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ANALYZING UNDER-FIVE MORTALITY RATE TRENDS IN NIGERIA USING THE LOGISTIC REGRESSION MODEL

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Abstract

Under-five mortality has long been a public health menace requiring research based knowledge of its determinants to enable relevant stakeholders and government to make informed decisions necessary for its reduction in line with the World Health's Organization standard of 25 deaths per 1000 live births as spelt out in the Sustainable Development Goal (SDG). This study therefore utilized the 2013 and 2018 dataset of the Nigeria Demographic and Health Survey (NDHS) in the analysis of the determinants of under-five mortality using the logistic regression model. Results from the study revealed that maternal characteristics such as age, educational level, region of residence and other environmental factors such as drinking water, toilet facility and type of cooking fuel are the most likely causative determinants of childhood mortality.

***Keywords*:** Under-five mortality; Logistic Regression; Trend; Nigeria.

1. Introduction

Mortality is the absence of all traces of life at any time after birth [1]. As certain as death is, nobody wants to die and certainly, nobody wants their child/children to die (at least not before their very eyes). Yet, the sad reality is that children still die every day and mostly from preventable causes/diseases both here in Nigeria and the world over. Under-five mortality refers to the death of children within the first five years of life. Whilst there have been relative progress in the global stage with respect to the fight against childhood mortality at the under-five level notably in Europe and America, childhood mortality in sub-Saharan Africa still pose as threat and a daunting challenge for the developing countries enveloped within its geographical boundaries [2]. An estimated 5.4 million children less than five years of age died in 2017, with roughly 50% of those deaths occurring in Sub-Sahara Africa [3]. About half of the world's under-five deaths occur in Nigeria, India, Congo, Pakistan and China [4], [5].

In Nigeria, the occurrence of preventable childhood death is still very frequent and unacceptably high. Previous studies reveal that up to 20 percent of child deaths in sub-Saharan Africa still occur in Nigeria. The Multiple Indicator Cluster Survey (MICS4) report indicates that under-five mortality in Nigeria increased from 138 deaths per 1,000 live births in 2007 to 158 deaths per 1,000 live births in 2011 [4], [5]. Currently, the level of child mortality in Nigeria is at a ridiculously high rate of 132 deaths per 1000 live births [6]. This trend is worrisome given the already established disadvantage of high childhood death rate to the dynamics of population and the serious consequences its impact has on life expectancy not to mention its poor reflection on the state of health/health facilities of the country. Having identified some of the causes of under-five mortality as pneumonia, preterm birth complications, intrapartum-related complications, diarrhea, malaria etc.[7], there is need to tackle this menace of under-five mortality that has remained a national public health concern for decades. Based on the current rate of under-five mortality which stands at 132 deaths per 1000 live births [8], genuine fears that Nigeria may fall short of the SDG target for childhood mortality are not out of place.

In the developing world like Africa, the determinants of under-five mortality each have different level of effects on childhood mortality. Child mortality cannot be isolated to one particular determinant and the rates determinants of under-five mortality are not static but are understood to change over time [9]. Although, several studies have identified various determinants of under-five mortality, it has been observed that recognizing the effects of various determinants is indeed a difficult task [10]. It has also been argued that the pathways of influence through which the various determinants operate is rather a complex one [11]. As a result, there is enormous debate on what constitute the determinants of under-five mortality particularly in the developing regions of the world. The trends and drivers of childhood mortality in Nigeria using NDHS 2003, 2008 and 2013 dataset has been examined by [12]. Findings from the study conducted by [12] showed a reduction in the proportions of under-five mortality in Nigeria, and that many of the drivers of under-five mortality had varying degrees and trends of change between 2003 and 2013. The result of a study on the statistical analysis of childhood mortality in Nigeria using NDHS 2013 dataset suggests that increase in women education could increase age at first birth and mitigate the risk of poor child health outcomes [13]. Other studies have tried to identify the relationship between certain determinants and childhood mortality. The relationship between educational attainment and lower mortality rates have been established in studies by [11], [14], [15].

The aim of this paper therefore is to identify the determinate factors affecting childhood mortality and to address the policy implications in order to reduce the menace of high child mortality rate in the country. It is our hope that the result of this study would serve as bedrock for planning

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suitable intervention programmes/policies to curb and reduce to the barest minimum, childhood deaths in Nigeria. This article presents a population-based study on the trends of under-five mortality in Nigeria for each of the five years period preceding the 2013 and 2018 NDHS dataset.

