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FERTILITY PATTERNS AND MATERNAL CHARACTERISTICS ACROSS NIGERIA'S GEOPOLITICAL ZONES: A LONGITUDINAL STUDY FROM 2003 TO 2018

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ABSTRACT

This study examines the reproductive and demographic traits of mothers in Nigeria while utilizing secondary data from the Nigeria Demographic and Health Survey (NDHS). The study uses Structural Equation Modeling (SEM) to examine the relationship between socioeconomic status, reproductive behaviour, and geo-cultural factors affecting fertility patterns in Nigeria. The results show that the average age of mothers at first birth has gradually increased, while the proportion of mothers with no formal education remains significant. The model reveals significant insights into how these latent constructs interact. The model indicates that higher SES leads to fewer children, while reproductive behaviours like age at first birth and marital status positively influence the total number of children ever born. The model fit indices: RMSEA of 0.072; TLI of 0.903; and CFI of 0.947, demonstrate a reasonable fit, suggesting that the model adequately captures the underlying relationships, but some coefficients suggest measurement issues. The study emphasizes the importance of cultural norms and socioeconomic conditions in shaping reproductive choices.

Keywords: Fertility patterns, Structural equation model, Socioeconomic status, Reproductive behaviour, Demographic traits, Model fit indices

INTRODUCTION

Fertility refers to the average number of children born to a woman during her reproductive years and is a crucial factor affecting population growth and composition (Hanson et al., 2015). When determining the fertility rate—which is the number of live births per 1,000 females over a specific period, usually one year—women between the ages of 15 and 49 are typically regarded as being of reproductive age (Heggenhougen & Quah, 2009). Nearly 90% of healthy, fertile women can become pregnant within a year if they participate in regular sexual activity without taking contraception (Santhya et al., 2008; Epstein et al., 2017). With an average of 5.5 children per woman, Nigeria boasts one of the highest fertility rates in the world (World Health Organization [WHO], 2023).

According to Mascarenhas et al. (2012), Africa has among the highest fertility rates in the world. Numerous factors contribute to these high fertility rates such as high rates of infant and child mortality, early marriage, inadequate contraceptive usage, early onset of childbearing, and the high regard societies accorded to procreation (Cleland, 2001; Bennett, 2013; Nwimo & Egwu, 2015; Avogo & Somefun, 2019). Because they think newborn and child mortality is high and because they expect some of their offspring will survive to carry on the family line, people have a lot of children (Gayawan et al., 2010). Studies show that changes in demographic, social, and cultural factors have a notable influence on variations in family size, age at first marriage, and access to and usage of contraceptives (Ariho et al., 2018). The six geopolitical zones of Nigeria have varying fertility rates; the North East and North West zones have the highest rates, while the South East and South West zones have the lowest rates (Unumeri et al., 2015).

Regional variations in Nigeria's fertility trends are noteworthy (Feyisetan & Bankole, 2009). The average number of children a woman is projected to have during her reproductive years is known as her total fertility rate (TFR), and it has been steadily declining (Opiyo, 2003; Alkema et al., 2011; Opiyo & Levin, 2013). The TFR has remained high as of late, while regional variations existed; generally speaking, the north of the nation had greater fertility rates than the south (Cleland, 1996; Mberu& Reed, 2014). The differences in birth rates throughout Nigeria's geopolitical zones are caused by a multitude of reasons; these elements consist of cultural norms, healthcare availability, and socioeconomic position (Popoola, 2019). Higher socioeconomic status may lead to lower fertility rates among women due to increased access to family planning resources and quality care during pregnancy and childbirth. It was found in the work of (Asemota & Klatsky, 2015; Vale et al., 2019) that reduced fertility rates are also more common in women who have more access to healthcare. Fertility rates may also be influenced by cultural values, for instance, women in societies that place a high importance on having many children are more likely to be fertile (Bau & Fernández, 2023).

Significant demographic shifts in Nigeria over the past few decades have affected the nation's reproductive trends (Bongaarts, 2008; Feyisetan & Bankole, 2009). Fertility rates have decreased gradually, but variations persist due to factors like socioeconomic status, educational attainment, urbanization, and cultural dynamics. Regional variations in Nigeria's fertility trends are noteworthy (Feyisetan & Bankole, 2009). Socioeconomic variables significantly impact fertility decisions, with urban settings with better infrastructure and educational resources potentially experiencing lower fertility rates compared to rural areas (Mashood, 2021). Cultural influences continue to play a major part in reproductive decisions; activities connected to marriage, childbearing, and family size often reflect cultural norms and traditions (Agbor, 2016; Bau & Fernández, 2023). Smith (2004) opined that Nigeria is amid a demographic transition, defined by shifts from high to decreasing fertility and death rates. Comprehending the phases of this shift is essential for forecasting future demographic patterns and guiding policy determinations.

