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DOES ECONOMIC STATUS INFLUENCE LIFE-TIME RISK OF MATERNAL DEATH? AN ANALYSIS OF EMPIRICAL EVIDENCE FROM NIGERIA

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Abstract

This study investigates the extent to which economic status influences life-time risk among women of reproductive age in Nigeria using time series data from 1990 to 2024. Real GDP per capita is used as a proxy for economic status, whereas life time risk of maternal mortality is measured as the probability that a 15-year-old female will die eventually from a maternal cause assuming that current levels of fertility and mortality do not change in the future taking into account competing causes of death. The study employed autoregressive distributed lag (ARDL) and Johansen cointegration techniques to examine both the short-run and long-run impact as well as VAR Granger Causality/Block Exogeneity Wald Test to analyse the direction of causality. The results revealed that economic status has negative and statistically significant impact on life-time risk of maternal death in Nigeria such that a percentage increase in the economic status reduces maternal death by about 0.173533%. Also, the result of causality test indicates the existence of unidirectional causality from economic status to life-time risk of maternal mortality implying that past values of economic status contain useful information for predicting the risk of maternal mortality in Nigeria. This implies that higher economic status contributes to better maternal health outcomes by reducing the number of maternal deaths. The study therefore, recommends prioritizing economic empowerment of pregnant and postpartum women, particularly by linking financial support to antenatal care (ANC) and skilled birth attendance. This is addition to reducing financial barriers to maternal healthcare utilization by subsidizing or eliminating out-of-pocket payment.

Key words: Economic Status, Life-Time Risk, Maternal Mortality, ARDL.
JEL Code: H51, H52, and H53, and H75

1. Introduction

Life-time risk of maternal death among women of reproductive age has been the case of great concern in less developed countries and Nigeria in particular, despite efforts to reduce its prevalence. According to Gupta, Kumar and Dorcas (2017), more than 50% of yearly maternal deaths in low-income countries is accounted for by complications associated with pregnancy and childbearing. This assertion is further buttressed by the report of World Health Organization (WHO, 2019) that in every 10 maternal deaths cases, 9 were reported from resource-constraint countries in which access to maternal healthcare services, both prenatal and postnatal care, has been at its lowest ebb, resulting to high life-time risk of maternal mortality among women. Comparatively, the life-time risk of pregnancy and childbearing-related deaths was 1 in every 37 women of reproductive age in Sub-saharan Africa, while in developed countries, was 1 in every 7,800 women (WHO, 2019). In Nigeria, the life-time risk of maternal death, as reported by WHO (2020), was 1 in every 22 women resulting from complications during pregnancy as well as before and after birth which was reckoned to be the highest globally. Similarly, Ope (2020) reported that the Nigeria recorded as high as 20 percent of the global maternal mortality ratio (MMR), which is further buttressed by WHO (2023) that maternal deaths in Nigeria

accounted for about 28.3 percent of global estimated cases, with MMR of 1047 per 100,000 livebirths.

Being the most populous country with the largest economy in terms of GDP in Africa, above situation in Nigeria is not only worrisome but also paradoxical, with tremendous effect on not only the affected women but also their immediate families and the country as a whole (Dogbanya, 2025). Health expenditure in Nigeria on one hand, and per capita GDP on the other should have been sufficient enough to provide healthcare services to its growing population, particularly to the vulnerable groups of women and children. As rightly stated by Oladapo et al. (2015), reducing maternal mortality in Nigeria requires rigorous commitment from the part of government if quality healthcare is to be improved within the country's healthcare facilities. This supported the position of WHO (2020) that the prevalence of maternal mortality in Nigeria is strongly connected with high inequalities in access to maternal healthcare services, notably among women living in resource-constraint settings.

