Tanzanian Journal of Population Studies and Development, Vol. 31 No. 2, 2024: 72-89

Maternal Mortality in Tertiary Health Facilities in Edo State, Southern Nigeria

Rebecca O. John-Abebe[*]

Abstract

Nigeria ranks high in maternal mortality among developing countries despite the effort to reduce it. This paper is based on a ten-year study from 2008 to 2017 on maternal mortality from two public healthcare facilities in Edo State that have the most referrals. A facility-based survey design was used to determine the maternal mortality ratio, level of obstetric utilisation (booked and un-booked patients), number of caesarean sections, and causes of maternal deaths. Information on maternal deaths was collected from the University of Benin Teaching Hospital and the Central Hospital. The number of maternal deaths was 350 with 54,124 live births; and the maternal mortality ratio (MMR) was 674 per 100,000 live births during this ten-year review. The findings show an increase of 11,780 caesarean sections among pregnant women during the delivery period. The major direct causes of maternal death were eclampsia and haemorrhage, while the indirect causes were HIV/AIDS, and other complications. The high number of pregnant women with no antenatal registration (un-booked) in these facilities depicts delays in receiving effective maternal healthcare services. Hence, there is need for early registration and basic/comprehensive emergency obstetric care (EMOC) at all tiers of health facilities, which will decrease the risk of mortality and morbidity. The study recommends that to prevent delays in offering maternal healthcare services, there should be effective EMOCs at all healthcare facilities. Also, there is a need to encourage early antenatal registration that could reduce caesarean sections at health facilities for most pregnant women.

Keywords: *maternal mortality, livebirths, skilled delivery, caesarean section, causes, Edo*

1. Introduction

Maternal death is the death of a woman while pregnant or within 42 days of termination of pregnancy. This is irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from unintentional or incidental causes (WHO, 2019).

All over the world, the estimates of maternal mortality from 185 countries are above 290,000; and 1 in 190 women dies as a result of maternal causes amongst women of reproductive ages. In 2017, Sub-Saharan Africa (SSA) and Southern Asia (SA) reported 86% (254,000) of maternal mortality. The SSA maternal mortality ratio (MMR) is 542 per 100,000 live births; and the region records a

[*]Department of Geography and Regional Planning, Faculty of Social Sciences, University of Benin, Benin City, Nigeria: rebecca.john-abebe@uniben.edu

 ▪ *https://doi.org/10.56279/tjpsd.v31i2.212*

lifetime risk of 1 in 37 women (WHO, 2019). Maternal mortality and morbidity from pregnancy and delivery are indicators of the status of healthcare, and a reflection of a country's health system (Bigby et al., 2020).

Therefore, maternal health status reflects efforts towards the improvement in the access, and quality of, healthcare services. With less than a decade to the end of the 2030 SDGs Goal for maternal mortality, there is a need for countries to urgently address this challenge. The international community calls for accurate data, through a civil/vital registration system, on the cause of maternal mortality. Many developing countries record high maternal deaths in public health facilities, and these records depict the proportion of expectant mothers who utilise obstetric services (Bwana et al., 2019; Sageer et al., 2019). Information on the number and causes of maternal mortality are mostly collected from hospitals. However, the data on maternal mortality health service do not capture deaths occurring outside health facilities. Also, there is a lack of data on the levels and causes of maternal deaths in health centres, clinics, and dispensaries (WHO, 2005).

The international classification of diseases that cause maternal mortality is divided into direct and indirect causes of obstetric deaths (WHO, 2012). A similar classification was used by Khan et al. (2006) when they identified the causes of maternal deaths to be direct or indirect. Bleeding, eclampsia, abortion, sepsis, and obstructed labour are known as the direct causes of obstetric deaths. The indirect causes of obstetric deaths include pre-existing health conditions, and health conditions aggravated by pregnancy. Also, according major studies, the indirect causes of obstetric deaths are anaemia, cardiovascular causes, hepatic disease, HIV, infections, malaria, pulmonary causes, and pneumonia. Too, pregnancy complications can lead to maternal mortality. The periods of pregnancy, delivery, and post-partum could be life-threatening for pregnant women due to pregnancy complications. Several studies report that SSA and Asia record a high number of direct and indirect causes of maternal deaths (Say et al., 2014; Streatfield et al., 2014).

Moreover, several studies have reported that maternal deaths recorded in Asia (India and Pakistan) have shown maternal mortality ratio of 158, 292, and 216 per 100,000 live births due to referrals occurring in tertiary health facilities. In these two countries, the major causes of obstetric deaths (of women aged between 15 to 49) at any stage of pregnancy were haemorrhage and eclampsia; while other direct causes were hypertension disorders and sepsis. The indirect causes were attributed to anaemia and hepatitis (Dasari, 2015; Malik et al., 2015; Singh et al., 2018; Mehboob et al., 2021). Hossain and Shaikh (2022) studied the indirect causes of maternal mortality in a tertiary care centre from 2018 to 2020 in Pakistan. The study's findings highlight the major causes of mortality to include delays in seeking medical care, referrals, and the lack of appropriate treatment. Eighteen (18) out of twenty-six (26) mortality cases were unregistered patients; and over 50 percent of the cases had caesarean section delivery, with most deaths occurring in the postnatal period.

In Africa, Bwana et al. (2019) found that maternal mortality from 34 public hospitals was 58 per 100,000 live births due to direct obstetric maternal causes (eclampsia, obstetric haemorrhage, and sepsis); while the indirect causes of maternal deaths were anaemia and cardiovascular disorders. Their study also depicts an increase in maternal deaths in public hospitals (ibid.). Studies in Egypt (Abbas et al., 2016; Mohammed et al., 2020) record MMR of 89 and 186 per 100,000 live births; with eclampsia, haemorrhage, and sepsis being the direct causes of the recorded mortality. The indirect causes of deaths were found to be hepatic disease, acute fulminant hepatitis, cardiac disease, and chronic chest diseases. On its part, Nigeria records 23% (67,000) of the world's mortality among pregnant women, with an MMR of 917 per 100,000 live births (WHO, 2019). The Fragile State Index states that the country is one of the high-alert countries with a very high maternal mortality ratio (ibid.). Likewise, the 2018 Nigeria Demographic Health Survey (NDHS) reports an MMR of 512 deaths per 100,000 live births; with the country's total fertility rate (TFR) being 5.3 (NPC & ICF, 2019).

