ADJUSTED AGE DISTRIBUTION AND ADULT MORTALITY IN SOUTH WEST NIGERIA

BY

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MATRIC NUMBER: 210577

A DISSERTATION SUBMITTED TO

THE DEPARTMENT OF EPIDEMIOLOGY AND MEDICAL STATISTICS,

FACULTY OF PUBLIC HEALTH,

COLLEGE OF MEDICINE,

UNIVERSITY OF IBADAN

IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF

MASTER OF PUBLIC HEALTH IN MEDICAL DEMOGRAPHY

FEBRUARY 2021

ABSTRACT

Globally, Nigeria is one of the countries with high adult mortality. Mortality rate generally is lowest in southwest Nigeria. However, lack of credible data constitutes a challenge to the true estimate of adult mortality in Nigeria including southwest part of the country. The vital registration system that ought to produce reliable estimate of adult mortality in Nigeria is either incomplete or non-existence. Most estimates in circulation do not show the techniques used for their computations and as such subject of criticism. The question to ascertain what a true estimate of adult mortality rate in Nigeria as it compares to the figure for southwest Nigeria where the rate is expected to be the least remains unanswered. Therefore, this study determined the adjusted age distribution and adult mortality in southwest Nigeria.

In this study, 2003, 2008, 2013, and 2018 Nigeria Demographic and Health Survey (NDHS) data were used. Also used was age distribution obtained from 2006 Nigeria Census. The estimates of mortality level and adult mortality were obtained through the combination of NDHS data and refined age distribution generated from the 2006 census. MORTPAK LITE was used to estimate childhood mortality based on the information on children ever born and children surviving. Trend in childhood mortality was regressed for 2020 projection. The Y-Logit transformation system and Coale-Demeny model life table model was used to adjust for age misreporting between sexes and adult mortality indices estimation respectively.

Age misreporting was found among different age groups, but was more prominent among females than males, revealing a similar pattern with the national estimates. The expectation of life at birth was higher for men (64 years), while for females it was 61 years. The probability of dying between age 15 years and 60 years was 0.2218 for males and 0.2371 for females. The probability of dying beyond age 60 years was higher among males (0.6721) than females (0.6370). A decline in mortality experience in the southwest region was found in 2020.

Adult mortality rate was high in southwest Nigeria, but the estimate was found to be lower than the that which was obtained at the national level. Females experienced higher adult mortality than males, but the reverse is the pattern for Nigeria. It is important for policy makers to begin to pay attention and mitigate possible threats to adult survival especially among the working population in southwest Nigeria.

Keywords: Adult mortality, Life expectancy, Survival probability, Southwest Nigeria

WORD COUNT: 401 words

CERTIFICATION

I certify that this work titled "Adjusted Age Distribution and Adult Mortality in South West Nigeria" was carried out by OLANIYAN, Damilola Gabriel, in the Department of Epidemiology and Medical Statistics, Faculty of Public Health, University of Ibadan under my supervision.

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DEDICATION

This research work is dedicated to everyone who came out stronger from depression and my parents for their supports throughout my educational career.

ACKNOWLEDGEMENTS

My deepest gratitude to my supervisor, Dr. S.A Adebowale, who without his support, understanding, this work will not have been completed. Words are not enough to thank him. I appreciate the supports from all the lecturers within and outside the department who at one time or the other taught courses in different aspects of demography and more closely Dr. Gbadebo and Dr. Akinyemi for their impact on us, reshaping us fit for the field of public health.

My utmost regard also goes to my parents, Mr & Mrs Olaniyan and my siblings for their prayers and understanding during this programme. I thank my wonderful friend and brother, Oluwatobi Olakojo, his parents Prof & Mrs. Olakojo for their encouragement, support, and firing the pressure not to give up, I appreciate you all dearly. A big thank you to Dr. Yemi Kale, DG, National Bureau of Statistics for supporting with access to the preliminary data required for this research; and to Dr Yetunde Fatogun for their understanding at work while I started the MPH programme - that I was able to cope emotionally and financially for the program was through her support.

My sincere appreciation also goes to Mr Tunbosun Olowolafe (Doctoral candidate) for always providing academic enlightenment every time required on this research work; and to my programme colleagues Olamide Taiwo, Yewande Adewoye and Temitope Layode for being wonderful colleagues to the only male in a group of four. Kofoworade Ayobami, my best friend; thank you for your prayers, understanding and amazing support; we did this together.

My deepest gratitude goes to Almighty God, who never sleeps "even when I slept" providing safety especially through the journeys of Lagos-Ibadan expressway, for sound health during the accompanied challenges during this study; and for grace to complete this program and research work against all odds.

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CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND

Mortality is a fundamental indicator of health and development – highlighting the differences between and within developing and developed countries (Timaeus & Graham, 1989). For more than two decades now, global public-health efforts have focused on the development and application of disease control programs to improve child survival in developing countries. The intervention has resulted to a decline in childhood mortality - hitherto slow over the years. Consequently, methods for calculating child mortality levels and trends from surveys are well-developed and generally yield accurate estimates. In contrast, little attention has been placed on adult mortality especially in most developing countries in sub-Sahara Africa.

Demographically, adult mortality is measured as the probability of dying between the ages of 15 and 60 years (UN, 2019). A decline from a global average of 371/1000 in 1960 to 137/1000 in 2019 was recorded although this rate has stalled especially in developing countries. Timely and reliable estimates of age-sex-specific death rates remain the cornerstone of health information systems, and synthetic measures of the level of mortality, such as life expectancy at birth or at age 15 and above, are used as indicators of health status and social development (Helleringer *et al.*, 2014; Timæus, 1991). Unfortunately, vital registration systems which is the ideal source of data for direct measurement of mortality (and other demographic) levels and trends is passive and not compulsory in Nigeria and as such, data is grossly incomplete, inadequate, and unreliable.

The pervasive lack of vital registration data makes it necessary to derive estimates of mortality using indirect demographic approaches based on survey and census data. Census data on deaths that occurred in the household in the last 12 months remain the most commonly available source of data to directly compute life tables, but reporting is often biased with omissions and age misreporting. Age misreporting occur in the form of digit preference, age shifting across critical age boundaries, and age exaggeration, and this common in demographic data from developing countries. Age and sex are two variables critical to almost all demographic enquiries (Ramachandran, 1989).

The quality of age and sex data in Nigeria has been widely discussed by many researchers including (Ohaegbulem, 2015) and (Nwogu & Nweke, 2016). Ohaegbulem (2015) assessed the quality of the age-sex data from the 1991 and 2006 Nigeria population censuses, using some conventional techniques of evaluating demographic data quality. The results show that there is an obvious preference for ages with end-digits 0 and 5, while other end-digits were avoided in the two censuses, this bias being more pronounced for females than males. The joint scores from the distribution of population by sex and five-year age groups was computed to be 54.83 for the 1991 census and 38.52 for the 2006 census. Nwogu (2011) also showed that the UN joint scores (38.52 for the 2006 census and 34.72 for the 2008 NDHS) indicate the two datasets are also defective but are usable with adjustments. These show that the quality of age and sex data is poor and unreliable, but the data are usable if proper adjustments are made.

It is in response to this reliability issues that demographers have developed a variety of alternative estimation methods aimed at measuring adult mortality and other demographic parameters using age-sex structure information from survey and census data on demographic events which include adult mortality (Hill *et al.*, 2005; Murphy *et al.*, 2001). Indirect estimates of adult mortality may be conducted based on information on the survival of the spouse (widowhood method), parents (maternal or paternal orphanhood), or siblings (brothers or sisters). It is important to note that adult mortality highlights the significance of demographic transition, especially in developing countries like Nigeria because of its broad significance to population health.

1.2 STATEMENT OF PROBLEM

For more than three decades now, the principal focus of global public health has been on improving child health and survival. The wealth of data available now on child mortality have generated several methodological advances that now allows the indirect estimates of child mortality from direct evidence (Trussell, 1975). Regrettably, estimates about levels of adult mortality has not kept pace with these developments. Goal 3 of the Sustainable Development Goals is targeted at ensuring healthy lives and promotion of well-being for all at all ages; it thus becomes germane to have an idea of adult mortality level in a developing country like Nigeria.

The UN has stated that adult mortality in 2015 was about 173 per 1,000 population. Between 2000 and 2015, the probability of dying for Nigerian males between 15 and 60 years per 1,000 of the population decreased from 426 to 375 while for females it declined from 407 to 335 (UN, 2019). For Africa's most populous nation, the rate of decline is not within an acceptable range when compared to the global average. Existing estimates of adult mortality in Nigeria is very narrow, and there are no reliable estimates at the sub-national level even though significant mortality differentials are highly likely to exist, given the socio-demographic profile of the country.

Vital Registration system in Nigeria is either inadequate or non-existence in some part of the country. Consequently, death statistics is grossly underreported, and inaccurate reporting has implication for planning health programmes that target adult survival. The changing age pattern, burden of disease, coupled with the unacceptable levels of mortality have triggered a quest to obtain better estimates of adult mortality levels. Thus, understanding the heterogeneity in mortality patterns helps to empirically influence the targeting of specific areas for health intervention, allocating resources and setting priorities where mortality is high (Ahmed & Hill, 2011).

1.3 JUSTIFICATION OF THE STUDY

Health development policies should be, concerned with improving health and survival across the lifespan. Murray *et al.*, (2003) stressed the need for greater public health focus on adult health; it majorly took the advent of HIV/AIDS which primarily affects young adults to galvanize support for adult health as a key international health priority. Globally, recent comparative analyses of the leading causes of adult mortality have highlighted heart diseases and lower respiratory infections, and rising burden of non-communicable diseases as more deadlier risk factors than HIV/AIDS (WHO 2019). In Nigeria, the prevalence of HIV among adults age 15-64 years has reduced to 1.5%.

The evolving increase in research studies on adult mortality in sub-Sahara Africa and particularly in Nigeria is highly commendable and long overdue and particularly relying on survey years. (Adedini *et al.*, 2015) had established the regional variations in infant and child mortality associating it with poor socio-economic characteristics in the northern part of the country which is much better in the southwest. For the southwest region that have achieved consistent decline in child mortality, it is important to know how much progress has been made with respect to preventing premature adult mortality. Hence, this study is aimed at bridging the gap in understanding the lagging component of the overall mortality experience of the region. This study will particularly be taking a step further to project estimates of mortality level, which will help to understand if significant variation exists in adult mortality indices at the sub-national level.

Globally, Nigeria is one of the countries with high adult mortality. Nigeria may have recorded reduction in infant and child mortality over the years, the mortality index amidst the economically productive age group of the country have not declined proportionately. The vital registration system that should document adult mortality is largely inexistent and where available is incomplete, as the age-sex distribution is fraught with errors. Consequently, the need to provide reliable estimate of adult mortality in Nigeria for planning and credible decision making. Estimates of adult mortality has been provided in the past in Nigeria. However, the methods used for these estimates are in most situations concealed to most researchers and most especially were based on the unrefined age distribution. Therefore, this study determined the adjusted age distribution and adult mortality in southwest Nigeria.

1.4 OBJECTIVES OF THE STUDY

1.4.1 General Objective:

- To obtain adult mortality levels for southwest Nigeria using the adjusted population census by age and sex from the 1991 and 2006 Nigerian censuses.

1.4.2 Specific objectives:

The specific objectives of the study are to:

- Refine the age distribution by five-year group across for southwest Nigeria.
- Determine the life expectancy at birth in the southwest region of Nigeria.
- Estimate the probability of surviving from age 15 to 60 years ($_{15}\mathbf{q}_{45}$) in the southwest regions of Nigeria.

CHAPTER TWO

LITERATURE REVIEW

Vital statistics are quantitative aggregates of demographic events such as fertility, mortality, migration, nuptiality etc. of a specified period and the characteristics of individuals involved in these events. They are important in public health for policy detailing, program planning, execution, and measurement of progress toward improving quality of life and other public health goals. This chapter aims to review important thematic areas as it relates to this study.

2.1 SOURCES OF DEMOGRAPHIC DATA

Globally, demographic parameters and statistics are collected from three sources. They are population censuses, sample surveys, and population registers. Each of these sources although unique in its nature and purpose, they are complementary to each other. Demographic parameters obtained through any of these sources of data are always collected, organized, analyzed, and reported based on age and sex distribution in all demographic enquiries (Ramachandran, 1989).

2.1.1 POPULATION CENSUS

Population census is the total process of collecting, compiling, evaluating, analysing, and publishing or otherwise disseminating demographic, economic, and social data pertaining, at a specified time, to all persons in a country or in a well delimited part of a country (UN, 1998). According to the UN, it is recommended that a national census be taken at least every 10 years. Censuses are indispensable tools to Africa's development as they provide data up to the finest level of geographic disaggregation, but unfortunately not given adequate priority, as most countries consider it an ad-hoc activity. It is largely expensive, regarding human resources, infrastructure, and financial commitment. In times past, the whole computing work is tedious and consumes time, but with the leveraging on technology, such cartographic tools at the planning stage, geographic information systems (GIS) and cellular telephones at the enumeration and dissemination stages, it becomes less cumbersome to the National Statistical Offices, even though there are risks, when lack of adequate human resources to man technology exist.