Therefore, the need for women to demand for maternal healthcare in order to avert unwanted pregnancy-related risks on one hand, and have amazing experience in the course of childbearing on the other, cannot be overestimated. This supports the argument that accessing and utilizing maternal healthcare services has been an easy way of curtailing maternal mortality in Sub-saharan Africa (Mekonnen and Dune, 2019 and Ahuru, Anyiwe, and Nzoputam, 2020). However, whether or not, a pregnant woman can demand for maternal healthcare services is strongly a function of her socioeconomic characteristics. As rightly argued by Modibbo and Farida (2019), factors such as culture practices, economic status, access, perceptions, education, age, birth order, and social roles all influence the choice to utilize healthcare services among women of reproductive age. Hence, life-time risk of maternal mortality is not unconnected with barriers to access and utilization of maternal healthcare services. These barriers, according to Okonofua, et al. (2018) and Yaya, et al. (2018), lead to some forms of delays including delay in making decision to demand for maternal healthcare services, visiting healthcare facility, and receiving quality antenatal and postnatal healthcare. Furthermore, Sui et al. (2021) argued that timely attendance and use of antenatal and postnatal care services offers not only a window for prompt detection of risks associated with pregnancy but also help in providing suitable measures to avoid potential complications notably preterm labour and stillbirth cases. Thus, life-time risk of maternal deaths could have been avoidable or at least minimized if maternal healthcare services were easily accessed and utilized by the affected mothers and their babies.

Taking economic status for instance, at micro level, women with higher economic status tend to utilize maternal healthcare services more frequently than those in the lower economic class, and this contributes to a significant reduction in maternal mortality and its associated life-time risk as documented in the literature to (Nwokocha *et al*., 2022; Hamal *et al*., 2020; etc.). Furthermore, Jeong *et al.,* (2020) reported that a significant relationship exists between socioeconomic status and maternal death and that women with lower economic status were 2.42 and 1.83 times more likely to experience maternal death compared to women with higher economic status within six weeks and one year, respectively. Therefore, with more than two-thirds (69%) of maternal deaths occurring in the African Region, there is a need to focus efforts on ways of reducing MMR to 70 maternal deaths per 100 000 live births by 2030 as targeted by Sustainable Development Goals (SDGs). Among such efforts is improving the economic status of individuals which an easy way to influence health-seeking behaviour among the target population. This study therefore, investigates the extent to which economic status influence life-time risk among women of reproductive age in Nigeria.

2. Literature Review

Various studies have been put forward to investigate the effect of socioeconomic status on maternal mortality across the globe. For instance, Abdi et al.

(2025) investigated the influence of socio-economic status on women's health outcomes, focusing on the effect of poverty on body mass index and maternal mortality in Somaliland with a view to conducting a comparative analysis across poorer and richer wealth quintiles. The findings revealed through the regression analysis that higher wealth is associated with higher body mass index and lower maternal mortality rates. The logistic regression results revealed that women in the poorer wealth quintile had 2.5 times higher odds of experiencing maternal mortality compared to those in the richer quintile. Similarly, Aminu et al. (2025) reassessed the impact of socio-economic status on the quality of life among women attending Gumel general hospital, Jigawa state, Nigeria. The study used a Modified Kuppuswamy socio-economic status scale to categorize socio-economic status into below the poverty line, middle, and high classes. The results showed that out of 87 women who are below the poverty benchmark, have lived a lower quality of life, as 38 (43.68%) have anemia, 14(16.09%) experienced birth-related complications, while 28(32.18) are suffering from other diseases.

Likewise, Vilda et al. (2019) analyzed U.S. national death and live birth records for the period 2011 to 2015 to assess the association between state-level income inequality and pregnancy-related mortality among non-Hispanic Black and White women. Using Poisson regression, they found no significant association for the overall population; however, among Black women, higher income inequality was significantly associated with increased risk, with a 15% rise in pregnancy-related mortality. In a similar study, Meh et al. (2019) used the Demographic and Health Surveys in 2008 and 2013 to assess the differences in the levels and determinants of maternal mortality in women of childbearing age (15–49 years) in the North and South of Nigeria. With the use of logistic regression, they found that the levels of maternal mortality were more pronounced in the North as it increased in 2013 compared to 2008, as against a slight decrease in the level of maternal death in the South. However, in both regions, age and community wealth were significantly associated with maternal mortality.

Correspondingly, Jeong et al. (2020) have done a nationwide population-based cohort study on the effect of socioeconomic status on all-cause of maternal mortality in South Korea through the application of a binomial regression model on the data of 3,334,663 nulliparous women for the period ranging from 2003 to 2018. A significant relationship between South Korean primiparas' socioeconomic status and maternal death was found, as women with lower economic status were 2.42 and 1.83 times more likely to experience maternal death compared to women with higher economic status within six weeks and one year, respectively. In a more recent and similar study, Abdulkarim et al. (2025) analyzed the socio-demographic determinants of maternal death in the Dekina local government area of Kogi State, Nigeria, and discovered that maternal death was high due to the socio-demographic factors, including employment status, income level, and occupation.