USAID (2015) recommends that maternal deaths should be prevented; with emphasis on the United Nation's Goals to achieve the best possible health, especially for reproductive women. Studies by Kullima et al. (2009), Olukoya and Sodipo (2015), Oyeneyin et al. (2017), and Olamijulo et al. (2022): all reported that the maternal death records from tertiary healthcare facilities in the northern and southwestern parts of Nigeria showed an MMR of 1837, 383, 7480, and 3556 per 100,000 live births. This high number of maternal deaths needs urgent attention in Nigeria, especially in states that record high fertility rates. Moreover, Ope (2020) stated the need to review maternal healthcare utilization at the point of delivery in healthcare facilities. This is geared towards increasing the utilization of maternal healthcare services in a bid to reduce maternal deaths in Nigeria. Nigeria's leading direct causes of maternal death are haemorrhage, postpartum infections, eclampsia, sepsis, obstructed labour, ruptured uterus, and complications of abortion; while the indirect causes of maternal deaths consist of malaria and anaemia.

One of the measures in preventing maternal mortality and morbidity, with medical justification, is through caesarean section as evidenced by the use of caesarean sections in European countries, which resulted in the reduction of maternal and infant mortalities. According to the WHO (2015), there has been an increase in the number of caesarean section births globally due to the risks faced by pregnant women. Also, Banke-Thomas et al. (2016) have identified caesarean section as one of eight emergency obstetric care interventions. Hence, most developing countries have a high rate of caesarean section as safe delivery to save mothers' lives (Bigby et al., 2020). The observed variation in caesarean section birth was higher amongst black women than white women (Martin et al., 2019).

Nigeria reported a 3% caesarean section deliveries in 2018 by mothers who claimed to experience medical conditions. Moreover, there were more caesarean sections in the southern part of the country (NPC & ICF, 2019). WHO (2015) identified socioeconomic variables, at the population level, associated with

increased caesarean section rates that reduce mortality. Other factors influencing the use of caesarean sections include socio-demographic, pre-natal, intervening, and family variables (Omona, 2021; Kibe et al., 2022).

Research on maternal mortality from tertiary health facilities in the Edo state has depicted a high mortality ratio. The MMR ranges from 2282, 1875, 2992, and 2230 per 100,000 live births from government-owned health facilities in the state. The cause of maternal obstetric deaths from these facilities includes HIV/AIDS, eclampsia, puerperal sepsis, unsafe abortion, postpartum haemorrhage, sepsis and ruptured uterus, pulmonary embolism, anaemic heart failure, anaesthetic complications, cancer in pregnancy, tuberculosis, and meningitis. Other causes were attributed to delays due to late referrals and un-booked patients in the tertiary health facilities (Omo-Aghoja et al., 2010; Onakewhor et al., 2011; Ande et al., 2012; Ntiomo et al., 2018; Aikpitanyi et al. 2019). Amongst the South-South states, the state had the highest total fertility rate (TFR) of 4.8 in 2018. Facility-based delivery was above 80%; and 69% of healthcare deliveries were assisted by a nurse/midwife. The state also reports a high percentage (5.8) of caesarean sections deliveries in the South-South region of Nigeria (NPC & ICF, 2019). What is deduced from the foregoing is that more women of reproductive age in this state might be susceptible to maternal deaths.

The maternal mortality data from health facilities in Edo State used in this study were from individual health facilities. The data depict that about 80% of the deliveries at health facilities were assisted by skilled personnel. This explains the need to ascertain the trend associated with direct and indirect causes of obstetric deaths over time, and the rate at which caesarean section conforms to set standards in health facilities in the state. This retrospective study seeks to analyse the trend of maternal death from hospital records, information on live births, maternal deaths ratio, causes of maternal deaths, and the prevalence of caesarean sections among reproductive women in Edo State, Nigeria. The period of this study spans from the MDGs into the SDGs era to ascertain if the state—and indeed the entire country—would make progress in the SDGs 3.1 goal.

2. Conceptual Framework

2.1 Conceptual Framework

Definitions of related concepts and conceptual frameworks buttress vital facts about the levels, trends, and causes of maternal mortality in this study. The concepts are health-related and medical in terminology for maternal mortality, especially in poor resource environments. Several theoretical frameworks exist in the investigation of maternal death and morbidity. Among them is that of McCarthy and Maine (1992), which is made up of determinants (like distant, intermediate, and outcomes) for examining factors that influence maternal deaths and effective program implementations to ensure mothers' health care. The conceptual framework in Figure 1—which is modified from framework on maternal health care utilization by Andersen's behavioural model, and the three delays model (Andersen & Newman, 2005; Thaddeus & Maine, 1994)—is employed in this study.

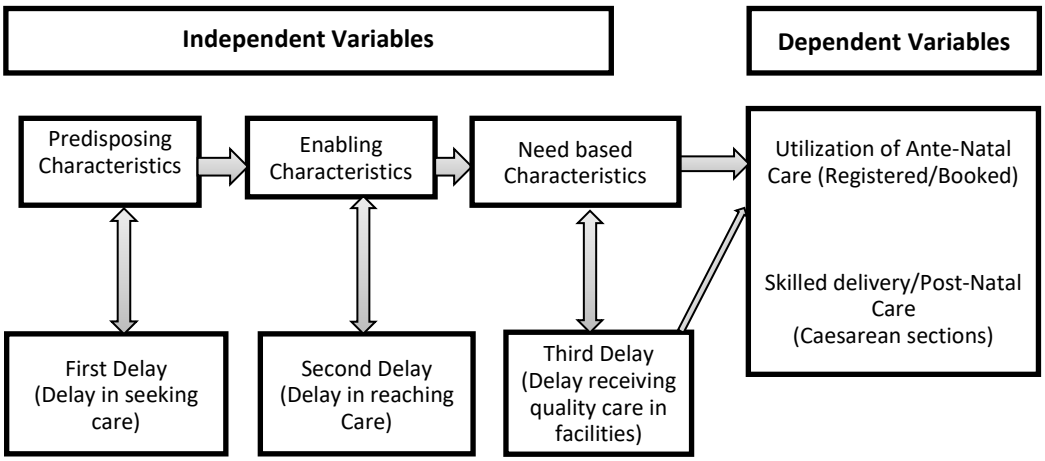

Figure 1: Modified Conceptual Framework based on Andersen's Behavioural Model and Three Delays Model

This study applied the Thaddeus and Maine (1994) delay model and its influence on the registration (booked and un-booked) status of pregnant women. Maternal healthcare utilisation through antenatal and postnatal care reduces the risk of late presentation, mortality, and caesarean section at health care facilities. The Three Delays model identify delays associated with maternal mortality related to health facilities. The first delay occurs in seeking medical services; the second delay is in referral to an appropriate facility, and the third delay is in receiving medical attention at a health facility (ibid.).

