Using the Sisterhood Method to Determine the Maternal Mortality Ratios in Six Local Governments of Ondo State, Nigeria

Ali Johnson Onoja[1], Simon Peterside Onuche[2], Felix Olaniyi Sanni[3], Sheila Iye Onoja[1], Theophilus Umogbai[4], Paul Olaiya Abiodun[5], Shehu Busu Mohammed[6]

[1]Research Department, African Health Project, [2]Obstetric & Gynaecology Department, Kogi State University Teaching Hospital, Anyigba, Kogi, Nigeria, [3]Department of Public Health, Triune Biblical University Global Extension, Brooklyn, NY, USA, [4]National Commission for Museums and Monuments, Owo, Ondo, Nigeria, [5]Department of National Integrated Specimen Referral Network, AXIOS International, Utako, FCT, [6]Microbiology Department, National Institute for Pharmaceutical Research and Development, Idu, Abuja, Nigeria

ORCID:
Ali Johnson Onoja: https://orcid.org/0000-0002-6764-5685

Abstract

Background: Maternal mortality is a major global health challenge and very common in sub-Saharan Africa and usually occurs due to complications during pregnancy and childbirth. This study aimed to determine the maternal mortality ratio (MMR) in six local government areas (LGAs) of Ondo State using the sisterhood method. **Methodology:** The study was a cross-sectional descriptive survey of women in the reproductive age group 15–49 years. Data related to maternal mortality were collected in March 2017 using the indirect sisterhood method. A structured questionnaire was used to collect data and was analyzed using IBM-SPSS version 25.0 software. **Results:** The average MMR in the 6 LGAs was 950 per 100,000 live births with a range of 584–1183 per 100,000 live births. Akoko South had the least MMR of 584 per 100,000 live births, Ondo West had 782 per 100,000 live births, Irele had 982 per 100,000 live births, Owo had 782 per 100,000 live births, Akure South had 1386 per 100,000 live births, and Ile-Oluji had the highest MMR of 1183 per 100,000 live births. The lifetime risk of dying a maternal death ranged from 0.03 to 0.07, with Ile-Oluji South having the highest risk. The greatest risk of dying a maternal death was found among adolescents and young adults aged 15–39 years with a peak at 20–24 years. **Conclusion:** This study found high MMR in Ondo State, with adolescents and young adults aged 15–39 years being at the highest risk. This calls for consistent interventions to minimize maternal deaths in the state and in Nigeria.

Keywords: Live birth, maternal mortality, pregnancy, sisterhood

INTRODUCTION

Maternal mortality has been a major global health challenge that is very common in sub-Saharan Africa and South Asia.[1] The world health organization[2] defined maternal mortality as the death of a woman during pregnancy, during childbirth, or within 42 days after birth. Maternal mortality usually occurs in women due to complications during pregnancy and childbirth.[3] The majority of the complications that occurred during pregnancy can be avoidable or curable. Complications in women before pregnancy sometimes get worse during pregnancy, when not treated. The major complications that usually lead to maternal death include bleeding (usually after childbirth), infections (particularly after childbirth), high blood pressure, complications from or during child delivery, and unsafe abortion.[3-8] In 2013, an estimated 289,000 maternal deaths occurred worldwide, and the maternal mortality ratio (MMR) in developing countries was 14 times greater than in advanced countries.[9] According to the WHO report,[2] about 810 women died daily of preventable pregnancy and

Address for correspondence: Dr. Ali Johnson Onoja,
African Health Project, Abuja, Nigeria.
E-mail: onojaali@yahoo.com

For reprints contact: WKHLRPMedknow_reprints@wolterskluwer.com

Access this article online

Quick Response Code:

Website:
http://iahs.kaums.ac.ir

DOI:
10.4103/iahs.iahs_74_20

How to cite this article: Onoja AJ, Onuche SP, Sanni FO, Onoja SI, Umogbai T, Abiodun PO, *et al*. Using the sisterhood method to determine the maternal mortality ratios in six local governments of Ondo State, Nigeria. Int Arch Health Sci 2020;7:192-7.