Similarly, the influence of socio-economic factors on infant and maternal mortality rates in Yobe State, Nigeria. The findings revealed that the spouse's economic status has a significant relationship with infant and maternal mortality. In the same analogy, Olonade et al. (2019) investigated the relationship between maternal mortality and maternal health care in Nigeria with a view to assessing their implications for socio-economic development. They found that socioeconomic factors significantly influenced the outcome of pregnancy.

Nwokocha et al. (2022) sought to find out the socioeconomic correlates of adequate maternal health care in Bangladesh using the Bangladeshi demographic and health survey 2017-2018 data. They found that lower wealth status was associated with a lower probability of adequate maternal care. Equally, Hamal et al. (2020) mapped and summarized the evidence on social determinants influencing maternal health in India. They found that economic status, among other factors were the most important structural

factor of maternal health service use and maternal mortality in India.

To observe whether the effect of nutrition on maternal mortality persists beyond income levels, Manfredini (2020) investigated the relationship between maternal mortality and nutrition in 19th and 20th-century Italy. With the use of ARDL, the results found that average caloric intake has a negative and statistically significant impact on maternal mortality rate.

With a cross-income-level analysis, Gao et al. (2025) found an overall descending trend in the average mortality rates in all the MENA countries; however, the magnitude of reduction among the countries differs, as the middle-income countries experienced the highest reduction rates, followed by high-income countries and then low-income countries. Additionally, the findings revealed that GDP per capita and greater health spending significantly reduced the maternal mortality rates. Correspondingly, Girum and Wasie (2017) have done an ecological study in 82 countries to assess the correlates of maternal mortality in developing countries. The findings revealed that among the socio-economic variables, GNI per capita was negatively and significantly correlated with maternal mortality rate. However, unemployment rate and health care expenditure were found to have insignificant positive and negative correlations, respectively, with maternal mortality rate among the developing countries.

Similarly, Frank (2020) applied an ARDL approach in Sub-Saharan Africa using a dynamic panel estimated through the Pooled Mean Group method. The study found that, in both the short and long run, higher maternal mortality is associated with lower per capita GDP. Contrarily, Mlambo et al. (2023) sought to investigate the macro determinants of maternal mortality in Southern African Development Community (SADC) states. With the use of GMM, the results revealed a significant positive impact of GDP per capita, fertility, and HIV on maternal mortality. This may not be uncorrelated with the findings revealed by Fariza et al. (2021), who examined the impact of national health insurance (JKN) on the maternal mortality phenomenon at the four (4) Banyuwangi Referral Hospitals, Indonesia. They found that the proportion of maternal mortality increased after the JKN implementation.

In an effort to analyse the impact of female employment on maternal mortality, Eboh and Aliu (2024) examined health expenditure, female employment, and educational attainment as predictors of maternal mortality in Nigeria. With the use of annual time series data spanning 2000-2019, the study applied OLS regression. The findings revealed that current health expenditure showed a statistically significant negative association with maternal mortality rate. Similarly, female primary school enrolment also demonstrated a significant negative relationship with maternal mortality. In contrast, female self-employment exhibited a positive but statistically insignificant relationship with maternal mortality rate. Moreover, Yadav et al. (2020) investigated the effects of education, employment, economic status, and empowerment on the utilization of maternal health care services in India using National Family Health Survey data from 2015 to 2016. The study used logistic regression, and the findings revealed that education, employment, economic status, and empowerment are significantly associated with the use of maternal health care services (prenatal, antenatal, and postnatal care)

Ahmed et al. (2026) examined the effects of maternity care improvement, fertility reduction, and increased contraceptive use on maternal mortality decline between 2000 and 2023. Bayesian regression was used, and the findings revealed that 61.2% of the global reduction in maternal mortality between 2000 and 2023 was attributable to improvements in maternity care, and 38.8% to reductions in women's fertility.