2.2 Operational Definition

Maternal Death

The WHO defines maternal death according to the international classification of diseases. Maternal death is defined as the death of a woman while pregnant or within 42 days of delivery or termination. This is irrespective of the duration and site of the pregnancy; from any cause related to, or aggravated by, the pregnancy or its management, but not from accidental causes.

Caesarean Section Delivery Rate

This is the total number of resident caesarean deliveries among women divided by the total number of all deliveries for a specified geographical area (country, province, city, or hospital), during a specified period, and per 100 live births.

Registered Patients

Registered (or booked) patients refer to pregnant women who registered for ante-natal services at a health facility with a minimum of four antenatal care services by a health care provider. An unregistered (un-booked) patient is referred to as a

patient with no medical health care record at the time of presentation at a healthcare facility, or through a referral from another healthcare facility.

Direct and Indirect Obstetric Deaths

Direct obstetric deaths (or direct maternal deaths) are those resulting from obstetric complications of the pregnant state (pregnancy, labour, and puerperium); and from interventions, omissions, incorrect treatment, or from a chain of events resulting from any of the above. Deaths due to obstetric haemorrhage or hypertensive disorders in pregnancy, or those due to complications of anaesthesia or caesarean section, are classified as direct maternal deaths. Indirect obstetric deaths (or indirect maternal deaths) are maternal deaths resulting from previous existing disease(s), or diseases that developed during pregnancy and were aggravated by the physiologic effects of pregnancy (WHO, 2023).

3. Methodology

3.1 Study Area

One of the three Senatorial districts that make up Edo State is Edo South, which is geographically located between latitudes 5°44′N and 6° 87′N and Longitude 5° 00′ E and 6° 43′E of the equator. Oredo, Ikpoba-Okha, Egor, Ovia North-East, Uhunmwode, Ovia South-West, and Orhionmwon are the seven local government areas in the district (Figure 2).

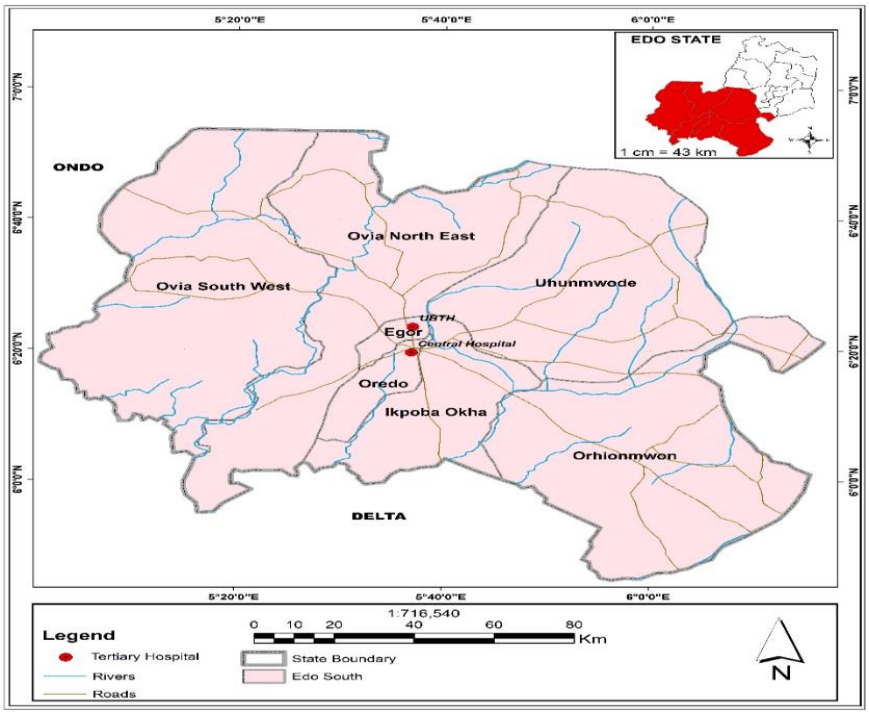

Figure 2: Public Tertiary Health Facilities in Edo South Senatorial District

3.2 Data Collection and Analysis

Data was obtained from health facilities in Egor Local Government Area of Edo State at the University of Benin Teaching Hospital, and Oredo Local Government Area at Central Hospital: both facilities are situated within metropolitan Benin. The study applied a purposive sampling technique in the selection of these public health facilities, which ranked highest in Edo State in terms of referral cases from health complications. These facilities are owned by the government. Each hospital provides tertiary obstetric health care services to women of reproductive ages in the Senatorial district and state. Ten years of retrospective hospital records (2008-2017) of all patients with pregnancy-related complications were collected. The objectives of the study are to measure maternal mortality levels, the causes, as well as the prevalence of caesarean section in health facilities in the state. At each tertiary facility, monthly data from the maternity ward registers were recorded.

The records of all maternal deaths at these hospitals, from 1st January 2008 to 31st December 2017, were retrieved from hospital registers at the obstetrics and gynaecology departments and labour wards of each health facility. The record files of the patients were retrieved from the medical records of the departments. The information about the registration/booking status and obstetric causes of deaths was extracted using a structured questionnaire, which was administered to the respectful head doctors and matrons in charge of the various departments and wards. The number of live births was also accessed from the record files at the labour wards. Data on the total number of live births, mode of delivery (vaginal and caesarean), number of maternal deaths, and causes of deaths were recorded. Departmental records of monthly clinical reviews for maternal deaths were used to determine the cause of maternal deaths by specialist doctors and nurses/midwives.

Also, all cases of maternal deaths were classified according to the 10th revised version of the WHO's (2015) International Classification of Diseases for maternal mortality. Other public health facilities were excluded from this study due to poor record keeping, e.g., community-based data on maternal mortality. Data were presented using univariate/descriptive statistical techniques (frequency, percentages, and charts). Five years moving average of maternal mortality ratio was used for trend analysis through Microsoft Office Excel (2010), and the collected data were quantitatively analysed. The results represented the entire district because the health facilities rank highest for rendering full tertiary and comprehensive healthcare services. They also have the highest percentage of referrals from all other health facilities within the district.

4. Findings and Discussion

Records of booked and un-booked patients, hospital live births, caesarean section, causes of maternal deaths, and the ratio of maternal mortality were reviewed. The observed number of maternal mortalities from hospital records, dating 2008–2017, was 350 as seen in Table 1. This gives a MMR of 701 per 100,000 live births.