2. Methodology

2.1 Data Source:

The data used for this study was extracted from the Nigeria Demographic Health Survey (NDHS) for 2013 and 2018. For the purpose of this study, the child recode data which contains all follow-up information on all children born to the interviewed women within five years preceding the survey is used.

2.2 Variables:

Dependent Variable; Under-Five Mortality

Independent Variables; Mother's Education = *MoEdu*, Mother's Region = *MoReg*, Place of residence = *PoRes*, Place of delivery = *PoDel*, Mother's age = *MoAge*, Sex of Child = *SoChi*, Drinking water = *DrWat*, Toilet facility = *ToFac*, Type of cooking fuel = *CoFuel*, Religious Affiliation = *MoRel*, Size at birth = *SiBir*, Mode of Delivery = *MoDe*l, Breast Feeding = *BrFed*, Wealth Status = *WeStat*, Number of Antenatal Visits = *NoAnt*

2.3 Statistical Analysis

First, the variables of interest in line with the objectives of this study were selected and recoded; missing values were accounted for using DHS weighted measure. Thereafter, the frequency distributions of selected and recoded independent variables according to the background characteristics of interest were analyzed and the results displayed in Table 1.

Next, the Chi-square test of association was employed for the bivariate analysis to determine the significant bivariate association between the dependent variables (Under-five mortality) and their risk factors which are the independent variables. The chi-square test statistics is given by

$$\chi^2 = \frac{\sum_{i=1}^{r}\sum_{j=1}^{c}(O_{ij}-E_{ij})^2}{E_{ij}} \sim \chi^2_{\alpha(r-1)(c-1),} \quad (1)$$

where

E_{ij} is the expected frequency corresponding to (i, j)

O_{ij} is the observed frequency

$(\mathrm{r}-1)(\mathrm{c}-1) =$ degree of freedom

r- number of rows

c- number of columns.

The test statistics χ^2 has (r-1) (c-1) degree of freedom and α level of significance. To broaden insights of the relevant determinants of under-five mortality useful for the assessment of sustainable target of childhood mortality in Nigeria, the method of Logistic Regression model was used. The binary logistic regression was applied to determine the extent to which all the variables had an impact on the outcome variable dependent on each other's presence.

The multiple logistic regression model is given as

$$P(Y=1|X) = f(x) = \frac{e^{\beta_0+\beta_1X_1+\beta_2X_2+\cdots+\beta_kX_n+\mu}}{e^{\beta_0+\beta_1X_1+\beta_2X_2+\cdots+\beta_kX_n+\mu}+1} \quad (2)$$

The Logistic regression model for this study can be written as

$$Y_{U5} = \frac{\exp(\beta_0+\beta_1MoEdu+\beta_2MoReg+\beta_3PoRes+\beta_4PoDel+\beta_5MoAge+\beta_6SoChi+\beta_7DrWat+\beta_8ToFac+\beta_9CoFuel+\beta_{10}MoRel+\beta_{11}SiBir+\beta_{12}MoDel+\beta_{13}BrFed+\beta_{14}WeStat+\beta_{15}NoAnt+\mu)}{\exp(\beta_0+\beta_1MoEdu+\beta_2MoReg+\beta_3PoRes+\beta_4PoDel+\beta_5MoAge+\beta_6SoChi+\beta_7DrWat+\beta_8ToFac+\beta_9CoFuel+\beta_{10}MoRel+\beta_{11}SiBir+\beta_{12}MoDel+\beta_{13}BrFed+\beta_{14}WeStat+\beta_{15}NoAnt+\mu)+1} \quad (3)$$

$$y_{Under5} = \begin{cases} 1 & child\ died\ before\ age\ 5 \\ 0 & child\ is\ alive \end{cases}$$

where

"$\mathbf{y}$" is the outcome variable and it refers to the logistic transformation of the probability of Under-5 mortality occurring.

β_0 is the intercept i.e the value of under five mortality when all the independent variables are held constant

$\beta_1,\ldots, \beta_{15}$ are the odds ratios of Under-5 mortality occurring and μ is the error term.

The method of Maximum Likelihood Estimation was adopted to estimate the regression coefficients and their standard errors. All analysis was done using SPSS software package version 22.0. Results of the regression analysis are displayed in Tables 3 and 4.

