healthcare services and contributes to an increase in maternal and child mortality rates in the country (paper 5).

7.3. Limitations of the study

As with every study, no matter how compelling and in-depth, there are limitations. Thus, owing to the unavailability of some data in the NDHS, we could not analyse supply-side factors such as the quality of service delivery and/or patient satisfaction variables in the decomposition analysis. Moreover, since our analyses were based on retrospective cross-sectional data, temporality could not be established between explanatory variables and geographic or socioeconomic inequality in maternal and under-five mortality, thus impeding causal inference. We also acknowledge the inherent data collection challenges that could manifest through misreporting the age of a child or age at death in months. The self-reported maternal healthcare use and teenage pregnancy may be subject to recall bias and social desirability bias. Finally, for the scoping review, access to grey literature, especially government reports on outbound medical tourism, was limited to digitally available articles only.

7.3.1. Future research directions

Therefore, future research needs to examine supply-side factors with an emphasis on the quality of healthcare delivery and patient satisfaction using a mixed-method study design. There is a need to explore the ways citizens could hold healthcare providers and government accountable for the quality of healthcare delivery since governance is key to health system strengthening.

7.4. Conclusion and policy implications

The utilisation of maternal healthcare is lower among poorer and less-educated women, as well as those living in the rural areas of Nigeria, especially in North-West and North-East geopolitical zones. There should be a focus on implementing context-appropriate interventions that will increase the uptake of maternal healthcare services among these groups.

Moreover, strategies to improve antenatal visits and the uptake of IPTp-SP among women residing in socioeconomically disadvantaged geographic zones (i.e., the North-East and North-West) may reduce pro-rich inequality in the uptake of maternal healthcare among pregnant women in Nigeria.

There is also a need for targeted formal education interventions in the North-West, North-East and North-Central geopolitical zones for maximum impact. This is vital towards achieving a reduction of both maternal-cum-teenage women and under-five mortality in Nigeria.

Finally, to improve public healthcare delivery, it is important to regulate³ government-sponsored international trips for medical treatment by public officials. Above all, strong political will, accountability, transparency and leadership by example are required to revamp the health system of Nigeria.

³ Public officers should access healthcare within the country except where the healthcare treatment is declared not locally available by the Medical and Dental Council of Nigeria.

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