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Research Paper

Analysis and Forecasting Of Maternal Mortality in Nigeria: A Mathematical and Sociological Approach

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Abstract
Nigeria has the highest maternal deaths in the world in 2015 with 58,000 maternal deaths (814 maternal mortality ratios) and also contributed 9.6% of the world's maternal mortality rates in the world. As women contribute greatly to the economic and sociological development of any community. Maternal mortality is a threat to the women's health, and the country's development at large. This research tends to analyze the causes, effects, and ways of controlling maternal mortality in Nigeria and also forecast the Maternal Mortality Ratio (MMR) in Nigeria from 2016-2025.
Key words:- *Maternal Death, Maternal Mortality Ratio (MMR), Arima Model.*

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I. INTRODUCTION

In both developing and developed countries, maternal mortality is an important measure of maternal health (Hoj et al., 2003). It is the woman's death during pregnancy or within 42 days of pregnancy termination, regardless of the duration or location of the pregnancy, from any caused directly or indirectly by the pregnancy or its maintenance (WHO, 2010). The Maternal Mortality Ratio (MMR) is the number of maternal deaths per 100,000 live births. A variety of factors influence it, including socio-cultural, socio-economic, and socio-demographic determinants, healthcare access such as antenatal care, and her dietary habits both in childhood and adulthood.

Pregnancy and delivery are natural physiological processes that provide people and families with a pleasurable experience. Pregnancy and delivery, on the other hand, are treacherous journeys in many parts of the globe, a difficult and sometimes fatal event for millions of women, particularly in poorer nations. Despite evidence to the contrary, motherhood can be safer for all women (De Browere, 1998), thanks to a set of life-saving methods that can operate even in low-resource situations (Shiffman, 2000). The typical maternal death rate in wealthy nations is 10-15/100,000 live births, but rates in poor nations are 100-200 times higher (Rosenfied, 1989).

Every year, more than 500,000 women and girls die as a result of pregnancy, delivery, and associated problems (WHO, 2010). Those in underdeveloped nations have a lifetime risk of maternal mortality that is more than 200 times higher than women in Western Europe and North America (WHO, 2010).

The problem of maternal mortality is exacerbated in Sub-Saharan Africa, where maternal mortality rates are greater than almost everywhere in the world (WHO, 2004).

Approximately 99 percent of maternal fatalities occur in the 53 low-income nations, defined as having a GNP per capita of $905 or less. Over 60% of these nations are in Sub-Saharan Africa (WHO, 2010). Every four years, about one million African mothers die as a result of avoidable health issues, whereas women in wealthier countries give birth with little chance of mortality. A mother dying in delivery has far-reaching consequences on her newborn, her other children, her family, and the society.Commitment is required from global public health authorities to discover best practises in lowering maternal mortality and to fund and implement initiatives with solid evidence of success in disproportionately impacted nations and communities.

Nigeria is the most populated country in Africa. Its 211 million inhabitants constitute over 250 ethnic nationalities. Half of the population is Muslim, 40% is Christian, and 10% practises indigenous traditions. Nigeria's position is particularly dire, as we continue to report maternal mortality rates on the range of 800-1,000 per 100,000 live births (N.P.C. 2003), ranking among the nations with the greatest number of maternal fatalities (WHO, 2004). Nigeria has approximately 1.7 percent of the world's population yet accounts for almost 10% of the worldwide estimate for maternal mortality (Grant, 1990).

A great deal of research has been conducted on causes and effect of maternal mortality in Nigeria, which have a large number of difficult cases. This purpose of this study is to investigate the causes and effect of maternal mortality in Nigeria and also use available data to forecast maternal mortality for ten years.

II. LITERATURE REVIEW

The socioeconomic factors of maternal mortality are complex, with the majority of them co-occurring. Poverty, illiteracy, unemployment, and gender relations are frequently highlighted in the research literature as contributing factors to maternal mortality rates (Muoghalu, 2010). Since the end of the oil boom in the 1970s, the rate and depth of poverty in Nigeria have grown (Muoghalu, 2010). Because most prenatal clinics and hospitals charge fees, the number of women who attend them and give birth in them has decreased as a result of the increase in poverty. Furthermore, poverty has a direct impact on women's nutrient intake, causing a rise in anaemia among pregnant women (Muoghalu, 2010). According to the World Bank, the number of Nigerians living on less than a US dollar per day has climbed from 43 percent in 1985 to 66 percent in 2008. (Lanre-Abass, 2008).