A series of censuses done at when due makes it possible to appraise the past, precisely describe the present, and predict the future. Makinwa (1985) documented that the first census in Nigeria was conducted in 1866 and covered only the Lagos area which was a British colony. Since then, Nigeria had conducted several censuses prior independence. Post-independence, Nigeria conducted census in 1952/53, in 1963 after the 1962 census was cancelled, and in 1973 which was also declared unacceptable (Iro, 1987; NPC, 1998). The 1991 census was declared a successful attempt, and it provided a robust set of socio-economic and demographic data for social and economic planning. Sixteen years later, another census was conducted which placed the country at a population over 140 million. Nigeria is currently the most populous country in Africa and ranks 7th most populous nation in the world. The 2020 mid-year estimate by the UN, placed Nigeria at a population above 206 million. Nigeria is placed at an annual growth rate of 2.64% as of mid-year 2020, with a sex proportion which did not change from 102 men for every 100 women obtained in 2006. Nigeria has a relatively young population with a median age of 18.1 years (UNFPA, 2020).

2.1.2 SURVEYS

Sample surveys are alternative to censuses for timely data and a more relevant and convenient alternative to administrative record systems (Suharto, 2001). Household surveys are the most flexible of the three data sources. With much lesser resources than in censuses, surveys can examine most subjects in much greater detail. While it is not possible to anticipate all the data needs of a country far into the future at the time a census is being planned, household surveys provide a mechanism for meeting emerging data needs on a continuing basis. Its flexibility makes it an excellent point of convergence for data users' needs for statistics which otherwise are unavailable, insufficient, or unreliable (Murray *et al.*, 2003). In contrast to population census, this technique takes less time and is less expensive. A sample survey can be utilized to enhance the census information and to execute further patterns in populace development in the middle of two evaluation activities. (Divisha, 2017).

Surveys uses the principle of sampling to the target population to assess their characteristics. This may be based on probability samples, and not based on probability samples (Yusuf *et al.*, 2014). In probability samples everyone in the target population has an equal chance of being selected and thus the probability of selection can be estimated numerically. Non-probability samples take many different approaches and formats. Among them, convenience or accidental sampling is a non-random sample used because of ease of access to the individuals being sampled. Most developing countries have embraced the DHS Program established by the United States Agency for International Development (USAID) in 1984 which has provided technical assistance to more than 350 surveys in over 90 countries, advancing global understanding of health and population trends in developing countries.

2.1.3 VITAL REGISTERS

Vital registration can be defined as formal recording of vital events such as births, deaths, marriages, divorce, migration, and any other important demographic event (UN, 2014). Vital registration is passive in Nigeria and close to non-existence. Comparing with countries like Denmark, Finland, and Sweden, where demographic events are registered promptly vast majority of Nigerians even in recent times have never seen the necessity to register these events. The heterogenous nature of cultural diversities in the country has not been established as an indirect cause of the nature the incompleteness. Norms and beliefs are still held very tightly in some culture in the form of taboos prohibiting registration of deaths and discouraging registration of births.

2.1.2. ERRORS IN AGE-SEX DATA

The personal characteristic of age and sex hold prime importance in population studies. Across all levels of governance, data classified by age has been increasingly used as a basis for socio-economic, political, health and developmental planning, policy design and distribution of resources. Census and surveys have been major sources of age data in developing countries due to the difficulty in the availability and completeness of other sources of age data such as vital statistics, civil registration, and population register. Ages reported in censuses and surveys in developing countries are subject to errors and bias resulting in uncertainties in population estimates and age distributions (Ewbank, 1981). Unfortunately for developing countries, their continuous quest to keep pace with the population policies aimed at reducing population growth and achieving overall development, have re-currently been thwarted due to inaccuracies in age data (Adebowale *et al.*, 2014). The quality of age and sex data in Nigeria has also been widely discussed by many researchers, including Ekanem (1972), Nwogu (2011) and Ohaegbulem (2015).

These errors which have been termed "age misreporting" are of different forms ranges from digit preference, age shifting across critical age boundaries, to age exaggeration (Ramachandran, 1989). Age and sex data distribution are known to provide base populations for the estimation of demographic parameters like fertility and mortality; and socio-economic characteristics (like nuptiality, education, and employment) that are required for planning, implementation, and monitoring of development plans. As such, the quality of these estimates depends on the quality of the base populations. Consequently, adjustment of the age-sex distribution has become an integral part of demographic data analysis to improve the quality of estimates of demographic parameters.

Over the years, demographers and statisticians have developed several methods of adjustments to age-sex data ranging from mathematical methods, graphical methods, and other smoothing methods. As there is no one size fits all, assumptions and characteristics of available data suggests the best fit for the adjustments.

2.2. OVERVIEW OF MORTALITY ESTIMATES

Death is a basic inevitable demographic event that must be procured within a population. Its estimates of trends, levels, and causes is of huge importance in demographic studies and public health administration. Mortality estimates reflect the changing morbidity pattern, possible dynamics of mortality, and possibly associated causes of death, in connection with the evaluation of a population or a group within it (Lilienfeld & Lilienfeld, 1980). The estimates may further help policy drivers and official authorities in the prioritization, allocation, and better utilization of available resources, and the projection of the health status of a population.

Using data conventionally obtained through direct or indirect techniques from population census, surveys, and seldomly registers, mortality estimates are often expressed over a period, an area, or other demographic delimiters in the form of rates, ratio, proportion. Common among these are crude death rate, age specific mortality rate, infant mortality rate, child mortality rate, adult mortality rate just to mention a few. In demography, child mortality (also called Under-5 mortality) refers to the death of children under the age of five while infant mortality refers to the death of those under the age of one. Adult mortality has been defined as the probability that a 15-year-old person will die before reaching his/her 60th birthday if subjected to age-specific mortality rates between those ages for the specified year (World Bank, 2011). These rates are often used to summarize life expectancy measure and have been tagged are key indicators of levels of health and development.

A huge amount of survey information detailing causes, determinants and preventive measures is available for child mortality, usually based on collection of direct or indirect birth histories from female respondents (UN IGME, 2014). Much of the success recorded in reducing child mortality globally lies with the increased efforts to monitor child mortality levels over three decades through direct and indirect methods to data on survival of children routinely collected in censuses and surveys. In contrast to child mortality, far less information is available on adult mortality levels and trends, if not for the interest in maternal mortality, and the emergence of AIDS as a killer disease especially among young adults, who constitute the bulk of the working population. The cause and level of adult mortality is thus a prerequisite for identifying a country's public health priorities as well as the effectiveness of a country's health system (Feinstein *et al.*, 2006)

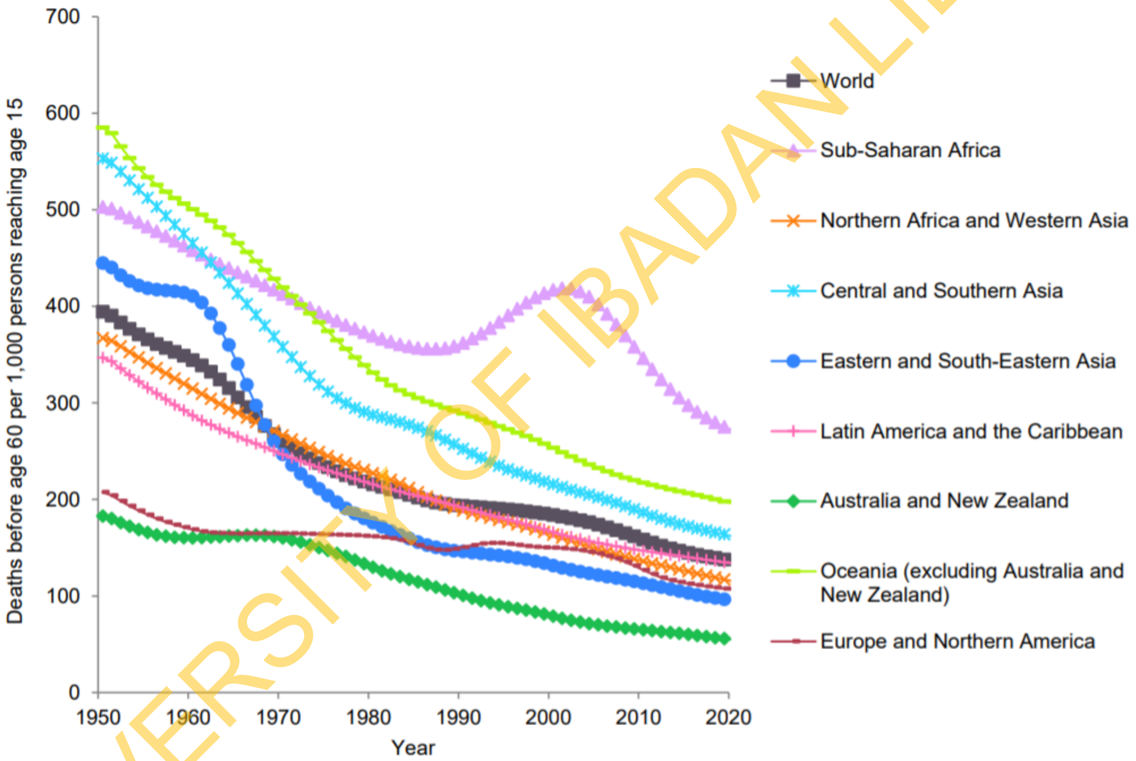
2.2.1 GLOBAL PERSPECTIVES OF ADULT MORTALITY

Globally, the probability of dying between ages 15 and 60 years decreased from 394 per 1,000 in 1950 to 190 per 1,000 in 1994, and further to 137 in 2019 (UN, 2019). It is also important to note that this rate nearly stagnated in the years prior to the 1994 ICPD held in Cairo, due to the adversative emergence of HIV/AIDS epidemic in sub-Saharan Africa and some parts of Europe. The progress made globally, and particularly in Africa over three decades was wiped out with the adult mortality in sub-Sahara Africa peaking at 420 deaths per 1000 persons in the early 2000s, courtesy of the HIV/AIDS epidemic. Thankfully, the introduction, availability, and rapid scale up of antiretroviral therapy (ART) which both protracts the survival of people living with HIV and reduces the probability of HIV transmission helped to revert adult mortality in sub-Sahara Africa to a declining at a faster rate in the late 2000s (Reniers *et al.*, 2014).

It has been observed that the decline in adult mortality among regions of the world is uneven. Five regions of the world were below the global average by the year 2019 – Europe & North

America, North Africa & Western Asia, Australia and New Zealand, East & South-Eastern Asia, Latin America, and Caribbean. In sub-Saharan Africa, adult mortality is 5 times higher than the lowest regional level of Australia and New Zealand at 275 adult deaths per 1000 persons. In a 2016 study, the demise of adults considerably impacts the mortality and morbidity in their dependents (infants, children, and spouse), as well as their socio-economic and sometimes education needs (Sheach-Leith & Stephen, 2016).

Figure 1: Life expectancy at age 60 for the world and regions, 1950-2019



Source: World Mortality Report, 2019

2.2.2 TRENDS AND PATTERNS OF ADULT MORTALITY IN SUB-SAHARA AFRICA

Between 1950 and 2019, Africa experienced a decline in adult mortality from 470 to 243 adult deaths per 1000 persons. It is important to note that within the peak of the HIV between 1990 and 2015, adult mortality rate in Africa declined by 23% and this contributed to the surge in population from 319 to 640 million adults aged 15-59 years (United Nations Population Division | Department of Economic and Social Affairs, 2017). There is a huge disparity in adult mortality rates within Africa. For example, the Southern Africa, and the Western Africa region adult mortality rate is three times that of the Northern Africa and are both the continent's average. According to the report, only Cape Verde had an adult mortality rate lower than the global average of adult mortality.

The World Mortality Report 2019 also showed that the higher adult mortality rate in Sub-Saharan Africa has may be due to economic and spatial inequality. The Commission of Social Determinants of Health by the World Health Organization (WHO) had indicated that the socioeconomic and political contexts are fundamental factors accountable for health, disease, and mortality, while the health care system and policy attributes are intermediate factors (Solar & Irwin, 2010). In a recent study in Burkina Faso, adults in urban areas of Burkina Faso still had health-benefit advantages over their counterparts in rural areas (Lankoande, 2016). In 2017, FAO reported that the prevalence of hunger was on the rise in Africa, after many years of decline. Between 2010 and 2017, the number of malnourished people in sub-Saharan Africa rose from 181 million to almost 237 million (FAO and ECA, 2018). The changes in the age pattern of most developing countries coupled with the unacceptable levels of mortality that occur in adulthood triggers a quest to understand and mitigate the still remarkably high adult mortality levels in sub-Sahara Africa.

2.2.3 ADULT MORTALITY IN NIGERIA

As of 2019, Nigeria ranks as one of the countries with the highest adult mortality in the world. Adult mortality is at 343 adult deaths per 1000 persons, and the rate has been projected to still be around 303 adult deaths by 2030 (UN, 2019). This rate is significantly higher than the global and continent's average meaning Nigeria is among the highest contributors to global adult mortality. The health sector is currently faced with the challenge of an uncompleted agenda on the containment of infectious disease, as well as the rapid and on-ongoing emergence of non-communicable diseases among young adults (Muhammad *et al.*, 2017). The first WHO Global Status Report on non-communicable disease listed Nigeria and some other developing countries as the worst hit with deaths from non-communicable diseases (WHO, 2010). These diseases with a rising burden in Nigeria include cardiovascular disease, cancer, hypertension, diabetes, chronic respiratory diseases, obesity, stroke, among others. Nigerians may continue to die from preventable conditions and disease if there are no proper programs designed to address each of these problems horizontally or vertically.

