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Examining the Relationships between Contraceptive Use and Childhood Mortality in Nigeria: A Multilevel Analysis

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Annotation: Background

Under-five mortality (U5M) in Nigeria continues to be high, while contraceptive use has not increased despite national and global commitments to improve reproductive health. This study examines the relationship between contraceptive use and childhood mortality. It further explores the direct and indirect pathways connecting contraceptive use to childhood mortality.

Methods

The research utilized data from the 2021 Nigeria Multiple Indicator Cluster Survey (MICS) that was carried out on a nationally representative sample of 38,768 women aged 15-49 years. Life table Stata ltable techniques were used to estimate child mortality rates from censored survival data, while logistic regression was employed to identify factors affecting contraceptive utilization. The Cox proportional hazards model was used to investigate the relationships between contraceptive use and under-five mortality.

Results

About two-thirds (62.2%) of the mothers were aged 25-34, 67.9% were rural residents, and

52.9% had given birth at home. The contraceptive prevalence rate (CPR) was 21.7%, while the under-five mortality rate was 103/1,000 live births.

Mothers who used contraception had a slower rate of experiencing childhood mortality compared to non-user mothers (aHR = 0.812, CI: 0.674–0.981). Children whose mothers were aged 35+ (aHR = 0.305, CI: 0.109 – 0.854) had a slower rate of experiencing childhood mortality compared to mothers aged 15–24. Higher maternal education was associated with reduced mortality risk (aHR = 0.231, CI: 0.083–0.640). The moderation analysis revealed a greater effect of contraceptive use in reducing child mortality among educated mothers (β = -0.054, 95% CI: -0.115 to -0.0113).

Conclusion

The study highlights the relationship between maternal age, education, marriage, and place of residence and use of contraception and child survival in Nigeria. Therefore, low levels of contraceptive use remain a contributing factor to under-five mortality in Nigeria. Hence, targeted and context-defined reproductive health interventions are required to improve child survival outcomes in Nigeria.

Keywords: Contraceptive use; Child mortality; Multiple Indicator Cluster Survey; Multilevel modeling.

INTRODUCTION

The mortality rate among children under five is often regarded as an indicator of a nation's progress, reflecting its commitment to healthcare and the overall well-being of its population [1]. Known as the under-five child mortality rate, this indicator represents the likelihood of a child dying between birth and reaching the age of five per 1000 live births[1, 2]. Globally, in 2020, the loss of 5 million children under five was recorded, translating to over 13,800 deaths per day [3,4,5],. Similarly, infant mortality rate (IMR) remains a significant public health concern, paralleling the challenges associated with under-five mortality[6]. Despite a global reduction in infant deaths over the past two decades, the child mortality rate has remained high, with figures declining from 65 deaths per 1,000 live births in 1990 to 27.4 deaths per 1,000 live births in 2022 [7-8]

The reduction in both infant and under-five mortality holds significant importance as they have persistently posed major public health challenges, particularly in low- and middle-income countries (LMICs)[9]. For countries like Nigeria, research findings have indicated a connection between infant and under-five mortality rates and maternal health[9-10] . Maternal health is a key indicator of children's living standards and the quality of maternal care they receive [6].

However, despite the global improvement of U5M, low- and middle-income countries, particularly the Sub-Saharan African (SSA) region, still record very high rates of infant mortality

as they contribute the highest to childhood mortality rates [11-12]. Nigeria, like other Sub-Saharan African countries, is facing similar public health challenges of high infant and under-five children mortality[13]. Out of the 1.9 million infant deaths recorded in the SSA region in 2019, Nigeria accounted for an estimated 548,116 infant deaths, representing about 28% of IMR in 2019 for the SSA region[5] . These figures are of deep concern for the country, given that IMR is also one of the indicators of a country's socio-economic development index and improvement in child health [14]. In addition, in 2019 also, Nigeria presented a high under-five mortality rate of 117 per 1,000 live births, ranking it among the top five countries with the highest under-five mortality rate [15]. Following this, there is a need to address the crisis of child mortality in Nigeria.

Unchecked, this rate, especially in low-and-middle-income countries with poor resource settings, presents diverse challenges to every member of society. As one of the solutions to these challenges, some countries institute different health policies with the aim of controlling under-five mortality rates [16]. A proven strategy for regulating under-five mortality that has been adopted globally is to improve the maternal health using contraceptive [17]. The use of contraception, also known as family planning, is used for the reduction of unintended pregnancies and allows the user to regulate when they would want to get pregnant [18-19].

Family planning is a cost-effective method of reducing child morbidity and mortality, and hence also achieving related Sustainable Development Goals (SDGs) [11]. With the use of family planning, especially the modern methods of contraception, it is projected that up to 1.8 million under-five child deaths could be averted in developing countries if there is at least a three-year interval between all pregnancies [20].

In the last decade, there has been an increase in modern contraceptive use [20]. Scaling up of family planning programs by governmental and non-governmental agencies increased the average contraceptive rate from 19% to 62% in developing countries with a corresponding decline of childhood mortality by 75% [21] .However, despite investments in promoting family planning and evidence supporting the use of contraceptives, gross inequalities persist in the adoption and use of contraceptives within and between countries, with LMICs having the lowest rates[22]. The unmet need for contraception among women in the most affected countries is still high [23]. In 2019, about 218 million women (28%) in developing countries who had the desire to prevent pregnancy were not using modern contraception [23].

Using Nigeria as a case study, despite extensive efforts by the government and donors to promote family planning in Nigeria, the country continues to grapple with one of the world's lowest contraceptive prevalence rates. The 2023-24 Nigeria Demographic Health Survey (NDHS) revealed a sobering statistic: only 20.0% of in-union women of reproductive age utilized any form of contraception, with 15% opting for modern contraceptive methods [25]. Although between 2008 and 2023-24, under-5 mortality decreased from 157 deaths per 1,000 live births to 110 deaths per 1,000 live births, the rate is still high[25]. Similarly, the infant mortality rate dropped from 75 deaths per 1,000 live births in 2008 to 63 deaths per 1,000 live births in 2023-24[25]. However, there have been no significant changes in neonatal mortality over the past decade, remaining at 40 deaths per 1,000 live births in 2008 and 41 deaths per 1,000 live births in 2023-24[25]. Therefore, given the impact of under-five children mortality rates in countries like Nigeria, improving contraceptive use among women becomes important for enhancing under-five survival. Hence, there's a clear imperative to evaluate the impact of contraceptive utilization on childhood mortality. Sustained endeavours are essential to further decrease under-five mortality rates and meet the corresponding Sustainable Development Goal (SDG) targets. Consequently, investigating under-five child mortality emerges as a significant and current public health concern in Nigeria. Given the increasing focus on family planning advancements in recent years, understanding the determinants of child mortality and its evolving patterns has also gained prominence.

