MORTALITY RATE, POPULATION GROWTH RATE AND AGING POPULATION IN NIGERIA: THE MODERATING EFFECT OF FERTILITY

OLUFAWO Henry Siji
Lagos State University of Science and Technology Ikorodu
Olufawohenry002@gmail.com
DALLAH Hamadu
University of Lagos Akoka
dhamadu@unilag.edu.ng
MESIKE Godson Chukwuwike
University of Lagos Akoka
gmesike@unilag.edu.ng

ABSTRACT

Population ageing is a new demographic concern that is influenced by changes in birth and death rates and population growth through the years. Although greater declines in mortality rates will tend to increase longevity, fluctuations in fertility and population growth rates can also affect the speed of population ageing. This research examines the association between mortality rate, population growth and ageing in Nigeria and moderating variable is fertility rate. Secondary data were collected from NBS and from the World Bank Development Indicators database for the duration of the study. To assess the relationships among the variables, multiple linear regression analysis was done in EViews 12 software. The results have shown that when taking into consideration fertility, overall population growth has a positive and statistically significant impact on the issue of ageing. For child mortality there was an inverse relationship with age and for fertility, the relationship was positive. The study suggests that the challenges of population ageing in Nigeria can be met by improvement of social welfare systems for elderly citizens, an increased availability of quality health services to elderly people and fortification of measures that can lower the mortality rate of children and young people.

Keywords: *Ageing process, chronic conditions, mortality rate, population growth.*

INTRODUCTION

Previous demographic investigations have found that declining mortality and fertility rates will result in an ageing population. The ageing process is a gradual, continuous process of natural changes that begin in early adulthood. During this period, many bodily functions gradually decline. People do not become old or elderly at any specific age, but traditionally, age 65years has been designated as the beginning of old age. During the ageing process, the following common signs begin to show: increased susceptibility to infection, greater risk of heart stroke or hypothermia, a slight decrease in height as the bones of the spine get thinner and lose some height, bones break more easily, joint changes, ranging from minor stiffness to severe arthritis.

Mortality, a key component of population change, is measured using different indices that relate the number of deaths within specific groups to the population at risk. It is commonly categorized into infant mortality (death before age one, including neonatal mortality withing the first 28days), child mortality (under-five and ages 5-14), and adult mortality (ages 15-64). Mortality rates, such as the death rate per 1,000 people, help assess population health and guide interventions. Several factors influence mortality, including healthcare access, medical facilities, nutrition, living standards, sanitation, potable water, hygiene, infectious diseases, conflict and crime. Environmental conditions such as poor sanitation, toxic chemical exposure, unsafe air and water quality also significantly affect maternal and child mortality, according to World Health Organization report (2022).

Population growth entails an increase in population size, i.e. the rate at which the number of individuals in a population increases over time. Population growth results from three major processes: natural changes (births and deaths), interregional migration, and international migration. In an attempt to forecast changes in the size of a population, researchers, policymakers, and government agencies typically focus on four main factors: fertility rate, mortality rate (life expectancy), the initial age profile of the population (whether it is relatively old or relatively young to begin with) and migration (Iberdrola, 2015). Other factors include increased climate change, decreased food security, overexploitation of resources and the impact of biodiversity loss.

Despite declining mortality rates and Sustained population growth in Nigeria, the proportion and challenges of the ageing population remain poorly quantified. Currently demographic policies focus largely on youth and fertility Oyewole, Ayuba &Iliya (2023); Dangiwa Timium & Haruna (2024), leaving a gap in understanding how mortality combined with population growth specifically shaped ageing trends, dependency ratios, and pressure on healthcare and social systems. This study examines the ageing process in Nigeria in the context of mortality of people aged less than 5 years and adults aged 15years to 65years and population growth with fertility rate as a moderating variable, to inform policy planning for elderly care. The research objectives are to examine the relationships among the ageing process, mortality rates (children and adults) and population growth; determine the effect of population growth on the ageing process; and analyse the impact of mortality rates (children and adults) on the ageing population. Furthermore, the study addresses the following research questions: (1) What are the relationships among the ageing process, mortality rates (child and adult) aged 15years to 60years, and population growth in Nigeria when fertility rate is the moderating factor? (2) To what extent does population growth affect the ageing process in Nigeria when fertility is the moderating factor? (3) To what extent does mortality (child and adult) affect the ageing population in Nigeria when fertility is a moderating factor?

The following hypotheses are formulated to address the research objectives:

i. There are no relationships among mortality, (child and adult) population growth and population ageing in Nigeria, when fertility is a moderating factor.
ii. There is no significant relationship between population growth and population ageing in Nigeria when fertility is a moderating factor.
iii. There is no significant relationship between mortality (child and adult) and ageing population when fertility is a moderating factor

Literature Review

This section reviews the literature on the ageing population, mortality, and population growth in Nigeria, with specific emphasis on the relationships among the ageing population, mortality rate, and population growth in Nigeria and the world at large. It also attempts to conceptualize the ageing process, mortality rate, and population growth, as well as to provide insight into some theoretical issues in ageing. The theories underpinning the study are categorised into three major hypotheses, which underscore their relevance to the study of demography in Nigeria.