Available data indicate that nearly 80% of NCD deaths occur in low- and middle-income countries, of which Nigeria is classified within this group. The 2018 WHO country profile reveals that NCDs accounted for an estimated 29% of all deaths in Nigeria with cardiovascular diseases as the primary cause of NCD-related death (11%) followed by cancers (4%), chronic respiratory diseases (2%) and diabetes (1%). The rage of NCDs is to a large extent fueled by socio-behavioral dynamics associated with economic transition and rapid urbanization common to developing countries like Nigeria. Particularly challenging, is the mortality incidence ratio of cancer for Nigeria when compared to other Nations. For example, deaths as a result breast cancer accounts for 19% of all cancer related deaths in the United States, while it accounts for 51% of all cancer related deaths in Nigeria – a triple rate compared to the US. (Globocan, 2012).

2.3. OVERVIEW OF LIFE TABLE

One important interest of medical statisticians in assessing the health status of a population is understanding how long people can expect to live. The expected longevity of life is computed in demography and public health as life expectancy among many other important statistical functions through the construction of a life table. The Measure Evaluation program defined life table as "a statistical tool that summarizes the mortality experience of a population and yields information about longevity and life expectation". It is a way terse way of showing the probabilities of a member of a particular population living to or dying at a precise age (Pavía *et al.*, 2012). Although it is generally used for studying mortality, the life table format has found a broader use within and outside public health such in summarizing other demographic experiences/events such as duration of marriage, contraceptive use, labour force participation etc. Several attempts were made between the 17th and 18th century to construct a life table hitherto with limited data. It was not until 1815 that a scientifically correct life table classified by age based on both population and death data was published and generally accepted.

2.3.1 LIFE TABLE CONSTRUCTION IN DEVELOPING COUNTRIES

The age-specific death rates calculated from data reported on deaths by age and sex (from vital registration) and the population distribution by age and sex (from census) are the basic data required for the construction of a life table. For most developing countries especially sub-Sahara Africa, the vital registration system does not exist, and in situations where it existed, data available are incomplete because of coverage errors. Principally, the incompleteness in data is what motivated demographers into the application of various adjustment techniques inorder to derive reasonable suitable life tables (Murray *et al.*, 2003). The failure of mathematical functions that fully resolves or addresses the irregularities in age patterns of mortality led to the development of a few empirical "universal" mortality models of varying degrees of sophistication often referred to as Model Life Tables (Keyfitz, 1984). Among the best known is the Coale-Demeny Model Life Tables which is used in this study.

The Coale and Demeny regional model life tables were first published in 1966 having been derived from a set of 192 life tables by sex from actual population. These sets of life table were derived from registration data, over several years prior and post second world war and were subjected to very stringent standards of accuracy. Supplementary analysis of the underlying relationships identified four typical age patterns of mortality, determined largely by the geographical location of the population, but also based on their patterns of deviations from previously estimated regression equations. The South model depicts a population with high child mortality in relation to infant mortality at high overall mortality, and low child relative to infant mortality at low overall mortality. For the East model, the population is characterized high child mortality in relation to infant mortality, while the North Model is characterized by comparatively low infant mortality, high child mortality and low old age mortality beyond age 50 years. The West model is a merger of the North model and the East model, as it is derived using residual tables, and from the largest number and broadest variety of cases and believed to represent the most general mortality pattern (Murray *et al.*, 2003).

2.3.2 INDICES FROM LIFE TABLE

A typical life table contains several columns, each with a unique interpretation. While some columns are obtained from actual death datasets, other columns are computed on mathematical iterations. Below are some of the important indices obtainable on a life table:

lx - Number of survivors at age x

nqx - Probability of dying between age x and x+n

nDx - Number of deaths between age x and x+n nLx - Number of person years lived between age x and x+n

Tx - Total number of person years lived after age x

Ex - Life expectancy at age x

Life expectancy at birth tells average mean length of life based on their birth, current age and other demographic factors including gender a newborn baby would live at the period of birth to the time of death (Shryock & Siegel, 1973). Although it is usually reported at birth, it can be applied to other ages as well to know how many more years a person is estimated to live. This measure is used globally to measure the effect the developing world's strides to achieve socio and economic progress in health sector, education, sanitation, social safety, and environmental management.

CHAPTER THREE

METHODOLOGY

3.1 STUDY AREA

Administratively, Nigeria is divided into regions often called geo-political zones, and there are six regions in Nigeria. The south west region is the most populous region in the southern part of the country and the second most populous with an estimated population of 27,722,432 according to the last population census conducted in 2006 (NPC & ICF Macro, 2009). It is bounded in the East by Edo and Delta states, in the North by Kwara and Kogi states, in the West by the Republic of Benin and in the South by the Gulf of Guinea. The south west region is predominantly occupied by the Yoruba ethnic group and can be largely described as a homogenous community. The rising re-emergence of noncommunicable diseases among young adult such as diabetes melitus, hypertension heart diseases and lately lower respiratory illness such as Covid-19 pose a major threat to the survival chances of Nigerian population.

3.2 DATA SOURCES

The data for this study are secondary and obtained from two sources - the 1991 & 2006 Nigeria Censuses, and the Nigeria Demographic and Health Survey for 2003, 2008, 2013 and 2018.

3.2.1 Population Census

The population distribution by sex and age in five-year groups for the south west region were derived from the 1991 and 2006 censuses. The creation of six new states (one in each region of the country) between the 1991 and 2006 census did not in any way result into the shifting of a state from one region to another.

3.2.2 Nigeria Demographic and Health Survey (NDHS)

The NDHS is a nationally representative cross-sectional study that covers the entire population residing in non-institutional dwelling units of the country. It obtains information on demographic and health indicators at the national, regional, and state levels in Nigeria. All women who are aged 15-49 who are usual members of the selected households or who spent the night before the survey in the selected household were eligible for the survey. So also, all men who are aged 15-49 who are usual members of the selected households or who spent the night before the survey in the selected household were eligible for individual interviews. Child mortality estimates, one of the parameters used for selecting appropriate model life tables, was obtained by analysing data elements/variables from the individual record components of the 2003, 2008, 2013 and 2018 NDHS datasets. This childhood mortality estimates were computed nationally and for the south west region across the series of the surveys, and this was used to adjust to refine the age-sex distribution reported by the census, using the mortality level derivates. It is important to note that the study used only the women questionnaire for the analysis.

3.3 DATA MANAGEMENT

Data for the study was analysed and computed using the Statistical Package for Social Sciences (SPSS) software, Microsoft Excel, and MORTPAK for Windows version 4.3. SPSS version 20 was used to analyse data from the NDHS datasets for 2003, 2008, 2013 and 2018. Variables analysed were "sons at home", "sons elsewhere", "sons who have died", "daughters at home", "daughters elsewhere", "daughters who have died", "region of residence" by "age in 5-year groups of women". Microsoft Excel was used to make computations using exports from SPSS such as children ever born and children surviving for both sexes, linear interpolations and extrapolations, and other forms of mathematical computations. The MORTPAK software was used to compute estimates of childhood mortality by applying the Trussell version of the Brass method based on the Coale-Demeny model life tables. It was also used to construct model life tables based on probability of dying estimated for the country and the southwest region.

3.4 DATA MEASUREMENT AND ANALYSIS

The nature of the data used in this study often characterized by errors particularly age misreporting necessitated the need for refining the age-sex distribution. Mathematical methods have been observed to smooth out genuine age features (Nwogu & Okoro, 2017), hence the need for adjustments based on population models. The Y-Transformation model (UN 1983) will be used in this study as the Brass Logit transformation has been shown in some applications not to provide satisfactory smoothing ate the early and late ages. The Y-Transformation is known to have showed significant improvement in all accuracy indices when adjusted data are revaluated. The study used a stable population to estimate adult mortality using mortality level and growth rate experienced by the population.

3.4.1 Y-TRANSFORMATION MODEL

Y-transformation requires the selection of an appropriate standard age distribution from a standard stable population, provided the growth rate is known and comparing it to the reported age distribution. This is followed by the adjustment of the standard age distribution to reflect the key features of the reported one. Thereafter, the comparison of the standard model and reported distributions are simplified using a logit transformation which linearizes the relationship between age and the cumulated proportion of the population under each age. The UN Manual X (1983) define Y-Transformation as:

$$Y(x) = \text{In}\left(\frac{1 + C(x)}{1 - C(x)}\right)$$

where C(x) is the proportion of the reported population under the age of x.

Also, for a given standard population with age distribution, $C^S(x)$, the Y-transformation is given as:

$$YS(x) = \text{In}\left(\frac{1 + CS(x)}{1 - CS(x)}\right)$$

where CS(x) is the proportion of the reported population under the age of x.

It is important to note that the Y-transformation of any proportion C(x) or CS(x) assumes values ranging from zero to infinity.

A second-degree polynomial was also fitted for the Y(x) and YS(x) based on the assumption that the expected parabola passes through the origin, and can be written as:

$$Y(x) = \boldsymbol{\alpha}[YS(x)]^2 + \boldsymbol{\beta}[YS(x)]$$

where α and **β** are constants whose estimates can be derived as:

$$\boldsymbol{\alpha} = \left(\frac{1}{[\overline{YS}_1 - \overline{YS}_2]}\right)\left(\frac{\overline{Y}_1}{\overline{YS}_1} - \frac{\overline{Y}_2}{\overline{YS}_2}\right)$$

$$\boldsymbol{\beta} = \left(\frac{\overline{Y}_2}{\overline{YS}_2} - \boldsymbol{\alpha}\,\overline{YS}_2\right)$$

where $\overline{YS}_1, \overline{Y}_1$ and $\overline{YS}_1, \overline{Y}_1$ are the mean points for the first and second group respectively. Hence, estimates of the adjusted $\hat{\mathbf{Y}}(\mathbf{x})$ and C(x) are respectively, given as

$$\hat{Y}(x) = \alpha[YS(x)]^2 + \beta[YS(x)]$$

$$\hat{C}(x) = \frac{\exp[\hat{Y}(x)] - 1}{\exp[\hat{Y}(x)] + 1}$$

These equations were used to obtain the expected the Y-transformation for the total age distribution by sex, as well as the estimated proportion in each five-year age group for both sexes. The adjusted proportion at each age group was multiplied by the reported total population to obtain the refined age distribution.

To assess the differentials in age misreporting in each age group, the adjusted population in each age group was subtracted from the reported population. Positive values of error indicate over reporting, while negative values indicate under reporting. This was done for males and females separately.

3.4.2 CHOICE OF STABLE POPULATION

The reliability of $\widehat{C}(x)$ from the Y-transformation depends on the choice of appropriate standard population. The standard population may be a model population or analogies (ECA, 1988). Brass (1975) suggested the use of probability of a newborn surviving to age 5 (l_5) obtained from data on average number of children dead among children ever born and the rate of growth (r) of the study population as entry parameters. This study relied on the mortality level of the population and growth rate to select the appropriate stable population. The growth rate for Nigeria was computed using the 1991 and 2006 census with the assumption that the population grows exponentially, while the mortality level appropriate mortality level for the year was selected with the aid of l(x) estimates using the Coale and Trussel model.

The West model of the Coale-Demeny life table was used in this study as the mortality experience is a summary of disparate tables from within Western Europe and other sources outside Europe, which makes it a generic pattern which can be used as a default when the other three models are not suitable. The age distribution for the standard was obtained through linear interpolation to match the calculated growth rates.

3.4.3 ESTIMATION OF CHILDHOOD MORTALITY

The mortality level was computed referencing *l*(x) estimates using the Coale and Trussel model. To obtain estimated *l*(x), data on age of mother, number of children ever born, number of children surviving was used to estimate probability of dying q(x) for male and female using the NDHS 2003, 2008, 2013 and 2018 datasets with the aid of MORTPAK software. The probability of surviving from birth l(x) corresponding to the probability of dying q(x) was used to determine the mortality level from the series of Coale-Demeny Life tables available in the United Nations Manual X. The mortality levels for the census years were obtained through linear interpolation to match the calculated probability of surviving. This was computed separately for male and female separately, for the country and the south west region in focus.

3.4.4 ADJUSTMENT OF POPULATION CENSUS DATA

The age distribution will be adjusted using the mortality level as implied by 5q0 from the Coale-Demeny model Life Table and the population growth rate (r) between the census periods. The growth rate will be estimated with the assumption that the population. growth in Nigeria follows an exponential model:

$$r = \frac{\log_e(P_t/P_0)}{t}$$

The value of r and $_5q_0$ were used to select the appropriate standard population from the Coale-Demeny model LT. The cumulative population proportion at each five-year age group *c (x, x+n)* will be obtained through linear interpolation if exact observed growth rate is not found in the model LTs.

3.4.5 ESTIMATES OF LIFE TABLE FUNCTIONS

For this dissertation, the United Nations software package – MORTPAK version 4.3 was used to compute the life tables by using l(x) functions of the calculated mortality level, obtained via interpolation of appropriate life tables from the Coale-Demeny west model. Thereafter, probabilities of dying within specific age intervals q(0,5), q(15,20), q(15,35), q(15,45), q(30,40) and q(60,20) were determined for males and females, respectively.