Education, particularly female education, is negatively connected to maternal difficulties and mortality (Fawole et al., 2012). Girls and women who are illiterate have restricted decision-making power at home. They are frequently ill-equipped to advocate for their own life in high-risk medical circumstances. Women with much literacy have smaller families, utilise contraception, communicate more effectively, and have higher ambitions for their children, all of which contribute to reducing risk (Okeke, Anyaehie, &Ezenyeaku, 2012).

In Nigeria, few women are working in official jobs. Many work on their spouses' fields, bringing commodities, fuel, and water over great distances while carrying it on their heads. Those who work are paid less than their male colleagues (Muoghalu, 2010). The uneven connection between the genders is another societal element that affects women. Most women are under their spouses' supervision, marriages are planned by their parents, many are in polygamous relationships, and women frequently have no property management rights (Muoghalu, 2010).

In certain regions of Nigeria, a wife must first obtain permission from her husband before seeking medical attention (Adegoke, Lawoyin, Ogundeji, & Thomson, 2007). Some Nigerians claim that women are sometimes regarded as "baby factories" and are not empowered (Lawoyin, Lawoyin, &Adewole, 2007).Uneven gender interactions, a poor education, and unemployment all of which contribute to poverty, severely disadvantage Nigerian women and increase their risk of mortality during pregnancy and delivery (Muoghalu, 2010).

In the professional literature, there is a scarcity of knowledge about cultural variables that contribute to maternal mortality. Some earlier articles describe taboos against eating giant plantains, snails, milk, eggs, okra soup, and snakes when pregnant (Muoghalu, 2010). It is unknown if this leads to vitamin deficits in pregnant women.Polygamy is also a cultural practise that might put a woman in danger since family assets must be divided among the wives and are decided by the husband.

Furthermore, it is claimed that behavioural taboos lead to maternal difficulties and fatalities via mystical interpretations of aetiology. For example, in certain Nigerian communities, a pregnant woman is thought to bleed or die during her pregnancy as a result of witchcraft, supernatural powers, adultery, or being disrespectful to her husband (Lawoyin et al., 2007).Communities that believe in the supernatural aetiology will seek care from religious healers rather than medical practitioners. Despite the modest relationship to obstructed labour and consequent mother and newborn death, none of the published academic publications or popular news pieces cite female circumcision or cutting as a contributing factor (Cancino, 2007).

The evaluated studies found primary causes of maternal mortality that are consistent with global statistics; 70% of maternal fatalities in Nigeria are caused by one of five complications: bleeding, infection, unsafe abortion, hypertensive illnesses of pregnancy, or obstructed labour (Lanre-Abass, 2008). While some of the incidents are predicted with standard prenatal care, the majority occur unexpectedly and without notice. All pregnant Nigerian women should be aware that they are at risk of these problems (Ijadunola, Ijadunola, Esimai, &Abiona, 2010). Women who have high blood pressure, diabetes mellitus, pre-term rupture of the membranes, a gestation of more than 42 weeks, or vaginal bleeding may be at increased risk during pregnancy (Fawole et al., 2012).Other prevalent risk factors for high-risk pregnancies in Nigeria such as being over 35 years old, anaemia, HIV infection, and malaria (Oye-Adeniran et al., 2014), renal disease (Harrison, 2009; Magashi, 2012), and developed immune to protein C^{12}.

III. METHODOLOGY

This is research tends to analyse and forecast the maternal mortality ratio in Nigeria. The study will use research questionnaire and personal interview to analyse the causes, effects and ways of reducing maternal deaths in Nigeria. Furthermore, the research adopt a statistical model called ARIMA model to use the maternal mortality data from 1990-2015 to forecast the maternal mortality ratio from 2016-2025.

