# Predictors of maternal mortality in institutional deliveries in Nigeria

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## Abstract

**Background:** Maternal mortality in poor countries reflects the under-development in these societies. Global recognition of the burden of maternal mortality and the urgency for a reversal of the trend underpin the Millenium Development Goals (MDGs).

**Objective:** To determine risk factors for maternal mortality in institutional births in Nigeria.

**Method:** Twenty one health facilities in three states were selected using stratified multi-stage cluster sampling strategy. Information on all delivered mothers and their newborn infants within a three-month period was culled from medical records.

**Results:** A total of 9 208 deliveries were recorded. About one-fifth (20.5%) of women had no antenatal care while 79.5% had at least one antenatal visit during pregnancy. Four-fifths (80.5%) of all deliveries were normal deliveries. Elective and emergency caesarean section rates were 3.1% and 11.5% respectively. There were 79 maternal deaths and 8 526 live births, giving a maternal mortality ratio of 927 maternal deaths per 100 000 live births. No antenatal care, parity, level of education, and mode of delivery were significantly associated with maternal mortality. Low maternal education, high parity, emergency caesarean delivery, and high risk patients risk independently predicted maternal mortality.

**Conclusion:** Meeting goal five of the MDGs remains a major challenge in Nigeria. Multi-sectoral approaches and focused political will are needed to revert the high maternal mortality.

**Key words:** maternal mortality; maternal death; predictors

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## Introduction

Maternal mortality as a significant public health problem was first highlighted in 1987 at the first International Safe Motherhood Conference in Nairobi, Kenya. Current estimates of maternal mortality indicate that about 358 000 maternal deaths resulting from complications of pregnancy and childbirth occur annually[1]. For every maternal death, many more women suffer serious complications[2].

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The causes of the vast majority of these deaths and complications namely obstetric haemorrhage, sepsis, unsafe abortion, hypertensive disorders, and obstructed labour are preventable[3]. Maternal mortality is a reflection of women's place in society and their lack of access to social, health and nutrition services, and to economic opportunities[2]. Introduction of improved asepsis, caesarean section, blood transfusion services, and improved prenatal care curtailed maternal mortality in industrialized nations almost a century ago[4]. However, access to these interventions is limited in developing countries.

There are several dimensions to maternal mortality. Fundamentally, a woman's death during pregnancy or childbirth is not only a health issue but

also a matter of social injustice[2] reflecting the failure of communities and governments to promote safe motherhood as a human right[5, 6]. Maternal mortality also reflects disparities in socio-economic development. The overwhelming majority of maternal deaths occur in developing countries[2]. Sub-Saharan Africa and South Asia account for about 87% of all maternal deaths[1]. The lifetime risk of maternal death in sub-Saharan Africa is 1 in 31 compared to 1 in 4,300 in developed regions[1]. The higher risk in developing countries reflects limited quality of care and provision of maternal health services[7, 8]. In sharp contrast, sequel to improvements in obstetric care over the past decades, a pregnant woman in the United Kingdom is reported to face a less than 1 in 19,020 risk of dying from obstetric complications directly related to the pregnant state[9].

Goal five of the Millenium Development Goals (MDGs) aims to achieve three-quarter reduction of maternal mortality by 2015[10]. Previous estimates of maternal mortality ratio in Nigeria showed that there had been an increase from 800[11] to 1 100[12] per 100 000 live births. However, the 2008 Demographic and Health Surveys (DHS) for Nigeria showed a decline in maternal mortality with a maternal mortality ratio of 545 maternal deaths per 100 000 live births[13]. Facility-based data support the contention that maternal mortality is on the decline. However, the figures remain high[14]. High maternal mortality in Nigeria is supported by the finding that Nigeria, along with five other countries contributed more than 50% of all maternal deaths worldwide in 2008[15].

Given the weak civic registration and national health information systems in many developing countries, these estimates remain guess work[16]. Therefore urgent initiatives to monitor maternal morbidity and mortality are imperative[17] to provide reliable information for planning and evaluation.

The WHO Global Maternal and Perinatal Health Survey implemented in 2005 aimed to establish a global data system comprising a network of health facilities that will collect focused information on maternal and perinatal health to facilitate identification of morbidity and mortality, monitoring of use of interventions and programme evaluation. This report discusses maternal characteristics associated with maternal mortality in Nigeria.

## Methods

This analytical cross sectional survey was designed as a pilot study for the WHO global datasystem. Countries were selected from the six regions of the WHO based on under-five and adult mortality rates[18]. Nigeria was one of the eight countries selected in the African region. In each country, three geographical regions which always included the capital city and two other states were randomly selected. Therefore the Federal Capital Territory, Katsina, and Lagos states were selected in Nigeria.