Therefore, this study aimed to examine the relationships between contraception use and childhood mortality in Nigeria, identifying potential moderators and mediators.

MATERIALS AND METHODS

The study area is the 36 states plus the federal capital territory (FCT) in Nigeria split into six geopolitical zones, i.e., North-East (NE), North-West (NW), North-Central (NC), South-East (SE), South-South (SS), and South-West (SW).

The data utilized in this study were obtained from the most recent only available national representative dataset Multiple Indicator Cluster Survey (MICS) conducted in Nigeria in the year 2021. The MICS is a household survey program instituted by UNICEF to generate reliable and internationally comparable data on the well-being of children, women, and families. Nigerian MICS 2021 employed a stratified, multistage cluster sampling technique to choose respondents among women aged between 15–49 years across the six geopolitical zones of the country. Data were collected on a wide variety of indicators of maternal and child health, fertility, contraceptive prevalence, and under-five mortality. Thus, a sample of 38,768 out of the eligible for interviews 40,326 women aged 15–49, identified in 37,000 households, participated in the survey, resulting in a remarkable 96.1% response rate. For this estimation, particular emphasis was given to women's reports of all births occurring during the last five years before the survey, their use of contraception behaviour, and socio-demographic characteristics [26].

Method of Data Analysis

Data extracted from the 2021 MICS undergoes thorough editing and cleaning procedures to ensure accuracy for analysis. The analysis was conducted using STATA version 18 SE. The dataset was appropriately coded and scored in alignment with the dependent and independent variables. The coded data was then utilized to generate the findings for the study. To assess the relationship between contraceptive utilization and childhood mortality in Nigeria, bivariate and multivariate analyses were employed. Childhood mortality rates were computed using the "ltable" command in Stata based on life tables for survival analysis. Inferential analysis was done using Cox proportional Hazards.

Specifically, the demographic characteristics such as maternal age, level of education, marital status, and wealth index were taken into account to identify their influence on the use of contraceptives and mortality among children.

More also, a logistic regression model (both adjusted and unadjusted) was employed to identify the factors affecting contraceptive utilization in Nigeria. The dependent variable indicated whether the respondent is currently using any contraceptives, with a value of one assigned to users and a value of zero assigned to non-users. Similarly, the independent variables included factor scores along with other theoretically relevant variables, such as area of resident, maternal age, marital status, education level, wealth index, Children Ever Born, and geographical zone.

The logistic regression equation for this analysis is expressed as follows:

$$log\frac{P}{1-P} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots \beta n X n + \epsilon \qquad \ldots\ldots\ldots\ldots\ldots Eq.1$$

- ✓ P = the probability of a respondent using contraceptives.
- ✓ β_0 = intercept of the model.
- ✓ β_1, β_2, ..., β_n = regression coefficients representing the effect of independent variables on contraceptive use.
- ✓ X_1 , X_2, ..., X_n = independent variables, including demographic, socioeconomic, and social influence factors.
- ✓ ϵ = the error term accounting for unobserved factors.

In identifying factors contributing childhood mortality in Nigeria, a crude Cox was done. The equation for the Cox model used was:

$h(t) = ho(t)e^{(\beta X)}$ ..... *Eq. 2*

- ✓ h(t) is the hazard function at time t, representing the instantaneous risk of child mortality.
- ✓ $h_0(t)$ = baseline hazard function.
- ✓ β: coefficient for the predictor X
- ✓ e^{β}: crude hazard ratio the effect of X on the hazard without adjusting for other variables

Investigating how the use of contraception influences child mortality in Nigeria, identifying potential moderators and mediators.

A Cox Proportional Hazards (Cox PH) Model was used to determine whether the use of contraception influences childhood survival while controlling relevant confounders such as maternal education and socioeconomic status. The general form of the model is:

$h(t) = ho(t)e^{(\beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \ldots \beta_nX_n)}$ ..... *Eq. 3*

Where:

- ✓ h(t) = is the hazard function at time t, representing the risk of child mortality at a given time.
- ✓ $h_0(t)$ = baseline hazard function.
- ✓ X_1, X_2,...,X_n are independent variables, including contraceptive use, maternal age, Marital status, education level, wealth index, CEB and place of delivery
- ✓ β_1, β_2,...,β_n = regression coefficients indicating the effect of each independent variable on the hazard of child mortality.

For the causal pathways of moderation contraceptive use on child mortality varies based on moderators (e.g., maternal education), interaction term was introduced into the Cox regression model:

$h(t) = ho(t)e^{(\beta_1X + \beta_2M + \beta_3(X*M) + \ldots \beta_4Z + \beta_nZ_n}$ ……..*Eq.4*

where

- ✓ X = contraceptive use.
- ✓ M = the moderator (e.g. maternal education).
- ✓ X×M = interaction term, which tests whether the impact of contraception on child mortality varies based on the moderator.
- ✓ Z = control variables (e.g., socioeconomic status).

RESULT

The distribution of demographic and socioeconomic characteristics among women is presented in Table 1 below. A total of 38,768 women of reproductive age were included in the analysis, with 67.9% (26,339) coming from rural areas and 32.1% (12,429) from urban areas. Among the mothers, 45.8% (17,785) were aged between 25 and 34 years, and 62.2% (24,134) were currently married or in a union. The data indicate that most of the children mother were in the poorest 22.0% (8,708), poorer 22.8% (8,838), and middle 22.0% (8,523) wealth index categories, while only 14.0% (5,543) were classified in the richest wealth index. Additionally, a majority of the children mother 28.8% (11,150) had between 3 to 5 children ever born, while only 17% (6,585) of the children mother had more than 6 children.