Some hospitals were selected in the six geo-political zones in Nigeria for the distribution of research questionnaire and personal interview. A total of 1350matarenal mortality cases were recorded. 1350 questionnaires were distributed to answer some questions related to the victims. The questionnaires were used by the health staffs to record the social-economic characteristics of maternal mortality victims.

IV. RESULTS

Table 1: Age

Age (years)	Frequency	Percentage
14-19	145	10.7
20-25	214	15.9
26-31	548	40.6
32-37	273	20.2
35-Above	170	12.6
Total	1350	100

Table 2: Education

Years of Education	Frequency	Percentage
0	**25**	**1.8**
1-3	**189**	**14**
4-7	**756**	**56**
8-11	**70**	**5.2**
12 or more	**310**	**23**
Total	**1350**	**100**

Table 3: Occupation

Age (years)	Frequency	Percentage
Higher Profession/ Skilled	95	7
Lower (Unskilled)	910	67.4
Unemployed	345	25.6
Total	1350	100

Table 4: Economic Status

Economic Status	Frequency	Percentage
Higher Class	267	19.8
Middle Class	452	33.5
Lower Class	631	46.7
Total	1350	100

Table 5: Place of Living

Place of Living	Frequency	Percentage
Urban	512	37.9
Rural	838	62.1
Total	1350	100

Table 6: Maternal Education

Maternal Education	Frequency	Percentage
Hospital	503	37.3
Home	847	62.7
Total	1350	100

Table 7: Nutrient Deficiency

Nutrient Deficiency	Frequency	Percentage
Yes	1002	74.2
No	348	25.8
Total	1350	100

Table 8: Place of delivery

Place of delivery	Frequency	Percentage
Hospital	503	37.3
Home	847	62.7
Total	1350	100

Table 9: Genital Cutting

Genital Cutting	Frequency	Percentage
Yes	445	33
No	905	67
Total	1350	100

Table 10: Parity

Parity	Frequency	Percentage
0-3	1268	93.9
4-7	59	4.4
8 or more	23	1.7
Total	1350	100

Table 11: Use of Traditional Medicine

Use of Traditional Medicine	Frequency	Percentage
Yes	983	72.8
No	367	27.2
Total	1350	100

Table 12: Modern Family Planning

Modern Family Planning	Frequency	Percentage
Yes	104	7.7
No	1246	92.3
Total	1350	100

V. DISCUSSION

The study's maternal mortality ratio (MMR) of 1350/100,000 live births is greater than Nigeria's national statistic of 800/100,000 live births. However, it is lower than the results of research conducted at teaching hospitals across the country, which place the rate between 1,000 to 3,000/100,000 live births (Oladapo et al., 2006, Daramola et al., 2004).

Table 1 shows that most of the victims of the maternal mortality are of 26-31 years old (40%), while the least are of the age range 14-19 years (10.7%). Also, Table 2 comprises the education of the victims, it shows that most of the victims have 4-7 years of education (56%), while the least have 0 years of education (1.8%). According to Table 3, the majority of the victims work in lower-status occupations. Table 4 and Table 5 show that most of the victims are of middle class economic status and living in rural area respectivly.

Table 6 also depicts the victims' education, revealing that the majority of victims (86 percent) have no maternal education of school, while the fewest have maternal education (14 percent). Table 7, 8, and 9 illustrate that the majority of victims of maternal death have nutrient deficiency (74.2%), have their delivery at home (62.7%), and do not have genital cutting (67%). Table 7, 8, and 9 illustrate that the majority of victims of maternal death have nutrient deficiency (74.2%), have their delivery at home (62.7%), and do not have genital cutting (67%).

Table 10 shows that the majority of maternal death victims have a parity of 0 to 3. (93.9 percent). Tables 11 and 12 show that the majority of victims of maternal mortality utilise traditional medicine for easy delivery (72.8%) and do not utilisemodern family planning (92.3%).

MATHEMATICAL APPROACH

ARIMA Model

The ARIMA model is a famous and commonly used statistical approach for time series forecasting. The two most generally used techniques to time series forecasting are exponential smoothing and ARIMA models, which give complimentary approaches to the problem. Whereas exponential smoothing methods try to explain the data's trend and seasonality, ARIMA models strive to characterise the data's autocorrelations.