3. Results and Discussion

Table 1: Frequency Distribution of the Independent Variables

	2013		***2018***	
Variables	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Region				
North Central	4614	14.7	5875	17.3
North East	6517	20.7	7211	21.3
North West	9906	31.5	10305	30.4
South East	2816	8.9	3798	11.2
South South	3747	11.9	3202	9.4
South West	3882	12.3	3533	10.4
Total	31482	100.0	33924	100.0
Place of Residence				
Urban	10351	32.9	11699	34.5
Rural	21131	67.1	22225	65.5
Total	31482	100.0	33924	100.0

Sex of Child				
Male	15965	50.7	17257	50.9
Female	15517	49.3	16667	49.1
Total	31482	100.0	33924	100.0
Mother's Education				
No education	14762	46.9	15391	45.4
Primary	6432	20.4	5274	15.5
Secondary	8365	26.6	10623	31.3
Higher	1923	6.1	2636	7.8
Total	31482	100.0	33924	100.0
Mother's Age				
15 – 19	1531	4.9	1434	4.2
20 -29	14845	47.2	16096	47.4
30 – 39	11859	37.7	13094	38.6
40 – 49	3247	10.3	3300	9.7
Total	31482	100.0	33924	100.0
Source of Drinking Water				
Improved water source	13390	42.5	12542	37.0
Unimproved water source	18092	57.5	21382	63.0
Total	31482	100.0	33924	100.0
Wealth Status				
Poor	14462	45.9	15809	46.6
Middle	6272	19.9	7171	21.1
Rich	10748	34.1	10944	32.3
Total	31482	100.0	33924	100.0
Mother's Religion				
Christianity	12654	40.4	13239	39.0
Islam	18354	58.6	20412	60.2
Others	302	1.0	273	.8
Total	31310	100.0	33924	100.0
Cooking Fuel				
Kerosene/Electricity/Gas	5359	17.0	5161	15.2
Wood/Charcoal/Coal	26123	83.0	28763	84.8
Total	31482	100.0	33924	100.0
Breast Feeding				
Breast fed	17192	54.6	17856	52.6
Not breast fed	14290	45.4	16068	47.4
Total	31482	100.0	33924	100.0
Mode of Delivery				
Normal Delivery	30512	97.9	32899	97.4
Caesarean Section	659	2.1	879	2.6
Total	31171	100.0	33778	100.0
Size				
Large	13589	44.0	33.8	33.8
Average	12689	41.1	52.6	52.6
Small	4595	14.9	13.7	13.7
Total	30873	100.0	100.0	100.0
Place of Delivery				
Home	19619	62.3	19949	58.8
Hospital	11822	37.6	13488	39.8
Other	41	.1	487	1.4
Total	31482	100.0	33924	100.0
Antenatal Visits				
None	18492	58.7	17824	52.5
Below 5	5621	17.9	8853	26.1
Above 5	7369	23.4	7247	21.4
Total	31482	100.0	33924	100.0
Toilet Type				
Improved Toilet Sanitation	4474	13.2	6550	19.3
Unimproved Toilet Sanitation	29450	86.8	27374	80.7
Total	33924	100.0	33924	100.0
Under-Five Mortality				
Alive	28596	90.8	30713	90.5
Dead	2886	9.2	3211	9.5
Total	31482	100.0	33924	100.0

Table 1 shows the frequency distribution of the selected independent variables used in this study. The total for some of the variable differs, due to missing values and no response. The results in Table 1 showed that we had more children from the North-West region 31.5% and 30.4% in 2013 and 2018 respectively and the lowest number of children in the South East with 8.9 % in 2013 and in the South South with 9.4% in 2018. The population percentage of participating children was consistently higher for the entire Northern region in 2013 and 2018 respectively than the

Southern region. Also, a larger percentage of the respondents were rural dwellers with a percentage of 67.1 and 65.5 in 2013 and 2018 respectively. This is consistently higher than those residing in the urban region. Furthermore, Table 1 reveals that a greater percentage of the interviewed mothers with 46.9% and 45.4% in 2013 and 2018 respectively had no education. Only 6.1% in 2013 and 7.8% in 2018 of the mothers had more than secondary school education. Given the fact that majority of the respondents were rural dwellers who probably had little or no access to health institutions, it came as little surprise that a higher number of mothers delivered their babies at home as shown by the 62.3% and 58.8% in 2013 and 2018 respectively while 37.6% and 39.8% of mothers visited the hospital for delivery in 2013 and 2018 respectively. The result also shows that we had 4.9% teenage mothers in 2013 and 4.2% teenage mothers in 2018 with the highest percentage of mothers falling into the (20 – 29) age bracket both in 2013 and 2018.