childbirth-related causes worldwide though there was a significant decrease in MMR of about 38% per 100,000 live births between 2000 and 2017. The report further revealed that 98% of the maternal deaths happened in low- and lower-middle-income countries with an estimated 295,000 deaths during pregnancy and childbirth in 2017 alone. Eighty six percent of maternal deaths in 2017 occurred in sub-Saharan Africa and Southern Asia with about 196,000 maternal deaths in sub-Saharan Africa alone; this value represents about two-thirds of the entire global maternal deaths in 2017.[2] The 2019 UNICEF[10] report puts Nigeria as the 4th country with the highest MMR of 917 (500–999) per 100,000 live births behind South Sudan (1150), Chad (1140), and Sierra Leone (1120) per 100,000 live births.

High MMR in Nigeria and Africa has been associated with inequalities in access to quality health services and due to the gap between the rich and the poor.[2,11] Studies have shown that poor women from regions or communities with a low number of skilled health-care personnel, especially in sub-Saharan Africa, are less likely to receive adequate health care.[2,12-14] Other obstacles that prevent women from seeking and receiving adequate care during pregnancy and childbirth include distance to health facilities, insufficient information, inadequate and poor-quality health-care services, and cultural beliefs and practices.[1,2,6,15,16]

In a review of five years maternal mortality deaths in a tertiary hospital offering free maternal services in Ondo State, Nigeria, the overall MMR was reported as 383/100,000 live births with a 70% reduction from 708 in 2010 to 208 in 2014.[15] Another retrospective study was conducted in the same hospital; MMR reduced by about 51% from 745 in 2009 to 381 per 100,000 live births in 2016.[7] A similar study in Ondo State from 2012 to 2015 showed MMR of 253, 192, and 170 per 100,000 births in 2012–2013, 2013–2014, and 2014–2015, respectively, indicating a 33% reduction in MMR over the course of the study period. However, these studies only reported retrospective findings from a particular region of the state, which may not account for the actual MMR in the larger proportion or the whole state.

The sisterhood approach is an indirect methodology for calculating maternal mortality rates in populations with high fertility.[1] With the introduction of sisterhood methods, the efficiency of mother mortality data capture has increased. These techniques have proven to be cost-effective, simple to implement, and used in surveys.[17] In several contexts, the sisterhood method was used and many reliability tests were made. The approach provides a basis for data collection as well as analysis.[17,18] Therefore, this study aimed to determine the MMR in six local government areas (LGAs) of Ondo State using the sisterhood method. This method will help account for both the maternal deaths presented in the hospitals as well as cases not presented in the hospitals due to the lack of a death registration system and the lack of a system for issuing burial permits, deaths that occurred in traditional birth attendants'

places, and deaths at home due to inability to afford obstetric charges in many rural communities.

METHODOLOGY

The study population

Ondo state is one of the six states in the south-western zone of Nigeria. The state lies between longitudes 4"30" and 6" East of the Greenwich Meridian and 5" 45" and 8" 15" North of the Equator. It has a land area of 14,788.723 km^2 and a population of over 3 million people comprising >1 million males and about 2 million females. The state has 18 LGAs, of which 6 local governments and 60 wards and many communities/clusters were involved in the survey. The LGAs involved in this study are Ile-Oluji, Irele, Akure, Akoko South, Ondo, and Owo. All these are urban cum semi-urban populations.

Study design

The study was a cross-sectional and used descriptive survey to collect data related to maternal mortality from all women in the reproductive age group 15–49 years using the indirect sisterhood method.

Sampling method

Probability sampling method was used. The six local governments in the state, ten wards in each of the six local governments, and the twenty communities or clusters in each of the selected wards were identified using a probability sampling method. Each local government had a supervisor, and there was in-depth communication with the leadership of the government and the communities who provided guides along with the cooperation of the primary health-care directors that made community identification and sampling easy and effective.