Significant geographical differences driven by a range of sociocultural and economic factors are highlighted in the material currently available on fertility rates in Nigeria.

structural equation modelling (SEM) has been crucial in helping researchers understand the complex relationships between fertility and maternal health. For example, Idoko and Ezeh (2023) used SEM to assess the impact of demographic and socioeconomic factors on fertility decisions, identifying important pathways through which income and education levels affected fertility behaviours. Mashood et al. (2023) examine the structural connections between maternal health outcomes, sociocultural variables, and the quality of prenatal care in Northern Nigeria using a count regression model. In a different study, the latent determinants affecting women's access to and use of maternal healthcare services in metropolitan Nigeria were identified using SEM (Okoye, 2024). Pearson correlation analysis was employed in the work of Wali et al. (2024) to assess the degree of association between the variables associated with the psychosocial and economic consequences of Vesicovaginal Fistula (VVF) on women in Kebbi State. Nevertheless, there aren't many thorough studies that quantitatively examine these complex correlations using sophisticated statistical techniques like SEM. The majority of research focuses on basic regression analysis or descriptive statistics, which fall short of capturing the intricate relationships between the variables influencing reproduction rates. This disparity calls for a more thorough investigation of how these variables interact and affect fertility throughout Nigeria's various geopolitical zones.

This research seeks to identify and analyse critical sociocultural and economic factors affecting fertility patterns across Nigeria's six geopolitical zones, examine the direct and indirect relationships among these factors utilising SEM, address health disparities, enhance healthcare, and contribute to global discourse on reproductive rights.

MATERIALS AND METHODS

This study uses secondary data from the National Demographic and Health Survey (NDHS), a five-year survey conducted by the National Population Commission (NPC) of Nigeria, to analyse demographic and health indicators like maternal death and fertility rates. The Structural Equation Model (SEM) was used to analyse the intricate interactions between variables in the model, assessing both direct and indirect effects on fertility. SEM is perfect for this study because it can model complex relationships with many variables at once, including latent constructs like socioeconomic status and cultural norms. It also provides fit evaluations beyond Chi-square, enabling more reliable conclusions about the relationships under study. The Chi-square test statistic at a 5% significance level, Comparative Index Fit (CFI), Tucker-Lewis Index (TLI), and Root Mean Square Error of Approximation (RMSEA) were used to evaluate the model fit. CFI value close to a minimum of 0.95, TLI value more than 0.95, and RMSEA value less than 0.08 suggest an acceptable fit of the model to the data. The analysis was conducted using the R statistical program (R Core Team, 2023). *Lavaan* (Yves, 2012), *semPlot* (Epskamp, 2022), *sem* (Fox et al., 2022), *OpenMx* (Boker et al., 2023), and *dplyr* (Wickham et al., 2023) were the packages used to complete the SEM.

This study used three computed SEM parameters: variance-covariances, regression, and latent variables. Latent variables were unobserved factors in the dataset, including reproductive behaviour (RB), geo-cultural factors (GCFs), and socioeconomic status (SES). The respective indicators for each of the latent variables are: RB is influenced by age at first marriage/cohabitation, age at first birth, fertility preference, and marital status; GCFs are influenced by educational level, region, religion, marital status, fertility preference, age at first marriage, and place of residence; and SES is defined by place of residence, wealth quintile/index, and educational level. The regression model used observed variables to predict endogenous variables like total children ever born. The variance-covariance component analyzed the relationship between unobserved variables. The study aimed to understand the impact of these variables on reproductive behaviour. The variables employed in this analysis are similar to those taken into account in other studies, including Bollen et al. (2007), Ajzen & Klobas (2013), Ibrahim (2016), Muoghalu (2016), Kiani et al. (2020), Ahinkorah et al. (2021), Mashood (2021), Mbulu (2021), Idoko & Ezeh (2023), and Mashood et al. (2023).

RESULTS AND DISCUSSION

A detailed summary of the demographic and reproductive characteristics of mothers according to age, education, wealth, marital status, region, and reproductive behaviours can be found in Table 1. The geographical scope is limited to Nigeria's six geo-political zones, and the study does not extend to sub-regional or local levels. A total sample size of 121,774 is provided for the years 2003, 2008, 2013, and 2018. The percentage of women aged 15-19 has remained constant but has decreased from 22.95% in 2003 to 20.14% in 2018, indicating a trend towards older maternal ages. The 30-34 age group has increased, indicating postponed motherhood. The average age of reproductive-age mothers increased from 28.02 years in 2003 as the base year to 29.16 years in 2018.