Children who had access to improved source of drinking water were 42.5% in 2013 and 37.0% in 2018 with 57.5% and 63.0% using water from unimproved source in 2013 and 2018 respectively. Given that the greater number of interviewed mothers and children were rural dwellers, it comes as little or no surprise that a very large percentage of 86.8 in 2013 and 80.7 in 2018 used toilet facilities with non-improved sanitation while only 13.2% and 19.3% had access to toilet facilities with improved sanitation in 2013 and 2018 respectively.

With regards to wealth index, the greater majority of children were born to parents who fell within the "poor" category with over 45% both in 2013 and 2018. On breast feeding, 54.6% and 52.6% of the babies born in each of the five years preceding the 2013 and 2018 surveys respectively were breast fed by their mothers. The ratio of boys to girls is approximately 1:1.

Given that a greater percentage of the respondents were rural dwellers, it is no surprise that 58.6% of mothers in 2013 and 52.5% in 2018 did not attend antenatal before the delivery of their babies. Of those that cared to keep an appointment with the doctor during pregnancy, only 23.4% and 21.4% in 2013 and 2018 respectively made 5 or more trips to the doctor's office. Majority of the respondents delivered their babies normally. Only a few of the mothers delivered through caesarean section (2.1% in 2013 and 2.6% in 2018).

Table 2: Bivariate Relationship between the independent variables and Under-five mortality

Variables	**2013**		**2018**		**Chi-square**	**P-value**
	Number of Children Alive	**Number of Children Dead**	**Number of Children Alive**	**Number of Children Dead**	a= 2013 b= 2018	a=2013 b=2018
Region						
North Central	4286	328	5403	472		
North East	5856	661	6481	730	170.513[a]	.000a
North West	8760	1146	8934	1371		.000b
South East	2553	263	3545	253	340.242[b]	
South South	3498	249	3021	181		
South West	3643	239	3329	204		
Place of Residence						
Urban	9685	666	10851	848	138.332[a]	.000a
Rural	18911	2220	19862	2363	102.404[b]	.000b
Sex of Child						
Male	14387	1578	15537	1720	19.997[a]	.000a
Female	14209	1308	15176	1491	10.317[b]	.001b
Mother's Education						
No education	13105	1657	13527	1864	195.420[a]	.000a
Primary	5836	596	4776	498		
Secondary	7818	547	9913	710	275.700[b]	.000b
Higher	1837	86	2497	139		
Mother's Age						
15 - 19	1349	182	1286	148	34.601[a]	.000a
20 -29	13549	1296	14620	1476		.001b
30 - 39	10814	1045	11878	1216	15.512[b]	
40 - 49	2884	363	2929	371		
Source of Drinking Water						
Improved water source	12276	1114	11434	1108	20.098[a]	.000a
Unimproved water source	16320	1772	19279	2103	9.244[b]	.002b
Wealth Status						
Poor	12740	1722	13920	1889	257.358[a]	.000a
Middle	5770	502	6509	662		.000b
Rich	10086	662	10284	660	264.904[b]	
Mother's Religion						
Christianity	11697	957	12338	901	66.476[a]	.000a
Islam	16467	1887	18113	2299		.000b
Others	273	29	262	11	195.675[b]	
Cooking Fuel						
Kerosene/Electricity/Gas	5059	300	4894	267	98.801[a]	.000a
Wood/Charcoal/Coal	23537	2586	25819	2944	130.843[b]	.000b

Breast Feeding						
Breast fed	16200	992	16747	1109	524.898[a]	.000a
Not breast fed	12396	1894	13966	2102	465.955[b]	.000b
Mode of Delivery						
Normal Delivery	27715	2797	29781	3118	.006[a]	.937a
Caesarean Section	598	61	792	87	.176[b]	.675b
Size						
Large	12577	1012	10293	982	118.918[a]	.000a
Average	11579	1110	16000	1551		
Small	4011	584	3977	595	83.184[b]	.000b
Place of Delivery						
Home	17649	1970	17772	2177	48.767[a]	
Hospital	10911	911	12492	996		.000a
Other	36	5	449	38	118.508[b]	.000b
Antenatal Visits						
None	16269	2223	15528	2296	439.231[a]	.000a
Below 5	5320	301	8326	527		
Above 5	7007	362	6859	388	513.153[b]	.000b
Toilet Type						
Improved Toilet Sanitation	4229	245	6140	410	85.328[a]	.000a
Unimproved Toilet Sanitation	24367	2641	24573	2801	97.346[b]	.000b

The result of the cross tabulation analysis carried out between the selected independent variables (determinants) and under-five mortality using Pearson Chi-square (χ^2) test of association is summarized in Table 2. The result in Table 2 shows that there is a strong bivariate relationship between each of the independent variables and under-five mortality with the exception of the "mode of delivery" which had a P-value > 0.05.