Table 1: Temporal Pattern of Maternal Profile of Edo South (2008–2017)

	Year										
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**TOTAL**
Number of maternal deaths	32	36	13	38	57	51	30	26	29	38	350
Total number of live births	2936	3877	5376	6521	6363	7190	6055	5822	4915	5069	54,124
Maternal mortality ratio	1089	929	457	582	895	709	495	446	590	749	647
Booked patients	2386	3603	5577	6369	7008	6365	5214	5821	5031	4844	52,218
Un-booked patients	3366	5661	6188	9711	10596	10308	9993	9846	9876	8605	84,150
Caesarean section	337	1043	1188	1315	1111	842	1125	1630	1538	1651	11,780

Source: Author's Field Work

The registered pregnant women for ante-natal booking was 24913, and a larger number was reported to be women who presented themselves at these facilities either due to the need for emergency obstetric services, or referrals from other centres. There were 35,522 un-booked women in need of emergency obstetric services. The number of caesarean sections carried out during deliveries was 4,994. The set standard of caesarean section is that no less than 5% of all births should come from caesarean section. There was a slight decrease in maternal death from 176 to 174 in the period 2013–2017, with the ratio of maternal mortality being 599/100,000 live births. The numbers of booked and un-booked pregnant mothers also increased (27,275 and 48,628, respectively). The number of caesarean sections were 6,686, which were far higher than the five-year interval of 2008–2012. These increases cannot be attributed to any factor as there was missing data observed during the 2008–2012 interval.

The MMR for the past ten years was 647/100,000 live births. From 2008–2017, the proportion of maternal mortality and live births from health records was 350 and 54124, which gives the ratio of maternal mortality as 647/100,000 live births. The numbers of booked and un-booked pregnant mothers were 54,218 and 84,150, respectively, showing clearly that a higher percentage of pregnant women were not registered at childbirth, or experienced pregnancy complications within these facilities. This finding reaffirms other researchers' findings on unregistered pregnant women that attend health facilities for child delivery (see, e.g., Omo-Aghoja et al., 2010; Onakewhor et al., 2011; Ande et al., 2012; Ntiomo et al., 2018; Singh et al., 2018, Mohammed et al., 2020).

Figure 3 shows that the maternal mortality ratio decreased in the 2008–2017 period in the study area. From 2016 to 2017, there was an observed increase in the MMR: 590–749/100,000 live births. The maternal mortality ratio average trends seem to be reducing steadily during the five-year moving average. In 2010, it was 790; which decreased to 628 in 2013, and further down to 598 in 2015.

Figure 3: Trend of Maternal Mortality and Moving Averages
Source: Author's Field Work

The five-year moving mean of maternal mortality ratio seems to be decreasing steadily from 790 to 598 per 100,000 live births. The rise or fall in the number of maternal deaths and childbirths is an important factor in determining measures to seal maternal mortality. The highest percentage of change was observed in 2011 with over 192% change, while that of deliveries was in 2010 with over 37% change. The fluctuations in maternal mortality numbers across the years show that the lowest number of maternal deaths was in 2010, and the highest number was in 2012, with 57 deaths. This gradually dropped to 26 in 2015, and increased to 38 in 2017. In 2008, the number of skilled deliveries was the lowest, but steadily increased in 2013. An observed steady drop thereafter was observed in 2014–2017. This reduction can be explained by the recently published total fertility rate of 3.8 for Edo State (NBS, 2018).

4.1 The Number of Maternal Deaths and Deliveries in the District

The pattern of maternal deaths and deliveries is seen from the annual trend of change for the different years in Table 2. These variables are important factors in determining maternal mortality health status in a geographical area, especially as it is viewed through the temporal pattern of the socio-demographic index (2008–2017) in Figure 4. A rise or fall in the number of deaths would invariably affect maternal mortality measures. From 2008 to 2012, there was an increase in the number from 11 to 19, and just one observed decrease in 2010, which is about 70% change. The highest percentage of change was observed in 2011 with over 192% change. The lowest decrease in the number of deliveries was in 2012, with less than 2% change. The highest percentage of deliveries was in 2010 with over 37% change. For the 2013–2017 interval, the lowest percentage of change in maternal deaths was in 2014, with less than 41%; and the highest was in 2017. This was almost the same for deliveries with the lowest percentage in 2014; but the highest percentage of change in 2013 stood at 13%.

Table 2: Pattern of Maternal Deaths and Deliveries in Edo South

Year	Maternal death	Increase/ Decrease	Percentage of Change	Skilled Delivery	Increase/ Decrease	Percentage of Change	Maternal Mortality Ratio
2008	32	-	-	2936	-	-	1089
2009	36	11	34.4	3877	941	32.1	109
2010	13	-30	-69.8	5376	1499	37.4	457
2011	38	25	192	6521	1145	21.3	582
2012	57	19	50	6363	-158	-2.4	895
2013	51	-6	-10.5	7190	827	13	709
2014	30	-21	-41.2	6055	-1135	-15.8	495
2015	26	-4	-13.3	5822	-233	-3.8	446
2016	29	3	11.5	4915	-907	-15.6	590
2017	38	9	31	5069	154	3.1	749
Total	**350**			**54124**			**647**