Based on the theoretical literature reviewed, a conceptual framework was adopted for this research, along with the gap in the literature that necessitates the present study.

Conceptual Review

In the last years, the knowledge about population ageing has been enriched by the discovery that, next to the inherited march-independent biological features, molecular and environmental factors which take part in the ageing process throughout the life are playing a role on the increase of longevity (Cattaneo, 2026; Argentieri et al., 2025). Furthermore, demographic research in modern times indicates that changes in life expectancy is now an important factor shaping population structure, with new health events like the outbreak of COVID-19 playing a role in altering mortality trends in many countries (Dowd et al., 2025;

Aburto et al., 2025). Moreover, ageing is being more associated with multimorbidity because low and middle-income (LMIC) countries, in particular, often have healthcare systems which are constrained in its resources, and multimorbidity, especially, is associated with ageing (WHO, 2023, Ahmed, Khan & Lawal, 2023).

In general, the process of ageing is assessed by analysing the age distribution pattern among population, specifically the percentage of older people and the median age. One difference is that between conventional measures, which categorize ageing as a set of chronological age cuts, and prospective measures, which define old age based on remaining life expectancy, as Sanderson et al. (2018) differentiate. However these may not be the most important demographic categories that would be relevant for comparison, as that that would be most important would be those of actual dependency – and this would generally be measured by a demographic category other than chronological age, for example only by a category that included all individuals aged 60 or more. Population ageing can be seen as two components: a decrease in the number of younger members of the population, and an increase in the number of older members of the population (as pointed out by Weil 1997). In this study, therefore, the focus is on the percentage of Seniors (persons aged 65 years and older) as the key indicator of the aging of the population. Demographic changes are also driven by population growth as the dynamic combination of all three influencing indicators, fertility, mortality and migration, affects age shapes over time (Tesch-Romer & Kondratowitz, 2006; Colombo et al., 2016).

Conditions of living and better health in all age groups continue to be closely linked. Cervellati and Sunde (2013) specifically suggested that provision of clean water, electricity, better household incomes and sanitary sewerage improve child mortality rates and life expectancy. There is evidence to support this, in Nigeria. The Nigeria General House Survey (NGHS Wave 5, 2023/2024) shows continued low access to electricity in rural areas, reduce nutrient intake, which compound to the already poor health condition and malnutrition among the children in the rural communities (National Bureau of Statistics, 2024). Similarly, the Nigerian Economic Summit Group (2025) noted the impact of rising living costs and poor infrastructure, on the nutritional intake of many households, thus underscoring the critical role of socio-economic factors in influencing population health.

In this study, the indicator of child mortality corresponds to the probability of dying before 5 years old (4q1). Differential inequality in under-five mortality levels is one of the most valid measures of health and socioeconomic development of a country as it accurately shows the effectiveness of healthcare systems, maternalism, nutrition and public health interventions (Tabutin and Masquelier, 2018). As such, the ability to reduce child mortality has been firmly identified as a great development goal and has been consistently featured on international agendas, including that of the Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs) (Govan, 2021).

In many developing countries, adult mortality had not been well studied in the past, due in part to poor vital registration practices. Kaufman et al. (1997) report that good census-level data on adult mortality are lacking throughout Sub-Saharan Africa. Yet, over the past few years, the civil registration and vital statistics system has been improved, leading to greater quality and quantity of mortality data that provides for more detailed demographic analyses (Setel et al., 2020; Lopez & Murray, 2020; AbouZahr et al., 2020).

Adult mortality is analysed as the likelihood of someone dying between the ages of 15 and 60 years (45q15). This indicator is especially relevant given that it covers the mortality risks in economically productive age-most of which are preventable with timely and appropriate health care interventions, as stated by UNDESA (2015). Káčerová et al. (2014) argued that falling child mortality rates lead to a larger population of grown-ups, wider base of younger generations, and quicker population growth.

Constantly improving survival at older ages will result in an increasing elderly population over time. The study also notes that fertility has an effect on demographic change but that mortality decline continues to have an overriding impact on long term demographic ageing.

Milne (2009) noted that there are five possible phases in human mortality pattern. The first stage is noted by having a high infant and childhood mortality rates from infectious and congenital disorders. This is followed by a drop in mortality as the child grows up and a rise at adolescence/early adulthood due to behaviour and environment. The third and fourth stages are half of the Makeham and Gompertz stages in which death rates increase continuously as age increases. The last stage is characterized by less of a increase in death rates at very old ages.

Haines (2020) also described the Gompertz curve, explaining that it reflects biological deterioration due to ageing, and called it intrinsic mortality; this is as distinct from extrinsic mortality, which happens as a result of external factors such as disease, environmental hazard, food shortage and accidents. The Gompertz model qualitatively indicates that death rates are related to old age in an exponential manner, among which it is applicable to model the demographic consequences of population ageing.

In the Gompertz model $R_t=R_o e^{\alpha t}$, R_t is the mortality rate at age t, R_o is the initial mortality rate, and $\propto$ refers to the rate of increase in mortality rate, also known as mortality acceleration, or the rate of demographic ageing, and it increases with age.