The number of deaths that occurred within the first five years of life reduced from 1657 to 86 in 2013 and from 1864 to 139 in 2018 for mothers who had no education and those who had higher education respectively. This shows clearly that mortality in children under five years of age has a strong bivariate relationship with the level of their mother's education with a p-value of 0.000 in both survey years.

Also, the financial status of households show strong bivariate relations with under-five mortality as the number of deaths in poor household was approximately three times higher both in 2013 and 2018 than was reported in rich households. (P-value = 0.000 in 2013 and 2018).

On the place of delivery, the number of babies lost to mothers who had delivery of their babies at home are 1,970 and 2,177 in 2013 and 2018 respectively which is over 100% of what was experienced by mothers who delivered their babies in the hospital. Mothers who went to the hospital for delivery experienced only 919 and 924 deaths in 2013 and 2018 with a P-value of 0.000 in both survey years.

The importance of good cultural practices in the survival of children less than five years of age in Nigeria was emphasized by the strong relationship that was shown between the type of toilet facility that households had access to and under-five mortality. In 2013, only 245 under-five deaths were recorded for households with access to improved toilet type compared to 2,641 deaths for households with unimproved toilet sanitation. With 410 and 2,801 deaths in 2018 for households with improved and unimproved toilet types respectively, we can safely conclude that there is a strong bivariate relationship between sanitation/toilet type and under-five mortality.

The choice of the place of residence of parents had a significant bivariate relationship with childhood mortality as the number of children that died in 2013 (666) and 2018 (848) for those living in urban centre was approximately one third of the number of under-five deaths recorded for those who resided in rural localities for both survey years. The Chi- square (χ^2) calculated for 2013 and 2018 are 138.322 and 102.404 respectively with an associated P-value of 0.000.

On breast feeding, the number of babies that died in the five years preceding the 2013 and 2018 survey from Table 2 was over 90% higher for mothers who did not breast feed their babies. This implies that the more a baby is breastfed, the stronger the immune system. With a P-value of 0.000 indicating statistical significance, there is clearly a bivariate relationship between breast feeding and childhood mortality. The Chi-square calculated for 2013 and 2018 are 524.898 and 465.955 respectively.

Other determinants of under-five mortality that showed significant bivariate relationship with childhood mortality include size of the baby at birth, cooking fuel, mode of delivery as well as the number of antenatal visits. All of the aforementioned recorded P-value < 0.05 and this can be found in Table 2. The Chi-square value for each of these variables for 2013 and 2018 are also shown in Table 2.

Table 3: Effect of the factors influencing under-five mortality for the five years preceding 2013

Variables	B	S.E.	Wald	Sig.	Exp(B)	95% C.I.for EXP(B)	
						Lower	Lower
Region							
North Central	Reference Category						
North East	.053	.100	.276	.599	1.054	.866	1.282
North West	-.126	.102	1.544	.214	.881	.722	1.076
South East	-.223	.102	4.747	.029	.800	.655	.978
South South	-.337	.106	10.156	.001	.714	.581	.878
South West	.286	.107	7.115	.008	1.331	1.079	1.642
Place of Residence							
Rural	Reference Category						
Urban	-.535	.046	135.677	.000	.586	.535	.641
Sex of Child							
Male	Reference Category						
Female	-.187	.042	20.054	.000	.829	.764	.900