Source: Author's Field Work

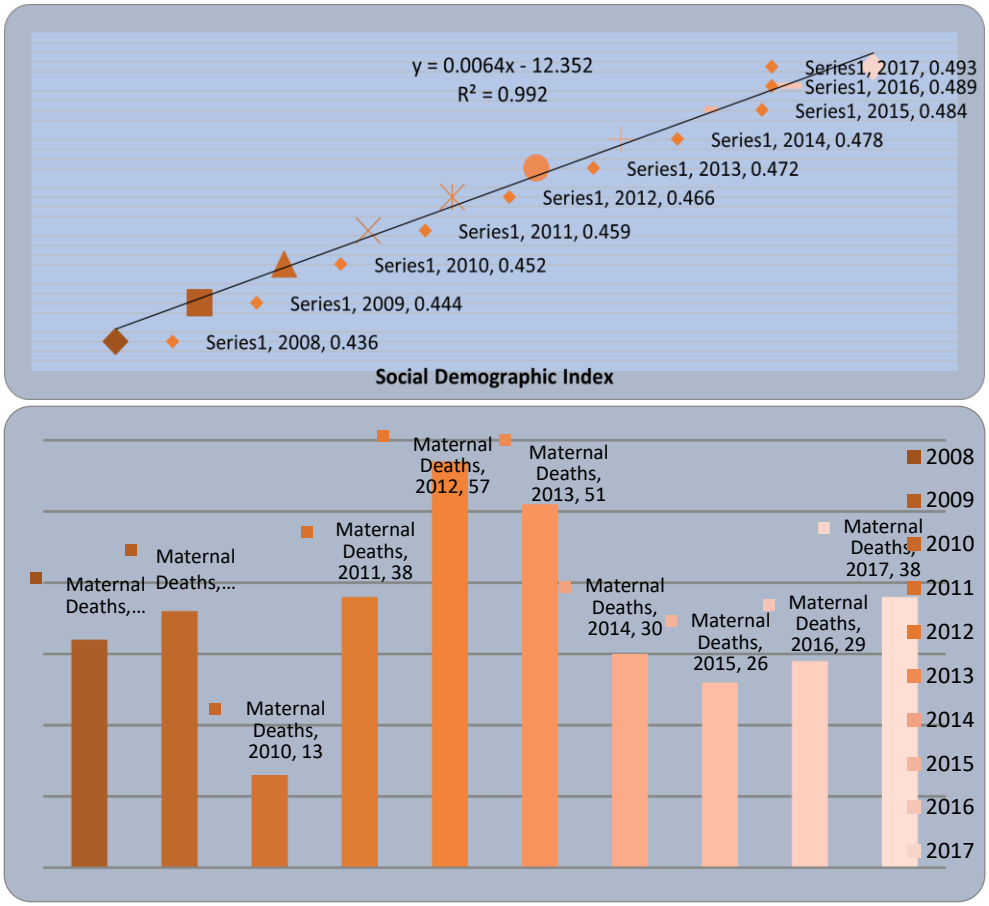

Figure 4: Temporal Pattern of Socio-Demographic Index for Nigeria and Maternal Deaths

Source: Institute for Health Metrics and Evaluation (GBD, 2017) and Author's Field work

Figure 5 shows that the number of maternal mortalities were fluctuating across the years under study: from 32 in 2008 to 36 deaths in 2009. In 2010, the lowest number of maternal deaths was recorded, and the maximum was in 2012 with 57 deaths. This gradually dropped to 26 in 2015; and increased to 38 in 2017. The year 2008 had the lowest number of skilled deliveries, with 2,936; and it steadily increased to 7,190 in 2013. A steady drop thereafter was observed in 2014–2017 (Figure 4). This can be explained by the drop in the TFR in the state (NDHS, 2014).

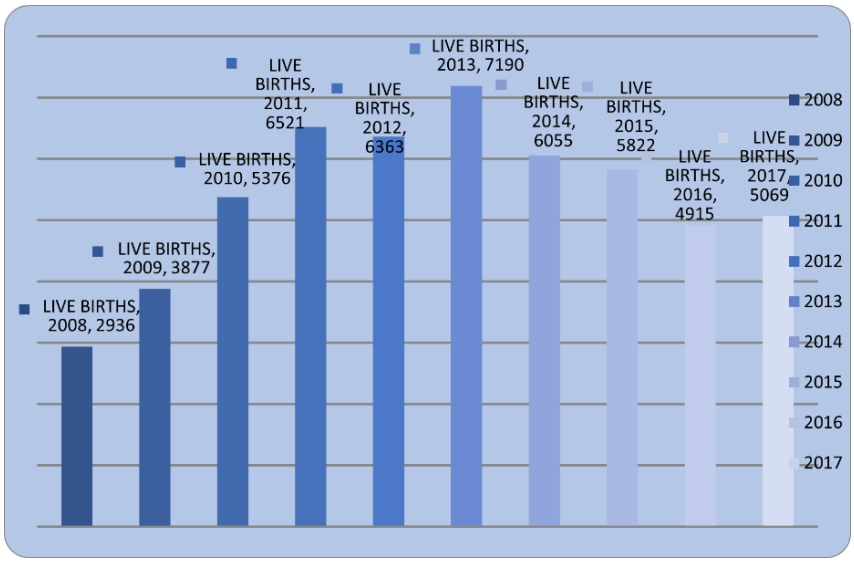

Figure 5: Trend of Skilled Deliveries in Edo South

4.2 Temporal Pattern of Caesarean Section in Edo South, Nigeria

There has been an observed increase in the number of caesarean section cases from 2008 to 2011. The years 2012 and 2013 experienced a decrease of less than 15% and 24%, respectively. The subsequent years (2014–2015) experienced an increase of over 34% and 45% change in the number of cases handled. This number fell slightly to less than 6%; and rose to over 7% in 2017. The estimated proportion of caesarean sections which stood at 11% was within the minimum/ maximum standard in 2008 since, according to WHO (2015), the minimum required percentage should not be less than 5, and the maximum not more than 15% of all deliveries. From 2009–2012, the observed trend was more than the acceptable standard. A decrease down to 11% was observed in 2013; and thereafter it has been on a steady increase up to the year 2017, as seen in Table 3. Hossain and Shaikh (2022) and Bigby et al. (2020) confirm the high number of caesarean sections in their studies. The estimated percentage exceeds that of the state as declared by the 2018 NDHS survey (NPC & ICF, 2019).

Table 3: Trend of Caesarean Section in Edo South

Year	Caesarean Section	Increase/ Decrease	Percentage of Change	Skilled Delivery	Increase/ Decrease	Percentage of Change	Percentage of C.S to Deliveries
2008	337			2936			11.5
2009	1043	706	210	3877	941	32.1	26.9
2010	1188	145	13.9	5376	1499	37.4	22.1
2011	1315	127	10.7	6521	1145	21.3	20.2
2012	1111	-204	-15.5	6363	-158	-2.4	17.5
2013	842	-269	-24.2	7190	827	13	11.7
2014	1125	283	33.6	6055	-1135	-15.8	18.6
2015	1630	505	44.9	5822	-233	-3.8	28
2016	1538	-92	-5.6	4915	-907	-15.6	31.3
2017	1651	113	7.4	5069	154	3.1	32.6
Total	**11780**			**54124**			**21.76**

As mentioned earlier, the ideal rate for caesarean sections is between 10% and 15% (WHO, 2015). When the maximum limit is exceeded, it is assumed that many avoidable caesarean sections are being performed. If it is less than 5%, it could equally mean more pregnant women are not getting the needed caesarean sections to save their lives and that of their unborn children. Hence, the percentage of 21.76 caesarean sections performed in the study area exceeds the maximum limit. This high percentage of caesarean sections being performed all over the district may be due to the need to prevent maternal deaths. What was seen from the medical records was a high number of un-booked cases, which could be due to a high number of referrals to the facilities from smaller centres, private clinics, and traditional birth attendants. This could lead to the late presentation or critical stages of obstetric cases that could necessitate emergency caesarean sections. Similar facts can be deduced from maternal health in Edo State (NPC & ICF, 2019).