A stratified multi-stage sampling design was used to obtain a representative sample of health facilities. In each of these geographical regions, a census of all major health facilities, both public and private, with annual deliveries of 1,000 or more was conducted. For this purpose, the average annual delivery of each health facility was derived from the total annual deliveries in 2002 and 2003. This list constituted the sampling frame of health facilities in each state from which seven were randomly selected. Thus a total number of 21 health facilities were selected.

Ethical approval for the study was obtained from WHO's Scientific and Ethical Review Group and Ethics Review Committee. Approval for the study was obtained from the Ministry of Health in Katsina and Lagos states and the Department of Health of the Federal Capital Territory. Administrative and ethical approvals were also obtained in the participating health facilities.

The study was conducted in the selected health facilities for a period of three months between October 2004 and March 2005. In each health facility, the study was conducted during a three month period. All women who delivered in the selected health facilities during this period comprised the study population. Data were obtained at the individual patient level and the health facility level. For individual patient data, maternal characteristics including age, marital status, education, weight, height, reproductive history, and last infant birth weight were documented. Pre-existing medical conditions such as diabetes mellitus, chronic hypertension, and pregnancy complications were recorded. Mode of onset of labour (spontaneous or induced) and indications for induction of labour were noted. Also recorded were the mode of delivery, whether spontaneous, vaginal birth after previous caesarean delivery, caesarean delivery (elective or emergency), instrumental delivery, symphysiotomy, or assisted breech delivery.

Gestational age and birth weight of the newborn were recorded. Maternal outcomes reported included infection, haemorrhage, transfusion, uterine rupture, hysterectomy, intensive care admission, referral and death. A woman was considered unbooked if she was referred for delivery in that health facility although she had received antenatal care elsewhere. Women who had no antenatal care were those did not register for formal antenatal care in the current pregnancy. The instrument for individual patient data collection was a 54-item pre-tested data form.

Facility level data included type of facility (primary without surgical facilities, secondary, or tertiary with surgical facilities); location (urban, semi-urban, and rural); hospital resources (blood transfusion or replacement capability, antibiotics, anaesthesia capability, intensive care unit); and birth attendants (type, number, qualifications). Facility level information was completed on a pre-designed data sheet by the medical director of each health facility.

The research team in each health facility comprised of a midwife and a physician. Prior to commencement of the study, the study team underwent a structured training. They were also guided by an operational manual which contained explicit criteria for data collection. Medical records of all study participants were reviewed and abstracted by the midwife.

It was not necessary to obtain consent from the patients because there was no direct contact with them. Incomplete data in medical records were updated by liaising with attending staff before the patient's discharge. A log book of all deliveries in each health facility was also completed to facilitate monitoring of completeness of patient recruitment. The number of completed forms was cross checked against the entries in the log book. During monitoring visits to each health facility, the entries in the log book were also cross checked with the labour ward birth register.

Data were entered onto an online global database at the country level by a data clerk who had received training. The study methodology has been previously published[19]. Data analysis was performed with SPSS software version 15.0. Associations were tested using chi square or Fisher's exact test as appropriate; the level of statistical significance was set at $p < 0.05$. Multivariate logistic regression analysis with analysis of variance was used to assess independent risk factors associated with maternal mortality.

## Results

Nigeria was one of the 26 countries in Africa, Latin America and Asia that participated in the global survey. Twenty one health facilities participated in the survey. Health facilities and their corresponding level of care are listed on Table 1.

**Table 1: Selected health facilities and level of care**

| FCT | Katsina State | Lagos |
|---|---|---|
| Gwarinpa General Hospital (Secondary) | Katsina General Hospital (Secondary) | Lagos State Univ. Teach. Hosp. (Tertiary) |
| Wuse General Hospital (Secondary) | Daura General Hospital (Secondary) | Lagos Univ. Teach. Hosp. (Tertiary) |
| Nyanya General Hospital (Secondary) | Kankia General Hospital (Secondary) | Island Maternity Hospital (Secondary) |
| Asokoro General Hospital (Secondary) | Malunfashi General Hospital (Secondary) | Gbagada General Hospital (Secondary) |
| Maitama General Hospital (Secondary) | Jibia General Hospital (Secondary) | R-Jolad Hospital(Secondary) |
| National Hospital (Tertiary) | Dutsenma General Hospital (Secondary) | Badagry General Hospital (Secondary) |
| Gwagwalada Specialist Hosp. (Tertiary) | Federal Medical Centre, Katsina (Tertiary) | Isolo General Hospital (Secondary) |

There were five tertiary and sixteen secondary health facilities and only one health institution was private. Available services and personnel in participating health facilities are shown in table 2. The estimated population served refers to the total population within the health facility's catchment area, while the percentage of pregnant population served was the proportion of pregnant women within the served population that patronise the health facility. Most health facilities reported availability and use of the

partograph for intrapartum care. A total of 9 208 deliveries were reported during the study period. One thousand one hundred and thirty two women (12.3%) were referred from elsewhere for delivery. Characteristics of the women are shown in table 3. Onset of labour was spontaneous in 8 251 (89.6%) women, while 577 (6.3%) had induction of labour.