Based on the forgoing, it is obvious that studies on the effect of socioeconomic status on maternal mortality are enormous across the globe. However, most of these studies such as Abdi et al. (2025); Aminu et al. (2025); Abdulkarim et al. (2025); Nwokocha et al. (2022) etc. were cross-sectional which could not

account for the cumulative and dynamic effects. Most importantly, none of the reviewed studies used life time risk data to analyse the relationship between maternal mortality and socioeconomic status among women of reproductive age in Nigeria. Hence, the novelty of this study.

3. Methodology

The data for this study, spanning from 1990 to 2024, is obtained from the World Bank's (2026) World Development Indicators. Economic status is measured by real GDP per capita based on the purchasing power parity; whereas life time risk of maternal mortality is measured as "the probability that a 15-year-old female will die eventually from a maternal cause assuming that current levels of fertility and mortality (including maternal mortality) do not change in the future taking into account competing causes of death" World Bank (2026). In addition, female employment rate, and female population relative to total population are employed as control variables in the study.

Having sourced the data, the estimation procedure begins with the examination of the stationarity properties of the variables using the Augmented Dickey-Fuller (ADF) and Dickey-Fuller Generalized Least Squares (DF-GLS) tests. The low power of the ADF test against near-stationary alternatives, particularly in small samples, justifies the use of the DF-GLS test to offer a more reliable inference in order to enhance the robustness of the unit root results.

To empirically account for both short- and long-run impact of the socioeconomic status the study employed autoregressive distributed lag (ARDL) approach to cointegration developed by Pesaran (2001). In addition to being relatively simple and applicable regardless of whether the variables are integrated of order one [I(1)]; order zero [I(0)]; or a mixture of both (Pesaran et al., 2001), the cumulative and dynamic effects among the variables over time are being accounted for by ARDL which cross-sectional studies fail to accommodate. However, in its level form, the functional model of this study is presented as follows:

$$LTRM_t = f(GDPPC_t, FPOP_t, FEMP_t) \quad \text{.....(1)}$$

However, model 1 above is replicated in an autoregressive distributed lag (ARDL) model as shown below:

$$\Delta LTRM_t = \phi_0 + \phi_1 LTRM_{t-1} + \phi_2 RGDPC_{t-1} + \phi_3 FPOP_{t-1} + \phi_4 FEMP_{t-1} + \sum_{t=1}^{m} \vartheta_1 \Delta LTRM_{t-1}$$

$$+ \sum_{t=1}^{n} \vartheta_2 \Delta RGDPC_{t-1} + \sum_{t=1}^{p} \vartheta_3 \Delta FPOP_{t-1} + \sum_{t=1}^{q} \vartheta_4 \Delta FEMP_{t-1} + \varepsilon_{t1} \quad \text{.....(2)}$$

Where Δ stands for the difference notation, while $LTRM_t$, $RGDPC_t$, $FPOP_t$, and $FEMP_t$ stand for life time risk, real GDP per capita, female population and female employment rate respectively. The null hypothesis is, however, given as $H_0 = \phi_1 = \phi_2 = 0$. To investigate the existence of long-run relationship among the variables, the significance of the lagged level variables is determined based on the F-statistics for the cointegration denoted as $F_{LTRM}(LTRM / RGDPC_t, FPOP_t, FEMP_t)$.

However, the appropriate number of lags for the model is chosen using the VAR lag order selection approach. To ensure robustness of the results, Johansen cointegration technique is also estimated, and diagnostic tests such as serial correlation, heteroskedasticity, normality, and Ramsey reset test for omission variable bias were conducted to ensure validity and reliability of the results.

4. Results and Discussion

This section presents the findings of the unit root test, bound test cointegration, as well as the short-run, and the long-run results. The findings are discussed in the subsequent paragraphs.

4.1 Unit Root Test

Table 1: Results of Unit Root Test

Variables	ADF at level values	ADF at first difference	Remark
Ln_RLTRM	0.034628	-4.674007***	I(1)
Ln_RGDPPC	-0.980178	-3.220590**	I(1)
Ln_RFPOP	0.638853	-3.088984**	I(1)
Ln_FEMPR	-1.441809	-5.956780***	I(1)
Variables	**DF-GLS at level values**	**DF-GLS at first difference**	**Remark**
Ln_RLTRM	1.261894	-3.588299***	I(1)
Ln_RGDPPC	-0.722368	-3.027838***	I(1)
Ln_RFPOP	0.677127	-2.781195***	I(1)
Ln_FEMPR	-1.296359	-1.677286*	I(1)

Note: *, **, *** indicate significance at 10%, 5%, 1% level, respectively.