Mother's Education							
No education	Reference Category						
Primary	-.502	.147	11.568	.001	.606	.454	.809
Secondary	-.561	.141	15.781	.000	.570	.432	.752
Higher	-.347	.134	6.684	.010	.707	.543	.919
Mother's Age							
15 – 19	Reference Category						
20 -29	-.249	.104	5.690	.017	.780	.635	.957
30 – 39	.096	.068	1.994	.158	1.101	.964	1.257
40 – 49	.102	.069	2.208	.137	1.108	.968	1.268
Source of Drinking Water							
Unimproved water source	Reference Category						
Improved water source	-.179	.040	20.057	.000	.836	.773	.904
Wealth Status							
Poor	Reference Category						
Middle	-.203	.082	6.152	.013	.816	.695	.958
Rich	.000	.080	.000	.997	1.000	.855	1.168
Mother's Religion							
Christianity	Reference Category						
Islam	.261	.198	1.736	.188	1.298	.880	1.915
Others	-.076	.197	.148	.700	.927	.630	1.363
Cooking Fuel							
Wood/Charcoal/Coal	Reference Category						
Kerosene/Electricity/Gas	-.617	.063	96.029	.000	.540	.477	.611
Breast Feeding							
Not Breast fed	Reference Category						
Breast fed	-.914	.041	498.112	.000	.401	.370	.434
Mode of Delivery							
Normal Delivery	Reference Category						
Caesarean Section	.398	.153	6.786	.009	1.489	1.104	2.009
Size							
Large	Reference Category						
Average	.453	.058	61.436	.000	1.572	1.404	1.761
Small	.322	.057	32.259	.000	1.380	1.235	1.543
Place of Delivery							
Home	Reference Category						
Hospital	.290	.042	48.070	.000	.804	.315	1.451
Other	-.219	.478	.209	.647	1.337	1.232	2.050
Antenatal Visits							
None	Reference Category						
Below 5	-.973	.058	276.890	.000	.913	.780	1.068
5 and Above	-.091	.080	1.288	.256	.378	.337	.424
Toilet Type							
Unimproved Toilet Sanitation	Reference Category						
Improved Toilet Sanitation	-.626	.069	82.816	.000	.535	.467	.612
Constant	1.877	.582	10.403	.001	6.536		

-2 Log likelihood	***Chi-square***	***df***	***P-value***
16680.496[a]	1403.246	27	.000

Table 3 presents the results of logistic regression model for under-five mortality used to identify significant determinants of under-five deaths for 2013. There are six distinct columns in the table. The first column displays the regression coefficient which is an estimate of the parameters of the model. It shows changes in a particular category with respect to a change in the reference category. The second column, gives the standard error of the estimates in the first column. The third column shows the result of the Wald test. The Wald test is used to evaluate the significance of the regression parameters called coefficient. In the fourth column, we have the associated P-value. The fifth column displays the exponential of the parameter estimates otherwise known as the odds ratios while the sixth column illustrates the 95% Confidence Interval (CI) for the odds ratio. The odds ratio simply defines the chances of the occurrence of under-five death with respect to each of the reference category.

The results from Table 3 shows that the odds of death in children given birth to in the South South are 0.714 less compared to children who were born in the North Central part of the country. The odds of dying in children under five years of age who lived in urban centres was 0.586 implying about 41% less chance of under-five mortality compared to children who resided in rural communities with an associated P-value of 0.000

On mother's education, mothers having higher education reduced the odds of deaths in children before their fifth birthday by 0.707 when compared to mothers with no education. This means that, mothers who had higher education experienced 70.7% less under-five deaths. The odds of under-five death among children whose mothers were aged 20 – 29 was 0.780 lower in comparison to the reference category which is teenage mothers aged 15 – 19. This implies that, mothers between the ages of 20 – 29 experienced 78% less under-five deaths than teenage mothers. Mothers aged 30 – 39 also experienced significant reductions in the risk of under-five death relative to teenage mothers.

On the place of residence, women who were located in the urban centres were likely to experience about 41% less under-five deaths than those who resided in rural areas as can be seen by the reduced odds of 0.586. (P-value = 0.000).

Access to improved water supply reduced the odds of under-five deaths to 0.836. This indicates that drinking water from improved sources reduced the likelihood of under-five deaths by about 16%.

The type of cooking fuel used by mothers was also found to be a significant predictor of under-five mortality. The odds of under-five mortality for households who used clean cooking fuel was 0.540 indicating that they had 46% less chances of losing their children before five years of age.

Using Christianity as the reference category for religion, the odds of under-five death for Islamic mothers was 1.298. This indicates that religion was a significant predictor of under-five mortality with women who were of the Islamic faith experiencing significantly higher risk of under-five mortality compared to mothers who were of the Christian faith. (P-value = 0.188).

With respect to the number of antenatal visits of mothers before the delivery of their babies, the result in table 3 showed that women who visited the hospital for antenatal on five or more occasions decreased the odds of their baby dying to 0.378 compared to women who did not visit the hospital during pregnancy with a P-value of 0.256 indicating statistical significance.