Furthermore, for the place of delivery, 52.9 % (17,423) of deliveries occurred at respondent's home, 31.4% (10,334) took place at public health facility, and only 8.5% (2,780) occurred in a Private Health Facility.

Table 1: Percentage and distribution of sociodemographic and birth history, Nigeria

Variables	Frequency (N=38,768)	%
Area		
Urban	12,429	32.1
Rural	26,339	67.9
Maternal Age		
Less than 20	8,761	22.57
25-34	17,785	45.82
35+	12,266	31.60
Marital Status		
Currently married/in union	24,134	62.2
Formerly married/in union	2,078	5.4
Never married/in union	12,556	32.4
Wealth Index		
Poorest	8,708	22.4
Poorer	8,838	22.8
Middle	8,523	22.0
Richer	7,156	18.5
Richest	5,543	14.3
Children Ever Born (CEB)		
1-2	7,546	19.4
3-5	11,150	28.8
6+	6585	17.0
Place of Delivery		
Public Health Facility	10,334	31.4
Private Health Facility Base	2,780	8.5
Respondent's Home	17,423	52.9
Others	2,349	7.1

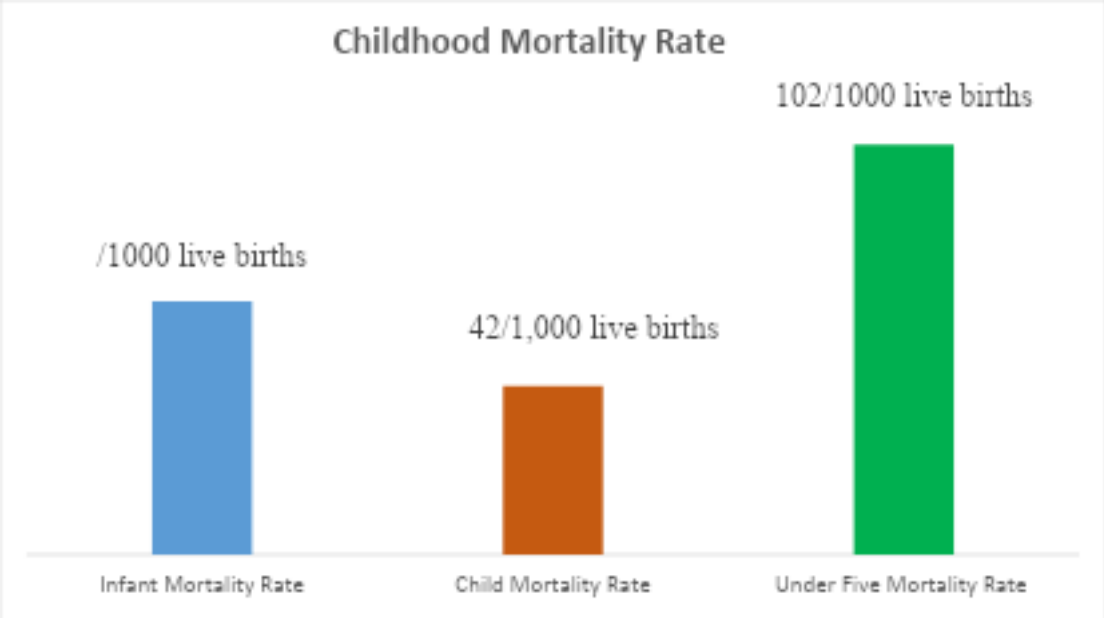

Fig 1: Distribution of Childhood Mortality Rate

The pattern of contraceptive use, infant mortality rate, child mortality rates, and under-five mortality rates is presented in Table 2 below. The findings reveal that the total contraceptive prevalence rate (CPR) for Nigeria is 21.7%, with an infant mortality rate of 63 per 1,000 live births, a child mortality rate of 42 per 1,000 live births, and an under-five mortality rate of 103 per 1,000 live births. The CPR is higher in urban areas (31.8%) compared to rural areas (14.8%). In contrast, the infant mortality rate (71 per 1,000 live births), child mortality rate (56 per 1,000 live births), and under-five mortality rate (123 per 1,000 live births) are all higher in rural areas than in urban areas.

The data also show that CPR is highest among women aged 35 to 49, at 24.7%. Women under 20 years of age experience higher rates of infant mortality (88 per 1,000 live births), child mortality (64 per 1,000 live births), and under-five mortality (147 per 1,000 live births). Conversely, women between the ages of 20 and 34 experience the lowest rates of infant mortality (55 per 1,000 live births), child mortality (38 per 1,000 live births), and under-five mortality (91 per 1,000 live births).

The findings in Table 2 further indicate that children whose mothers use contraceptive are moderately distributed across previous birth intervals. Infant mortality (98 per 1,000 live births), child mortality (56 per 1,000 live births) and under-five mortality (148 per 1,000 live births) are highest among women with a previous birth interval of less than two years. Despite the fact that the majority of women with higher or tertiary education report a CPR of approximately 36%, women with no education experience the highest rates of infant mortality (79 per 1,000 live births), child mortality (68 per 1,000 live births), and under-five mortality (142 per 1,000 live births). Similarly, the wealthiest women in the wealth index quintile report the highest CPR (36.7%), while the poorest women have the lowest CPR (9%). On the other hand, women in the poorer wealth index quintile experience the highest rates of infant mortality (76 per 1,000 live births), child mortality (64 per 1,000 live births), and under-five mortality (136 per 1,000 live births).

Geographically, the children whose mothers use contraceptives in the South West are higher (35.4%), compared to their counterparts in the North East (9.8%). However, all childhood mortality rates are highest in the North West (infant mortality rate: 89 per 1,000 live births, child mortality rate: 76 per 1,000 live births, and under-five mortality rate: 158 per 1,000 live births) and lowest in the South West (infant mortality rate: 36 per 1,000 live births, child mortality rate: 13 per 1,000 live births, and under-five mortality rate: 48 per 1,000 live births).

Table 2. Patterns of Contraceptive Use, Infant Mortality and Under-five mortality in Nigeria.