Conceptual Framework

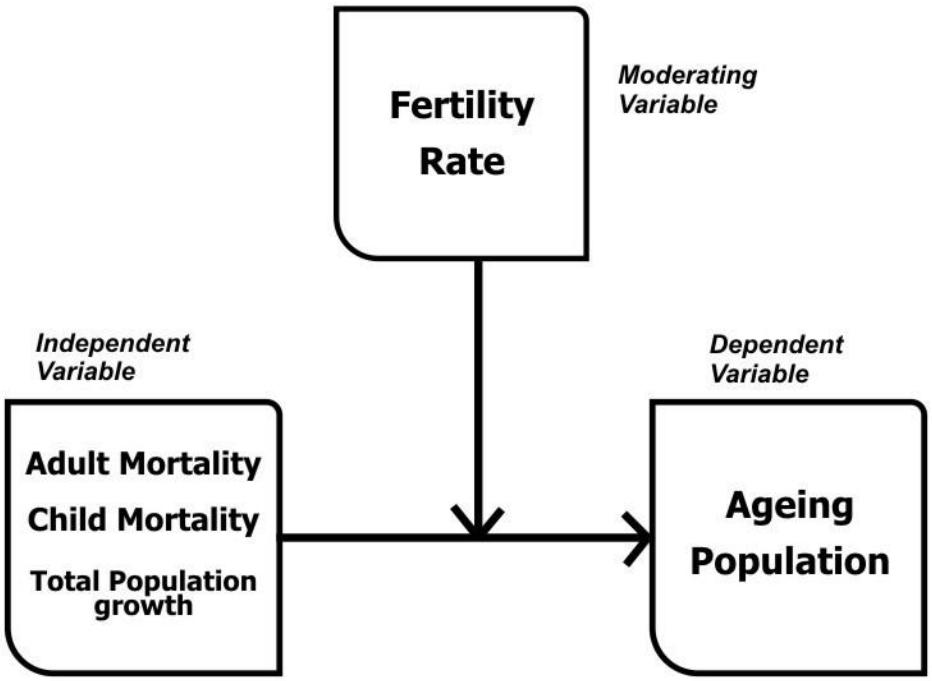

Figure 1: Model Showing Relationship among Mortality Rate, Total Population Growth, Fertility rate and Ageing Population

Theoretical Review

This study was informed by the theories of population ageing which are presented by Jelena (2019) and the demographic transition theory (Kirk, 1996).

Recent scholarship has reflected progress as well as persistence on improving the quality of data, including notions of the catalyst role played by civil registration and vital statistics (CRVS) systems to meet this goal (Setel et al., 2020; Lopez & Murray, 2020; AbouZahr et al., 2020).

The measure of adult mortality was 45q15 giving the probability of dying in the age group 15-60 years. This is a significant health policy indicator as it reflects the risk of death, with over 50% of deaths, especially to young and middle-aged adults, being assumed to be preventable (UNDESA, 2015). Káčerová et al. (2014) studied the interaction of child mortality, fertility and population ageing, which highlights that the decrease in infant and child mortality creates more surviving population, speeding up the population growth. If these cohorts survive to the reproductive age, then they will yet further solidify growth, resulting in a youthful age structure of growth and the resulting enlarged adult body. It is recognized that high birth rates of baby boomers can contribute to ageing, but this does not imply that high birth rates are most important. Important, as mentioned by Káčerová et al. (2014) is that the number of elderly people may not grow markedly even in countries with high levels of fertility and mortality, even if the number of born infants and children diminishes: Therefor mortality patterns have a two-fold effect: either reducing the number of children born or reducing the number of people who die during their old age, population aging occurs.

There are five major phases of human mortality curves identified by Milne (2009), albeit not all are seen between countries. The first, the "birth or childhood phase", refers to a drastically lower level of mortality rate at young ages (ages 8 – 9) where many factors that make an infant vulnerable to causes of death, such as congenital defects, infant mortinatality, and infant mortality will be at play. The second, 'sexual maturity and early adult life', is a phase in which increased exposure to mortality risks and risktaking behaviors lead to increased mortality rates.

Empirical Review

There have been several studies on the elderly population undertaken to help the policy makers or government agencies design and analyse policies regarding the growing elderly population and to do a proper planning for the ever huge elderly population. Very little research has been carried out in developing countries which looks at the impact demography has on the ageing population, unlike developed countries. According to Bangtson and Scott (2024), population ageing is a global phenomenon, and it is a problem that affects the newly developed and developing nations to a greater extent. They said that the increased life expectancy and its trend towards longer lived expectancy might be some of the factors leading to the increase in the older population. Suaharsanan et al., (2018) forecasted that in years ahead there will be increasing representation of an ageing population in most LMC countries and less in most western European countries, where the process has already started.

A demographic study of current trends in Europe by England and Azzopardi (2017) indicates that population shifts in the continent are due to changes in population specifically related to ageing, a drop in birth rates, and variegated migration movements. Recent reports, by the European Commission (2020), by Kiss (2020), and Sobotka & Zeman (2020) attest to the continued low levels of fertility in Eastern and Southern Europe, as well as Eastern Europe's net population loss and its ageing workforce.

Recent research (Sobotka & Zeman, 2020) confirmed the situation of the working population in countries like Bosnia, Macedonia and Serbia with restrictive employment. These demographic shifts have a potential to effect public health depending on country actions as highlighted by the European Commission (2020).