The sample size was rounded up to 1100 respondents per local government based on the assumption of 45% response rate from an estimated 2400 eligible women from each local government. The population was obtained from an estimated 120 eligible women from each of the 20 communities, making a total of 2400 from 10 wards.[17]

$$45\% \text{ of } 2400 = \frac{45}{100} \times 2400 = 1080$$

The approximated minimum sample size was 1100 responses per local government, giving a minimum total of 6600 from the six LGAs.

Data collection

The survey was carried out by African Health Project using a structured questionnaire to collect data from the Women of Reproductive Age. Eight research assistants and one supervisor were allocated to each local government, making a total of 54 field workers in all the LGAs. Before fieldwork, training was conducted for all officers involved in the survey at the state and local government levels and the tools were pretested on the fields. These officers were selected using predetermined academic qualifications (a minimum of higher

national diploma) and experience ability to fluently speak the local languages (Yoruba). The supervision provided by these officers and supervisors ensures that the quality and quantity of data collected were not compromised. The data collection spanned over a period of 2 weeks in March 2017 with team meetings and reviews on each day of the process. To validate the research instrument, the questionnaire was pretested on 110 women of reproductive age in Ose LGA and all necessary corrections and improvements were made before the final use. Attention was given to translation into local language, based on the understanding of the women during the pilot study.

Previous studies had established a series of basic questions for the sisterhood method of calculating maternal mortality.[1,17-19] There are four standard indirect sisterhood method questions used to estimate MMR which are (1) How many sisters have you ever had, born to the same mother, who ever reached the age of 15 (or who were ever married), including those who are now dead? (2) How many of your sisters who reached the age of 15 are alive now? (3) How many of these sisters are dead? (4) How many of your sisters who are dead died during a pregnancy or during childbirth, or during the 6 weeks after the end of a pregnancy?

Data analysis

Data entry was done by trained data entry clerks and validated using the IBM SPSS Statistics for Windows, version 25.0 (IBM Corp., Armonk, N.Y., USA). The entry was supervised by a data manager who participated actively in data entry. Descriptive statistical analyses were performed and the results were tabulated in tables, maternal mortality ratios were also estimated and recorded. A standard set of questions established in previous studies was used to calculate the MMR based on the sisterhood method of maternal mortality estimation.[17] The questions used included the number of respondent's maternal sisters, ever attained age 15 or ever married, including the living and the dead, applying the equation below to calculate the MMR (deaths per 100,000 live births).

$$\text{Probality of survival} = 1 - \frac{\sum r\text{i}}{\sum N\text{i } A\text{i}}$$

where r_i = Number of maternal deaths, N_i = Number of ever-married sisters, and A_i = Adjustment factor.[20] The probability of survival was calculated from the inverse of the lifetime risk of dying. From that, MMR was calculated using the formula:

$$\text{MMR} = 1 - (\text{probability of survival})^{1/\text{TFR}}$$

where TFR = Total fertility rate 5.2 for Ondo State before this study.[13,20,21]

Ethical approval was obtained from the National Health Research Ethics Committee (NHREC) of the Federal Ministry of Health with approval number NHREC/01/03/2017-20/03/2017. All the study respondents signed an informed consent form, and they were dully assured of the confidentiality of the information provided.

Results

Maternal mortality

The age distribution of all the study participants is shown in Tables 1-6. The average MMR in the 6 local governments was 950/100,000 live births with a range of 584–1183/100,000 live births.

There were 1991 respondents in Akoko South, with a total of 5001 married sisters and 68/393 (17.2%) maternal deaths. The MMR in Akoko South was 584 per 100,000 live births [Table 1]. As shown in Table 2, there were 1,697 respondents in Irele LGA with 4,029 ever-married sisters. There a total of 325 deaths recorded in this LGA of which 66 (20.3%) were maternal deaths. The MMR for this local government was calculated as = 982 per 100,000 live births.

In Ondo West LGA, 2129 study respondents reported having 5,172 ever-married sisters. The proportion of maternal death in this LGA was 80 (21.3%) with MMR of 782 per 100,000 live births, as shown in Table 3.

The number of respondents in Owo LGA was 1.930 with 4853 ever-married sisters with a maternal death of 84 (22.2%) and MMR of 782 per 100,000 live births [Table 4].