Variables	CPR	Infant mortality rate/1000 live births	Child mortality rate/ 1000 live births	Under Five mortality rate/1000 live births
Total	21.7	63	42	102
Area				
Urban	31.8	47	20	67
Rural	14.8	71	56	123
Mother's age				
Less than 20	4.2	88	64	147
20-34	19.7	55	38	91
35 - 49	24.7	74	44	115
Birth order				
1	24.2	61	35	94
2-3	39..4	46	32	77

4-6	28.8	66	47	109
7+	7.6	97	71	161
Previous birth interval				
First Birth	21.8	63	36	96
< 2 years	19.8	98	56	148
2 years	21.2	55	48	101
3 years	22.6	52	39	89
4+ years	23.5	44	25	68
Maternal Education				
None	10.1	79	68	142
Primary	21.1	65	45	107
Junior secondary	23.1	57	38	92
Senior secondary	30.4	50	17	66
Higher/tertiary	35.8	33	8	40
Wealth Index Quintile				
Poorest	9.3	74	64	133
Poorer	13.0	76	64	136
Middle	21.4	61	39	98
Richer	28.9	49	25	73
Richest	36.7	41	6	47
Sex of child				
Male	-	68	45	109
Female	-	58	40	95
Geopolitical zone				
North Central	23.5	45	18	62
North East	9.8	68	49	114
North West	12.7	89	76	158
South East	30.5	27	29	54
South South	25.4	64	20	82
South West	35.4	36	13	48

The findings in 3 below indicate that there is no significant difference in contraceptive use between urban and rural residents (aOR = 1.002; C.I = 0.93 - 1.08, $p < 0.001$). Additionally; children whose mothers are aged 25–34 years are 3.06 times more likely to use contraceptives compared to those whose mothers are aged 15–24 years (C.I= 2.68 - 3.50; $p < 0.001$). Furthermore, children of mothers aged 35 years and above are also more likely to use contraceptives than those aged 15–24 (aOR = 2.75; C.I = 2.37 - 3.20, $p < 0.001$).

The data also shows that children whose mothers are formerly married are less likely (aOR = 0.71; C.I = 0.63 - 0.80; $p < 0.001$) to use contraceptives compared to those of currently married women. In contrast, children whose mothers have never been married are 1.32 times more likely to use contraceptives (C.I = 1.12 - 1.56; $p < 0.001$).

Additionally, children whose mothers have secondary education are 1.75 times more likely to use contraceptives compared to those with no formal education ($p < 0.001$). Those whose mothers have higher education are 2.07 times more likely (C.I = 1.83 - 2.34; $p < 0.001$) to use contraceptives compared to children of mothers with no formal education. The wealth index of

children of mothers in the richest quintile are 2.04 times more likely (C.I = 1.79 - 2.32; p < 0.001) to use contraceptives compared to those in the poorest quintile.

Children of mothers living in the North East and North West regions are significantly less likely to use contraceptives, with odds ratios of 0.46 (C.I = 0.42 - 0.51; p < 0.001) and 0.54 (C.I = 0.49 - 0.60; p < 0.001), respectively, compared to those in the North Central region.

Table 3: Logistic Regression of Factors Affecting Contraceptive Utilization in Nigeria.

Variables	Adjusted Odds Ratio (aOR)	P value	[95% conf. interval]
Area			
Urban *(Ref. Cat.)*	1		
Rural	1.002	0.963	0.927 1.082
Maternal Age			
15-24 *(Ref. Cat.)*	1		
25-34	3.064	0.001**	2.684 3.499
35+	2.752	0.001**	2.369 3.198
Marital Status			
Currently married/in union *(Ref. Cat.)*	1		
Formerly married/in union	0.708	0.001**	0.627 0.800
Never married/in union	1.323	0.001**	1.122 1.561
Educational Level			
None *(Ref. Cat.)*	1		
Primary	1.269	0.001**	1.147 1.404
Secondary	1.749	0.001**	1.592 1.921
Higer	2.072	0.001**	1.834 2.340
Wealth Index			
Poorest *(Ref. Cat.)*	1		
Poorer	1.251	0.001**	1.129 1.385
Middle	1.605	0.001**	1.446 1.781
Richer	1.712	0.001**	1.527 1.919
Richest	2.038	0.001**	1.790 2.320
Children Ever Born			
0 *(Ref. Cat.)*	1		
1-2	1.019	0.951	0.565 1.834
3-5	1.645	0.103	0.905 2.991
6+	1.832	0.169	0.735 2.914
Child Sex			
Boy *(Ref. Cat.)*	1		
Girl	.969	0.294	0.914 1.027
Household Size			
Small Household Size (1-3) *(Ref. Cat.)*	1		
Medium Household size (4-6)	1.014	0.810	0.911 1.126
Large Household size (>6)	0.997	0.943	0.918 1.083
Zone			
North Central *(Ref. Cat.)*	1		

North East	0.462	0.001**	0.418 0.512
North West	0.540	0.001**	0.489 0.597
South East	0.5404	0.001	0.893 1.089
South South	1.056	0.267	0.959 1.164
South West	1.053	0.297	0.956 1.160
_Con	0.017	0.000	0.013 0.021

*P<0.05, **P<0.01.

Relationship between contraception and child mortality in Nigeria.

The Crude Cox Proportional Hazards (Cox PH) regression results indicate that children of mothers who use contraceptives experience a lower hazard of under-five mortality compared to those of mothers who do not use contraceptives (HR = 0.78, CI: 0.61–0.98, p = 0.04). Maternal age is also associated with variation in the hazard of under-five mortality. Compared to children of mothers aged 15–24 years, those whose mothers are aged 25–34 years show a reduced hazard of dying before age five (HR = 0.65, CI: 0.50–0.85, p = 0.01). Similarly, the hazard is further reduced for children of mothers aged 35 years and above (HR = 0.55, CI: 0.34–0.89, p = 0.03).

Children born to never-married mothers face a higher hazard of under-five death compared to those of currently married mothers (HR = 2.50, CI: 1.41–4.47, p = 0.005). Educational attainment of mothers appears to influence child survival. Compared to children of mothers with no education, those whose mothers attained secondary (HR = 0.76, CI: 0.60–0.97, p = 0.01) and higher education (HR = 0.53, CI: 0.34–0.81, p = 0.001) experience a delayed occurrence of under-five mortality.