Population of older people is increasing rapidly and in large numbers and has significant implications for the political, economic and social roles of societies in both developed and developing economies. As per the report of Population Division of the United Nations Department of Economic and Social Affairs (2015), the global population of older persons (persons aged 65 and above) has increased to 12.3% and

it will go up to nearly 22% by the year 2050. Sub-Saharan Africa, where the older population comprises the smallest proportion of the population and will be ageing at lower rates than the developed regions will see their older population increase by 250 per cent before 2030 (UNDESA, 2015).

Addressing the health-related quality of life (HRQoL) of older people in Nigeria is still susceptible, as access to primary care and neighborhood walkability, as well as caregiving arrangements have significant effects on HRQoL (BMC Primary Care, 2023; Okigbo et al., 2026; Archives of Public Health, 2024).

The mortality rate in Nigeria has been falling over the years significantly such as a reduction of 79.6 infant deaths in the year 1980 to virtually 65 infant deaths, a reduction of 73.1 over the previous 40years (2020-1980) in 1986-2018.In Nigeria, mortality rates have thus been declining significantly in recent years; for example, the child mortality rate stood at 65 deaths per 1000 live births in 2020, down from 79.6 deaths per 1000 births in 1980, and a decrease of 79.6 in 40years (2020-1980) is observed. In Nigeria for instance where the economy is not good and the poorness of the population is high, population ageing can give rise to a greater proportion of old people in particular who are receiving poor welfare sustenance, which can in turn increase the tensions suffered by the individual and families obliged to provide for them and consequently large-scale old age people neglect and abuse (Perpetua, Pelner and Mba, 2018).

There's also been a gradual decline in the fertility rate among the youths in Nigeria, but they are still among the highest in Africa. Eririogu, Okezie and Ebukiba (2020) found that this reduction has been shown to contribute to the increase in the proportion of elderly population in Nigeria. The fertility rate in Nigeria has experienced a slight decrease, from 6.12 in 2000, to 5.34 in 2020 and will be predicted to be around 4.45 in 2030 (Worldometers, 2022).

Other than low birth rates, improved health and sanitation conditions have also helped to improve life expectancy, according to Alhasan, et al, 2021. According to Perpetua, Pelser and Mba (2018) aging makes people less active and weaker and they become more at risk to catch a disease which places them at a higher risk of being discriminated against and subjected to prejudice. Goran (2021) investigated the impact of child and adult death rates, population growth on population ageing taking a pool sample of 9 lower and upper-middle income countries in Europe. The study discovered that the increasing ageing process within these countries is consequence of the negative impact of population growth and the influence of adult mortality for both sexes. Redonda et al. (2009) examined the acceleration process of population ageing, and the result revealed that population ageing was due to rising life expectancy and decreasing fertility. In its separate works, Lee (2003) and Willekens (2014) have indicated that mortality has fallen first, and, as a result, the population growth rate is higher at the beginning, before falling again as a result of fertility decline to lower levels and, owing to the earlier mortality decline, an older age structure.

Eririogun's (2020) study contains explanation of the 4 stages of the Demographic transition. At the first stage, high mortality rates coupled with a high birth rates occur at almost a comparable level but are liable to sudden fluctuations depending on natural occurrence e.g. famine, drought, disease etc. (Eririogun, 2020). Population growth at this stage is generally slow with population levelling off at times (Eririogun, Okezie and Ebukiba, 2020). The second stage as he puts it, usually witnesses a drop-in mortality rate because of improvement in food supply resulting from better method of famine and improvement in health and sanitation which increase longevity but the birth rate remain very high due to poor access to contraception, poor girl child education and low female participation in labour force (Eririogun, 2020). In the third stage the birth rate started to decline due to access to contraception, improvement in girls' education at this stage a parent may begin to put a lot more resources into education, and hence decline in birth rate (Eririogun, Okezie and Ebukiba, 2020). The fourth phase is characterized by low birth rate, which is being sustained, and consistently low death rate and the population is now on the decline as the birth rate is now lower than the replacement rate of 2.1 children per woman (Eririogun, 2020).

Nigeria is in the second phase of the demographic transition model: declining mortality rates (especially mortality for children), but high birth rates resulting in very high population growth rates. Over the last twenty years, Nigeria population has increased by over 2.5% per year (Eririogun, Okezie and Ebukiba, 2020). Nigeria is home to over 200 million people to date, and is expected to reach approximately 400 million people in the year 2050 (AfDB, 2022). The population growth of the country has been maintained due to a greater reduction in the mortality rate compared with the reduction in fertility rate (Alhassan et al., 2021), mainly because of reduced access to clean water and weaker the transmission of preventable and communicable diseases. The health environment in Nigeria has undergone a dramatic change over the last four decades, and is expected to further change as Nigeria moves forward over the next 30 years. Nigeria has done a lot in achieving healthy people. Despite the difficulties of epidemic diseases and food insecurity, there is clear need to strengthen health system and enhance the available and quality health services available, which include decreasing infant and maternal mortality (AfDB, 2022).