The proportion of mothers giving birth before 15 years has decreased from 8.78% in 2003 to 5.11% in 2018, largely due to better access to family planning and education. Around 78% still give birth between 15 and 22 years, indicating a trend towards more responsible parenting. The survey shows stability in marriage rates, with two-thirds of respondents married. Cohabitation and singlehood are becoming more acceptable. Marriage before the age of 15 has declined, while cohabitation is common between 16 and 20 (more than 50%). Younger populations' standards for relationships and marriage are evolving, with women's rates of never having sex increasing from 26.25% in 2003 to 52.91% in 2018. However, a drop-in sex before 17 indicates postponement. The survey shows a stable number of children ever born, with one-third of mothers reporting no children. The mean number of children per mother is around three, suggesting family sizes may be decreasing. The proportion of mothers with no children has slightly decreased, while those with one to three children remain stable.

Table 1: Frequency (percentages in parenthesis) Distribution of Explanatory Variables Across the Survey Years (2003 – 2018)

Covariates	Levels	Years 2003 (n = 7,620)	2008 (n = 33,385)	2013 (n = 38,948)	2018 (n = 41,821)	Combined Years (N = 121,774)
Mother's current age	15 – 19	1749 (22.95)	6591 (19.74)	7905 (20.30)	8423 (20.14)	24668 (20.26)
	20 – 24	1464 (19.21)	6103 (18.28)	6714 (17.24)	6844 (16.36)	21125 (17.35)
	25 – 29	1356 (17.80)	6303 (18.88)	7037 (18.07)	7203 (17.22)	21899 (17.98)
	30 – 34	940 (12.34)	4557 (13.65)	5373 (13.80)	5997 (14.34)	16867 (13.85)
	35 – 39	798 (10.47)	3883 (11.63)	4701 (12.07)	5406 (12.93)	14788 (12.14)
	40 – 44	695 (9.12)	3043 (9.11)	3663 (9.40)	4057 (9.70)	11458 (9.41)
	45 – 49	618 (8.11)	2905 (8.70)	3555 (9.13)	3891 (9.30)	10969 (9.01)
	Mean(SD)	28.02 (9.61)	28.65 (9.49)	28.86 (9.69)	29.16 (9.71)	28.85 (9.64)
Mother's age at 1st birth	≤14	669 (8.78)	2426 (7.27)	2458 (6.31)	2139 (5.11)	7692 (6.32)
	15 – 22	6149 (80.70)	26293 (78.76)	30714 (78.86)	32895 (78.66)	96051 (78.88)
	23 – 30	737 (9.67)	4274 (12.80)	5220 (13.40)	5994 (14.33)	16225 (13.32)
	31 – 38	64 (0.84)	366 (1.10)	530 (1.36)	753 (1.80)	1713 (1.41)
	39 – 48	1 (0.01)	26 (0.08)	26 (0.07)	40 (0.10)	93 (0.08)
	Mean(SD)	18.87 (3.35)	19.22 (3.64)	19.40 (3.66)	19.60 (3.81)	19.38 (3.70)
Number of living children	Nil	2626 (34.46)	10053 (30.11)	11914 (30.59)	12214 (29.21)	35469 (29.13)
	1 – 3	2675 (35.10)	12459 (37.32)	14100 (36.20)	15403 (36.83)	38906 (31.95)
	4 – 6	1749 (22.95)	8375 (25.09)	9949 (25.54)	10846 (25.93)	29183 (23.96)
	≥7	570 (7.48)	2498 (7.48)	2985 (7.66)	3358 (8.03)	18216 (14.96)
	Mean(SD)	2.36 (2.46)	2.54 (2.44)	2.55 (2.46)	2.62 (2.48)	2.56 (2.46)
Place of residence	Urban	3057 (40.12)	10489 (31.42)	15545 (39.91)	16984 (40.61)	75699 (62.16)
	Rural	4563 (59.88)	22896 (68.58)	23403 (60.09)	24837 (59.39)	46075 (37.84)
Mother's age at 1st Sex	Never had sex	2000 (26.25)	12065 (36.14)	6812 (17.49)	22127 (52.91)	43004 (35.31)
	≤ 17	1386 (18.19)	7458 (22.34)	6864 (17.62)	12688 (30.34)	28396 (23.32)
	18 – 28	2944 (38.64)	9149 (27.40)	19426 (49.88)	217 (0.52)	31736 (26.06)
	29 – 96	1258 (16.51)	4583 (13.73)	5745 (14.75)	6749 (16.14)	18335 (15.06)
	Others	32 (0.42)	130 (0.39)	101 (0.26)	40 (0.10)	303 (0.25)
	Mean(SD)	44.84 (41.26)	36.39 (37.22)	54.22 (42.18)	19.60 (3.81)	35.03 (36.68)
Total children ever born	Nil	2509 (32.93)	9634 (28.86)	11497 (29.52)	11829 (28.28)	35469 (29.13)
	1 – 3	2234 (29.32)	10588 (31.71)	12249 (31.45)	13835 (33.08)	38906 (31.95)
	4 – 6	1616 (21.21)	7889 (23.63)	9401 (24.14)	10277 (24.57)	29183 (23.96)
	≥7	1261 (16.55)	5274 (15.80)	5801 (14.89)	5880 (14.06)	18216 (14.96)
	Mean(SD)	3.02 (3.18)	3.14 (3.08)	3.07 (3.03)	3.05 (2.96)	3.08 (3.03)
Ideal Number of Children	Nil	2 (0.03)	635 (1.90)	280 (0.72)	1010 (2.42)	1927 (1.58)
	1 – 4	1878 (24.65)	8802 (26.37)	11380 (29.22)	12964 (31.00)	35024 (28.76)
	Others	5740 (75.33)	23948 (71.73)	27288 (70.06)	27847 (66.59)	84823 (69.66)
	Mean(SD)	16.31 (27.92)	17.34 (29.38)	12.73 (23.10)	8.59 (14.98)	12.77 (23.36)
Age at 1st Cohabitation	≤15	2582 (33.88)	10704 (32.06)	11112 (28.53)	10313 (24.66)	34711 (28.50)
	16 – 20	4026 (52.83)	17137 (51.33)	20774 (53.34)	22619 (54.09)	64556 (53.01)
	21 – 25	744 (9.76)	3848 (11.53)	4845 (12.44)	5674 (13.50)	15084 (12.39)
	26 – 30	221 (2.90)	1349 (4.04)	1743 (4.48)	2385 (5.70)	5698 (4.68)
	≥31	47 (0.62)	347 (1.04)	474 (1.22)	857 (2.05)	1725 (1.42)
Education level	None	3005 (39.44)	13242 (39.66)	13740 (35.28)	14398 (34.43)	44385 (36.45)
	Primary	1666 (21.86)	6591 (19.74)	7104 (18.24)	6383 (15.26)	21744 (17.860
	Secondary	2462 (32.31)	10905 (32.66)	14407 (36.99)	16698 (39.93)	44472 (36.52)
	Higher	487 (6.39)	2647 (7.93)	3697 (9.49)	4342 (10.38)	11173 (9.18)
Wealth Index	Poorest	1479 (19.41)	7282 (21.810)	6602 (16.95)	7747 (18.52)	23110 (18.98)
	Poorer	1399 (18.36)	6819 (20.43)	7515 (19.29)	8346 (19.96)	24079 (19.77)
	Middle	1510 (19.82)	6582 (19.72)	8001 (20.54)	8859 (21.18)	24952 (20.49)
	Richer	1544 (20.26)	6546 (19.61)	8450 (21.70)	8840 (21.14)	25380 (20.84)
	Richest	1688 (22.15)	6156 (18.44)	8380 (21.52)	8029 (19.20)	24253 (19.92)