Children in the middle (HR = 0.65, CI: 0.45 – 0.93, p = 0.03) and richest wealth categories (HR = 0.40 CI: 0.24 – 0.66, p = 0.001) show reduced hazards of under-five mortality compared to those whose mothers were poorest. Also, children of mothers with 3–5 births (HR = 2.00, CI: 1.12 – 3.57, p = 0.02) and those with 6 or more births (HR = 2.50, CI: 1.50 – 4.20, p = 0.005) have a higher hazard of dying before age five compared to those whose mothers had fewer than two children

Deliveries at home (HR = 1.80, CI: 1.09–2.98, p = 0.02) and in other unspecified locations (HR = 2.10, CI: 1.02 – 4.33, p = 0.05) are associated with an increased hazard of under-five mortality compared to those whose mothers delivered at the public health facility.

Table 4. Cox Proportional Hazards of how the use of contraception influences childhood mortality in Nigeria,

Variables	Unadjusted			Adjusted (AHRs)		
	Hazard Ratio (HR)	P-value	95% Conf. Interval	Hazard Ratio (HR)	P-value	95% Conf. Interval
Contraception						
Not Using Contraceptive (Ref. Cat.)	1.000	-	-	1	–	–
Contraceptive use	0.78	0.04*	0.61 – 0.98	0.812	0.042*	0.674 – 0.981
Maternal Age						
15-24 (Ref. Cat.)	1.000	-	-	1	–	–
25-34	0.65	0.01*	0.50 – 0.85	0.021	0.001**	0.004 – 0.118
35+	0.55	0.03*	0.34 – 0.89	0.305	0.010**	0.109 – 0.854

Marital Status						
Currently married/in union (Ref. Cat.)	1.000	-	-	1	–	–
Formerly married/in union	1.82	0.12	0.84 – 3.94	3.217	0.065	0.942 – 10.985
Never married/in union	2.50	0.005**	1.41 – 4.47	4.915	0.001**	1.904 – 12.688
Educational Level						
None (Ref. Cat.)	1.000	-	-	1	–	–
Primary	0.93	0.27	0.70 – 1.22	2.804	0.038*	1.061 – 7.407
Secondary	0.76	0.01**	0.60 – 0.97	1.906	0.081	0.915 – 3.971
Higher	0.53	0.001**	0.34 – 0.81	0.231	0.004**	0.083 – 0.640
Wealth Index						
Poorest (Ref. Cat.)	1.000	-	-	1	–	–
Poorer	0.78	0.09	0.60 – 1.01	0.476	0.041*	0.236 – 0.963
Middle	0.65	0.03*	0.45 – 0.93	0.521	0.063	0.263 – 1.034
Richer	0.60	0.12	0.34 – 1.04	0.442	0.052	0.195 – 1.001
Richest	0.40	0.00**	0.24 – 0.66	0.765	0.312	0.438 – 1.338
Children Ever Born (CEB)						
Below 2 (Ref. Cat.)	1.000	-	-	1	–	–
2	1.50	0.25	0.85 – 2.68	2.708	0.231	0.527 – 13.911
3-5	2.00	0.02*	1.12 – 3.57	2.905	0.024*	1.150 – 7.337
6+	2.50	0.005**	1.50 – 4.20	3.760	0.017*	1.269 – 11.137
Place of Delivery						
Public Health Facility (Ref. Cat.)	1.000	-	-	1	–	–
Private Health Facility	1.18	0.30	0.80 – 1.73	0.684	0.297	0.331 – 1.415
Respondents' Home	1.80	0.02*	1.09 – 2.98	2.794	0.021*	1.170 – 6.671
Others	2.10	0.05	1.02 – 4.33	2.991	0.095	0.841 – 10.627

*P<0.05, **P<0.01.

Adjusted Hazard Ratios (AHRs) Cox Proportional Hazards of Relationship between contraception and child mortality in Nigeria.

The multivariable Cox proportional hazards model in table 4 above revealed several significant associations between key contraceptive use and childhood mortality in Nigeria. Contraceptive use was associated with a delayed time to childhood mortality, with children of contraceptive users having a lower hazard compared to non-users (AHR = 0.812, CI: 0.674–0.981, p = 0.042,). Maternal age showed a strong gradient: mothers aged 25–34 years had a significantly reduced hazard of childhood mortality (AHR = 0.021, CI: 0.004 – 0.118, p = 0.001), as did those aged 35 years and above (AHR = 0.305, CI: 0.109 – 0.854, p = 0.010), relative to mothers aged 15–24.

In terms of marital status, children of never married mothers experienced a significantly higher hazard of mortality (AHR = 4.915, CI: 1.904 – 12.688, p = 0.001), while formerly married women also showed elevated hazard, though not statistically significant (AHR = 3.217, CI: 0.942 – 10.985, p = 0.065). Maternal education played a protective role at higher levels; children of mothers with higher education had a significantly reduced hazard (AHR = 0.231, CI: 0.083 – 0.640, p = 0.004) compared to children of mothers with no formal education.

Children from mothers with higher parity (3–5 and 6+ births) had a significantly higher hazard of mortality (AHR = 2.905, CI: 1.150 – 7.337, p = 0.024 and AHR = 3.760, CI: 1.269 – 11.137, p = 0.017, respectively) compared to those with fewer than two children. In addition, the place of delivery was also influential: children born at home faced significantly higher hazards (AHR = 2.794, CI: 1.170 – 6.671, p = 0.021) compared to those born in public health facilities.

Potential Moderator Causal Pathways

The direct effect results in table 5 showed that mothers who use contraceptives are less likely to experience child mortality (β =-0.055, CI: -1.128 to -0.350, p = 0.001). Likewise, the causal path way results showed that children born to higher educated mothers are less likely to die (β = -0.097, CI: -0.124 to -0.070, p < 0.001)

The **moderator** pathway also revealed a significant indirect effect of contraception use on child mortality (β = -0.012, CI: -0.580 to -0.100, p = 0.005), which further substantiates the protective role of contraception against childhood mortality.