Table 1 presents the results of the unit root tests. Both the ADF and DF-GLS tests produced consistent results regarding the variables' order of integration. The findings indicated that all the variables are statistically not significant at their level values, signifying that both tests fail to reject the null hypothesis of a unit root at conventional significance levels. However, after first differencing, all the variables became stationary at varying significance levels. Specifically, both the ADF and DF-GLS test reject the null hypothesis for Ln_RLTRM at 1% level of significance. For Ln_RGDPPC and Ln_RFPOP, the ADF test reject the null hypothesis at 5% significance level, whereas the DF-GLS test rejects it at the 1% level. For Ln_FEMPR, the ADF test rejects the null hypothesis at the 1% level, whereas the DF-GLS test rejects it at the 10% level. Overall, the results confirm that all variables are integrated of order one I(1), indicating that they are non-stationary at level but become stationary after first differencing. Therefore, the overall results for the unit root tests revealed the variables to be either I(1). This motivates the use of the Autoregressive Distributed Lag (ARDL) bounds testing approach to confirm the presence or otherwise of cointegration among the variables.

4.2 Result of Bound Test

Given that all the variables from both the tests are integrated of the same order, I(1) as established by the results of the unit root tests, the Bound test approach to the ARDL model is employed to confirm the presence or otherwise of cointegration among the series.

Table 2: ARDL Bound Test

Test Statistics	Value	Sig. Level	I(0) Bound	I(1) Bound
F-Statistics	8.207248	1%	4.614	5.966
		5%	3.272	4.306
		10%	2.676	3.586

Note: I(0) and I(1) are respectively the stationary and non-stationary bounds

Table 2 presents the results of the ARDL bound test approach to cointegration. From the results of the analysis, the F-statistic was found to be 8.207248, which exceeds the upper I(1) bound critical values of 5.966, 4.306, and 3.586 at 1%, 5%, and 10% levels of significance, respectively. This gives statistical evidence to reject the null hypothesis of no level relationship, thereby confirming the existence of a long-run relationship among the variables. Similarly, the finding implies that the variables move together in the long run, and any short-term deviations that may occur will be corrected over time. This paved the way

for the estimation of the error correction model (ECM) so as to capture both short-run dynamics and long-run equilibrium adjustments.

Table 3: Long Run and Short Run Results
Selected model: ARDL (1,3,4,3)

Variable	Coefficient	Standard Error	t-Statistics	Probability
		Short run		
ΔLn_RGDPPC	0.288732***	0.100992	2.858976	0.0097
Δ(Ln_RGDPPC(-1))	0.457438***	0.087404	5.233590	0.0000
Δ(Ln_RGDPPC(-2))	-0.211913**	0.085231	-2.486324	0.0219
Δ(Ln_RFPOP)	64.97807***	12.03345	5.399787	0.0000
Δ(Ln_RFPOP(-1))	-74.86544***	21.37108	-3.503119	0.0022
Δ(Ln_RFPOP(-2))	87.36972***	22.11888	3.950006	0.0008
Δ(Ln_RFPOP(-3))	-101.9644***	16.75941	-6.084011	0.0000
Δ(Ln_FEMPR)	-2.312738***	0.394211	-5.866750	0.0000
Δ(Ln_FEMPR(-1))	3.705702***	0.716802	5.169772	0.0000
Δ(Ln_FEMPR(-2))	4.620886***	0.765460	6.036742	0.0000
ECT	-1.147624***	0.160236	-7.162074	0.0000
		Long Run		
LN_RGDPPC(-1)	-0.173533**	0.064169	-2.704310	0.0117
LN_RFPOP(-1)	12.04746***	0.709150	16.98859	0.0000
LN_FEMPR(-1)	-6.203541***	0.732604	-8.467796	0.0000
C	-16.81103***	3.573602	-4.704225	0.0001

Note: *, **, *** indicate significance at 10%, 5%, and 1% level respectively. Model selection is based on the Akaike information criterion (AIC)

On the basis of the appropriate lag order selection criteria, the ARDL (1,3,4,3) is estimated and the results are presented in Table 3. The error correction term (ECT) is found to be negative and statistically significant ((-1.1476) at one percent, confirming the existence of a stable long-run cointegration among the variables. The ECT also indicates the speed of adjustment to the long run, and the results show that the model is over adjusting itself with about 114% of short-run deviations being corrected within a year.