Covariates	Levels	Years				Combined Years (N = 121,774)
		2003 (n = 7,620)	2008 (n = 33,385)	2013 (n = 38,948)	2018 (n = 41,821)	
Marital status	Never in union	2087 (27.39)	8021 (24.03)	9820 (25.21)	10669 (25.51)	30597 (25.13)
	Living with partner	166 (2.18)	475 (1.42)	871 (2.24)	1047 (2.50)	2559 (2.10)
	Married	4991 (65.50)	23479 (70.33)	26403 (67.79)	27841 (66.57)	82714 (67.92)
	Not living together	88 (1.15)	345 (1.03)	429 (1.10)	604 (1.44)	1466 (1.20)
	Divorced	121 (1.59)	301 (0.90)	432 (1.11)	543 (1.30)	1397 (1.15)
	Widowed	167 (2.19)	763 (2.29)	993 (2.55)	1117 (2.67)	3040 (2.50)
Region	North Central	1256 (16.48)	6366 (19.07)	6251 (16.05)	7772 (18.58)	21645 (17.77)
	North East	1413 (18.54)	6217 (18.62)	6630 (17.02)	7639 (18.27)	21899 (17.98)
	North West	1791 (23.50)	7297 (21.86)	9673 (24.84)	10129 (24.22)	28890 (23.72)
	South East	1081 (14.19)	3667 (10.98)	4462 (11.46)	5571 (13.32)	14781 (12.14)
	South-South	938 (12.31)	4813 (14.42)	6058 (15.55)	5080 (12.15)	16889 (13.87)
	South West	1141 (14.97)	5025 (15.05)	5874 (15.08)	5630 (13.46)	17670 (14.51)
Visited health facility last 12 months	Yes	2472 (32.44)	6462 (19.36)	8875 (22.79)	16562 (39.6)	34371 (28.23)
	No	5144 (67.51)	26745 (80.11)	29909 (76.79)	25259 (60.4)	87057 (71.49)
	Unknown	4 (0.05)	178 (0.53)	164 (0.42)	0 (0.00)	346 (0.28)
Religion	Islam	1423 (18.67)	15449 (46.28)	18578 (47.70)	20959 (50.12)	56409 (46.32)
	Catholic	1161 (15.24)	3583 (10.73)	4081 (10.48)	4436 (10.61)	13261 (10.89)
	Other Christian	1300 (17.06)	13588 (40.70)	15757 (40.46)	16070 (38.43)	46715 (38.36)
	Others	3736 (49.03)	765 (2.29)	532 (1.37)	356 (0.85)	5389 (4.43)