Table 5: Effects of Contraception Use on Child Mortality with Education as a Moderator

Pathway	Coefficient	Std. Error	z-value	P-value	95% Confidence Interval
Direct Effects					
Child Mortality ← Contraception Use)	-0.055	0.221	-3.46	0.001	-1.128 to -0.350
Child Mortality ← Maternal Education	-0.097	0.014	-6.99	0.000	-0.124 -0.070
Indirect Effects (Mediation Pathway)					
Child Mortality ← Contraception Use	-0.012	0.122	-2.79	0.005	-0.580 to -0.100
Moderation Effects					
Contraception use × Maternal Education Interaction (Moderator)	-0.054	0.148	3.46	0.000	-0.115 -0.0113

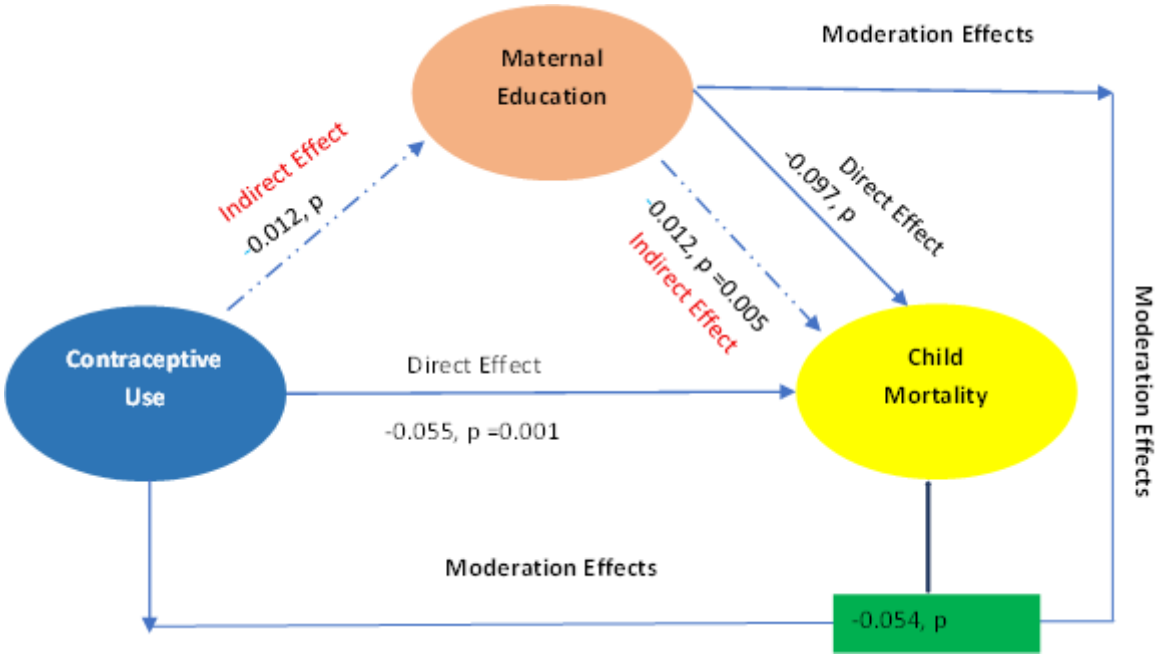

Fig 2: Effect of Contraception Use on Child Mortality with Education as a Moderator Pathway

Discussion

This study focused on examining the relationship between contraception use and child mortality in Nigeria through a multilevel analysis.

The research establishes that age significantly impacts contraceptive utilization levels. Especially, mothers aged 25–34 years and those aged over 35 years have a higher likelihood using contraceptives compared to those mothers aged between 15–24 years. This contrasts with the observation by Kundu et al. (2022) as being the case in Ethiopia, where women aged 15–34 years had lower chances of using contraceptive methods compared to younger women. One probable explanation for the different trends in Nigeria is the greater access to education that women in the age group of 25–34 are likely to have. Increased education has been shown to correlate with higher levels of awareness regarding the use of contraceptives and the consequences of family planning [27]. Moreover, women in this age group are likely to be more in charge of reproductive health issues and could be focused on career development, which has the tendency to delay childbearing[28-29]. In this respect, Adebowale et al. (2021) note that young Nigerian women are subjected to more familial and societal pressure to get pregnant, which can deter them from using contraception. On the other hand, older women may have already completed their desired family size and hence be more open to family planning tools [30-31].

Similarly, the results showed that mothers with secondary and above level of education are likely to utilize contraceptives compared to mothers with no education. This collaborates Fadeyibi et al. (2022) findings, which stated that, there was a high-level positive correlation between the household head education attainment and utilization of contraceptives. Higher education among women permits greater information about contraceptive use and results in greater decision-making autonomy over reproduction[33-34]. Women who are educated are more inclined to engage actively in family planning and access contraceptive services, and they can overcome deeply ingrained social culture that discourages the use of contraceptives[35]. Furthermore, the Ghana study conducted by Wulifan et al. (2021) showed that secondary and tertiary-educated ever-married mothers were more than twice as likely to utilize contraceptives as compared to non-educated mothers.

The study indicates that mothers who belong to the richest quintile are more likely to be using contraceptives compared to mothers who belong to the poorest quintile. This is attested to by

Dadzie (2024), whose assessment relied on data gathered from the 2016-2018 Demographic and Health Survey (DHS), indicating that the women in the richest quintile experienced a higher prevalence of modern contraceptive use. Also, Bongaarts, (2020) noted that economic security empowers women to access quality healthcare, education, and family planning services. Wealthier women are likely to have the economic means to purchase contraceptives and exercise more autonomy over reproductive health decisions free from the constraint of economic limitations [38-39]. In contrast, economic instability and dependence on male partners frequently restrict access to contraceptives among poorer women[39]. Underlying this economic context, a Ghana-based study by Budu et al. (2023) found that women in the richest wealth quintile were 1.67 times more likely than their counterparts in the poorest quintile to use modern contraceptives in their family planning, demonstrating stark economic limitations placed on the use of contraceptives.