Studies of the ageing population have been conducted and mostly focused on welfare and forecast (Eririogun, Okezie and Ebukiba, 2020); Perpetua, Pelser & Mba, 2018); Bangtson & Scott, 2024). Also, studies have been done on the relationship between an ageing population and population growth; most of these studies are foreign empirical studies Goran (2021); England & Azzopardi, 2017). There has been less attention so far to establishing the links between the ageing population, mortality rates in Nigeria, especially of children and adults, and the uncontrolled population growth which has continued to challenge the elderly in the society. This is evidenced in the dearth of literature on this study area.

There seems to be a lack of local empirical research concerning the ageing population, the effects of population growth and mortality. Therefore, it is expected that the output of this study will be invaluable not only to the government but also to government agencies as it can serve as a database as well as a resource to the government of the country on mortality, population growth and other attendant effects on the ageing process. It would also add to the existing body of literature presenting results of the ageing process, mortality, and population growth rates in Nigeria which is already considered a developing country.

Method

This section provides detail on the method used for this research. It includes data source, data collection, scope of study, method of data analysis and model specification.

A number of variables have been taken into account in looking at the effects of change in mortality rates and population growth on the ageing process. The aging population growth (APG) is the dependent variable while child mortality rate (CMR), Adult Mortality Rate for Males (AMM), and Adult Mortality Rate for Females (AMF) are the independent variables. Total Population Growth (TPG) and Total Fertility Rate (TFR as independent variables.) The information compiled for this study was obtained from the World Bank website, the population records from the Nigerian Population Commission and the United Nations' Department of Economic and Social Affairs, Population Division.

The study spans twenty years (2004–2023). This is perhaps the latest era and most of the variables and information used was not prior to this era. For this reason, we conclude that it is useful to begin our analysis in 2004.

To test the relationship among the ageing process, mortality (adults) and population growth, the first step is to check if the time series data used in the model are stationary, as most time series data tend to be trending and are usually not stationary. To analyse the stationary of the time series data a research into the Augmented Dickey fuller test was conducted. Eview 12 was used to analyse the data.

The collected data was analyzed using Multiple regression models to determine the functional relationship between the ageing process (dependent variable), mortality rates of adults and children, population growth in Nigeria (independent variable). Data were analysed by E-View 12 statistical package. Several other

studies reported that the independent variables have some effect on the ageing process either at one point or another (Kacerova et al., 2014; Goran, 2021) hence they were adopted in this study.

Therefore, following the methodology of Grossman (1972), Fayissa and Gutema (2005) the models in this study are specified below:

APG = f (CMR + AMM + AMF + TPG + TFR) ……1

Where

APG = Annual Ageing Population Growth.
CMR = Annual Child Mortality Rate
AMM = Annual Adult Mortality Rate Male
AMF = Annual Adult Mortality Rate Female
TPG = Annual Total Population Growth Rate
TFR = Annual Total Fertility Rate (Control variable)

The regression equation for Model 1 is as follows:

$$Y_t = \beta_0 + \beta_1 A_t + \beta_2 B_t \quad \beta_3 C_t + \beta_4 D_t + \beta_5 E_t + e_t \quad \ldots\ldots\ldots\ldots\ldots\ldots 2$$

Y_t is the Annual Ageing Population Growth.
A_t is the annual Child Mortality Rate
B_t is the annual Adult Mortality Rate Male
C_t is the annual Adult mortality Rate Female
D_t is the annual Total Population Growth
E_t is the annual Total Fertility Rate (Control variable)
β_0 is Constant
e_t is the error term

Discussion of Results

The Augmented Dickey-Fuller test was used to determine the stationarity of the variables. This is necessary because non-stationary data series may produce spurious results. The results of the

Augmented Dickey-Fuller test are provided in Table I.

Table I: Augmented Dickey- Fuller (ADF) Unit Root Test

Variables	t-test	Prob	Oder of integrations
APG	-6.7082	0.000	I(1)
CMR	-4.20252	0.0241	I(1)
AMM	-4.38355	0.0032	I(0)
AMF	-4.17664	0.0208	I(0)
TPG	-4.1212	0.0068	I(1)
TFR	-4.13441	0.0004	I(1)

Source: *Researchers' Analysis using EViews 12*

Table 1 shows that variables such as adult mortality rate, male and female adult mortality rates, ageing population growth rate, child mortality rate, population growth rate, and fertility rate are not stationary at order 1 (0). In contrast, adult mortality rates for males and females were stationary at order 1(0). However, all the variables become stationary in first differences.

Table 2 shows regression analysis results. The regression analysis of the model parameters is presented in Table 2, with ageing population growth (APG) as the dependent variable and mortality (child and adult), total population growth, and total fertility rate (child variable) as independent variables.