Educational attainment has increased, with women having better access to education, which is linked to postponed childbirth and lower fertility rates. The proportion of women without formal education has decreased and a sizable portion have completed at least secondary school. By 2018, the percentage of urban respondents rose from 40% to over 62%, indicating a significant growth in urban living. The frequency of visits to health facilities has increased, possibly due to increased health awareness and better access to healthcare services. The desire for larger families with more than four children has remained constant, although, by 2018, the number of people who prefer less than four children has slightly increased. Better access to healthcare and education, which can affect family planning and reproductive decisions, is probably the cause of this development. Although the wealth index is stable across categories, a sizable percentage of it still falls into the quintile with the lowest wealth. Islam is becoming more and more represented among respondents, which reflects changes in the demographics of areas where Islam is the predominant religion. Relative stability is evident in regional distributions, although there are still noticeable differences in reproductive health outcomes between the northern and southern regions.

Overall, these results show that among women surveyed between 2003 and 2018, there have been notable changes in maternal age, reproductive behaviour, education, and access to healthcare. Policymakers must comprehend these trends to address health disparities and enhance reproductive health services that are adapted to changing economic and social standards. To improve women's health outcomes throughout Nigeria's various demographics, future research areas and policy actions might benefit from the detailed analysis presented here, which captures both stability and change within these crucial variables.

Table 2: Fertility Patterns in Nigeria (2003 – 2018)

Geo-political Zones	2003 (Base Year)	2008	2013	2018	Changes in Fertility Rate (%)		
					2008	2013	2018
North Central	1256	6366	6251	7772	406.8471	397.6911	518.7898
North East	1413	6217	6630	7639	339.9858	369.2144	440.6228
North West	1791	7297	9673	10129	307.4260	440.0893	465.5500
South East	1081	3667	4462	5571	239.2229	312.7660	415.3562
South-South	938	4813	6058	5080	413.113	545.8422	441.5778
South West	1141	5025	5874	5630	340.4032	414.8116	393.4268
TOTAL	**7,620**	**33,385**	**33,948**	**41,821**	**339.1233**	**345.5118**	**448.8320**

Table 2 shows the percentage change in fertility rates from 2003 to 2018 with 2003 as the base year. Nigeria's fertility rate increased significantly from 7,620 in 2003 to 41,821 in 2018, indicating population growth and a notable increase over time. The North West zone saw the most significant increase, with 207.42% change in 2008, 340.09% in 2013, and 365.55% in 2018. Variables such as early marriage, low education, limited access to family planning facilities, cultural norms, and the influence of neighbouring nations with higher fertility rates may contribute to this increase. Fertility rates in the South East zone increased by 315.36% in 2018, 212.77% in 2013, and 139.22% in 2008, despite cultural norms valuing having many children. In the South-South zone, rates increased by 313.11% and 341.58%.

Conclusively, with 7,772 births in 2018, North Central has the highest fertility rate, a significant rise from 1,256 in 2003. Moreover, North West saw a significant rise, going from 1,791 in 2003 to 10,129 in 2018. On the other hand, compared to other regions, the South West had the lowest fertility rate in 2018, at 5,630, but it was still significantly higher than 1,141 in 2003 (a change of 393.43%).

Structural Equation Model

The categories under which the SEM results group several latent variables are RB, SES, and GCFs. Each latent variable is quantified using particular indicators that are observed. Figure 1 gives a visual representation that illustrates and validates the results obtained from the SEM analysis shown in Table 4. It visually presents the relationships and patterns discovered through the analysis. The measurement model of the SEM result (see Figure 1) is constructed in such a way that there is a negative (red arrow) relationship between SES and Total Children Ever Born (TCEB), and cultural and regional factors have significant negative effects on TCEB. On the other hand, RB has a positive (green arrow) influence on TCEB but RB has an inverse relationship with SES. However, a minimal direct relationship between SES and GCFs was identified.