3.5 ETHICAL APPROVAL

This study is based on secondary analysis of existing dataset. The 1991 and 2006 census data were obtained via written request to the National Bureau of Statistics and National Population Commission, respectively. The study also used with permission NDHS datasets - which survey protocols were reviewed and approved by the National Health Research Ethics Committee of the Federal Ministry of Health, and from the ICF Institutional Review Board.

CHAPTER FOUR

RESULTS

This chapter presents the results obtained from the analysis of data from the study. Results from the study include the refined age-sex distribution for the 2006 census, the variation in age misreporting, life expectancy, and probability of surviving from age 15 to 60 years by age and sex, in the south-west region of the country. The interpretation of these results is also presented in this chapter.

4.1 ESTIMATES OF CHILDHOOD MORTALITY LEVEL (2006)

Tables 1 to 6 displays the probability of dying q(x) and the corresponding probability of surviving l(x) for males, females and both sexes in the South West region as computed from the 2003 NDHS and 2008 NDHS based on the West model of Coale-Demeny System of probability of surviving. Using l(2) as reference, tables 1, 2 & 3 displays the probability of surviving is 0.090057, 0.85590 and 0.87987 for male, female and both sexes in 2003 respectively. In 2018, the probability of surviving is 0.090252, 0.94997 and 0.92592 for male, female and both sexes respectively as shown in tables 4, 5 & 6. From the tables below, the probability of surviving decreases with increasing age of mother.

Linear interpolation was conducted to estimate the mortality estimates for 2006 on the assumption of constant reduction in childhood mortality in the region over the years. The interpolated result indicates that the probability of surviving is 0.90174, 0.91234 for male and female respectively.

Table 1: Derivation of Mortality Level for Male, South West Nigeria (2003)

Age Group	CEB	CS	# of Women	Average # CEB	Average # Surviving	Proportion of Dead	x	q(x)	l(x)	t(x)	Ref Date
15 - 19	6	5	218	0.02752	0.02294	0.16667	1	0.17553	0.82447	1.2	2002.3
20 - 24	45	41	187	0.24064	0.21925	0.08889	2	0.09943	0.90057	2.0	2001.5
25 - 29	155	145	186	0.83333	0.77957	0.06452	3	0.06914	0.93086	3.2	2000.3
30 -34	214	192	126	1.69841	1.52381	0.10280	5	0.11056	0.88944	4.7	1998.8
35 - 39	230	200	96	2.39583	2.08333	0.13043	10	0.14259	0.85741	6.5	1997
40 - 44	189	159	72	2.62500	2.20833	0.15873	15	0.17166	0.82834	8.7	1994.8
45 - 49	235	204	75	3.13333	2.72000	0.13191	20	0.14145	0.85855	11.7	1991.8

Table 2: Derivation of Mortality Level for Female, South West Nigeria (2003)

Age Group	CEB	CS	# of Women	Average # CEB	Average # Surviving	Proportion of Dead	x	q(x)	l(x)	t(x)	Ref Date
15 - 19	7	7	218	0.03211	0.03211	0.00000	1	0.00000	1.00000	1.4	2002.1
20 - 24	38	33	187	0.20321	0.17647	0.13158	2	0.14410	0.85590	2.3	2001.2
25 - 29	131	116	186	0.70430	0.62366	0.11450	3	0.12304	0.87696	3.3	2000.2
30 -34	156	137	126	1.23810	1.08730	0.12179	5	0.13224	0.86776	4.6	1998.9
35 - 39	166	148	96	1.72917	1.54167	0.10843	10	0.12001	0.87999	6.1	1997.4
40 - 44	193	164	72	2.68056	2.27778	0.15026	15	0.16469	0.83531	8.1	1995.4
45 - 49	190	160	75	2.53333	2.13333	0.15789	20	0.17153	0.82847	11.1	1992.4

Table 3: Derivation of Mortality Level for Both Sexes, South West Nigeria (2003)

Age Group	CEB	CS	# of Women	Average # CEB	Average # Surviving	Proportion of Dead	x	q(x)	l(x)	t(x)	Ref Date
15 - 19	13	12	218	0.05963	0.05505	0.07692	1	0.07685	0.92315	1.30	2002.2
20 - 24	83	74	187	0.44385	0.39572	0.10843	2	0.12013	0.87987	2.10	2001.4
25 - 29	286	261	186	1.53763	1.40323	0.08741	3	0.09380	0.90620	3.30	2000.2
30 -34	370	329	126	2.93651	2.61111	0.11081	5	0.11969	0.88031	4.70	1998.8
35 - 39	396	348	96	4.12500	3.62500	0.12121	10	0.13326	0.86674	6.30	1997.2
40 - 44	382	323	72	5.30556	4.48611	0.15445	15	0.16807	0.83193	8.40	1995.1
45 - 49	425	364	75	5.66667	4.85333	0.14353	20	0.15483	0.84517	11.40	1992.1

Table 4: Derivation of Mortality Level for Male, South West Nigeria (2008)

Age Group	CEB	CS	# of Women	Average # CEB	Average # Surviving	Proportion of Dead	x	q(x)	l(x)	t(x)	Ref Date
15 - 19	62	56	1321	0.04693	0.04239	0.09677	1	0.10280	0.89720	1.1	2007.6
20 - 24	378	344	1095	0.34521	0.31416	0.08995	2	0.09748	0.90252	2.2	2006.5
25 - 29	1211	1101	1322	0.91604	0.83283	0.09083	3	0.09413	0.90587	3.7	2005
30 -34	1479	1374	993	1.48943	1.38369	0.07099	5	0.07404	0.92596	5.6	2003.1
35 - 39	1720	1544	866	1.98614	1.78291	0.10233	10	0.10853	0.89147	7.7	2001
40 - 44	1445	1284	626	2.30831	2.05112	0.11142	15	0.11684	0.88316	10.2	1998.5
45 - 49	1595	1339	566	2.81802	2.36572	0.16050	20	0.16694	0.83306	13.1	1995.6

Table 5: Derivation of Mortality Level for Female, South West Nigeria (2008)

Age Group	CEB	CS	# of Women	Average # CEB	Average # Surviving	Proportion of Dead	x	q(x)	l(x)	t(x)	Ref Date
15 - 19	41	37	1321	0.03104	0.02801	0.09756	1	0.11764	0.88236	0.8	2007.9
20 - 24	374	357	1095	0.34155	0.32603	0.04545	2	0.05003	0.94997	1.9	2006.8
25 - 29	1115	1031	1322	0.84342	0.77988	0.07534	3	0.07697	0.92303	3.7	2005
30 -34	1447	1311	993	1.45720	1.32024	0.09399	5	0.09589	0.90411	6.0	2002.7
35 - 39	1672	1506	866	1.93072	1.73903	0.09928	10	0.10268	0.89732	8.6	2000.1
40 - 44	1441	1296	626	2.30192	2.07029	0.10062	15	0.10274	0.89726	11.3	1997.4
45 - 49	1456	1282	566	2.57244	2.26502	0.11951	20	0.12109	0.87891	14.3	1994.4

Table 6: Derivation of Mortality Level for Both Sexes, South West Nigeria (2008)

Age Group	CEB	CS	# of Women	Average # CEB	Average # Surviving	Proportion of Dead	x	q(x)	l(x)	t(x)	Ref Date
15 - 19	103	93	1321	0.07797	0.07040	0.09709	1	0.11003	0.88997	0.90	2007.8
20 - 24	752	701	1095	0.68676	0.64018	0.06782	2	0.07408	0.92592	2.10	2006.6
25 - 29	2326	2132	1322	1.75946	1.61271	0.08340	3	0.08584	0.91416	3.70	2005
30 -34	2926	2685	993	2.94663	2.70393	0.08237	5	0.08499	0.91501	5.80	2002.9
35 - 39	3392	3050	866	3.91686	3.52194	0.10083	10	0.10563	0.89437	8.10	2000.6
40 - 44	2886	2580	626	4.61022	4.12141	0.10603	15	0.10975	0.89025	10.70	1998
45 - 49	3051	2621	566	5.39046	4.63074	0.14094	20	0.14474	0.85526	13.70	1995

4.2 PROJECTED ESTIMATES OF CHILDHOOD MORTALITY LEVEL (2020)

Tables 7, 8 & 9 also displays the probability of dying q(x) and the corresponding probability of surviving l(x) for male, females and both sexes for the region based on data from 2013 NDHS and 2018 NDHS. Using l(2) as reference, the probability of surviving l(x) is 0.92943, 0.92651, and 0.92803 for male, female and both sexes respectively in 2013, while in 2018, the probability had increased to 0.96231, 0.96930 and 0.96566 for male, female and both sexes respectively as shown in tables 10, 11 & 12..

By fitting a linear regression model from the mortality experience from the last four rounds of NDHS (2003 – 2018), the projected 2020 probability of survival is 0.939774, 0.91069 and 0.93496 for males, females and both sexes respectively as shown in figure 2. The projected estimates indicated a higher probability of survival among males than females in south west Nigeria.

Table 7: Derivation of Mortality Level for Male, South West Nigeria (2013)

Age Group	CEB	CS	# of Women	Average # CEB	Average # Surviving	Proportion of Dead	x	q(x)	l(x)	t(x)	Ref Date
15 - 19	47	44	1121	0.04193	0.03925	0.06383	1	0.07322	0.92678	0.9	2012.4
20 - 24	356	333	936	0.38034	0.35577	0.06461	2	0.07057	0.92943	2.0	2011.3
25 - 29	1070	963	1116	0.95878	0.86290	0.10000	3	0.10264	0.89736	3.8	2009.5
30 -34	1562	1396	1042	1.49904	1.33973	0.10627	5	0.10929	0.89071	5.9	2007.4
35 - 39	1788	1612	900	1.98667	1.79111	0.09843	10	0.10275	0.89725	8.3	2005
40 - 44	1508	1309	646	2.33437	2.02632	0.13196	15	0.13607	0.86393	10.9	2002.4
45 - 49	1413	1210	554	2.55054	2.18412	0.14367	20	0.14699	0.85301	13.9	1999.4

Table 8: Derivation of Mortality Level for Female, South West Nigeria (2013)

Age Group	CEB	CS	# of Women	Average # CEB	Average # Surviving	Proportion of Dead	x	q(x)	l(x)	t(x)	Ref Date
15 - 19	34	27	1121	0.03033	0.02409	0.20588	1	0.24052	0.75948	0.9	2012.4
20 - 24	319	298	936	0.34081	0.31838	0.06583	2	0.07349	0.92651	1.9	2011.4
25 - 29	1089	996	1116	0.97581	0.89247	0.08540	3	0.08923	0.91077	3.5	2009.8
30 -34	1513	1386	1042	1.45202	1.33013	0.08394	5	0.08760	0.91240	5.4	2007.9
35 - 39	1754	1586	900	1.94889	1.76222	0.09578	10	0.10138	0.89862	7.7	2005.6
40 - 44	1458	1302	646	2.25697	2.01548	0.10700	15	0.11188	0.88812	10.2	2003.1
45 - 49	1379	1225	554	2.48917	2.21119	0.11168	20	0.11585	0.88415	13.3	2000

Table 9: Derivation of Mortality Level for Both Sexes, South West Nigeria (2013)

Age Group	CEB	CS	# of Women	Average # CEB	Average # Surviving	Proportion of Dead	x	q(x)	l(x)	t(x)	Ref Date
15 - 19	81	71	1121	0.07226	0.06334	0.12346	1	0.14271	0.85729	0.90	2012.4
20 - 24	675	631	936	0.72115	0.67415	0.06519	2	0.07197	0.92803	2.00	2011.3
25 - 29	2159	1959	1116	1.93459	1.75538	0.09264	3	0.09595	0.90405	3.60	2009.7
30 -34	3075	2782	1042	2.95106	2.66987	0.09528	5	0.09873	0.90127	5.60	2007.7
35 - 39	3542	3198	900	3.93556	3.55333	0.09712	10	0.10211	0.89789	8.00	2005.3
40 - 44	2966	2611	646	4.59133	4.04180	0.11969	15	0.12432	0.87568	10.50	2002.8
45 - 49	2792	2435	554	5.03971	4.39531	0.12787	20	0.13177	0.86823	13.60	1999.7

Table 10: Derivation of Mortality Level for Male, South West Nigeria (2018)

Age Group	CEB	CS	# of Women	Average # CEB	Average # Surviving	Proportion of Dead	x	q(x)	l(x)	t(x)	Ref Date
15 - 19	28	27	1215	0.02305	0.02222	0.03571	1	0.04528	0.95472	0.7	2018.1
20 - 24	355	343	1026	0.34600	0.33431	0.03380	2	0.03769	0.96231	1.8	2017
25 - 29	1052	981	1217	0.86442	0.80608	0.06749	3	0.06898	0.93102	3.7	2015.1
30 -34	1632	1512	1209	1.34988	1.25062	0.07353	5	0.07475	0.92525	6.0	2012.8
35 - 39	2026	1859	1180	1.71695	1.57542	0.08243	10	0.08480	0.91520	8.7	2010.1
40 - 44	1664	1528	763	2.18087	2.00262	0.08173	15	0.08296	0.91704	11.5	2007.3
45 - 49	1609	1430	656	2.45274	2.17988	0.11125	20	0.11210	0.88790	14.6	2004.2