In Akure South LGA, 1006 respondents reported having 2252 ever-married sisters and 239 deaths of which maternal death was 64 (26.8%). The overall lifetime risk of dying a maternal death was 0.06 with MMR of 1183 per 100,000 live births [Table 5].

There were 2318 respondents in Ile-Oluji with 5430 ever-married sisters. There were 466 reported deaths of which maternal deaths accounted for 117 (25.1%) with a lifetime risk of dying a maternal death of 0.04 and MMR of 1386 per 100,000 live births [Table 6].

Discussion

In this study, the highest MMR of 1386 per 100,000 live births was found in Ile-Oluji, followed by 1183 and 782 per 100,000 live births in Akure South and Owo LGAs, respectively, and the least MMR was found in Akoko South with 584 per 100,000 live births. The overall MMR of 950 (584–1386) per 100,000 live births was within the 500–999 per 100,000 live births recorded for Nigeria in 2017[10] though the UNICEF report did not show MMR per state. The average MMR found in this study is, however, higher than 208 and 381 per 100,000 live births reported in the state in previous studies[7,15] though these other studies only reported cases found in a particular hospital whereas this survey covered several communities and wards in each local government and used the sisterhood method. The use of the sisterhood method might be responsible for higher MMR found across all LGAs in this study compared to health facility-based studies. Unlike health facility-based studies, sisterhood method is able to account for many unreported maternal deaths due to the use of unskilled birth attendants and deaths occurred during

Table 1: Akoko South: Maternal mortality ratio

Age group of respondents=i	Number of respondents	Number of ever-married sisters=Ni	Number of maternal deaths=ri	Number of deaths due to other causes	Total dead sisters	Proportion of maternal deaths (%)	Adjustment factor=Ai	Lifetime risk of dying a maternal death=ri/NiAi
15- 19	63	145	0	4	4	0.00	0.107	0.00
20- 24	335	749	18	46	64	28.13	0.206	0.12
25- 29	317	844	10	44	54	18.52	0.343	0.03
30- 34	560	1387	19	88	107	17.76	0.503	0.03
35- 39	292	706	9	41	50	18.00	0.664	0.02
40- 44	227	653	7	61	68	10.29	0.802	0.01
45- 49	197	517	5	43	48	10.42	0.900	0.01
Total	1991	5001	68	327	395	17.22		0.03

MMR=584 per 100,000 live births. MMR=$1-(1-0.03)^{1/5.2}$. MMR: Maternal mortality ratio

Table 2: Irele: Maternal mortality ratio

Age group of respondents=i	Number of respondents	Number of ever-married sisters=Ni	Number of maternal deaths=ri	Number of deaths due to other causes	Total dead sisters	Proportion of maternal deaths (%)	Adjustment factor=Ai	Lifetime risk of dying a maternal death=ri/NiAi
15- 19	87	183	1	4	5	20.00	0.107	0.05
20- 24	292	655	21	39	60	35.00	0.206	0.16
25- 29	301	720	9	37	46	19.57	0.343	0.04
30- 34	457	1076	11	81	92	11.96	0.503	0.02
35- 39	232	590	12	35	47	25.53	0.664	0.03
40- 44	150	477	4	39	43	9.30	0.802	0.01
45- 49	178	328	8	24	32	25.00	0.9	0.03
Total	1697	4029	66	259	325	20.31		0.05

MMR=982 per 100,000 live births. MMR=$1-(1-0.05)^{1/5.2}$. MMR: Maternal mortality ratio

Table 3: Ondo West: Maternal mortality ratio

Age group of respondents=i	Number of respondents	Number of ever-married sisters=Ni	Number of maternal deaths=ri	Number of deaths due to other causes	Total dead sisters	Proportion of maternal deaths (%)	Adjustment factor=Ai	Lifetime risk of dying a maternal death=ri/NiAi
15- 19	98	209	0	9	9	0.00	0.107	0.00
20- 24	370	873	25	44	69	36.23	0.206	0.14
25- 29	375	977	10	45	55	18.18	0.343	0.03
30- 34	547	1278	20	71	91	21.98	0.503	0.03
35- 39	309	721	4	29	33	12.12	0.664	0.01
40- 44	232	669	10	74	84	11.90	0.802	0.02
45- 49	198	445	11	24	35	31.43	0.9	0.03
Total	2129	5172	80	296	376	21.28		0.04