The data indicate that caesarean sections were 11,780 in the ten years, and the number increased in the 2008–2011 interval. The highest rate of change was in 2009 and 2015. Martin et al. (2019) and Kibe et al. (2022) reported similar findings in 2009. As stated earlier, the high percentage of caesarean sections during delivery in the state is far above the maximum percentage prescribed for caesarean sections globally. This implies a lot of caesarean sections could have been due to poor maternal healthcare utilization, and late presentation at these hospitals.

The medical causes of maternal deaths from health records showed that eclampsia was responsible for 26% of maternal deaths, and it was closely followed by primary postpartum haemorrhage (with 19%). When all forms of haemorrhage are considered together (antepartum haemorrhage, primary postpartum haemorrhage, and secondary postpartum haemorrhage), it adds to 26% of the reported maternal deaths. Sepsis, uterine rupture, and abortion had 14%, 6%, and 4% of the total deaths, respectively. Other reasons of maternal deaths comprise indirect and unknown causes of the 19% of the total deaths, among which was 'dead-on arrival; as listed in the records. Table 4 and Figure

6 clearly show the causes of direct and indirect maternal deaths from health facilities within the study area. The indirect obstetric causes (ectopic pregnancy, HIV/AIDS, malaria, and anaemia) contribute less than 6%. Ande et al. (2012) reported a high percentage of indirect causes of maternal deaths due to HIV.

Table 4: Temporal Pattern of Maternal Death Causes in Edo South

Causes of Maternal Mortality	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
Eclampsia	5	4	5	6	16	15	10	10	14	7	92
Sepsis	3	6	0	7	12	6	2	4	2	7	49
Antepartum Haemorrhage	1	1	0	4	1	1	1	2	2	2	15
Primary Postpartum Haemorrhage	8	6	2	8	12	10	8	4	6	4	68
Secondary Postpartum Haemorrhage	1	0	0	1	1	0	0	1	0	4	8
Prolong Obstructed Labour	0	0	0	0	0	0	0	2	0	0	2
Uterine Rupture	2	0	0	5	7	2	0	1	1	2	20
Abortion Complication	1	2	0	0	0	4	0	0	0	2	9
Malaria	0	0	0	0	1	0	0	0	0	0	1
Severe Anaemia	0	1	0	1	0	0	0	0	0	0	2
Ectopic Gestation	1	1	0	1	0	0	0	0	0	0	3
HIV/AIDS	3	6	0	0	1	2	0	0	1	1	14
Others	7	9	6	5	6	11	9	2	3	9	67
Total	**32**	**36**	**13**	**38**	**57**	**51**	**30**	**26**	**29**	**38**	**350**

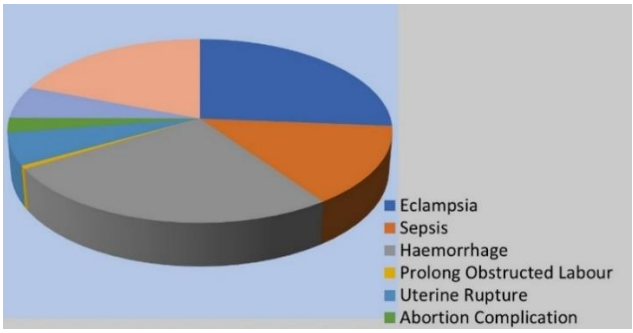

Figure 6: The Causes of Direct and Indirect Maternal Deaths in Edo South

Based on the foregoing, and the information provided in Table 4 and Figure 6, the major causes of maternal death identified are eclampsia (pregnancy-induced hypertension) and haemorrhage within the study area. The direct and indirect causes of maternal mortality from health facilities were from Egor and Oredo local government areas. Other researches have also affirmed the major causes of maternal mortality to be haemorrhage and eclampsia (Aikpitanyi et al., 2019; Bwana et al., 2019; Sageer et al., 2019). Maternal mortality measures are estimated

from hospital records, and temporal patterns are shown across the district. The medical information on live births, maternal deaths, and causes of death among reproductive women are retrieved data from 2008 to 2017. The data was successfully retrieved from health facilities in Egor (University of Benin Teaching Hospital) and Oredo (Central Hospital); both situated within the urban areas. The data collected was analysed and used to represent the entire district due to the high percentage of maternal health care services rendered by these two public health facilities, and the referrals from other health facilities within the district.

There were a lot of missing data from various records of the local government health facilities. Therefore, five out of the seven local government areas were not captured as part of the hospital records used for this analysis. This study and others affirm that good record keeping of births and maternal deaths is needed for effective monitoring of maternal mortality (Abouzahr & Wardlaw, 2001; Hakkert, 2001). The negative impact of under-reporting maternal deaths, even in countries with vital registration of births and deaths, can invariably lead to incorrect classification of the causes of deaths, as well as measures to prevent them (Zolala, 2009; NIPORTS, 2012).

5. Conclusion and Recommendations

The high rate of fertility and caesarean section in Edo State of Nigeria implies under-utilization of comprehensive maternal healthcare services. The number of referrals and un-booked mothers at the tertiary health facility results in the high maternal mortality ratio. This ratio is above the set target as Nigeria heads toward SDG 3.1 by 2030. To reduce maternal deaths—especially the ones caused by pregnancy-induced hypertension and haemorrhage—there is a need for an effective campaign on ante-natal, delivery, and post-natal care/services. Also, there is an urgent need to enlighten reproductive women on the indirect causes of maternal mortality—especially HIV/AIDS—to assist in the reduction of maternal mortality incidences. With early treatment/intervention, maternal and neonatal deaths can be reduced. The increased number of indirect causes of maternal deaths should also be a focus for the state and federal governments. For a functioning referral system, there is also a need to improve the health system in the state/country, especially at the grassroots.

Although records from Nigeria's demographic health survey show a high healthcare delivery utilisation, it also depicts a poor use of antenatal care services. The 'dead-on-arrival' cases, and the high number of un-booked women, connote late presentation at health facilities, which further buttresses the need to address healthcare utilisation in the country, and in Edo State in particular. The Edo State data show that most referral comes directly from home during pregnancy complications or deliveries. This could explain the reason for the high number of caesarean sections before the onset of labour. The most vulnerable are women in rural settings (with just primary health care centres), where emergency obstetric

services are mostly needed and managed by registered nurses/midwives. The high number of direct obstetrics causes of death and caesarean sections does not conform to the international set goals. Health facilities should, therefore, offer basic emergency obstetric services and emergency response services. This will assist in curbing the delays experienced in seeking healthcare services.

Ethical Approval

Ethical approvals were obtained from the Ministry of Health in Edo State, Nigeria and the University of Benin Teaching Hospital Ethics and Research Committee. Hospital records provided information on maternal deaths and the number of live births from 2008 to 2017 in public health facilities.