The long-run results showed that the economic status proxied by real GDP per capita has a negative and statistically significant impact on maternal mortality in the long-run, signifying that a percentage increase in the economic status reduces maternal death by about 0.173533%. This implies that higher economic status contributes to better maternal health outcomes by reducing the number of maternal deaths. This finding is consistent with the a priori expectation of the economic theory and also consistent with the findings of Abdi et al (2025), Aminu et al. (2025), Gao et al. (2025) that higher wealth or GDP per capita is associated with decrease in maternal mortality. This further correlates with the findings of Jeong et al. (2020), who estimated that women with lower economic status were 2.42 and 1.83 times more likely to experience maternal death compared to women with higher economic status within six weeks and one year, respectively.

Conversely, the number of females proxied by the ratio of females from the total population is found to have a long-run positive and highly statistically significant impact on the maternal mortality in Nigeria, implying that an increase in the female population increases the number of females of productive age, which increases the maternal death. This reflects the demographic reality and a priori expectation that an increase in the female population

increases the chances of maternal mortality by 12.04746%. The result is related to the findings of Ahmed et al. (2026), who estimated that 38.8% of the global reduction in maternal mortality between 2000 and 2023 was attributable to women's fertility reduction. Likewise, Howkisn et al (2020) found that reducing women's access to family planning and reproductive health services through clinic closures or gestational limits for abortion contributes to rising maternal mortality rates in the United States of America (USA).

On the contrary, female employment revealed a long-run positive and significant impact on maternal mortality. The results showed that a one percent increase in the female employment rate leads to about 6.203541% decrease in the rate of maternal death in Nigeria. This conforms with the a priori expectation that an increase in women's economic power leads to female financial independence and facilitates access to maternal health information. This eventually reduces the chances of maternal death. The finding also corresponds with the recent studies, including Abdulkarim et al. (2025), who discovered employment status, income level, and occupation as the crucial determinants of maternal death in the Dekina local government area of Kogi State, Nigeria. In a similar study, Girum and Wasie (2017) found women's unemployment to be positively related to maternal mortality in developing countries like Nigeria. Likewise, Yadav et al. (2020) employed logistic regression in the context of India and found that women's education, employment, economic status, and empowerment are significantly associated with the use of maternal health care services (prenatal, antenatal, and postnatal care). However, the finding contradicts the study by Eboh and Aliu (2024) and Sajedinejad et al. (2015), and the findings revealed that employment and labor structure are positively related to maternal mortality in Nigeria and a panel of 179 countries, respectively.

The short-run results, however, showed different adjustment patterns of maternal mortality. In contrast to the long-run result, the current and first lag of Ln_RGDPPC showed a short-run positive and significant effect on maternal mortality in Nigeria. This result may not be unrelated to the short-term disruptions associated with economic growth, as found by Mlambo et al. (2023), who reported that GDP per capita has a significant positive impact on maternal mortality in Southern African countries. However, the effect became negative after a two-year lag, supporting the a priori expectation that economic growth influences better health outcomes through health investments.

Consistent with the long-run result, there is a positive and significant relationship between Ln_RFPOP and maternal mortality in the current period; however, the relationship becomes negative after a one-year lag, suggesting that health care services may respond to increased demand for health care. However, as indicated by the second lag of the variable, a further increase in the female population may outweigh the system’s response and, once again, raise the rate of maternal mortality, reflecting the gap between healthcare supply and demand in resource scarcity, where over 64% of women in high maternal mortality countries (including Nigeria) face barriers to healthcare access (Negash et al., 2024). As the system stabilizes, the effect becomes negative, as shown by the third-year lag of the variable, indicating that healthcare infrastructure and service delivery eventually adjust to demographic changes over time, as indicated by Tatem (2014).

Furthermore, the short-run result for Ln_FEMPR is consistent with the long-run findings in the current period, revealing a negative and significant relationship between female employment and maternal mortality. This justifies the argument that women's economic status positively influences maternal health, as evidenced by Yadav et al. (2020). Over time, however, the effect becomes positive at the first and second lags.