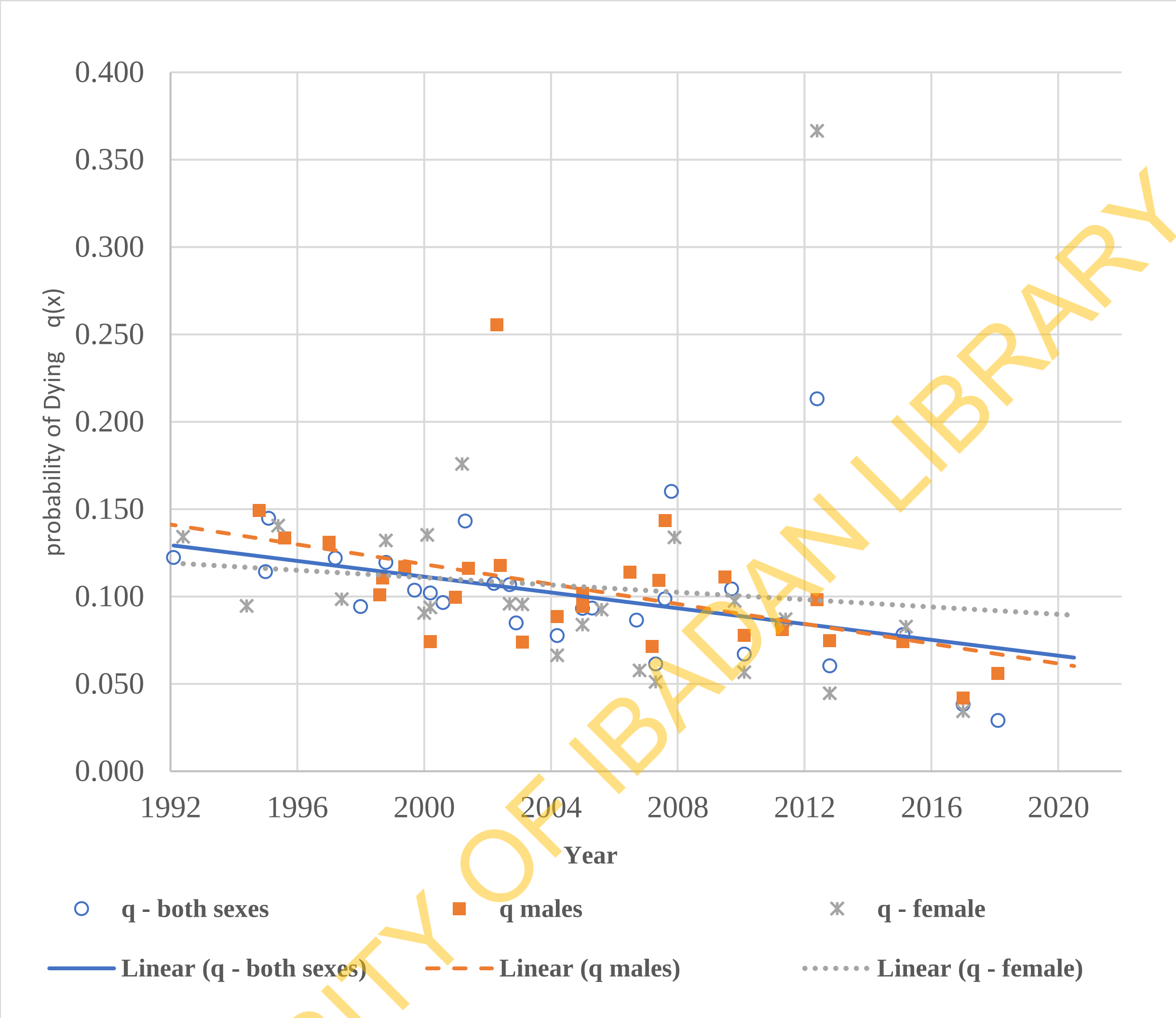
Table 11: Derivation of Mortality Level for Female, South West Nigeria (2018)

Age Group	CEB	CS	# of Women	Average # CEB	Average # Surviving	Proportion of Dead	x	q(x)	l(x)	t(x)	Ref Date
15 - 19	24	24	1215	0.01975	0.01975	0.00000	1	0.00000	1.00000	0.7	2018.1
20 - 24	328	319	1026	0.31969	0.31092	0.02744	2	0.03070	0.96930	1.8	2017
25 - 29	983	910	1217	0.80772	0.74774	0.07426	3	0.07602	0.92398	3.6	2015.2
30 -34	1479	1414	1209	1.22333	1.16956	0.04395	5	0.04471	0.95529	6.0	2012.8
35 - 39	2002	1882	1180	1.69661	1.59492	0.05994	10	0.06170	0.93830	8.6	2010.2
40 - 44	1557	1466	763	2.04063	1.92136	0.05845	15	0.05935	0.94065	11.5	2007.3
45 - 49	1428	1308	656	2.17683	1.99390	0.08403	20	0.08471	0.91529	14.6	2004.2

Table 12: Derivation of Mortality Level for Both Sexes, South West Nigeria (2018)

Age Group	CEB	CS	# of Women	Average # CEB	Average # Surviving	Proportion of Dead	x	q(x)	l(x)	t(x)	Ref Date
15 - 19	52	51	1215	0.04280	0.04198	0.01923	1	0.02447	0.97553	0.70	2018.1
20 - 24	683	662	1026	0.66569	0.64522	0.03075	2	0.03434	0.96566	1.80	2017
25 - 29	2035	1891	1217	1.67214	1.55382	0.07076	3	0.07238	0.92762	3.60	2015.2
30 -34	3111	2926	1209	2.57320	2.42018	0.05947	5	0.06048	0.93952	6.00	2012.8
35 - 39	4028	3741	1180	3.41356	3.17034	0.07125	10	0.07332	0.92668	8.70	2010.1
40 - 44	3221	2994	763	4.22149	3.92398	0.07048	15	0.07155	0.92845	11.50	2007.3
45 - 49	3037	2738	656	4.62957	4.17378	0.09845	20	0.09923	0.90077	14.60	2004.2

Figure 2: Trend of mortality pattern between 1992 and 2020 in southwest Nigeria



4.3 ADJUSTED AGE DISTRIBUTION IN SOUTH WEST NIGERIA

Tables 13 & 14 shows the derivation of logit transformation and the adjusted age distribution for the 2006 census for the region. The table reveals that there was under-reporting at ages less than 15 years, and at ages 45 years and above, while overreporting occurred at ages 15 to 44 years among male. Among females, in the southwest region, underreporting was also occurred at ages less than 15 years, and at ages 40 years and above, while overreporting spanned only between the ages of 15 and 39 years only.

Table 15 describes level of errors in each five-year age group for both sexes. Errors in each five-year age group was computed by comparing the total adjusted population for the age group with the total reported population for the age group. A positive error value indicates the level of over-reporting and a negative error value indicates under-reporting. The table reveals that the level of errors was higher in females than in male age groups, and the level of error was lower in the southwest compared to the national estimates. Gross age misreporting was recorded in ages 60 and above in the study area.

Figures 2, 3 & 4 depicts the deviation in the proportion of population at different age groups with respect to adjustments based on the West model of Coale-Demeny model life table used for this study. As indicated between sexes, the proportion of age groups in the reported population varies hugely from the adjusted proportion particularly at ages 20 – 35 years and the variation were much higher among the females compared to the male. Overall, the reported proportion was found to be much similar to the adjusted proportion within the ages 40 – 50 years irrespective of sex.

Table 13: Adjusted age distribution [males] for South West region, 2006 Nigeria Census.

Age (x)	Males	Prop in 2006	2006 Proportion Under x CMr (x)	Stable Proportion Under x CMs (x)	Y(m) Logit (2006)	Y(m) Logit (Stable)	YM(x)	Cm (x) Estimated	Cm Estimated (x, x+5)	Adjusted Age distribution
5	1,779,736	0.1264	0.1264	0.1769	0.2542	0.3576	0.3028	0.1502	0.1502	2,114,990
10	1,729,610	0.1228	0.2492	0.3237	0.5091	0.6715	0.5719	0.2784	0.1282	1,805,204
15	1,559,591	0.1108	0.3600	0.4480	0.7538	0.9644	0.8260	0.3910	0.1126	1,585,538
20	1,478,281	0.1050	0.4650	0.5530	1.0073	1.2454	1.0724	0.4901	0.0991	1,395,443
25	1,469,723	0.1044	0.5694	0.6413	1.2933	1.5208	1.3163	0.5771	0.0870	1,225,061
30	1,334,375	0.0948	0.6642	0.7154	1.6006	1.7963	1.5628	0.6535	0.0764	1,075,800
35	1,032,828	0.0733	0.7375	0.7774	1.8900	2.0775	1.8169	0.7204	0.0669	942,029
40	859,922	0.0611	0.7986	0.8290	2.1895	2.3699	2.0839	0.7787	0.0583	820,931
45	739,417	0.0525	0.8511	0.8718	2.5203	2.6811	2.3711	0.8292	0.0505	711,098
50	593,062	0.0421	0.8932	0.9068	2.8751	3.0184	2.6859	0.8724	0.0432	608,306
55	486,703	0.0346	0.9278	0.9350	3.2847	3.3935	3.0403	0.9087	0.0363	511,146
60	277,864	0.0197	0.9475	0.9571	3.6135	3.8203	3.4492	0.9384	0.0297	418,210
65	266,252	0.0189	0.9664	0.9738	4.0694	4.3220	3.9373	0.9617	0.0233	328,091
70	145,845	0.0104	0.9768	0.9856	4.4451	4.9264	4.5363	0.9788	0.0171	240,788
75	135,510	0.0096	0.9864	0.9932	4.9840	5.6806	5.3003	0.9901	0.0113	159,117
80	63,253	0.0045	0.9909	0.9975	5.3881	6.6834	6.3447	0.9965	0.0064	90,119

Estimates: α – 0.01623, β - 0.84085

Table 14: Adjusted age distribution [females] for South West region, 2006 Nigeria Census.

Age (x)	Females	Prop in 2006	2006 Proportion Under x CFr (x)	Stable Proportion Under x CFs (x)	Y(f) Logit (2006)	Y(f) Logit (Stable)	YF(x)	Cf (x) Estimated	Cf Estimated (x, x+5)	Adjusted Age distribution
5	1,735,812	0.1272	0.1272	0.1712	0.2558	0.3458	0.3096	0.1536	0.1536	2,095,300
10	1,642,018	0.1204	0.2476	0.3142	0.5057	0.6504	0.5861	0.2850	0.1314	1,792,464
15	1,491,816	0.1094	0.3570	0.4360	0.7469	0.9346	0.8475	0.4001	0.1151	1,570,111
20	1,438,083	0.1054	0.4624	0.5394	1.0007	1.2066	1.1006	0.5007	0.1006	1,372,312
25	1,488,112	0.1091	0.5715	0.6270	1.2995	1.4729	1.3512	0.5887	0.0880	1,200,432
30	1,441,132	0.1056	0.6771	0.7009	1.6475	1.7381	1.6036	0.6651	0.0764	1,042,193
35	1,069,254	0.0784	0.7555	0.7631	1.9713	2.0072	1.8626	0.7312	0.0661	901,688
40	859,380	0.0630	0.8185	0.8153	2.3045	2.2853	2.1332	0.7882	0.0570	777,553
45	664,204	0.0487	0.8672	0.8589	2.6434	2.5783	2.4215	0.8369	0.0487	664,330
50	496,162	0.0364	0.9036	0.8950	2.9830	2.8930	2.7351	0.8781	0.0412	562,021
55	408,335	0.0299	0.9335	0.9247	3.3699	3.2410	3.0863	0.9126	0.0345	470,624
60	229,611	0.0168	0.9503	0.9486	3.6697	3.6352	3.4900	0.9408	0.0282	384,684
65	235,914	0.0173	0.9676	0.9673	4.1064	4.0970	3.9706	0.9630	0.0222	302,836
70	133,362	0.0098	0.9774	0.9812	4.4716	4.6576	4.5654	0.9794	0.0164	223,717
75	113,233	0.0083	0.9857	0.9906	4.9335	5.3555	5.3232	0.9903	0.0109	148,690
80	58,973	0.0043	0.9900	0.9964	5.2933	6.3182	6.4001	0.9967	0.0064	87,304

Estimates: α - 0.01972, β - 0.88836

Table 15: Errors in age reporting and adjusted age distribution [males, females and both sexes], 2006 South West Nigeria.

Age (x)	**Error (Male)**	% Error (Male)	**Error (Female)**	**% Error (Female)**	Reported Age Distribution	Adjusted Age Distribution	% Error	Pt(x)	Adjusted Pt
5	-335254	-18.84	-359488	-20.71	3515548	4210290	-19.76	0.1268	0.1519
10	-75594	-4.37	-150446	-9.16	3371628	3597668	-6.7	0.1216	0.1298
15	-25947	-1.66	-78295	-5.25	3051407	3155649	-3.42	0.1101	0.1138
20	82838	5.6	65771	4.57	2916364	2767755	5.1	0.1052	0.0998
25	244662	16.65	287680	19.33	2957835	2425493	18	0.1067	0.0875
30	258575	19.38	398939	27.68	2775507	2117993	23.69	0.1001	0.0764
35	90799	8.79	167566	15.67	2102082	1843717	12.29	0.0758	0.0665
40	38991	4.53	81827	9.52	1719302	1598484	7.03	0.062	0.0577
45	28319	3.83	-126	-0.02	1403621	1375428	2.01	0.0506	0.0496
50	-15244	-2.57	-65859	-13.27	1089224	1170327	-7.45	0.0393	0.0422
55	-24443	-5.02	-62289	-15.25	895038	981770	-9.69	0.0323	0.0354
60	-140346	-50.51	-155073	-67.54	507475	802894	-58.21	0.0183	0.029
65	-61839	-23.23	-66922	-28.37	502166	630927	-25.64	0.0181	0.0228
70	-94943	-65.1	-90355	-67.75	279207	464505	-66.37	0.0101	0.0168
75	-23607	-17.42	-35457	-31.31	248743	307807	-23.74	0.009	0.0111
80	-26866	-42.47	-28331	-48.04	122226	177423	-45.16	0.0044	0.0064
Total		**-172.41**		**-229.9**					

Table 16: Adjusted age distribution [males] for Nigeria, 2006 Nigeria Census.