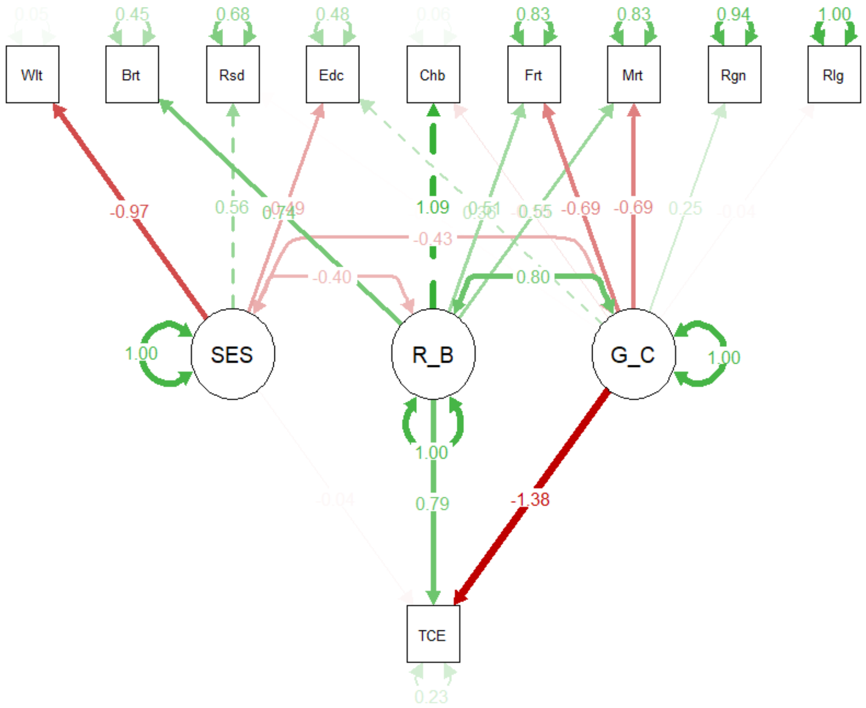

Figure 1: Diagram reflecting the validated result of the SEM analysis

The relationships between SES, RB, and GCFs are depicted in the measurement models defined below along with their corresponding indicators. The way these structures interact concerning the Nigerians' fertility patterns according to the result of the SEM analysis depicted by the path analysis diagram (Figure 1) and structural equations. The measurement model of the SEM result presented in Table 4 and shown in Figure 1 can be summarised in the following equations:

SES Model:

$SES = \beta_1 \times Place\ of\ residence + \beta_2 \times Wealth + \beta_3 \times Education + \xi_{SES}$

RB Model:

$RB = \beta_4 \times Cohabitation + \beta_5 \times Age\ at\ first\ birth + \beta_6 \times Marital\ status + \beta_7 \times Fertility\ preference + \xi_{RB}$

GCFs Model:

$GCF = \beta_8 \times Education + \beta_9 \times Region + \beta_{10} \times Religion + \beta_{11} \times Marital\ status + \xi_{GCF}$

Regression Equations for TCEB:

$TCEB = \gamma_1 SES + \gamma_2 RB + \gamma_3 GCF + \mu$

Table 3: SEM Model Fit Indices Result

Indices	Values	Remarks
RMSEA	0.072	Reasonable fit
TLI	0.903	Within acceptable fit
CFI	0.947	Model fits well

The fit indices for the SEM used in this study are summarised in Table 3. The TLI, CFI, and RMSEA are important indices that offer important information about how well the model captures the relationships between the latent constructs being studied. Together, these indices provide a thorough assessment of the SEM's performance, with each index having a specific function in determining model fit. The RMSEA value of 0.072 indicates a reasonable fit, indicating that the model adequately approximates the population covariance matrix. This value suggests that the discrepancies between observed data and model predictions are relatively small. The TLI value of 0.903 falls within the acceptable range for model fit, with values closer to 1 indicating better fit. A TLI above 0.90 is typically acceptable, suggesting that this model provides a good representation of the data relative to a null model. The CFI value of 0.947 suggests that the model fits well within the context of SEM analysis, explaining a substantial proportion of variance in the observed data compared to a baseline model. This high CFI value suggests that the hypothesized relationships among latent constructs are well-supported by the data. According to the fit indices, the model is rather well-specified based on the available data, however there is still opportunity for improvement.

The proposed model effectively captures the complex relationship between socioeconomic status, reproductive behaviour, and geo-cultural factors influencing fertility patterns, with room for improvement in achieving better-fit indices, particularly concerning RMSEA and TLI thresholds.