MMR=782 per 100,000 live births. MMR=$1-(1-0.04)^{1/5.2}$. MMR: Maternal mortality ratio

Table 4: Owo: Maternal mortality ratio

Age group of respondents=i	Number of respondents	Number of ever-married sisters=Ni	Number of maternal deaths=ri	Number of deaths due to other causes	Total dead sisters	Proportion of maternal deaths (%)	Adjustment factor=Ai	Lifetime risk of dying a maternal death=ri/NiAi
15- 19	90	172	0	1	1	0.00	0.107	0.00
20- 24	314	730	18	47	65	27.69	0.206	0.12
25- 29	330	853	6	51	57	10.53	0.343	0.02
30- 34	571	1437	35	80	115	30.43	0.503	0.05
35- 39	274	715	9	35	44	20.45	0.664	0.02
40- 44	193	577	10	58	68	14.71	0.802	0.02
45- 49	158	369	6	22	28	21.43	0.9	0.02
Total	1930	4853	84	294	378	22.22		0.04

MMR=782 per 100,000 live births. MMR=$1-(1-0.04)^{1/5.2}$. MMR: Maternal mortality ratio

Table 5: Akure South: Maternal mortality ratio

Age group of respondents=i	Number of respondents	Number of ever-married sisters=Ni	Number of maternal deaths=ri	Number of deaths due to other causes	Total dead sisters	Proportion of maternal deaths (%)	Adjustment factor=Ai	Lifetime risk of dying a maternal death=ri/NiAi
15- 19	75	143	0	14	14	0.00	0.107	0.00
20- 24	177	404	19	28	47	40.43	0.206	0.23
25- 29	148	372	3	21	24	12.50	0.343	0.02
30- 34	238	554	12	49	61	19.67	0.503	0.04
35- 39	163	263	9	15	24	37.50	0.664	0.05
40- 44	98	270	5	34	39	12.82	0.802	0.02
45- 49	107	246	16	14	30	53.33	0.9	0.07
Total	1006	2252	64	175	239	26.78		0.06

MMR=1183 per 100,000 live births. MMR=$1-(1-0.06)^{1/5.2}$. MMR: Maternal mortality ratio

Table 6: Ile-Oluji: Maternal mortality ratio

Age group of respondents=i	Number of respondents	Number of ever-married sisters=Ni	Number of maternal deaths=ri	Number of deaths due to other causes	Total dead sisters	Proportion of maternal deaths (%)	Adjustment factor=Ai	Lifetime risk of dying a maternal death=ri/NiAi
15- 19	155	276	6	15	21	28.57	0.107	0.20
20- 24	430	972	31	52	83	37.35	0.206	0.15
25- 29	397	959	15	46	61	24.59	0.343	0.05
30- 34	502	1171	23	70	90	25.56	0.503	0.04
35- 39	371	753	10	41	51	19.61	0.664	0.02
40- 44	240	712	8	70	78	10.26	0.802	0.01
45- 49	223	587	24	58	82	29.27	0.9	0.05
Total	2318	5430	117	352	466	25.11		0.07

MMR=1386 per 100,000 live births. MMR=$1-(1-0.07)^{1/5.2}$. MMR: Maternal mortality ratio

home deliveries due to inability to afford obstetric charges at formal health-care facilities.[1,17,18] This method also accounts for maternal deaths without birth certificates. Furthermore, the higher MMR might also be due to the wide coverage of the present study.