Age (x)	Males	Prop in 2006	2006 Proportion Under x CMr (x)	Stable Proportion Under x CMs (x)	Y(m) Logit (2006)	Y(m) Logit (Stable)	YM(x)	Cm (x) Estimated	Cm Estimated (x, x+5)	Adjusted Age distribution
5	11,569,218	0.1622	0.1622	0.1896	0.3273	0.3838	0.3568	0.1765	0.1765	12,592,479
10	10,388,611	0.1456	0.3078	0.3420	0.6362	0.7127	0.6563	0.3169	0.1404	10,016,907
15	8,504,319	0.1192	0.4270	0.4699	0.9124	1.0199	0.9308	0.4345	0.1176	8,390,229
20	7,536,532	0.1056	0.5326	0.5771	1.1875	1.3162	1.1908	0.5338	0.0993	7,084,607
25	6,237,549	0.0874	0.6200	0.6662	1.4500	1.6078	1.4420	0.6175	0.0837	5,971,617
30	5,534,458	0.0776	0.6976	0.7399	1.7252	1.9005	1.6896	0.6884	0.0709	5,058,395
35	4,505,186	0.0631	0.7607	0.8005	1.9957	2.2000	1.9382	0.7483	0.0599	4,273,595
40	3,661,133	0.0513	0.8120	0.8502	2.2657	2.5137	2.1935	0.7993	0.0510	3,638,620
45	3,395,489	0.0476	0.8596	0.8902	2.5836	2.8458	2.4579	0.8423	0.0430	3,067,856
50	2,561,526	0.0359	0.8955	0.9222	2.8981	3.2071	2.7389	0.8786	0.0363	2,589,841
55	2,363,937	0.0331	0.9286	0.9473	3.2963	3.6096	3.0437	0.909	0.0304	2,168,903
60	1,189,770	0.0167	0.9453	0.9664	3.5713	4.0694	3.3812	0.9342	0.0252	1,797,906
65	1,363,219	0.0191	0.9644	0.9803	4.0106	4.6104	3.7639	0.9547	0.0205	1,462,583
70	628,436	0.0088	0.9732	0.9897	4.2990	5.2636	4.2049	0.9706	0.0159	1,134,393
75	765,988	0.0107	0.9839	0.9955	4.8140	6.0946	4.7330	0.9826	0.0120	856,146
80	327,416	0.0046	0.9885	0.9985	5.1528	7.1947	5.3750	0.9908	0.0082	585,033

Estimates: α – -0.02682, β - 0.94002

Table 17: Adjusted age distribution [females] in Nigeria, 2006 Nigeria Census.

Age (x)	Females	Prop in 2006	2006 Proportion Under x CFr (x)	Stable Proportion Under x CFs (x)	Y(f) Logit (2006)	Y(f) Logit (Stable)	YF(x)	Cf (x) Estimated	Cf Estimated (x, x+5)	Adjusted Age distribution
5	11025749	0.1596	0.1596	0.1804	0.322	0.3648	0.3608	0.1785	0.1785	12331905
10	9616769	0.1392	0.2988	0.3270	0.6164	0.6789	0.6684	0.3223	0.1438	9934610
15	7631631	0.1105	0.4093	0.4511	0.8695	0.9722	0.9530	0.4435	0.1212	8373260
20	7362887	0.1066	0.5159	0.5561	1.1415	1.2543	1.2245	0.5457	0.1022	7060620
25	7197530	0.1042	0.6201	0.6442	1.4503	1.5306	1.4881	0.6316	0.0859	5934513
30	6676968	0.0966	0.7167	0.7180	1.8017	1.8070	1.7496	0.7038	0.0722	4988031
35	4962352	0.0718	0.7885	0.7794	2.1349	2.0877	2.0130	0.7643	0.0605	4179721
40	3670622	0.0531	0.8416	0.8303	2.4533	2.3782	2.2831	0.8149	0.0506	3495767
45	3060981	0.0443	0.8859	0.8723	2.8051	2.6852	2.5659	0.8573	0.0424	2929259
50	2029767	0.0294	0.9153	0.9067	3.1185	3.0173	2.8688	0.8926	0.0353	2438746
55	1885282	0.0273	0.9426	0.9344	3.5217	3.3840	3.1996	0.9216	0.029	2003503
60	876477	0.0127	0.9553	0.9564	3.7783	3.8038	3.5734	0.9454	0.0238	1644254
65	1087067	0.0157	0.9710	0.9732	4.2190	4.2990	4.0079	0.9643	0.0189	1305731
70	522612	0.0076	0.9786	0.9852	4.5268	4.8988	4.5247	0.9786	0.0143	987934
75	564609	0.0082	0.9868	0.9930	5.0141	5.6515	5.1585	0.9886	0.0100	690863
80	252422	0.0037	0.9905	0.9975	5.3448	6.6834	6.0009	0.9951	0.0065	449061

Estimates: α - 0.01443, β - 0.99433

Table 18: Errors in age reporting and adjusted age distribution [males, females and both sexes] for Nigeria, 2006 Census.

Age (x)	**Error (Male)**	% Error (Male)	**Error (Female)**	**% Error (Female)**	Reported Age Distribution	Adjusted Age Distribution	% Error	Pt(x)	Adjusted Pt
5	-1023261	-8.84	-1306156	-11.85	22,594,967	24,924,384	-10.31	0.1609	0.1775
10	371704	3.58	-317841	-3.31	20,005,380	19,951,517	0.27	0.1425	0.1421
15	114090	1.34	-741629	-9.72	16,135,950	16,763,489	-3.89	0.1149	0.1194
20	451925	6.00	302267	4.11	14,899,419	14,145,227	5.06	0.1061	0.1007
25	265932	4.26	1263017	17.55	13,435,079	11,906,130	11.38	0.0957	0.0848
30	476063	8.60	1688937	25.29	12,211,426	10,046,426	17.73	0.087	0.0715
35	231591	5.14	782631	15.77	9,467,538	8,453,316	10.71	0.0674	0.0602
40	22513	0.61	174855	4.76	7,331,755	7,134,387	2.69	0.0522	0.0508
45	327633	9.65	131722	4.30	6,456,470	5,997,115	7.11	0.046	0.0427
50	-28315	-1.11	-408979	-20.15	4,591,293	5,028,587	-9.52	0.0327	0.0358
55	195034	8.25	-118221	-6.27	4,249,219	4,172,406	1.81	0.0303	0.0297
60	-608136	-51.11	-767777	-87.60	2,066,247	3,442,160	-66.59	0.0147	0.0245
65	-99364	-7.29	-218664	-20.12	2,450,286	2,768,314	-12.98	0.0174	0.0197
70	-505957	-80.51	-465322	-89.04	1,151,048	2,122,327	-84.38	0.0082	0.0151
75	-90158	-11.77	-126254	-22.36	1,330,597	1,547,009	-16.26	0.0095	0.011
80	-257617	-78.68	-196639	-77.90	579,838	1,034,094	-78.34	0.0041	0.0074
Total	-1023261	-8.84	-1306156	-11.85	22,594,967	24,924,384	-10.31	0.1609	0.1775

Figure 3: Percentage error in Age Reporting in South-West Nigeria, 2006 Census

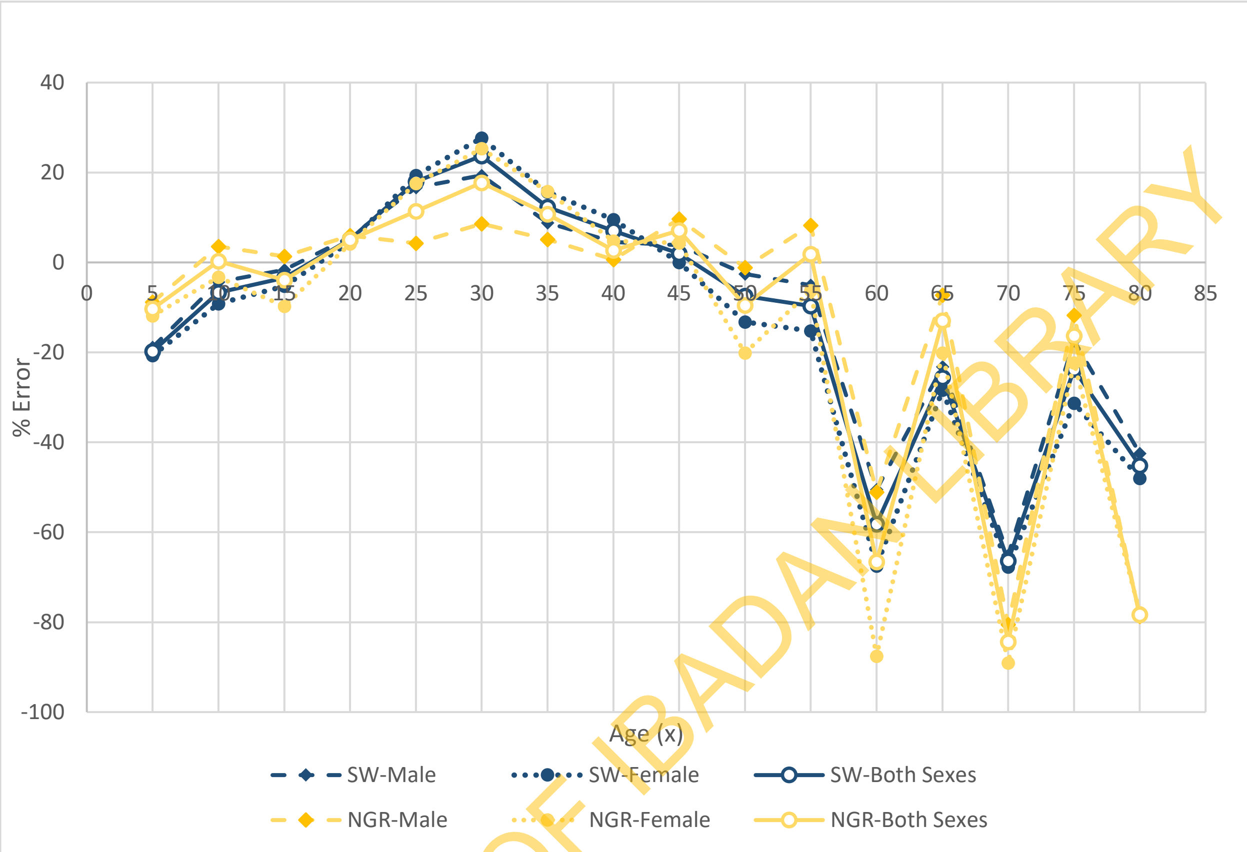


Figure 4: A comparison of the reported and adjusted proportion in each age group, among males in Nigeria and South-West Nigeria 2006

Figure 5: A comparison of the reported and adjusted proportion in each age group, among females in Nigeria and South-West Nigeria 2006