Closer examination reveals notable regional differences in the contraceptive use rates. Specifically, the study indicates that children whose mothers reside in Nigeria's North East and North West are significantly less likely to use contraceptive methods. The finding highlights the importance of acknowledging local cultural, religious, and socio-economic contexts that may influence reproductive health decisions and access to family planning services. Strategies specifically targeting such intra-country gaps will be crucial to improving use of contraceptives and accomplishing improved reproductive health outcomes for women across Nigeria [40].

Research evidence from the findings revealed that children whose mothers are aged 25–34 years and 35 years and older have much greater survival chances than children born to younger mothers, i.e., aged 15–24 years. This finding has been affirmed by the research conducted by Smith et al. (2020) that provides evidence of the link between advanced maternal age and improved child survival due to the benefits of reproduction. These are responsible for the decreased chances of obstetric complications, reduced unstable maternal health, and enhanced emotional maturity. However, in controlling variables of socioeconomic status and availability of care, the direct effect of maternal age on the survival of the child appears to be constrained [41]. Finlay (2015) postulates that maternal age often serves as a proxy for determinants of higher order, such as educational attainment, economic standing, and access to healthcare but not as an independent predictor of child mortality. This result indicates that higher risk with younger maternal age may be less a matter of age itself and more about the connected risks with young mothers, including fewer years of education and economic resources.

Maternal education comes out as one of the strongest and most consistent predictors of child survival. The research uncovers that secondary education or higher among mothers yields considerably lower rates of child mortality than for mothers with no education. This is supported by the study of Cleland et al. (2019), which found that educated mothers are likely to possess better information regarding key aspects of child care, place of deliveries, contraceptive use, and proper medical intervention in the event of illness.

The study shows that there is a connection between increased family sizes and increased childhood mortality rates, particularly in families with seven or more surviving children. Adebowale et al. (2019) support this finding by illustrating how limited resources in large families can lead to poor parental attention, suboptimal care levels, and delayed healthcare. Children of women with high parity typically suffer from maternal depletion syndrome, which occurs when typical pregnancies drain maternal supplies of nutrients and thus increase risks of infant and child mortality [43].

The findings indicate that children whose mothers use contraceptives experience a lower hazard of under-five mortality compared to those whose mothers do not use contraceptives. This finding agrees with current evidence claiming that proper family planning plays a critical role in increasing the survival of children since it helps in proper spacing of births as well as in general maternal well-being [44-45]. Nevertheless, establishing this association calls for an assessment of

different confounding variables, such as maternal health status, socio-demographic factors, as well as the purpose behind conception, which all have a contribution in the observed results[8,13,47]. One of the most significant explanations for the reduced child mortality that comes with the use of contraceptives is the birth spacing theory. It has been repeatedly shown in research that short birth intervals are linked with higher child mortality risks [8,13,48]. This is because of maternal reduction, as mothers may find it physically and emotionally demanding to recover between births, leading to adverse health consequences for the subsequent child [49].

Nevertheless, Bongaarts (2020) argues that longer birth spacing allows mothers time to recover and gain in emotional and physical strength between birth events, thus improving the chances of subsequent pregnancies being healthier and, in consequence, reducing child mortality. In the same vein, research by Gage et al. (2021) revealed that those women who used contraceptives effectively are more likely to experience planned pregnancies that are linked to higher use of prenatal care and overall healthier births. These determinants of health add up in terms of affecting the enhanced child survival rates past the infant level [43,51].

Although, a number of interdisciplinary researches corroborate that the use of contraceptive contributes to reducing child mortality rates. Bongaarts (2020) highlights that contraception allows families to devote increased resources to the care of each child through population regulation. When households are able to control the number of children born to them, they are in a better place to ensure proper healthcare, and provide education, factors that are central to facilitating child survival [28,52]. This is notably so in Nigeria, where high family sizes are commonplace, translating into resource depletion that can negatively impact child health status[2].

However, despite the evidence that shows the positive impact of contraception on child survival, there are critics among researchers regarding the level of causality between the two variables. Ahinkorah et al. (2021) note that the women who use contraceptive methods might already have underlying health issues or might have already experienced negative outcomes in pregnancy previously, and thus the risks associated with child mortality could be increased. This perspective allows for the possibility of reverse causality, wherein the choice to use contraception results from a prior history of undesirable pregnancy outcomes, as opposed to the use of contraception causing the reduced mortality directly [13]. Moreover, Yaya et al., (2018) caution against placing too much emphasis on the impact of the use of contraceptives, suggesting that maternal education levels and family income are perhaps more powerful predictors of child mortality than the use of contraception per se. Secondly, evidence is reported that contradicts the belief that the effects of contraception can be universally applied across populations. For instance, Gage (2021) carried out a study in sub-Saharan Africa and found that although the use of contraceptives is associated with lower child mortality rates in urban areas, its impact is less pronounced in rural areas. This difference highlights the fact that without immediate development in healthcare facilities and maternal education, the complete impact of contraception on child survival could be left unexploited.

The study finds that maternal education has a significant effect on Children Under Five mortality, with maternal education emerging as a key moderator of the relationship between contraceptive use and child mortality outcomes. Educated mothers are more likely to deliver at the health facilities, understand the importance of contraception use which reflect positively on the health of their children[46-47]. These suggest reasons why mothers, who tend to have lower levels of education, might experience a higher child mortality rate.

Sinai et a., (2020) present research strongly illustrates how higher levels of maternal education are linked to significant decreases in the risks of child mortality. More educated mothers possess a greater understanding of significant aspects of child care. Moreover, educated mothers would utilize maternal and child health services more effectively, thereby improving child survival[1]. Therefore, enhancing women's education, particularly in poor and rural communities, is a vital strategy to respond to and reduce child mortality.

In addition, Fagbamigbe et al. (2020) presented evidence in Nigeria demonstrating how maternal education significantly reduces the risk of child mortality. Their findings showed that children whose mothers experienced secondary education and above were far less likely to die before their fifth birthday than the children whose mothers received no formal education. This aligns with Odimegwu et al. (2020), who similarly observed that younger maternal education is the secret to improving child survival rates. On the contrary, uneducated mothers are not likely to use skilled birth attendants, adhere to information on contraception use, or recognize early signs of childhood illness, all of which increase child mortality chances [8-9, 11-13]. Thus, maternal education is a strong protective factor, counteracting the effect of maternal age on child mortality.