Table 4: Result of Structural Equation Model

	Estimate	Std. Error	Z-value	P-value	Std. lv	Std. all
Latent Variables						
SES						
Place of residence	1.000				0.271	0.559
Wealth	-5.027	0.045	-112.204	< 0.05	-1.363	-0.974
Education	-1.849	0.013	-137.200	< 0.05	-0.502	-0.487
Reproductive Behavior						
Cohabitation	1.000				4.532	1.089
Age at 1st Birth	0.607	0.005	117.794	<0.05	2.753	0.745
Marital status	0.098	0.001	66.903	< 0.05	0.443	0.546
Fertility preference	0.122	0.002	62.913	< 0.05	0.553	0.508
Geo-cultural Factors						
Education	1.000				0.374	0.363
Region	1.131	0.016	70.879	< 0.05	0.423	0.254
Religion	-0.648	0.055	-11.734	< 0.05	-0.243	-0.036
Marital status	-1.492	0.020	-75.237	< 0.05	-0.558	-0.688
Fertility preference	-2.002	0.026	-75.643	< 0.05	-0.749	-0.687
Cohabitation	-1.756	0.073	-24.161	< 0.05	-0.657	-0.158
Residence	-0.012	0.004	-2.763	0.006	-0.005	-0.009
Regressions						
TCEB						
SES	-0.466	0.056	-8.319	< 0.05	-0.126	-0.042
Reproductive Behavior	0.529	0.010	52.161	< 0.05	2.396	0.791
Geo-cultural factors	-11.173	0.159	-70.237	< 0.05	-4.183	-1.381
Covariances						
SES						
Reproductive Behaviour	-0.486	0.007	-73.597	< 0.05	-0.395	-0.395
Reproductive Behaviour						
Geo-cultural factors	1.353	0.017	77.613	< 0.05	0.797	0.797
SES						
Geo-cultural factors	-0.044	0.001	-71.641	< 0.05	-0.432	-0.432
Variances						
Place of residence	0.161	0.001	203.250	< 0.05	0.161	0.683
Wealth	0.102	0.011	9.010	< 0.05	0.102	0.052
Education	0.509	0.003	187.917	< 0.05	0.509	0.479
Cohabitation	1.103	0.086	12.771	< 0.05	1.103	0.064
Age at 1st birth	6.091	0.045	134.983	< 0.05	6.091	0.446
Fertility preference	0.982	0.005	218.206	< 0.05	0.982	0.826
Marital status	0.545	0.002	218.537	< 0.05	0.545	0.828
Region	2.604	0.011	244.149	< 0.05	2.604	0.936
Religion	45.720	0.185	246.712	< 0.05	45.720	0.999
TCEB	2.121	0.064	33.101	< 0.05	2.121	0.231
SES	0.074	0.001	72.687	0.967	1.000	1.000
Reproductive Behavior	20.543	0.266	77.273	< 0.05	1.000	1.000
Geo-cultural factors	0.140	0.002	59.174	< 0.05	1.000	1.000

Table 3 presents the findings from a structural equation modelling that analyzed the connections and consequences of socioeconomic status, reproductive behaviour, and geo-cultural variables. The study showed that the p-value (<0.05) achieved suggests a statistically significant fit, indicating that the suggested model does a good job of capturing the relationships identified in the data. With 30 model parameters, the SEM model used Maximum Likelihood as the estimator. A significant (p-value <0.05) and a value of 16,001.95 with 25 degrees of freedom were obtained from the chi-square statistic. The model focuses on the impact of SES on reproductive behaviour. Reproductive behaviour and SES have an inverse relationship and significant covariance (Estimate = –0.486, $p < 0.05$), where higher SES is associated with different reproductive behaviours than those observed in lower SES; and between reproductive behaviour and geo-cultural factors (Estimate = 1.353, $p < 0.05$) there exists a positive covariance, indicating a modest correlation between these factors, that is, cultural contexts may shape reproductive behaviours. The covariance between SES and geo-cultural factors (Estimate = –0.044, $p < 0.05$) is negligible, suggesting a minimal direct relationship between these constructs within this model.

Wealth index, educational level, and place of residence play key roles in SES. However, SES has a negative impact on place of residence (Estimate = –5.027, $p < 0.05$), a positive impact on place of residence (set at 1.000) and educational level (Estimate = –1.849, $p < 0.05$). This implies an unexpectedly negative relationship between SES and these indicators, suggesting that people with higher SES are less likely to have wealth and attain higher education. Higher wealth and education levels may be associated with lower SES ratings in this context, which could indicate problems with how these variables are operationalised or with the particular demographic dynamics under investigation. Age at first birth (Estimate = 0.607, $p < 0.05$), marital status (Estimate = 0.098, $p < 0.05$), and fertility preference (Estimate = 0.122, $p < 0.05$) are measures of reproductive behaviour that have a positive effect on the model with age at first marriage/cohabitation serves as the reference variable. The older age at first birth positively influences reproductive behaviour, aligning with literature suggesting that delayed childbearing often leads to different reproductive choices (Fagbamigbe & Idemudia, 2016; De la Croix & Pommeret, 2021). Furthermore, fertility preference and marital status both have a favourable impact on reproductive behaviour, suggesting that societal norms around marriage and preferences for family size play a big role in reproductive decision-making.