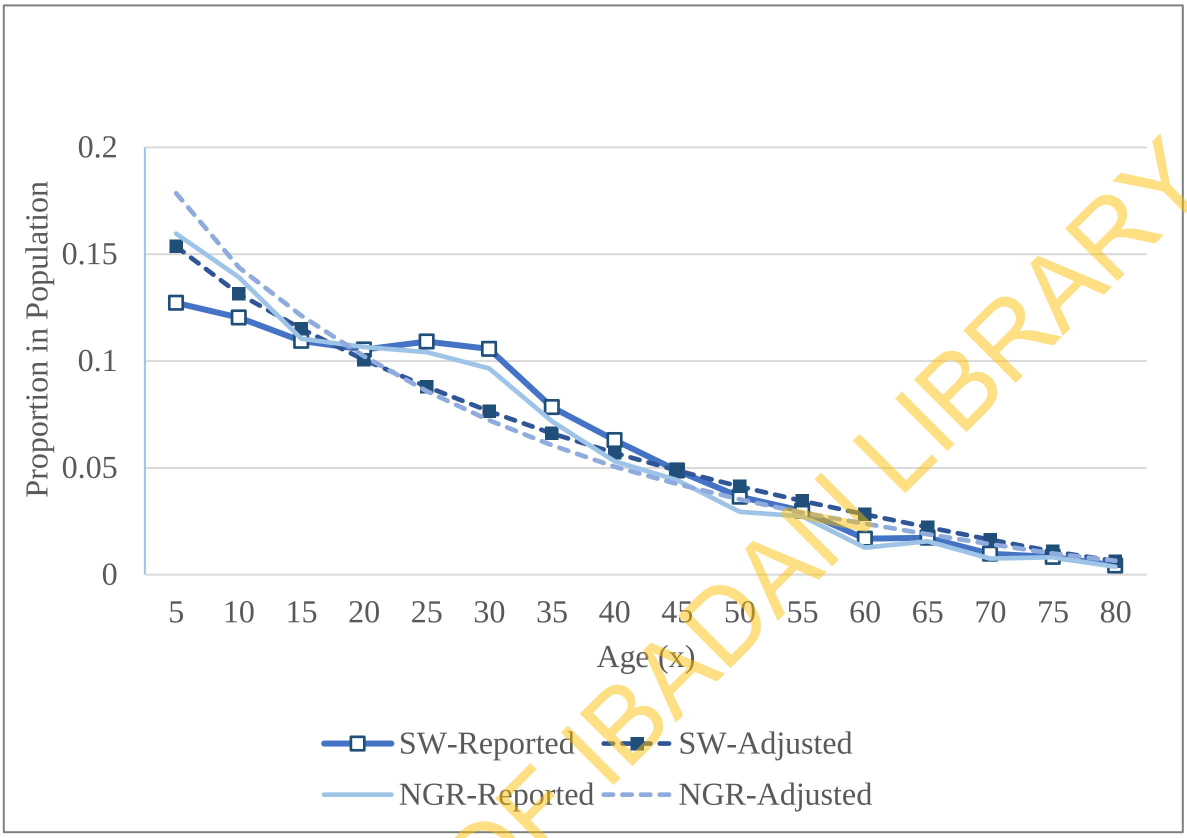
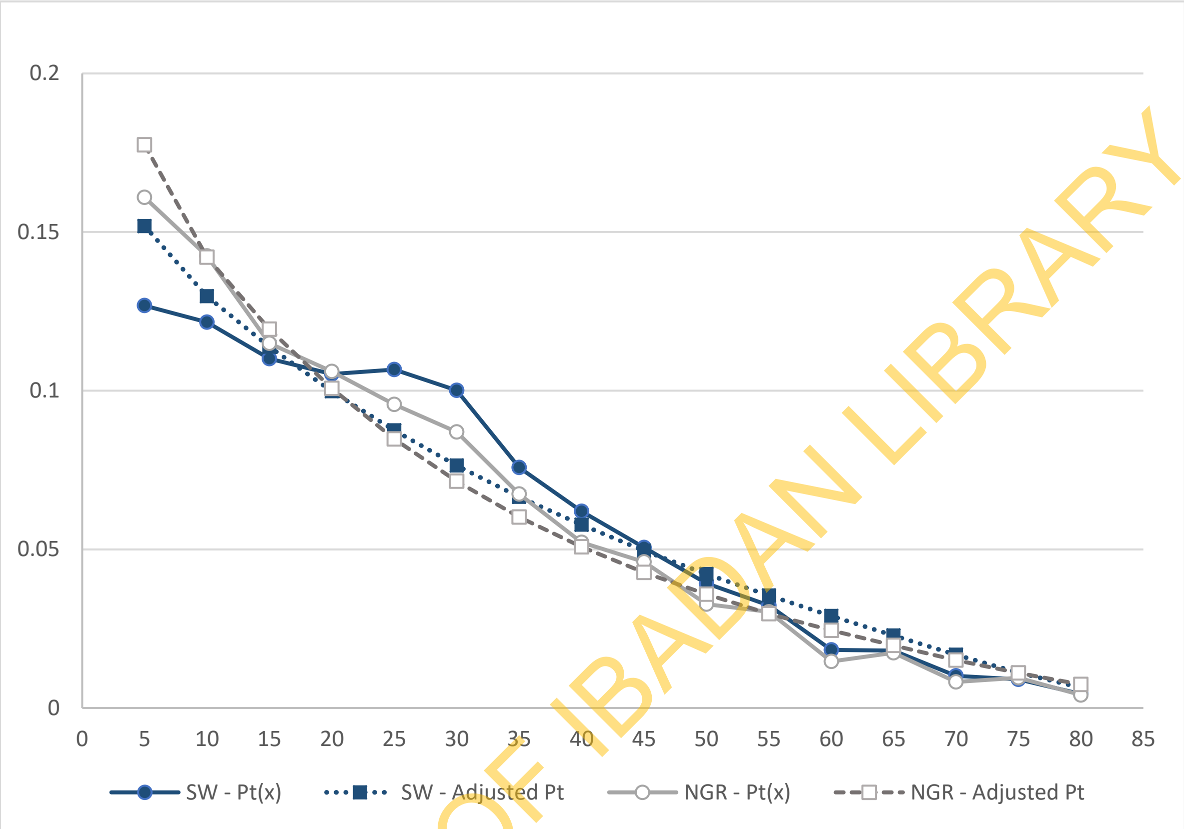


Figure 6: A comparison of the reported and adjusted proportion in each age group, in Nigeria and South-West Nigeria 2006



4.4 ESTIMATES OF LIFE TABLE FUCTIONS IN SOUTH WEST NIGERIA

Tables 19 and 20 details the estimates of life table components derived using the West model of the Coale-Demeny Life tables based on the expected mortality level to be experienced by the south west region of Nigeria in 2020 using mortality trends spanning over 15 years from the 2003 to 2018 NDHS surveys. The table indicates the life expectancy at birth (e0) is 64 years for males while 61 years for females in this region. The probability of dying before reaching age 5 years q(0,5) is 0.0602 for males and 0.0893 for females. The probability of a person surviving till age 15 years and dying before the age 35 years q(15,20) is 0.0426 and 0.0603 for male and female respectively, while the probability of a 15-year-old person before the age of 60 years q(15,45) is 0.2218 and 0.2371. Having survived till the age of 60 years, the probability of a person dying before the age of 80 years q(60,20) is 0.6721 and 0.6370 for males and females respectively.

From the above, the survivorship function (lx) for males in the southwest region indicated that the number of persons alive at a referenced age reveals that 93977 (93%), 82743 (82%), 52538 (52%) persons will be alive to age 25, 50 and 70 respectively, while 88565 (88%), 77137 (77%), 51977 (51%) of females are expected to live till age 25, 50, and 70 respectively.

Table 19: Life Table Estimates for South-West region (Male)

Age	m(x,n)	q(x,n)	l(x)	d(x,n)	L(x,n)	S(x,n)	T(x)	e(x)
0	0.0502	0.0483	100000.0000	4825.745	96048.87	0.9475	6463816	64.64
1	0.0032	0.0126	95174.2545	1196.857	377714	0.9890	6367767	66.91
5	0.0012	0.0058	93977.3980	540.5787	468535.5	0.9949	5990053	63.74
10	0.0009	0.0045	93436.8193	421.0438	466131.5	0.9941	5521518	59.09
15	0.0016	0.0079	93015.7756	734.0292	463379.8	0.9904	5055386	54.35
20	0.0022	0.0111	92281.7464	1025.042	458920.9	0.9886	4592006	49.76
25	0.0023	0.0114	91256.7046	1042.953	453703.4	0.9880	4133086	45.29
30	0.0026	0.0129	90213.7515	1161.435	448244.2	0.9856	3679382	40.79
35	0.0033	0.0162	89052.3160	1444.886	441809.8	0.9809	3231138	36.28
40	0.0046	0.0226	87607.4296	1976.816	433380.8	0.9723	2789328	31.84
45	0.0069	0.0337	85630.6138	2886.69	421394.1	0.9583	2355947	27.51
50	0.0105	0.0510	82743.9235	4223.224	403828.6	0.9365	1934553	23.38
55	0.0162	0.0782	78520.6999	6138.512	378166.1	0.9034	1530725	19.49
60	0.0250	0.1182	72382.1880	8553.737	341626.5	0.8550	1152559	15.92
65	0.0387	0.1769	63828.4507	11290.13	292089.6	0.7835	810932	12.70
70	0.0607	0.2643	52538.3245	13884.7	228849.5	0.6808	518842.4	9.88
75	0.0958	0.3860	38653.6281	14921.88	155806.9	0.4627	289992.9	7.50
80	0.1769	...	23731.7525	23731.75	134186.1	...	134186.1	5.65

Table 20: Life Table Estimates for South-West region (Female)

Age	m(x,n)	q(x,n)	l(x)	d(x,n)	L(x,n)	S(x,n)	T(x)	e(x)
0	0.0663	0.0632	100000	6315.509	95196.84	0.9264	6193407	61.93
1	0.0071	0.0279	93684.49	2615.905	367992.2	0.9784	6098210	65.09
5	0.0019	0.0095	91068.59	861.3427	453189.6	0.9916	5730218	62.92
10	0.0015	0.0074	90207.24	665.1294	449373.4	0.9912	5277028	58.50
15	0.0022	0.0109	89542.11	976.6169	445403.1	0.9872	4827655	53.91
20	0.0029	0.0145	88565.5	1285.598	439723	0.9843	4382252	49.48
25	0.0034	0.0169	87279.9	1470.806	432802.7	0.9819	3942529	45.17
30	0.0039	0.0195	85809.09	1669.826	424964.4	0.9789	3509726	40.90
35	0.0046	0.0229	84139.27	1923.754	416009.4	0.9750	3084761	36.66
40	0.0056	0.0276	82215.51	2265.322	405594.1	0.9690	2668752	32.46
45	0.0072	0.0352	79950.19	2812.982	393020.1	0.9585	2263158	28.31
50	0.0100	0.0490	77137.21	3781.345	376694.1	0.9420	1870138	24.24
55	0.0142	0.0688	73355.86	5043.515	354838.9	0.9153	1493444	20.36
60	0.0219	0.1039	68312.35	7099.302	324778.2	0.8720	1138605	16.67
65	0.0340	0.1571	61213.05	9616.039	283198.8	0.8039	813826.8	13.29
70	0.0551	0.2433	51597.01	12555.95	227677.2	0.7019	530628	10.28
75	0.0891	0.3649	39041.06	14245.26	159811	0.4725	302950.7	7.76
80	0.1732	...	24795.79	24795.79	143139.7	...	143139.7	5.77

Figure 7 below shows the comparism of life expectancies for the study area by sex. The figure reveals an insignificant difference in the life expectancy between male and female except for a slight variation between the sex at early ages. Life expectancy at birth was slightly higher for males than females.

The figure 8 below describes the variation in adult mortality indices by sex in the region revealing a higher probability of females dying between the ages of 15 and 60 years, while the probability of survival switched in favor of the females between the ages of 60 and 80 years.

Figure 9 compares the survivorship probabilities in between age groups by sex. The figure shows a similar probability of survival between an age group and the next until age group 55 – 60 years which revealed a slightly higer probaility of survival for female between age groups till age 70 years.

Figure 7: Estimates of Life Expectancy in South West Nigeria, 2020

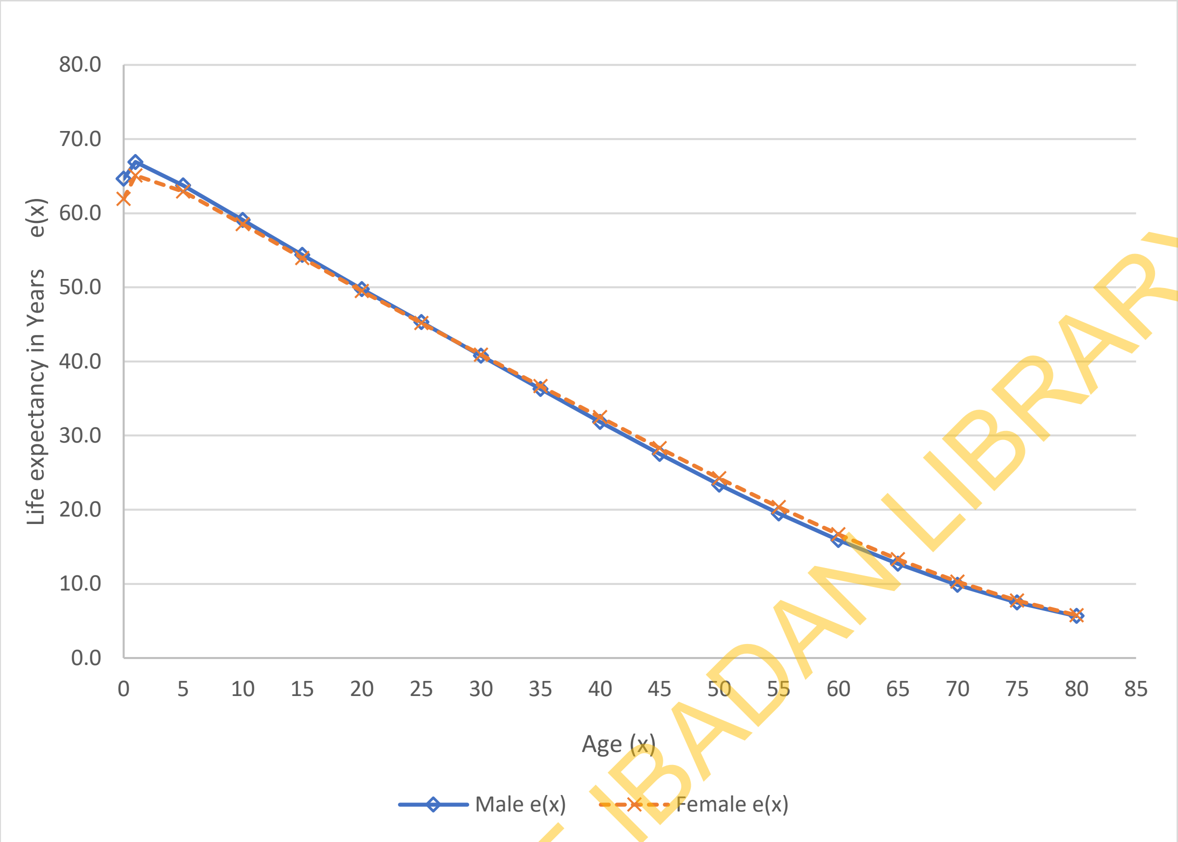


Figure 8: Analysis of adult mortality indices among males in South West Nigeria, 2020