On the place of delivery, mothers who went to the hospital for the delivery of their babies had reduced under-five mortality odds of 0.804 indicating a 20% improved chance of childhood survival compared to mothers who delivered their babies at home.

Other variables that were statistically significant determinants of childhood mortality includes: Size of the baby at birth and sex of the child.

Table 4: Effect of the factors influencing under-five mortality for the five years preceding 2018

Variables	B	S.E.	Wald	Sig.	Exp(B)	95% C.I.for EXP(B)	
						Lower	Upper
Region							
North Central	Reference Category						
North East	.224	.069	10.505	.001	1.251	1.092	1.432
North West	.519	.067	60.893	.000	1.681	1.475	1.915
South East	-.026	.095	.077	.782	.974	.808	1.174
South South	-.262	.103	6.485	.011	.770	.629	.941
South West	-.197	.102	3.699	.054	.822	.672	1.004
Place of Residence							
Rural	Reference Category						
Urban	-.089	.053	2.860	.091	.915	.825	1.014
Sex of Child							
Male	Reference Category						
Female	.146	.039	14.158	.000	.864	.801	.932
Mother's Education							
No education	Reference Category						
Primary	-.247	.054	21.211	.000	.781	.703	.868
Secondary	-.591	.048	150.158	.000	.554	.504	.609
Higher	-.806	.093	74.322	.000	.447	.372	.537
Mother's Age							
15 - 19	Reference Category						
20 -29	-.131	.091	2.072	.150	.877	.734	1.049
30 - 39	-.117	.092	1.623	.203	.890	.743	1.065
40 - 49	.096	.103	.869	.351	1.101	.900	1.346
Source of Drinking Water							
Unimproved water source	Reference Category						
Improved water source	-.118	.039	9.236	.002	.888	.823	.959
Wealth Status							
Poor	Reference Category						
Middle	-.288	.048	36.714	.000	.749	.683	.823
Rich	-.749	.047	253.315	.000	.473	.431	.519
Mother's Religion							
Christianity	Reference Category						
Islam	.553	.041	181.763	.000	1.738	1.604	1.884
Others	-.554	.310	3.194	.074	.575	.313	1.055
Cooking Fuel							
Wood/Charcoal/Coal	Reference Category						
Kerosene/Electricity/Gas	-.737	.066	125.559	.000	.478	.421	.544
Breast Feeding							
Not breast fed	Reference Category						
Breast fed	-.821	.039	446.776	.000	.440	.408	.475
Mode of Delivery							
Caesarean Section	Reference Category						
Normal Delivery	-.048	.115	.176	.675	.953	.762	1.193
Size							
Small	Reference Category						
Average	-.450	.055	66.418	.000	.638	.572	.711
Large	-.434	.051	71.353	.000	.648	.586	.717
Place of Delivery							
Home	Reference Category						
Hospital	-.429	.040	115.274	.000	.651	.602	.704
Other	-.370	.170	4.705	.030	.691	.495	.965
Antenatal Visits							
None	Reference Category						
Below 5	-.848	.050	285.944	.000	.428	.388	.472
5 and Above	-.961	.057	286.438	.000	.383	.342	.428
Toilet Type							
Unimproved Toilet Sanitation	Reference Category						
Improved Toilet Sanitation	-.535	.055	95.332	.000	.586	.526	.652
Constant	-2.846	.421	45.642	1	.000		

-2 Log likelihood	***Chi-square***	***df***	***P-value***
19002.684[a]	1709.825	28	.000

Table 4 presents the results of the logistic regression model for under-five mortality used to identify significant determinants of under-five deaths for 2018. From Table 4, we observe that the odds of childhood mortality in Nigeria reduced from 1.251 in North East to as low as 0.770 in South South indicating that children had a higher chance of survival in the southern part of the country relative to those born and raised in the north. On

the place of residence, children given birth to in an urban centre experience reduced under-five mortality odds of 0.915 compared to children who were born in urban areas.

Considering mother's education, compared to mothers with no education, having primary or higher education reduced the odds of deaths in children before their fifth birthday to 0.781. This means that, mothers who had at least primary education experienced about 22% less under-five deaths. As the educational level increased, the odds of under-five death reduced further increasing the chances of under-five's survival for educated mothers. With a P-value of 0.000, mother's education is considered a significant determinant of under-five mortality.

The odd of under-five mortality for females was 0.864 indicating that female children had a 14% less chance of experiencing under-five mortality compared to male children with a P-value of 0.000 indicating statistical significance.