Moreover, the findings of this study also reveal that birth spacing is the most important single mediators of the relationship between contraceptive use and child mortality. Findings of this study revealed that child mortality is reduced in younger women who use contraceptives, which shows that effective family planning is a significant factor for improved child survival. Close birth intervals births within 24 months of a previous birth are associated with high risks of preterm delivery, which increase child mortality rates[4-6],[14]. Effective birth spacing allows mothers ample time to recover from previous pregnancies and provide adequate care for their babies. Ahinkorah et al. (2021) demonstrated that well-spaced pregnancies significantly reduce the risks of infection, and developmental delays for children. Similarly, Fagbamigbe et al. (2020) indicated that Nigerian women with ideal birth spacing (more than two years between births) had significantly lower child mortality compared to women with shorter birth intervals. The study emphasized that contraceptive use enables women to plan their pregnancies better so that all children will be born under conditions that favor survival and good health. These findings also justify the inclusion of reproductive health education as part of maternal and child health interventions. Supply of modern family planning methods and contraceptive services to women, particularly young mothers, may be a strategic activity in reducing child mortality in Nigeria.

Conclusion and Recommendation

The findings of this study revealed the factors that influence contraceptive use and child mortality in Nigeria. Maternal characteristics of age, marital status, level of education, and number of living children are significant predictors of the likelihood of contraceptive use and, by implication, child survival rates. Nigeria's persistently high under-five mortality rates owe to a multiplicity of closely related factors including, among others, low rates of access to family planning, economic disparity, and in adequate utilization of health facilities. These serve to hinder women making appropriate reproductive choices and therefore drive fertility levels upward as well as promote poor maternal and child health indicators.

Among the most significant results of this study is that contraception use significantly reduces the risk of child mortality by improving birth intervals, reducing unwanted pregnancies, and preventing high-risk births.

In addition, studies attest that children of mothers who are not using contraception have a higher risk of mortality between one to five years compared to infants whose mothers were using contraception. The outcome also indicated the stark regional disparity for infant deaths and use of contraceptives, where the North-East, North-West, and part of the South-South regions recorded significantly higher infant mortality.

The lesson is the need for region-specific interventions, with due priority being accorded to healthcare intervention strengthening, improving family planning commodity availability, and elimination of socio-cultural barriers to the use of contraceptives. Without such targeted interventions, disparities in child health outcomes across regions will persist, further exacerbating maternal and child health inequalities. Increased promotion of maternal health services, affordable access to contraception, and economic incentive programs are needed to reverse these challenges. Strengthening public awareness initiatives, health infrastructure, and

integration of family planning services with routine maternal and child health programs will promote increased use of contraception and reduced child mortality throughout the country.

In order to address the challenges that this research has identified, a multi-pronged approach is required to enhance the utilization of contraceptives and improved child survival rate in Nigeria. First, there is a need to increase access to contraceptive services and family planning programs, particularly in rural and poor areas where coverage is low. Government agencies, in collaboration with NGOs and international partners, must increase the availability and accessibility of contraceptive methods. Integrating family planning services into routine maternal and child health programs will ensure that women are given appropriate counseling during antenatal and postnatal visits. In addition, subsidized or free access to contraceptives should be provided to poor and vulnerable groups with highest priority so that economic constraints to use can be eliminated. Supply chain inefficiencies are also crucial to ensure that no contraceptive methods run out of stock at health facilities so that stockouts are reduced to the minimum to restrict women's access to their preferred method of contraceptive. The participation of traditional, community and religious leaders as advocates for family planning can be a critical influence on community attitudes. Information, Education, and Communication (IEC) programs have to be rolled out on many media platforms like radio, Television, social media, and outreach programs to reach different segments of the population. Schools must have comprehensive reproductive health education as a part of the curriculum to empower adolescents with contraception information prior to reaching reproductive age.

Regular training should be provided for health care providers to improve their skills, attitude, and knowledge on contraception so that they could provide proper information and non-judgmental advice to women receiving family planning services.

This study provides a valuable contribution to the literature on the relationship between the use of contraceptives and child mortality in Nigeria from a multilevel, integrated model that controls for individual, household, and regional heterogeneity. Unlike earlier research, which has largely focused on the use of contraceptives or under-five mortality in isolation of each other, this study addresses both aspects with the aim of offering a general description of the impact of the use of contraceptives on the survival of under-fives among various socio-demographic groups.

Limitations and Strengths

This study provides an insight into the relationship between contraception use and under-five mortality in Nigeria, using nationally representative data. Despite this, some limitations were encountered, including the cross-sectional nature of the 2021 MICS data, which restricts the possibility of determining causality. Although statistical association was observed between child mortality and contraceptive use, causality cannot be established because there is no temporal ordering. MICS 2021 dataset does not include data on religion, limiting the ability to explore the influence of religious affiliation on contraceptive use and child mortality.

Furthermore, the study relies on self-reported data, which is subject to social desirability bias and recall bias, particularly on sensitive questions like the use of contraceptives and child deaths. Even though the study attempted to control various confounding variables through the application of multivariate analysis, residual confounders not picked up during the data collection process, including cultural beliefs, and partner influence. Additionally, the study did not consider the methods of contraceptive used, which may have differing effects on maternal and child health outcomes.

Despite these weaknesses, the study also possesses a variety of significant strengths such as use of a large nationally representative dataset (MICS 2021) enhances the external validity of findings in Nigeria. Frequentist and Bayesian geo-additive model approaches provided a robust framework for assessing spatial trends and adjusting for unobserved heterogeneity. The inclusion

of both direct and indirect pathways (moderating and mediating) variables in this research facilitates a more nuanced level of understanding of the mechanisms behind child mortality.

Finally, this study adds an important contribution to existing studies as it draws attention to the nexus of contraceptive use, child survival, and geographic inequality—something that has yet to be fully captured in sub-Saharan Africa.

Ethical Approval:

Ethical approval of data collection was already documented for survey [69]

COMPETING INTERESTS

Authors have declared that no competing interests exist

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