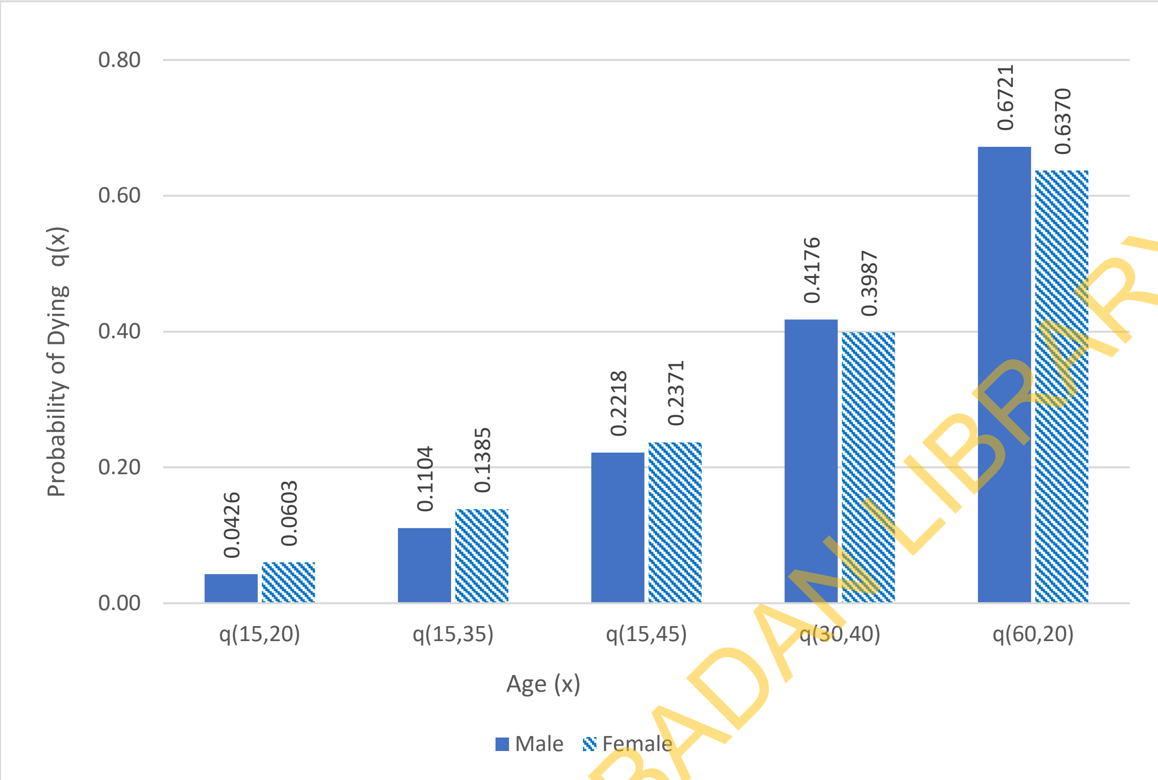
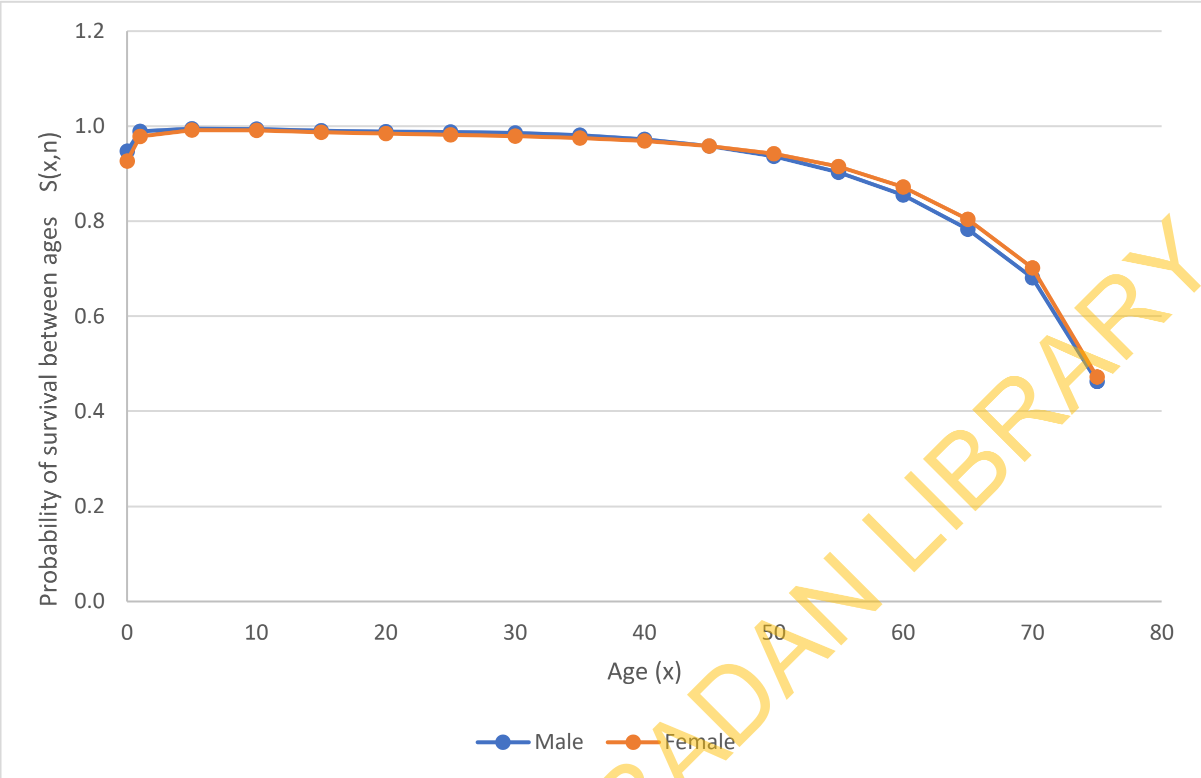


Figure 9: Estimates of Survivorship probabilities for Male & Female in SouthWest



CHAPTER FIVE

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

This chapter presents the findings of this study according to its objectives, the strength and limitation of the study, as well as the conclusion and recommendation of the study.

5.1 DISCUSSION OF FINDINGS

The objective of the study was to obtain a refined age-distribution by five-year group for the southwest region, determine life expectancy in the south west region, and the probability of surviving from age 15 to 60 years q(15,45) in the region. The study extracted data from the Nigeria Demographic and Health Survey datasets for the year 2003 and 2008 to determine the mortality level for the census year. Using information on children alive at home, children elsewhere and children dead to estimate for childhood mortality for both male and female, the probability of surviving was converted to the mortality level from the series of west model Coale-Demeny system available in the United Nations Manual X.

The study reveals gross age misreporting in all age groups in both sexes. As with most censuses in developing countries on younger ages (Ramachandran, 1989), a significant under-reporting was reported in ages less than 15 years. Overreporting also occurred unanimously between ages 15 – 39 years for both sexes while it extends to age 44 years among males. Gross age misreporting was recorded in ages 60 and above for both sexes particularly in the last 5 years of the decade. Findings from a similar report indicated that the reported population at older ages is composed of persons younger than the stated age. Between sexes, males are more likely to report their true ages between ages 10 – 15 and 45 – 55 years than females within the same age group. The net effect of both age under-reporting and over-reporting between the ages 0 and 45 makes misstatement of age more rampant among females than males (Adebowale *et al.*, 2014). The population between ages 50 – 55 years are more likely to report their true ages, while ages 20 – 40 years are more prone to errors than any other group within the population. The pattern of age misreporting from this study do not significantly differ from the country's pattern of age misreporting as documented by (Adebowale *et al*., 2014). There was a tendency to under-report ages between 0 to 17 years and those above 55 years, whereas a gross over-reporting of ages was seen for ages between 18 and 55 years.

This study also projected the mortality experience of the South West region for the year 2020 using the probability of surviving on the West model of Coale-Demeny life tables to generate some life table parameters. From this study, the projected estimates of probability of life at birth was 64 years for male, and 61 years for female. A higher life expectancy is observed in the south west region compared to the national estimate in 2013 reported by (Afam *et al*., 2018). A higher chance at surviving metrics for the region may have been influenced by the consistent decline in infant and childhood mortality recorded in the region as documented in the last national demographic and health survey (NPC, 2019). In contrast to common knowledge on life expectancy estimates for most countries, where life expectancy favours females over males, the life expectancy at birth for 2020 in the south west region however switched in favour of males. It should be noted that women living longer is not necessarily healthy lives is partly due to an inherent biological advantage for the female, and a reflection of behavioural differences between men and women (WHO, 2009).

In a previous study, (Sundberg *et al.*, 2018) had highlighted a reduction in life expectancy between sexes, accompanied by an increase in life expectancy as a result of decreased mortality from ischemic heart disease. The impact of other causes of death, particularly smoking-related causes, decreased in men but increased in women, also brings about reduction in life expectancy between sexes. This suggests the position that an increased imbalance in biological exposure to the risk factors of any demographic event can alter public outcomes. Results from this study also estimates a higher probability of surviving from age 15 to 60 years q(15,45) compared to the same estimate for the region in 2013 and the overall national estimate (Afam *et al.*, 2018; Akinyemi & Olowolafe, 2017). The probability of adult mortality was slightly higher in female between the ages of 15 – 60 years, and this adult probability became sharply higher in male between the ages of 60 – 80 years. The findings of this study within this age group may not be unconnected with the rising prevalence of non-communicable diseases in developing countries (WHO, 2010).

In a research among civil servants in Ibadan, the most populous town in Nigeria and West Africa, a high prevalence of cardio-metabolic risk factors was found among the working class, he concluded on the dominance of risk factors of non-communicable disease especially among females (Olawuyi & Adeoye, 2018). In a similar study in oncology centres within the region, the peak age of cancer incidence was earlier among women between the ages of 40-44 years while 50-54 years among men with females facing more variants of cancer than men at a sex ratio 3:1 (Sowunmi *et al.*, 2018). Recently, there is an increasing prevalence and mortality of breast cancer among females, with a reduced prevalence of lung cancer in males and high survival rate of prostatic cancer as most men with prostatic cancer usually die of other diseases (Akinde *et al.*, 2015).

A rising trend of cardiovascular diseases has also been documented among females in south western Nigeria, particularly with hypertension and its related complications constituting majority of cardiovascular diseases (Adedapo, 2017). With increasing female participation in labour force in the region, the author had opined that the stress induced hormonal changes which goes down in men on returning home from work and goes up in women who are faced with cooking, housework, and childcare may also contribute as a predisposing factor for the changes in probability of survival. Beyond the predominant ages of working class, the probability of survival becomes higher for women even though on a doubling increase. The traditional constant activeness of women caring for the family and other social needs, and increased inactivity in men as a predisposing factor may have now favoured the higher survival in women.

Although a higher socio-economic development which is evident in the region has been found to improve healthcare practices and quality of life (Adedini *et al.*, 2015), it is imperative to watch out for the mortality rates among adults especially among the working class in line with the Goal 3 of the Sustainable Development Goals targeted at ensuring healthy lives and promotion of well-being for all at all ages.

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5.2 STRENGTHS AND LIMITATION OF THE STUDY

A major strength of this study is that it utilizes several rounds of regular and sequential representative survey which factors effective selection of samples in the region from the population over the years to make a subnational projection of mortality estimates for the year 2020. The study highlights the importance of relying on regional mortality and other demographic estimates for bespoke planning and efficient policy drive at the national level achieve desired health outcomes.

One important limitation of this study is that although it reviewed for possible variation in age misreporting and mortality level experienced at the subnational level, this study did not analyse the reasons for the causal factors within the region. Inability to report deaths correctly or completely which may include misclassification of infants or still births may contribute recall or response bias since records on deaths are based on reports given by respondents.

5.3 CONCLUSION AND RECOMMENDATION

The study has discussed the adjustment of age-sex data due to errors from a regional perspective. Hitherto, the level of errors varies between sex, the pattern of errors from the 2006 census data is similar at both the national and regional level. It is imperative that deliberate efforts must be made to minimize errors in the field rather than depending on post-field adjustments. The usual practice of obtaining information on each household member from the head may be responsible for some of the distortions in the demographic data. With the use of technology, enumerators should be able to check age misstatement through the harmonization of the different government standalone databases on civic registrations.

The adult survivorship probability estimates from this study may seem to have followed the same pattern with the national estimate, the rising higher probability of dying among female due to varying predisposing factors in the region associated with better socio-economic developments needs to be checked immediately. It becomes germane for policy makers to put in consideration regional diversities in addressing all forms of preventable mortality at all age groups. Further studies into estimates of demographic parameters at the regional level will help to provide policy makers with bespoke direction using the bottom-top approach in achieving better health outcomes for the country.

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