Stationary Time Series

A time series is said to be stationary if its mean, variance, and auto-covariance are time invariant, which means they do not vary over time. It does not alter or remain steady. The time series is rendered stationary so that we may examine its behaviour across the time period under consideration as well as forecast it.

Non-Stationary Time Series

If the mean, variance, and auto-covariance of a time series fluctuate with time, it is said to be non-stationary. As a result, it is not consistent throughout time.

ARIMA (Auto-Regressive Integrated Moving Average) is an abbreviation that stands for Auto-Regressive Integrated Moving Average. It is a model class that catches a variety of conventional temporal patterns in time

series data.In this paper, wewill develop an ARIMA model for time series forecasting of maternal mortality ratio.
The following are the ARIMA model's parameters:
p: The number of lag observations in the model, commonly known as the lag order.
d: The number of times the raw observations have been differed, also known as the degree of difference.
q: The size of the moving average window, also known as the moving average order.
A linear regression model is built with the necessary number and type of elements, and the data is processed with a degree of differencing to make it stationary, i.e. to remove trend and seasonal features that might otherwise damage the regression model.

Dataset

Table 13: Table showing maternal mortality in Nigeria from 1990-2015

YEARS	MMR	YEARS	MMR	YEARS	MMR
1990	1350	2000	1170	2010	867
1991	1320	2001	1140	2011	824
1992	1300	2002	1090	2012	819
1993	1280	2003	1040	2013	821
1994	1270	2004	986	2014	820
1995	1250	2005	946	2015	814
1996	1250	2006	890		
1997	1240	2007	884		
1998	1220	2008	829		
1999	1200	2009	883		

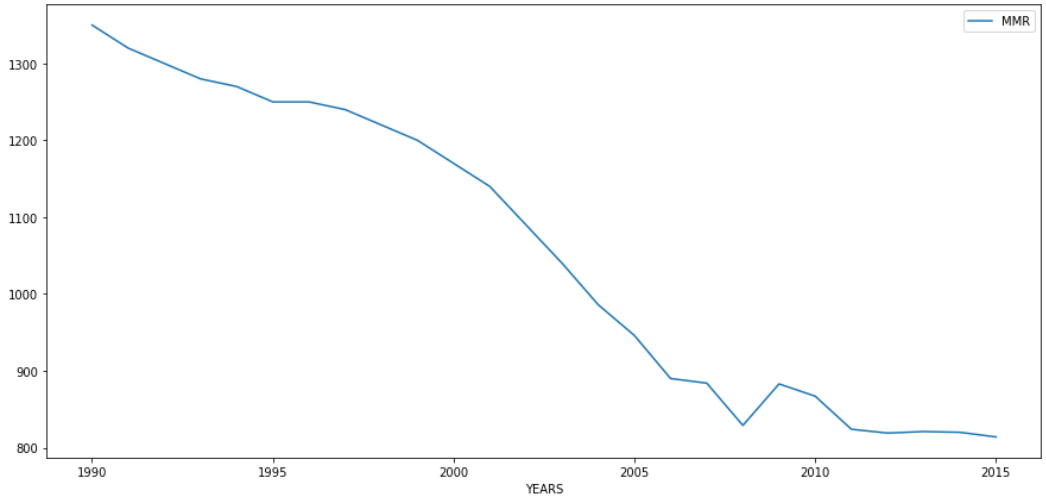

Figure 14: Maternal Mortality Ratio in Nigeria from 1990-2015

The first step in ARIMA is to determine if the data is stationary or non-stationary. If the data is non-stationary, we shall attempt to make it stationary before proceeding.
The null hypothesis will be used to determine the type of data.

H0: The null hypothesis is as follows: It is a proposition about the population that is either accepted as true or is used to make an argument, unless it can be proven to be false beyond a possible suspicion.

H1: An alternate hypothesis: It is a population assertion that contradicts H0 and what we infer when we reject H0.

Ho: It is non-stationary
H1: It is stationary

We will be considering the null hypothesis that data is not stationary and the alternate hypothesis that data is stationary.