Education is set as the reference variable in the third latent variable. The positive coefficient for the region (Estimate = 1.131, $p < 0.05$) suggests that geographic location significantly influences geo-cultural factors, while the negative coefficients for religion (Estimate = –0.648, $p < 0.05$), marital status (Estimate = –1.492, $p < 0.05$), and fertility preference (Estimate = –2.002, $p < 0.05$) imply a complex relationship where certain cultural or religious affiliations may negatively impact perceptions or practices related to fertility. TCEB is influenced by SES, reproductive behaviour, and geo-cultural factors; such that higher SES and improved geo-cultural factors are associated with fewer children, as indicated by the regression path's negative influence on TCEB (Estimate = –0.466, $p < 0.05$) and (Estimate = –11.173, $p < 0.05$) respectively; which aligns with global trends indicating that increased economic resources often correlate with lower fertility rates due to factors such as enhanced access to family planning and education. On the other hand, reproductive behaviour positively affects TCEB (Estimate = 0.529, $p < 0.05$), suggesting that decisions about family size are greatly influenced by behaviours like cohabitation and married status, supporting the idea that social circumstances are important in determining reproductive outcomes (Sede & Rolle, 2017; Smith, 2023). The significant negative impact of geo-cultural factors on TCEB indicates that regional settings and cultural norms have a significant impact on reproductive decisions, possibly reflecting societal expectations or family planning-related resource accessibility. Geo-cultural factors, such as religion, marital status, fertility preference, age at first marriage/cohabitation, and place of residence have an inverse impact; meanwhile, region (Estimate = 1.131, $p < 0.05$) has a significant direct relationship with geo-cultural factors. The study also revealed positive significant variances in all the variables considered for the analysis, indicating diverse characteristics within the population.

CONCLUSION

The SEM analysis offers a sophisticated comprehension of the fundamental patterns present in the dataset. This study elucidates the intricate interactions among demographic, socio-economic, and reproductive behaviour factors that influence reproductive practices throughout Nigeria's geopolitical zones. According to the results, fertility rates have risen dramatically over time, with North Central and North West having the highest rates. Early marriage, low educational attainment, and limited access to family planning are important factors that contribute to high fertility, and these factors are most common in the northern zones. On the other hand, there is a strong correlation between lower fertility rates and socioeconomic class, particularly education, which supports the link between cohabitation and postponed childbirth.

Higher SES levels are associated with reduced fertility desires, according to the SEM analysis, which also indicated that SES affects reproductive behaviour and fertility preferences. Additionally, SES affects wealth distribution and residence patterns, demonstrating that people with higher SES are less likely to live in rural areas and, as a result, are subject to different fertility pressures than their counterparts in rural areas. Despite being studied, cultural elements like religion and marital status had little effect on reproductive behaviour, indicating that socioeconomic and educational factors are more important. All things considered, the study offers a crucial framework for comprehending demographic changes as well as practical advice on how to control fertility trends in Nigeria through family planning and education.

The linkages and influences that have been uncovered offer significant contributions to the disciplines of cultural studies, demography, and sociology. The intensity and direction of these associations are indicated by the positive or negative coefficients. The corresponding p-values establish the relevance of the coefficients. These results improve our understanding of the intricate interactions among cultural dynamics, reproductive behaviours, and socioeconomic circumstances. All things considered, the SEM results offer insightful information on how interactions between reproductive behaviour, socioeconomic level, and geo-cultural factors affect fertility patterns in Nigeria. These interactions are reasonably represented by the model's fit indices, but several of the coefficients point to possible measurement issues or relationships that defy logic and need more research.

The proposed model effectively captures the complex relationship between socioeconomic status, reproductive behaviour, and geo-cultural factors influencing fertility patterns. These findings confirm that the model offers a strong foundation for comprehending these linkages, even though getting even better-fit indices is still possible, especially about the RMSEA and TLI thresholds for "good" fit. While there's room for improvement, it provides a robust framework for understanding these relationships. Future research could explore additional variables or alternative modelling techniques to enhance explanatory power. These findings offer valuable insights into reproductive health dynamics and can inform policy interventions to improve fertility and family planning outcomes.

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