References

Abbas, A., Amin, M., Ali, S. & Salem, N. (2016). Maternal Mortality: A Tertiary Care Hospital Experience in Upper Egypt. *International Journal of Reproduction, Contraception, Obstetrics and Gynecology,* 1466–1S471. https://doi:10.18203/2320–1770.ijrcog2016.

AbouZahr, C. & Wardlaw. T. (2001). Maternal Mortality at End of a Decade: Signs of Progress. Bulletin of the World Health Organization, 79: 32–34. https://www.ncbi.nlm.nih.gov/books/NBK2279/pdf/Bookshelf_NBK2279.pdf.

Aikpitanyi, J., Ohenhen, V., Ugbodaga, P., Ojemhen, B., Omo-Omorodion, B.I., Ntoimo, L.F.C., Imongan, W., Balogun, J.A. & Okonofua, F.E. (2019). Maternal Death Review and Surveillance: The Case of Central Hospital, Benin City, Nigeria. *PLoS ONE* 14(12): e0226075. https://doi.org/10.1371/journal.pone.0226075.

Ande, A., Olagbuji, B. & Ezeanochie, M. (2012). An audit of Maternal Deaths from a referral University Teaching Hospital in Nigeria: The Emergence of HIV/AIDS as a Leading Cause. The *Nigerian Postgraduate Medical Journal*, 19(20): 83–87. https://www.npmj.org/temp/NigerPostgradMedJ19283–4240777_114647.pdf.

Andersen, R. & Newman, J.F. (2005). Societal and Individual Determinants of Medical Care Utilization in the United States. *Milbank Q*: 83(4): 1–28. http://www. milbank. org/uploads/documents/QuarterlyCentennialEdition/Societal%20and%20Indv.pdf.

Banke-Thomas, A., Wright, K., Sonoiki, O., Banke-Thomas, O., Ajayi, B., Ilozumba, O. & Akinola, O. (2016). Assessing Emergency Obstetric Care Provision in Low- and Middle-Income Countries: A Systematic Review of the Application of Global Guidelines. *Global health action,* 9: 31880. https://doi.org/10.3402/gha.v9.31880.

Bigby, J., Anthony, J., Hsu, R., Fiorentini, C. & Rosenbach, M. (2020). *Recommendations for Maternal Health and Infant Health Quality Improvement in Medicaid and the Children's Health Insurance Program.* Division of Quality & Health Outcomes, Baltimore. https://www.medicaid.gov/medicaid/quality-of-care/downloads/mih-expert-workgroup-recommendations.pdf.

Bwana, V.M., Rumisha, S.F., Mremi, I.R., Lyimo, E.P. & Mboera, L.E.G. (2019). Patterns and Causes of Hospital Maternal Mortality in Tanzania: A 10–year Retrospective Analysis. *PLoS ONE* 14(4): e0214807. https://doi.org/10.1371/journal.pone.0214807.

Dasari, P. (2015). Maternal Mortality and Its Relationship to Emergency Obstetric Care (EMOC) in a Tertiary Care Hospital in South India. *Obstetric Medicine*, 8(2): 86–91. https://doi:10.1177/1753495x15575949.

Global Burden of Disease. (2017). Global Burden of Disease Study 2017 (GBD 2017). Data Resources. https://ghdx.healthdata.org/gbd-2017.

Hakkert, R. (2001). *Country Estimates for Maternal Mortality: An Alternative Model. Statistics in Medicine*, 20(23): 3505–3524.

Hossain, N. & Shaikh, Z. F. (2022). Maternal Deaths Due to Indirect Causes: Report from a Tertiary Care Center of a Developing Country. *Obstetric Medicine*, 15(3): 176–179. https://doi.org/10.1177/1753495X211037916.

Kibe, P.M., Mbuthia, G.W., Shikuku, D.N., Akoth, C., Oguta, J.O., Ng'ang'a, L. & Gatimu, S.M. (2022). Prevalence and Factors Associated with Caesarean Section in Rwanda: A Trend Analysis of Rwanda Demographic and Health Survey 2000 to 2019–20. *BMC Pregnancy Childbirth*, 22: 410. https://doi.org/10.1186/s12884–022–04679–y.

Kullima, A.A., Kawuwa, M.B., Audu, B.M., Geidam, A.D. & Mairiga, A.G. (2009). Trends in Maternal Mortality in a Tertiary Institution in Northern Nigeria, *Annals of African Medicine,* 8: 221–224. https://www.bioline.org.br/pdf?am09048.

Malik, F. R., Swati, A. A., Akhter, S., Hadi, A., Safi, S. I., Wazir, S. ul I., Afridi, R. & Anas, M. (2015). Retrospective Analysis of Maternal Mortality at a Tertiary Care Hospital of Peshawar, Pakistan. *Khyber Medical University Journal,* 7(1): 25–29. https://www.kmuj.kmu.edu.pk/article/view/14379.

Martin, J. A., Hamilton, B. E., Osterman, M. J. K. & Driscoll, A. K. (2019). Births: Final Data for 2018. National Vital Statistics Reports: From the Centers for Disease Control and Prevention, National Center for Health Statistics, *National Vital Statistics System,* 68(13): 1–47. https://www.cdc.gov/nchs/data/nvsr/nvsr68/nvsr68_13–508.pdf.

McCarthy, J. & Maine, D. (1992). A Framework for Analyzing the Determinants of Maternal Mortality. *Studies in Family Planning*, 23(1): 23–33.

Mehboob, R., Gilani, S. A., Khalid, S., Hassan, A. & Alwazzan, A. (2021). Maternal Mortality Ratio in Low Income Developing Countries. In (Ed.): *Global Women's Health*. IntechOpen. https://doi.org/10.5772/intechopen.95258.

Mohammed, M. M., El Gelany, S., Eladwy, A. R., Ali, E. I., Gadelrab, M. T., Ibrahim, E. M., Khalifa, E. M., Abdelhakium, A. K., Fares, H., Yousef, A. M., Hassan, H., Goma, K., Ibrahim, M. H., Gamal, A., Khairy, M., Shaban, A., Amer, S., Abdelraheim, A. R. & Abdallah, A. A. (2020). A Ten-year Analysis of Maternal Deaths in a Tertiary Hospital Using the Three Delays Model. *BMC Pregnancy and Childbirth*, 20(1): 585. https://doi.org/10.1186/s12884–020–03262–7.

National Population Commission (NPC) and ICF International (2014). Nigeria Demographic and Health Survey 2013. Abuja, Nigeria and Rockville, USA.