Table 14: Results for test of stationarity of time series data

Test Statistic	p-value	Critical Values (1%)	Critical Values (5%)	Critical Values (10%)
-0.8887	0.7917	-3.7238	-2.9865	-2.6328

Here P-value is 0.7917 which is greater than 0.05, which means data is accepting the null hypothesis, which means data is non-stationary.
Computing the MMR difference, we obtain

Table 15: Results for test of stationarity of time series data

Test Statistic	p-value
--3.6232	0.0053

Strong evidence against the null hypothesis(Ho), reject the null hypothesis. Data is stationary

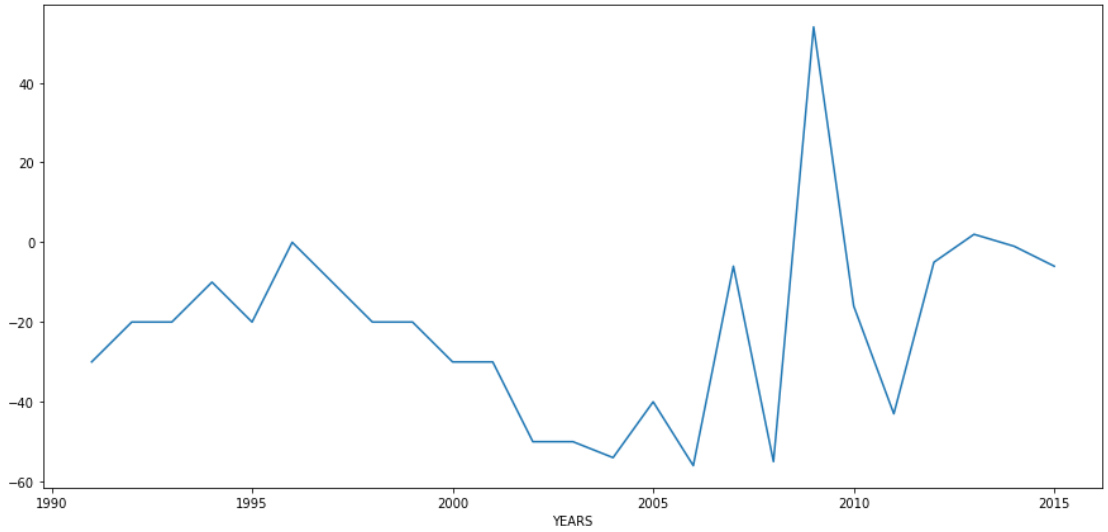

Figure 2: MMR Difference

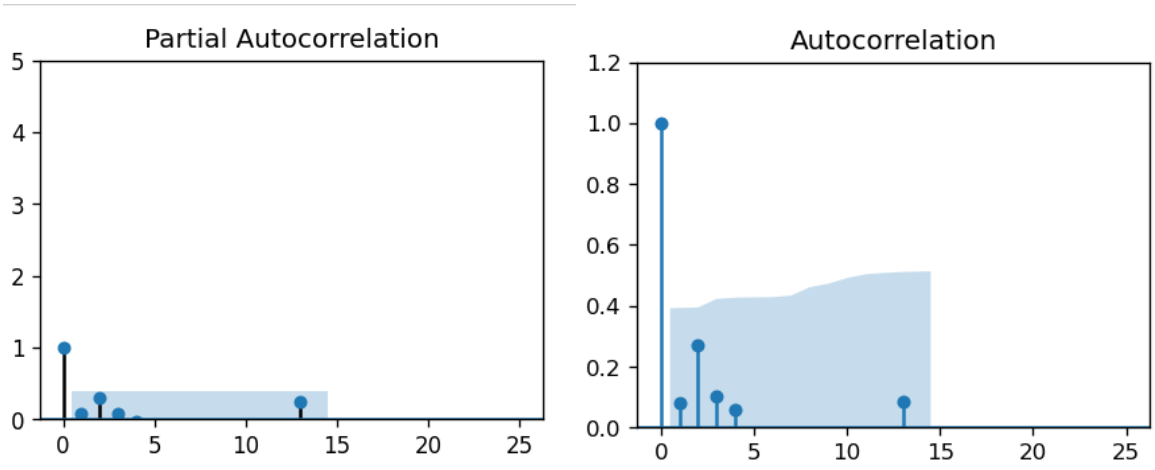

Figure 3

From the above figures, we have to use ARIMA (1, 1, 0) model.