The MMR obtained in this study is lower than 1400 per 100,000 live births reported in two local governments in Kaduna State, North-Western Nigeria,[1] and 1400 per 100,000 live births reported in another study comprising three LGAs in Kaduna.[17] The average MMR of 2849/100,000 deliveries reported at the Federal Medical Centre, Nguru, from 2003 to 2007[22] was about three times the average MMR seen in this study. Higher MMR ratio of 1,732 per 100,000 live births was also obtained in Bauchi, North-East region of Nigeria,[23] which is > 2 times higher than our finding. A previous study conducted in Benin, Edo State, South-South region of Nigeria, reported MMR of 2356/100,000 deliveries,[14] which is about 2.5 times more than the average 950 MMR found in this study. Our finding is slightly higher than 840/100,000 live births found in Enugu State, South-East region of Nigeria.[12] The lower MMR reported in Ondo State as compared to some regions in Nigeria may be attributed to some factors such as the high impact of "Abiye" ("safe motherhood") program that was intensified since 2009 in the state.[16,24,25]

The greatest lifetime risk of dying a maternal death in our study was among young women greater 15 years and older

women less than 40 years with a peak at the age of 20–24. This finding is similar to the report of some previous studies.[1,17,26] This might be due to high level of marriage among women within the age range. Previous studies have documented the risk of maternal mortality and complications in pregnancies among adolescent girls aged 10–19 years.[2,27,28] It might also be as a result of a high number of pregnancies among women in less developed than women in developed countries, which constitutes higher lifetime risk of death due to pregnancy as reported by the World Health Organization.[2]

Conclusion

This study found high maternal mortality rates in Ondo state, with an average that is within the range found in Nigeria by the UNICEF in 2017. Adolescents and young adults aged 15–39 years are at higher risk of maternal deaths than other age groups. This calls for consistent interventions to minimize maternal deaths in the state and Nigeria as a whole.

Limitations

This study did not account for the influence of education on the MMR since the respondents' sisters were not directly interviewed. Furthermore, the sisterhood method used in this study had a limitation in the sense that it can only capture retrospective data rather than current information and estimates as statistical documentation would. However, it is advantageous in capturing maternal deaths not reported in the