Table 4: Results of VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	243.2184	NA	2.33e-12	-15.43344	-15.24841	-15.37313
1	400.2061	263.3343	2.64e-16	-24.52943	-23.60428	-24.22785
2	482.7758	117.1957	3.82e-18	-28.82425	-27.15897	-28.28141
3	510.1531	31.79300	2.13e-18	-29.55827	-27.15287	-28.77417
4	558.5905	43.74993*	3.63e-19*	-31.65100*	-28.50548*	-30.62564*

Source: Author's Computation

To determine the appropriate number of lags for the analysis, the VAR lag order selection is applied, with the results shown in Table 4. The analysis suggests that the maximum number of lags to include is four (4), as indicated by all the lag selection criteria. Although all criteria are important, this study primarily follows the Akaike information criterion (AIC).

Table 5: Results of Johansen Cointegration Test

Hypothesized No. of CE(s)	Test Statistics	95% Critical Value	P. Values
Trace Statistics			
None *	91.19111	47.85613	0.0000
At most 1 *	46.81492	29.79707	0.0002
At most 2 *	23.58527	15.49471	0.0024
At most 3 *	7.516071	3.841465	0.0061
Maximum Eigen Value			
None *	44.37619	27.58434	0.0002
At most 1 *	23.22965	21.13162	0.0250
At most 2 *	16.06920	14.26460	0.0256
At most 3 *	7.516071	3.841465	0.0061

Source: Author's Computation

The result of the Johansen cointegration test is presented in Table 4. The findings revealed the presence of cointegration when both the Trace statistics and the Maximum Eigenvalue are considered. From each of the two tests, the result indicated 4 cointegrating equations at the 5% level of significance, suggesting the rejection of the null hypothesis of no level relationship, confirming the presence of a long-run equilibrium relationship among the variables. This finding conforms with the findings of the ARDL bound test, which confirmed the presence of a level relationship among the variables. Therefore, the presence of cointegration indicates the presence of causality in at least one direction. Therefore, the VAR Granger Causality/Block Exogeneity Wald Test is applied to examine the direction of causality among the variables.

Table 6: VAR Granger Causality/Block Exogeneity Wald Tests Results

Dependent Variable	Excluded Variable	Chi-sq	df	P-value
LN_RLTRM	LN_REALGDPPC	15.23405	2	0.0005***
	LN_RFPOP	20.80014	2	0.0000***
	LN_FEMPR	20.19158	2	0.0000***
	All	37.68011	6	0.0000***
LN_REALGDPPC	LN_RLTRM	0.137005	2	0.9338
	LN_RFPOP	17.23421	2	0.0002***
	LN_FEMPR	2.449528	2	0.2938

	All	21.61024	6	0.0014***
LN_RFPOP	LN_RLTRM	2.406858	2	0.3002
	LN_REALGDPPC	20.91828	2	0.0000***
	LN_FEMPR	0.097778	2	0.9523
	All	119.7094	6	0.0000***
LN_FEMPR	LN_RLTRM	1.256724	2	0.5335
	LN_REALGDPPC	2.036567	2	0.3612
	LN_RFPOP	4.751454	2	0.0929*
	All	15.69989	6	0.0155**