National Population Commission (NPC) [Nigeria] and ICF (2019). 2018 *Nigeria DHS Key Findings.* Abuja, Nigeria and Rockville, Maryland, USA: NPC and ICF.

Nigeria Bureau of Statistics. (2018). *2017 Demographic Statistics Bulletin*.

NIPORT, MEASURE Evaluation, ICDDR, B. (2012). Bangladesh Maternal, Mortality and Health Care Survey 2010. National Institute of Population Research and Training, MEASURE Evaluation, and International Centre for Diarrheal Disease Research, Bangladesh, Dhaka.

Ntoimo, L. F., Okonofua, F. E., Ogu, R. N., Galadanci, H. S., Gana, M., Okike, O. N., Agholor, K. N., Abdus-Salam, R. A., Durodola, A., Abe, E. & Randawa, A. J. (2018). Prevalence and Risk Factors for Maternal Mortality in Referral Hospitals in Nigeria: A Multicenter Study. *International Journal of Women's Health*, 10: 69–76. https://doi.org/10.2147/IJWH.S151784.

Olamijulo, J.A., Olorunfemi, G. & Okunola, H.A. (2022). Trends and Causes of Maternal Death at the Lagos University Teaching Hospital, Lagos, Nigeria (2007–2019). *BMC Pregnancy and Childbirth,* 22.

Olukoya, O.A. & Sodipo, A. A. (2015). Statistical Analysis of Maternal and Infant Mortality in Sagamu Ogun State (A Case Study of Olabisi Onabanjo University Teaching Hospital. *International Journal of Preventive Medicine Research*, 1(3): 109–117. https://www.aiscience.org/journal/ijpmr.

Omo-Aghoja, L.O., Aisien, O.A., Akuse, J.T., Bergstrom, S. & Okonofua, F.E. (2010). Maternal Mortality and Emergency Obstetric Care in Benin City South Nigeria. *Journal of Clinical Medicine and Research*, 2(4): 055–060.

Omona, K. (2021). Determinants of Caesarean Section Rates in Private Not for Profit Healthcare Facilities: St. Joseph's Hospital Kitovu, *Cogent Medicine*, 8:1: 1928939: DOI: 10.1080/2331205X.2021.1928939.

Onakewhor, J. U., Olagbuji, B. N., Ande, A. B., Ezeanochie, M. C., Olokor, O. E. & Okonofua, F. E. (2011). HIV-AIDS Related Maternal Mortality in Benin City, Nigeria. *Ghana Medical Journal,* 45(2): 54–59. https://doi.org/10.4314/gmj.v45i2.68929.

Ope, B.W. (2020). Reducing Maternal Mortality in Nigeria: Addressing Maternal Health Services' Perception and Experience. *Journal of Global Health Reports*. e2020028. https://doi:10.29392/001c.12733.

Oyeneyin, L.O, Akintan, A.L., Aderoba, A.K. & Owa, O.O. (2017). Maternal Mortality Ratio in a Tertiary Hospital Offering Free Maternity Services in South-western Nigeria–a Five-year Review. *Tropical Journal of Obstetrics and Gynaecology*, 34:112-115.

Sageer, R., Kongnyuy, E., Adebimpe, W. O., Omosehin, O., Ogunsola, E. A. & Sanni, B. (2019). Causes and Contributory Factors of Maternal Mortality: Evidence From Maternal and Perinatal Death Surveillance and Response in Ogun State, Southwest Nigeria. *BMC Pregnancy and Childbirth*, 19(1). DOI:10.1186/s12884–019–2202–1.

Singh, S., Singh, N., Nagar, J. K. & Jain, S. (2018). Maternal Mortality at a Tertiary Health Care: A Retrospective Study. *International Journal of Reproduction, Contraception, Obstetrics and Gynecology*, 7(5): 1773–1777. https://doi:10.18203/2320–1770.ijrcog20181576.

Streatfield, P. K., Alam, N., Compaoré, Y., Rossier, C., Soura, A. B., Bonfoh, B., Jaeger, F., Ngoran, E. K., Utzinger, J., Gomez, P., Jasseh, M., Ansah, A., Debpuur, C., Oduro, A., Williams, J., Addei, S., Gyapong, M., Kukula, V. A., Bauni, E., Mochamah, G., … Byass, P. (2014). Pregnancy-related Mortality in Africa and Asia: Evidence from INDEPTH Health and Demographic Surveillance System Sites. *Global Health Action,* 7: 25368. https://doi.org/10.3402/gha.v7.25368.

Thaddeus, S. & Maine, D. (1994). Too Far to Walk: Maternal Mortality in Context. *Soc Sci Me,* 38(8): 1109–1120.

United States Agency for International Development. (2015). Ending Preventable Maternal Mortality: USAID Maternal Health Vision for Action Evidence for Strategic Approaches.

World Health Organization (2005). Reducing Maternal Deaths: The Challenge of the New Millennium in the African Region. Brazzaville: WHO.

World Health Organization (2012). The WHO Application of ICD-10 to Deaths During Pregnancy, Childbirth and Puerperium: ICD-MM. WHO Press, Geneva, Switzerland. https://iris.who.int/bitstream/handle/10665/ 70929/ 9789241548458 _eng.pdf.

World Health Organization (2015). WHO Statement on Caesarean Section Rates. https:// iris.who.int/bitstream/handle/10665/161442/WHO_RHR_15.02_eng.pdf.

World Health Organization. (2015). *WHO Statement on Caesarean Section Rates*. Geneva, Switzerland: Department of Reproductive Health and Research. https://apps. who.int/ iris/ bitstream/handle/10665/161442/WHO_RHR_15.02_ eng. pdf; jsessionid= 27FD7A EE6FD1059F065393F9A5AD2756?sequence=1.

World Health Organization (2019). *Trends in Maternal Mortality* 2000 *to* 2017. *Estimates by WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division.* Geneva. https://www.who.int/reproductivehealth/publications/maternal- mortality-2000–2017/en/

World Health Organization. (2023). Trends in maternal mortality 2000 to 2020: estimates by WHO, UNICEF, UNFPA, World Bank Group and UNDESA/Population Division. Geneva. https://iris.who.int/ bitstream/ handle/ 10665/366225/ 9789240068759–eng. pdf? sequence=1.

Zolala, F. (2009). Exploring routine data collection systems in Iran, focusing on maternal mortality and using the city of Bam as a case study (Master of Philosophy (MPhil). Thesis. University of Edinburgh. https://www.era.lib.ed.ac.uk/bitstream/handle/ 1842/ 5962/Zolala2011.pdf;sequence=2.