Table 2: Dependent Variable: Ageing Population Growth (APG) Without Moderating Variable

Variable	Coefficient	Std. Error	t-Statistic	Prob.
AMF	-3.93	1.42	-2.77	0.01

AMM	2.95	1.16	2.54	0.02
CMR	-1.00	1.03	-0.97	0.35
TPG	0.38	0.06	5.95	0
Constant	2.48	0.31	7.78	0

R-squared	0.90
Adjusted R-squared	0.87
S.E. of regression	0.02
Sum squared resid	0.01
Log likelihood	54.13
F-statistic	32.17
Prob(F-statistic)	0.00

Source: Researchers' Analysis using EViews 12

Without a moderating variable in the model, Table 2 above shows that adult male mortality (AMM) and total population growth (TPG) both have positive and significant effects on APG (Ageing population) at the 5% significance level. The results show that a 1% increase in adult mortality and in the total population growth rate will lead to 2.95% and 0.38% increases in the ageing population growth rate (APG), respectively, both significant at 2% and 0%. On the other hand, adult mortality female (AMF) and child mortality (CMR) both have a negative impact on population ageing (APG). The table revealed that a 1% increase in the child mortality rate (CMR) and in adult female mortality will lead to decreases in the ageing population (APG) of 1% and 3.93%, respectively, with only adult female mortality being significant at 0.01.

R^2 provides an information about the proportion of variance of the dependent variable in the model, that is, the dependent variable was explained well by the independent variables in the model, and adjusted R2 shows that the model is well known with the possibility of not over-fitting. According to the model, the R-squared value of 0.90 indicates that the independent variables explain 90% of the variation in the dependent variable. Just 10% is accounted for by causes beyond the model, or not within the model.

Fittedness of the model with the value of Adjusted R2 0.87 indicates that model is fitted with 87%. The value of the constant in the table indicates the value of the dependent variable (APG) when all the independent variables are zero.

Table 3: Dependent Variable: Ageing Population Growth Rate (APG) with TFR as moderating Variable

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
AMF	-2.64	1.71	-1.55	0.14
AMM	2.06	1.32	1.56	0.14
CMR	1.83	2.40	0.76	0.46
TFR	-0.22	0.17	-1.30	0.21
TPG	0.56	0.16	3.61	0.00
CONSTANT	2.72	0.36	7.55	0.00

R-squared	0.91
Adjusted R-squared	0.87
S.E. of regression	0.02
Sum squared resid	0.00
Log likelihood	55.27
F-statistic	27.26

Prob(F-statistic)	0.00

Source: Researchers' Analysis using EView 12

With a moderating variable included in the model. Table 3 shows that adult mortality male (AMM), child mortality (CMR) and total population growth rate (TPG) all have a positive impact on ageing population (APG), with values 2.06, 1.83 and 0.56, respectively, with only total population growth rate (TPG) being significant at 0%. This means that a 1% increase in (AMM), (CMR), and (TPG) would result in 2.06%, 1.83%, and 0.56% increases in (APG), respectively. On the other hand, adult mortality female (AMF) and Total fertility rate (TFR) have a negative impact of -2.64 and -0.22, respectively, with neither being significant. This means that a 1% increase in the AMF and AFR will result in a decrease of 2.64% and 0.22% in the ageing population.

Table 3 shows that R^2, which describes the proportion of variation explained by the model, increased from 0.90 (without a control variable) to 0.91 with the inclusion of a moderating variable. This means that the fertility rate (Fertility Rate) is a relevant variable for the study.

Summary, Conclusion and Recommendation

The Augmented Dickey-Fuller test (ADF) and the regression Analysis model were employed to conduct the study. The study was conducted on the relationship between the aging population, child and adult mortality on population growth in Nigeria with the involvement of Augmented Dickey-Fuller Test (ADF) and the regression Analysis model. The data used in this study were sampled annually from 2004 to 2023. The World Bank indicators' website was used to obtain data on child mortality, adult mortality, population growth, and total fertility rate which were thought to influence the ageing population. Nigerian Population Commission records were used to obtain data on total fertility rate.Data on child mortality rate, adult mortality rate, population growth rate and total fertility rate was obtained from the website of indicators on data from the World Bank as well as records from the Nigeria Population Commission which was used to obtain the data on total fertility rate.

Child and Adult mortality, population growth and ageing population were investigated as the relationship and showing the impact on total fertility as a moderating variable. From the findings of the study (Table 3) it could be almost assured that the adult mortality rate, male population growth rate and total population growth rate have negative and significant relationship with the ageing population in the long run, whereas the mortality rate of adults has positive and significant relationship to the ageing population.

The results showed that, both total population growth rate and the adult mortality index male, at significant level 5%, contributed to hasten the ageing population, in support to the second demographic transition theory, fathered by Jennifer et al. (2021) while, on the other hand, child mortality rate and the adult mortality index female at significant level 5% could slow down the growth of ageing population.

Table 3 further with the inclusion of moderating variable indicates that except total population growth rate and the intercept which are significant at 5% level, none of the other estimated ones is so significant, therefore, the empirical result suggests that the total fertility is negatively associated with the growth rate of ageing population at an insignificant level, implying that decrease in the fertility rate could lead to an increase in the growth rate of ageing population, this finding is in line with the second demographic transition theory among other findings that population ageing would be influenced by declines in the fertility rate, which translate into increased life expectancy and the changes in marriages pattern would have an impact on population ageing.

The results of this study have shown that rapid child mortality and population growth rate are of great concern in Nigeria, particularly as they affect the ageing population in the long run. With the government's various interventions to reduce the child mortality rate, such as immunization of children and pregnant

women against communicable diseases, the child mortality rate and population growth seem to be very high compared to other countries in the world.