Forecasting

ARIMA (1, 1, 0) Model Results

Log Likelihood	No. Observations:	AIC	BIC	HQIC	S.D. of innovations	MAE
-114.677	25	235.353	239.01	236.367	23.76	38.7281

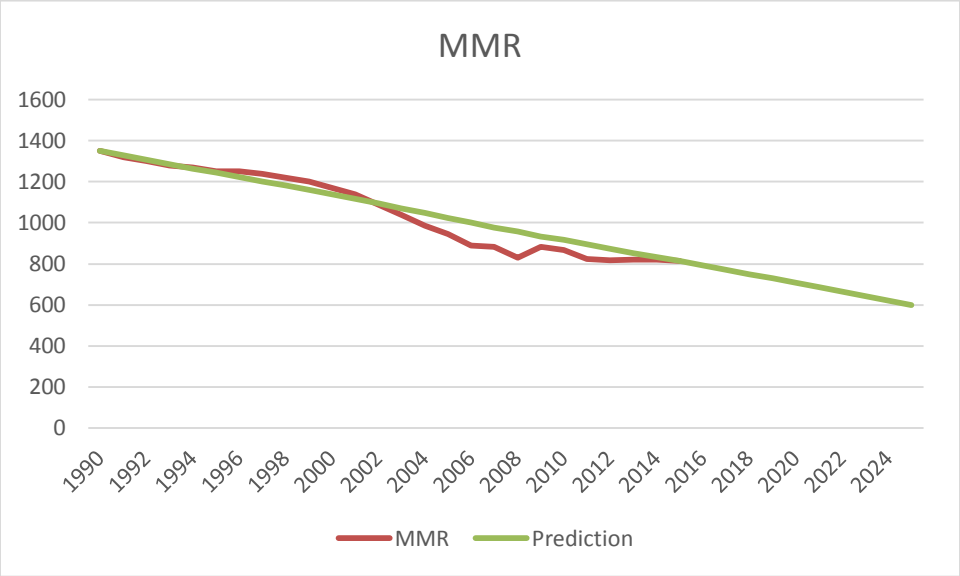

Figure 4: Forecasting of Maternal Mortality Ratio

Table 16: Forecasting of Maternal Mortality Ratio

YEAR	MMR	Prediction
2011	824	896
2012	819	873
2013	821	853
2014	820	833
2015	814	813
2016		793
2017		772
2018		750
2019		729
2020		708
2021		686
2022		665
2023		643
2024		622
2025		600

VI. CONCLUSION

In this study, we find out that education, particularly female education, is negatively connected to maternal difficulties and mortality. Women who are illiterate have restricted decision-making power at home. They are frequently ill-equipped to advocate for their own life in high-risk health conditions. Women with higher levels of education have fewer children, use contraception more frequently, communicate more effectively, and have higher ambitions for their children, all of which contribute to risk reduction. In Nigeria, few women are working in official jobs.Furthermore, poverty has a direct impact on women's nutritional intake,

leading to a rise in anaemia among pregnant women. This also contributed to the high rate of maternal death.The availability and acceptability of contemporary, effective family planning technologies has a social and cultural impact on maternal mortality. The use of modern contraception promotes child spacing and lowers newborn and mother mortality. As a result, offering adequate health care and education would help to reduce maternal mortality in Nigeria.

Finally, we see from the ARIMA model and forecasting that the maternal mortality ratio in Nigeria is considerably dropping, and that the maternal mortality ratio in Nigeria will be very low in a few decades.

Ethical considerations

The study attempted to follow research ethics throughout the process. For example, the respondents were obviously conscious of the purpose of the study, and their participation was entirely voluntary. As a result, they were advised to withdraw from the study at any time. Furthermore, no personal information was ever requested of them.