With respect to the age of the mothers at the time of delivery, relative to teenage mothers, women who gave birth to their babies between the ages of 20 – 29 were less likely to experience under-five deaths. The odds of childhood death were reduced up to 0.877 suggesting about 12% decrease in under-five mortality. Advanced mothers between the ages of 40 – 49 had significantly higher odds (1.101) of experiencing childhood death relative to teenage mothers when compared with the other two age groups.

The place of clean and improved source of water in childhood mortality cannot be over emphasized as shown in Table 4. Households who had access to, and used clean water or that consumed water from improved sources experienced reduced under-five mortality odds of 0.888, which implied that their children were about 11% more likely to experience childhood mortality. With a P-value of 0.002, source of drinking water is considered to be statistically significant.

The wealth index of households into which children under five years of age were born was found to be a significant determinant of under-five mortality in Nigeria. Compared to the poor, households in the middle and rich wealth index experienced reduced under-five mortality odds of 0.749 and 0.473 respectively. This suggests that the middle and rich income class would experience about 25% and 53% less under-five mortality. This can be seen to be true as the more access to funds that a household have, the more they are able to meet the nutritional and health care needs of their little children. The P-value of 0.000 also makes it a statistically significant determinant of childhood mortality in Nigeria for the year 2018.

The type of cooking fuel used by mothers was also found to be a significant predictor of under-five mortality. The odds of under-five mortality in households who made use of clean cooking fuel such as kerosene, electricity and gas was reduced to 0.478 compared to those who used unclean cooking fuel. With a P-value of 0.000 and a reduced risk of over 50%, the type of cooking fuel is also a statistically significant determinant of under-five mortality.

The chances of survival of children beyond their fifth birthday is significantly increased by 56% for children who were breastfed compared to children who were not breastfed as seen by the odd ratio of 0.440 with a P-value of 0.000.

Regarding the place of delivery, mothers who went to the hospital for the delivery of their babies had significantly reduced odds of 0.651 of experiencing childhood mortality compared to women who delivered their babies at home. The place of delivery with a P-value of 0.000 and a reduced risk of 35% is a significant determinant of under-five mortality.

On the number of antenatal visits of mothers before the delivery of their babies, the result in Table 4 shows that women who visited the hospital for antenatal on less than five occasions significantly decreased the odds of their baby dying to 0.428 compared to women who did not visit the hospital during pregnancy. The odds of under-five death are further reduced as the number of visits increased. Frequent antenatal visit during pregnancy is also a statistically significant determinant of under-five mortality in Nigeria.

Using unimproved toilet sanitation as the reference category for toilet type, the odds of under-five death for households who used improved toilet type was reduced to 0.586. This indicates that the type of toilet used by households was a significant predictor of under-five mortality with women who had access to clean and improved toilet type experiencing about 41% less risk of under-five mortality.

4. Conclusion

In this study, an attempt has been made to examine the trends, pattern and determinate factors of childhood mortality in Nigeria using data obtained from Nigeria Demographic and Health Survey (NDHS) for 2013 and 2018. The study employed the logistic regression model for the analysis of the data set with a view to broadening insight of the drivers of under-5 mortality useful for the assessment of sustainable targets of child mortality in Nigeria.

Findings from this study revealed that the mortality rate across both survey years for under-five children were consistently higher for mothers of younger age (15 – 19) than they were for mothers who were older (20 – 39). This could be as a result of naivety on the part of the adolescent / teenage mothers with respect to child rearing or perhaps physical immaturity and its attendant complications during pregnancy.

The study also showed that there exist a significant relationship between childhood mortality and mother's educational level. Educated mothers are more likely to adhere to instructions from medical personnel during pregnancy and after childbirth as well as make informed and better decisions regarding the health of their children than their less educated counterparts.

Also, the mortality rates for under-five were higher in rural areas than the urban areas. This could be as a result of limitations such as difficulty in accessing health care facility, lack of qualified/skilled health care officials, difficulty in accessing remote communities for the purpose of administering immunization to children, little or no access to clean source of drinking water and so on.

The relationship between type of cooking fuel, source of drinking water, type of toilet facility used and childhood mortality also showed that women who used biomass/unclean fuel, water from unimproved sources and unimproved toilet facilities experienced higher under-five deaths than those using clean fuel, improved water sources and improved toilet facilities respectively. Diarrhea disease is usually common among children who used water from unimproved sources and who were reported to engage in poor sanitation practices.

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