The following are the policy implications of the study's findings. There should be an increase in the level of involvement by the government in improving the quality of life of older citizens by formulating good policies that will provide quality welfare to the older citizen, such as provision of good and quality welfare homes, provision of medical facilities that will enable them to enjoy a sickness-free life at old age and provision of financial support to the elderly. These policies, if well implemented, will produce a healthy ageing population and remove unnecessary burden from the working population, thereby increasing productivity in the long run.

The study recommends that the government increase its involvement in improving citizens' quality of life by formulating policies that guide fertility-related activities, thereby preventing population explosion. These policies, when properly implemented, have the potential to reduce population pressure on development and to improve the life expectancy of people in society, both in the short and long term.

The results of the study indicate that addressing environmental issues that impact outside the healthcare system (e.g., reducing environmental pollution) is important to creating a more human-friendly environment to ensure healthy ageing.

The impact of factors not covered by this study's model, e.g. immigration and other socio-economic, variables on the ageing population would be an interesting area to explore and may be considered for future research.

REFERENCES

Aburto, J. M., et al. (2025). Global age-sex-specific all-cause mortality and life expectancy estimates for 204 countries and territories and 660 subnational locations, 1950–2023: A demographic analysis for the Global Burden of Disease Study 2023. The Lancet, 406 (10513), 1731–1810. `https://doi.org/10.1016/S0140-6736(25)01330-3` [(doi.org in Bing)]

Ahmed, A., Khan, H. T. A., & Lawal, M. (2023). Systematic literature review of the prevalence, pattern, and determinant of multimorbidity among older adults in Nigeria. Health Services Research & Managerial Epidemiology, 10,1–9. (https://doi.org/10.1177/23333928231178774)

Alhassan, GN, Adedoyin, F. F. Bekun, F. V, and Agabo, T. J. (2021). Do life expectancy, death rate and public health expenditure matter in sustaining economic growth under COVID-19? Empirical evidence from Nigeria? *Journal of Public Affairs, 21*(4), e2302 https://dio.org/10.1002 pa.2302.

Argentieri, M. A., Amin, N., Nevado-Holgado, A. J., Sprov, W., et al. (2025). Integrating the environmental and genetic architectures of aging and mortality, Nature Medicine.

Bengtsson, T, Scott, K. (2024). The Aging population. In Bengtsson T. (ed). Population Ageing – A Threat to the Welfare State? Demographic Research Monographs, Berlion Heidelberg-springer, 2010, pp. 7-22 doi:10. 1007/978-3-642-12612-32 (Cross Ref) (Google Scholar).

Cattaneo, M. (2026). Decoding human longevity: Genetic and molecular insights from accelerated to successful ageing . Ageing Research Reviews, 119, 103176.

Cervellati, M., & Sunde, U. (2011). Life expectancy and economic growth: The role of the demographic transition. Journal of Economic Growth, 16 (2), 99–133. `https://doi.org/10.1007/s10887-011-9065-2` [(doi.org in Bing)

Colombo, E. Rotondi, V., Stanca, L. (2016). Macroeconomic conditions and health: Insectary transmission mechanism, working papers. 337, University of Milano-Bicocca. Department of Economics (PubMed).

Dangana, G O, Timium, G A, Haruna,S A (2025). Demography of the ageing population in Nigeria: trends, challenges and implications.Gasau Journal of Sociology https:// doi.org| 10.57233 gujos.v4i3.7

Dickey, D. A. & Fuller, W. A. (1979). Distribution of the estimators for autoregressive time series with a unit root. *Journal of the American Statistical Association* 74 (366a), 427 – 431.
DOI: [10.1553/0x003c8f0b]
doi:10: 1016/j.exger.2009.11.008 (PubMed) (cross red) (Google Scholar).

Dowd, J. B., Schöley, J., Polizzi, A., Aburto, J. M., Jaadla, H., Lei, H., & Kashyap, R. (2026). Temporary shock or lasting scar? Life expectancy trajectories since COVID-19. medRxiv. `https://doi.org/10.64898/2026.02.25.26347112` [(doi.org in Bing)]
Encyclopedia of European Social History, retrieved August 15 2023, from

England K, Azzopardi Muscat N. (2017). Demographic trend and public health in Europe. *European journal of public health 27(4) pg 9-13 doi 10.2093/eur pub/ck159* (pubmed) (Google Scholar).

Eririogu, H. I., Okezie, C., & Ebukiba, E. (2020). Demographic transition in the past and projected over the next five decades in Sub-Saharan Africa, 1967–2068: Empirical evidence from Nigeria. Journal of Scientific Research and Reports, 26 (1), 56–71.(https://doi.org/10.9734/JSRR/2020/v26i130214)

Fayissa, B. & Gutema, P (2005). Estimating a health production function for Sub-Saharan Africa (SSA), Applied Economics 37(2),155–164.

Goran, M. (2021). Mechanism between mortality, population growth, and population ageing in the European lower- and upper-middle-income countries. Journals of the Public Library of Science, DOI: 10.1371/journal: pone 0259169.

Grossman, M. (1972). On the concept of health capital and the demand for health. Journal of Political Economy, 80(2), 223–255. (https://doi.org/10.1086/259880)

Haine, M. R. (2020). The population of Europe: the demographic transition and after, https://www.encyclopedia.com (Google Scholar).