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REFERENCES:

[1]. Adegoke, Adetoro, TaiwoLawoyin, Martins Ogundeji, and Ann Thomson. 2007. "A Community-Based Investigation of the Avoidable Factors of Maternal Mortality in Nigeria: The Pilot Experience." African Health Science 7 (3): 176–81.
[2]. Cancino, Rebecca Cutie. 2007. "Associated Social, Economic and Political Factors." Women's Health Journal 3–4: 75–90.
[3]. De Browere V. (1998). Strategies for reducing maternal mortality in developing countries: What can we learn from the history of the industrialized West? Tropical Medicine and International Health 3(10): 771-782.
[4]. Fawole, Adeniran, Archana Shah, AoFabanwo, OmololuAdegbola, A.A. Adewunmi, A.B. Eniayewun, K. Dara, et al. 2012. "Predictors of Maternal Mortality in Institutional Deliveries in Nigeria." African Health Sciences 12 (1): 32–40.
[5]. Grant J.P. (1990). State of the World's Children, New York Oxford University Press, 1990.
[6]. Harrison, Kelsey. 2009. "The Struggle to Reduce High Maternal Mortality in Nigeria." African Reproductive Health 13 (3): 9–20.
[7]. Hoj, L., Hedegaard, K., and Sandstro, A. (2003). Maternal mortality: only 42 days? BJOG: An International Journal of Obstetrics and Gynaecology,110, 995-1000.
[8]. Ijadunola, Kayode, MacellinaIjadunola, OlapejuEsimai, and TitilayoAbiona. 2010. "New Paradigm Old Thinking: The Case for Emergency Obstetric Care in the Prevention of Maternal Mortality in Nigeria." BMC Women's Health 6 (10): e10.1186/1472-6874-10-6.
[9]. Lanre-Abass, Bolatito. 2008. "Poverty and Maternal Mortality in Nigeria: Towards a More Viable Ethics of Modern Medical Practice." International Journal for Equity in Health 7: 11–25.
[10]. Lawoyin, Taiwo, OlusheyiLawoyin, and David Adewole. 2007. "Men's Perception of Maternal Mortality in Nigeria." Journal of Public Health Policy 28 (3): 299–318.
[11]. Magashi, Aminu. 2012. Trends in Maternal Mortality in Nigeria. Washington, DC: SyndiGate Media Inc. Mezie-Okoye, Margaret, FolukeAdeniji, Charles Tobin-West, and SeyeBabtunde. 2012. "Status of Emergency Obstetric Care in a Local Government Area in South-South Nigeria." African Journal of Reproductive Health 16 (3): 170–79.
[12]. Muoghalu, Caroline Okumdi. 2010. "Socio-Economic and Cultural Factors in Maternal Mortality in Nigeria." Gender and Behaviour 8 (2): 3226–39.
[13]. National Population Commission (2003). Nigeria Demographic and Health Survey (2003). IRD Macro International USA.
[14]. Okeke, Tochukwu, Bond Anyaehie, and C.C.K. Ezenyeaku. 2012. "An Overview of Female Genital Mutilation in Nigeria." Annals of Medical and Health Sciences Research 2 (1): 70–73.
[15]. Oye-Adeniran, Bonaface, KofoworolaOdeyemi, AbidoyeGbadegesin, Olubunmi Akin-Adenekan, OluwatosinAkinsola, EkanemEkanem, and OluwaseunOsilaja. 2014. "Causes of Maternal Mortality in Lagos State, Nigeria." Annals of Tropical Medicine and Public Health 7 (3): 177–81.
[16]. Rosenfield A. (1989). Maternal Mortality in Developing Countries. An ongoing but neglected tragedy. JAMA 262(3): 376-379.
[17]. Shiffman J. (2000). Can poor countries surmount high maternal mortality? Studies in Family Planning, 31(4):274-289.
[18]. World Health Organization (2004). Maternal Mortality in 2000: Estimates Developed by WHO, UNICEF and UNFPA. World Health Organization, Geneva.
[19]. World Health Organization (WHO). 2010. Trends in Maternal Mortality: 1990 to 2008 [Online]. https:// www.who.int/reproductivehealth/publications/monitoring/9789241500265/en/. Accessed June 16, 2020.