health facilities, especially in local communities where there are poor health facilities and lack data capturing processes.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Usman NO, Abdullahi HM, Nmadu AG, Omole VN. Estimation of maternal mortality by sisterhood method in two rural communities in Kaduna State, Nigeria. Med Trop 2019;21:62-6.
2. WHO. Maternal Mortality. World Heal Organization; 2019. Available from: https://www.who.int/news-room/fact-sheets/detail/maternal-mortality. [Last accessed on 2020 Jun o9].
3. Say L, Chou D, Gemmill A, Tunçalp Ö, Moller AB, Daniels J, *et al.* Global causes of maternal death: A WHO systematic analysis. Lancet Glob Health 2014;2:e323-33.
4. Aa I, Grove MA, Haugsjå AH, Hinderaker SG. High maternal mortality estimated by the sisterhood method in a rural area of Mali. BMC Pregnancy Childbirth 2011;11:56.
5. Adegoke AA, Campbell M, Ogundeji MO, Lawoyin TO, Thomson AM. Community Study of maternal mortality in South West Nigeria: How applicable is the sisterhood method. Matern Child Health J 2013;17:319-29.
6. Meh C, Thind A, Ryan B, Terry A. Levels and determinants of maternal mortality in northern and southern Nigeria. BMC Pregnancy Childbirth 2019;19:417.
7. Ewemooje OS, Omoniyi OO. Maternal mortality and associated obstetric risk factors at mother and child hospitals, Ondo State, Nigeria. Afr J Appl Stat 2017;4:183-91.
8. Vogel JP, Fawole B, Adeniran AS, Adegbola O, Oladapo OT. The burden of severe maternal outcomes and indicators of quality of maternal care in Nigerian hospitals: A secondary analysis comparing two large facility-based surveys. BJOG 2019;126 Suppl 3:49-57.
9. Finlay JE, Moucheraud C, Goshev S, Levira F, Mrema S, Canning D, *et al.* The effects of maternal mortality on infant and child survival in rural Tanzania: A cohort study. Matern Child Health J 2015;19:2393-402.
10. UNICEF. Maternal Mortality UNICEF DATA. Unicef; 2019. Available from: http://data.unicef.org/topic/maternal-health/maternal-mortality. [Last accessed on 2020 Jun 09].
11. UNFPA. Maternal Health in Africa. UNFPA; 2013. p. 2-5. Available from: http://www.unfpa.org. [Last accessed on 2020 Jun 09].
12. Ezugwu EC, Onah HE, Ezugwu FO, Okafor II. Maternal mortality in a transitional hospital in Enugu, south east Nigeria. Afr J Reprod Health 2009;13:67-72.
13. Idris H, Tyoden C, Ejembi C, Taylor K, Macro NI. Nigeria demographic and health survey 2008. Abuja, Nigeria: National population commission and ICF macro. Natl Popul Comm ICF Macro 2009;14:1-630.
14. Omo-Aghoja LO, Aisien OA, Akuse JT, Okonofua FE. Maternal mortality and emergency obstetric care in Benin City South-South Nigeria. J Chinese Clin Med 2010;5:164-70.
15. Oyeneyin L, Akintan A, Aderoba A, Owa O. Maternal mortality ratio in a tertiary hospital offering free maternity services in South-Western Nigeria – A five-year review. Trop J Obstet Gynaecol 2017;34:112.
16. Mojekwu JN, Ibekwe U. Maternal mortality in Nigeria: Examination of intervention methods. Int J Humanit Soc Sci 2012;2:135-49.
17. Idris H, Tyoden C, Clara Ejembi KT. Estimation of maternal mortality using the indirect sisterhood method in three communities in Kaduna State, Northern Nigeria. Afr J Reprod Health 2010;14:77-81.
18. Olsen BE, Hinderaker SG, Kazaura M, Lie RT, Bergsjø P, Gasheka P, *et al.* Estimates of maternal mortality by the sisterhood method in rural northern Tanzania: A household sample and an antenatal clinic sample. Br J Obstet Gynaecol 2000;107:1290-7.
19. Scott S, Kendall L, Gomez P, Howie SR, Zaman SM, Ceesay S, *et al.* Effect of maternal death on child survival in rural West Africa: 25 years of prospective surveillance data in The Gambia. PLoS One 2017;12:e0172286.
20. Abuja N. National Population Commission and ICF Macro; 2009. National Population Commission (NPC)[Nigeria] and ICF Macro Nigeria Demographic and Health Survey. 2008.
21. National Bureau of Statistics. Projected population by state (2012-2016). Demogr Stat Bull 2017;2:1-26
22. Kullima AA, Kawuwa MB, Audu BM, Geidam AD, Mairiga AG. Trends in maternal mortality in a tertiary institution in Northern Nigeria. Ann Afr Med 2009;8:221-4.
23. Saleh W, Mairiga AG. Maternal mortality at the state specialist hospital Bauchi, Northern Nigeria. East Afr Med J 2009;86:4.
24. Oyeneyin L, van den Akker T, Durojaiye O, Obaado O, Akanbiemu F, Olagbuji Y, *et al.* Confidential enquiries into maternal deaths in Ondo State, Nigeria-a comparative analysis. BMC Pregnancy Childbirth 2019;19:514.
25. Love OO. Experiences of women participating in a safe motherhood (Abiye) project in Ondo state of Nigeria. Int J Curr Microbiol App Sci 2013;2:148-61.
26. Ujah IA, Aisien OA, Mutihir JT, Vanderjagt DJ, Glew RH, Uguru VE. Factors contributing to maternal mortality in north-central Nigeria: A seventeen-year review. Afr J Reprod Health 2005;9:27-40.
27. Ganchimeg T, Ota E, Morisaki N, Laopaiboon M, Lumbiganon P, Zhang J, *et al.* Pregnancy and childbirth outcomes among adolescent mothers: A World Health Organization multicountry study. BJOG 2014;121 Suppl: 40-8.
28. Althabe F, Moore JL, Gibbons L, Berrueta M, Goudar SS, Chomba E, *et al.* Adverse maternal and perinatal outcomes in adolescent pregnancies: The Global Network's Maternal Newborn Health Registry study. Reprod Health 2015;12 Suppl 2:S8.