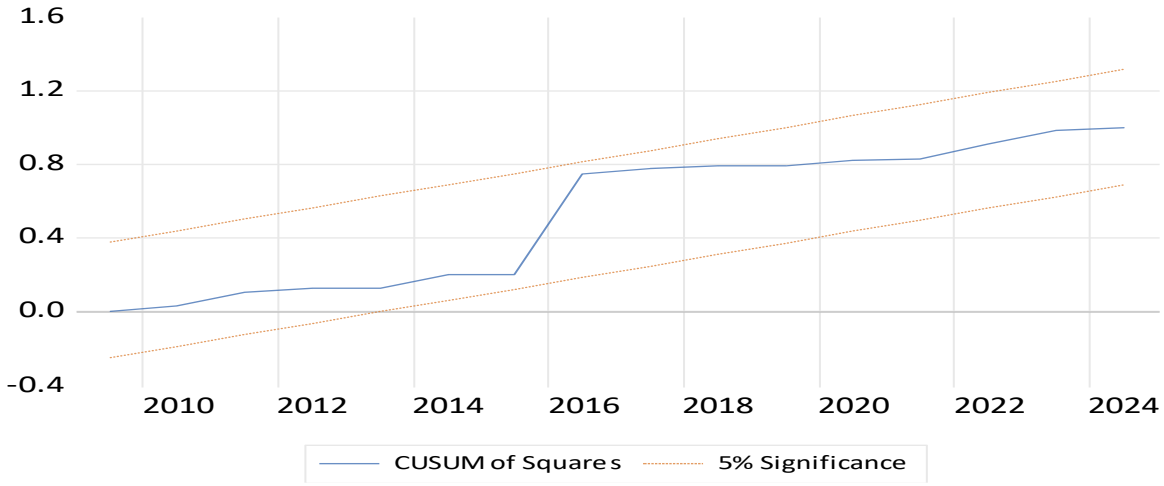
The table reports Wald test statistics for block exogeneity (Granger causality) from a VAR model with 2 lags. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 6 presents the results of the Wald test statistics for block exogeneity (Granger causality) from a VAR model with the null hypothesis stating that excluded variable(s) do not Granger-cause the dependent variable. The findings revealed that LN_REALGDPPC, LN_RFPOP, and LN_FEMPR all Granger-cause LN_RLTRM (maternal mortality risk) at the 1% significance level, implying the rejection of the null hypothesis that none of the explanatory variables Granger-cause maternal mortality. This indicates that past values of economic status, female population, and female employment contain useful information for predicting maternal mortality risk in Nigeria. This supports the inclusion of these variables as determinants of maternal mortality in the ARDL model. On the contrary, maternal mortality was not found to Granger-cause economic status, female population, and female employment. This finding is line with the a priori expectation that the past values of maternal mortality have no predictive power to explain the current situation of economic status, female population, and female employment. Moreover, the absence of reverse causality strengthens the validity of the model specification, confirming that maternal mortality risk is appropriately treated as the dependent variable.

However, a bidirectional relationship was found between economic status (LN_REALGDPPC) and female population (LN_RFPOP), with each Granger-causing the other. This reflects the well-established demographic transition framework, in which economic development drives changes in population age structure. This causes a relative increase in the more productive proportion of a population and increases the chance of economic growth (Lutz, 2025).

Table 7: Diagnostics:

S/N	Tests	H_0	P-value	Conclusion
1.	Breusch–Godfrey Serial Correlation LM test	No serial correlation	0.5635	There is no serial correlation
2.	Breusch–Pagan-Godfrey test for heteroskedasticity	Constant variance	0.5525	There is no heteroskedasticity
3.	Jarque-Bera normality test	Normality	0.413983	Residuals are normally distributed
4.	Ramsey RESET test	The model has no omitted variables	0.4615	No variable was wrongly omitted



5. Conclusion and Recommendations

This study investigates the extent to which economic status influence life-time risk among women of reproductive age in Nigeria using time series data from 1990 to 2024. Real GDP per capita is used as a proxy for economic status, whereas life time risk of maternal mortality is measured as the probability that a 15-year-old female will die eventually from a maternal cause assuming that current levels of fertility and mortality do not change in the future taking into account competing causes of death. The study employed autoregressive distributed lag (ARDL) and Johansen cointegration techniques to examine both the short-run and long-run impact as well as VAR Granger Causality/Block Exogeneity Wald Test to analyse the direction of causality. The results revealed that economic status has negative and statistically significant impact on life-time risk of maternal death in Nigeria such that a percentage increase in the economic status reduces maternal death by about 0.173533%. Also, the result of causality test indicates the existence of unidirectional causality from economic status to life-time risk of maternal mortality which implies that past values of economic status contain useful information for predicting maternal mortality risk in Nigeria. Thus, the study concludes that higher economic status contributes to better maternal health outcomes by reducing the number of maternal deaths. Therefore, based on the major findings, the study recommends prioritizing economic empowerment of pregnant and postpartum women, particularly by linking financial support to antenatal care (ANC) and skilled birth attendance. This is addition to reducing financial barriers to maternal healthcare utilization through subsidizing or eliminating out-of-pocket payment.

However, this study is not exhaustive. For instance, mechanisms through which economic status may reduce life-time risk of maternal death has not been examined. Also, the issue of threshold effect may arise due to varying income levels among women of reproductive age, as well as time-varying cointegration due to changes in healthcare policies and programmes. Future studies therefore should take these challenges and build on the existing literatures.

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