Iberdrola, P. (2015). Impact of population growth and climate change on Africa. Integrated Geoscience Research Group, Sant'Alberto, Ravenna 48123, Italy.

Kacerova M, Ondackora J, Mladeki. J (2014). Time-space differences in population ageing in Europe. Hungarian geographical bulletin pg 177-199 Doi: 10: 15.201/lungeobull 6.3.2.4 (cross ref.) (Google Scholar).

Kaufman, J. S., Asuzu, M. C., Rotimi, C. N., Johnson, O. O., Owoaje, E. E., & Cooper, R. S. (1997). The absence of adult mortality data for sub-Saharan Africa: A practical solution. Bulletin of the World Health Organization, 75 (5), 389–395. PMID: 9447773; PMCID: PMC2487019.

Kiss, M. (2020). Demographic outlook for the European Union 2020. European Parliamentary Research Service (EPRS), Brussels. DOI: [10.2861/999213] ISBN: 978-92-846-6344-6

Lee, R. (2003). The demographic transition: Three centuries of fundamental change. *Journal of Economic erspectives, 17 (4), 167–190. `https://doi.org/10.1257/089533003772034943` [(doi.org in Bing)].

Magalhães, J. P. de. (2025). An overview of contemporary theories of ageing. Nature Cell Biology, 27, 1074–1082. (https://doi.org/10.1038/s41556-025-01698-7)

Masquelier, B. (2018). Mortality between ages 5 and 15. Population & Sociétés, 559(9), 1–4. (https://doi.org/10.3917/popsoc.559.0001)

Milne EMG (2009). Dynamics of human mortality. Experimental Gerontology:45(3) 180-207

National Bureau of Statistics. (2024). Nigeria General Household Survey – Panel Wave 5 (2023/2024). Abuja: NBS.

Nigerian Economic Summit Group. (2025). Snapshot of General Household Survey (GHS) Wave 5 2024. NESG Publications.

Oyewole, M A, Ayuba, A O, Iliya, R S (2023). Nigeria's population ageing: A health crisis in the making. Fountain journals. https://www.fountain journal.com

Perpetua, L.T. Pelser A, Peter m (2018). Care of the elderly in Nigeria: implications for policy, Loment Social Science, 1555, 201, doi: 10. 1080/23311 886.2018 1555201.

Sanderson W.C, Sherborn, S., Garland, P. (2018). The end of population ageing in high-income countries. Vienna Yearbook of Population Research, pp. 163–173. doi: 10.15531/population-yearbook (Google Scholar).

Sobotka, T., & Zeman, K. (2020). European Demographic Data Sheet 2020. Vienna Institute of Demography (VID) & International Institute for Applied Systems Analysis (IIASA), Wittgenstein Centre for Demography and Global Human Capital.

Suaharsanan, N. Bloom, D. (2018). Live long and prosper. The economics of an ageing population, Harvard University https://content.sph. Harvard.Edu.

Tabutin, D., & Masquelier, B. (2017). Mortality inequalities and trends in low- and middle-income countries, 1990–2015. Population, 72 (2), 227–307. `https://doi.org/10.3917/popu.1702.0227` (doi.org in Bing)

Tesch-Römer C, Von Kondratowitz H.J. (2006). Comparative ageing research: a flourishing weld in need of theoretical cultivation. European journal of Agieng pg 155-167 doi 10.1007/s10433-006-0034 (Google Scholar).

UN DESA. (2024). Policy Brief No. 167: Leveraging population trends for a more sustainable and inclusive future: Insights from World Population Prospects 2024. United Nations Department of Economic and Social Affairs.

United Nations. (2024). World Population Prospects 2024: Summary of Results. Population Division, UN DESA.

Warner, M. E., Zhang, X., & Guillemot, J. (2024). Demographic ageing: An opportunity to rethink economy, society and regions. Cambridge Journal of Regions, Economy and Society,18(1),7992.[https://doi.org/10.1093/cjres/rsae031]

Weil DN (1997). The Economics of Population Ageing. In Rosenzwelg, MR. Stark, O. (eds). Handbook of Population and Family Economics, pp. 968–1014, Elsevier Science BV, Amsterdam, 1997. (Google Scholar).

Willekens, F. (2014). Demographic transitions in Europe and the world. MPIDR Working Paper WP-2014-004. Rostock: Max Planck Institute for Demographic Research. `https://doi.org/10.4054/MPIDR-WP-2014-004` [(doi.org inBing)]

World Health Organisation (2022). Report available at URL: LHP://www.who.int/health-system /uhc cited August 23 2024.

World Health Organisation:(2022). Towards policy for health and ageing available from URL LHP /www.who.int/ aging/ publication/ak fs ageing policy pdf (cited November 15 2024).

World Health Organization (WHO). (2023). United Nations agencies launch first report on the Decade of Healthy Ageing, 2021–2030. WHO Publications.

World Population Prospects (2022). Demography of Nigeria www.worldometers.info(1).

Yaya Sani (2017). Prevalence and determinants of childhood mortality in Nigeria BMC Public Health https://doi.org/10.1186/512889-017-44207.