**Table 2: Characteristics, services, and personnel in participating health facilities**

| Characteristic | Number of health facilities (n) | % |
|---|---|---|
| **Number of maternity beds** | | |
| ≤ 30 | 11 | 52.4 |
| 31 – 50 | 5 | 23.8 |
| 51 – 100 | 3 | 14.3 |
| ≥ 100 | 2 | 9.5 |
| **Estimated population served** | | |
| < 100,000 | 3 | 25.0 |
| 100,000 – 500,000 | 6 | 50.0 |
| > 500,000 | 3 | 25.0 |
| **Percentage of pregnant population served** | | |
| < 25% | 5 | 55.6 |
| 25 – 50% | 2 | 22.2 |
| > 50% | 2 | 22.2 |
| **Functional blood bank** | | |
| Yes | 18 | 85.7 |
| No | 3 | 14.3 |
| **Neonatal intensive care unit** | | |
| Yes | 11 | 52.4 |
| No | 10 | 47.6 |
| **Obstetrician available** | | |
| Yes | 16 | 76.2 |
| No | 5 | 23.8 |
| **Anaesthetist available** | | |
| Yes | 10 | 50.0 |
| No | 10 | 50.0 |
| **Nurse/Paramedic performing anaesthesia** | | |
| Yes | 16 | 76.2 |
| No | 5 | 23.8 |
| **Partograph available for intrapartum care** | | |
| Yes | 15 | 71.4 |
| No | 6 | 28.6 |

**Table 3: Characteristics of delivered mothers**

| Age group (years) | N | % |
|---|---|---|
| ≤ 20 | 1298 | 14.1 |
| 21 – 25 | 1935 | 21.0 |
| 26 – 30 | 3161 | 34.4 |
| 31 – 35 | 1843 | 20.1 |
| 36 – 40 | 789 | 8.6 |
| > 40 | 168 | 1.8 |
| **Duration of schooling (years)** | | |
| None | 1890 | 20.7 |
| 1 – 6 | 1443 | 15.8 |
| 7 – 12 | 3270 | 35.9 |
| ≥ 13 | 2513 | 27.6 |
| **Parity** | | |
| 0 | 2543 | 28.9 |
| 1 -2 | 3549 | 39.3 |
| 3 – 4 | 1631 | 18.5 |
| > 5 | 1169 | 13.3 |
| **Risk level** | | |
| Low risk | 6771 | 23.5 |
| High risk | 2437 | 76.5 |
| **Number of antenatal visits** | | |
| None | 1877 | 20.5 |
| 1 – 4 | 1859 | 20.3 |
| > 4 | 5421 | 59.2 |

The mode of delivery is shown in table 4. The majority of the women (7 374; 80.1%) had normal vaginal delivery. One thousand three hundred and forty four (14.6%) women had caesarean delivery distributed as: elective caesarean section (282; 3.1%) and emergency caesarean section (1 062; 11.5%). Instrumental delivery was performed in 156 women (1.7%) and assisted breech delivery in 289 women (3.1%). Laparotomy for ruptured uterus was reported in 23 (0.3%) women. There were 8 526 (92.6%) live births, 369 (4.0%) fresh stillbirths and 282 (3.1%) macerated stillbirths. A total of 79 maternal deaths were reported. Overall maternal mortality ratio was thus 927 maternal deaths per 100,000 live births. Maternal mortality ratios for the states were 568; 1 315; and 993 per 100 000 live births for FCT, Katsina and Lagos states respectively.

**Table 4: Association between maternal characteristics and maternal death**

| **Education** | | |
|---|---|---|
| **Duration of schooling (years)** | **No. of maternal deaths** | **%age within group** |
| None (N - 1885) | 27 | 1.4 |
| 1 – 6 (N – 1441) | 18 | 1.2 |
| 7 – 12 (N – 3264) | 22 | 0.7 |
| ≥ 13 – 18 (N – 2502) | 10 | 0.4 |
| **(chi square – 17.6; p < 0.001)** | | |
| **Parity group** | **No. maternal of deaths** | **%age within group** |
| 0 (N – 2538) | 12 | 0.5 |
| 1 – 2 (N – 3455) | 28 | 0.8 |
| 3 – 4 (N – 1630) | 11 | 0.7 |
| ≥ 5 (N - 1166) | 23 | 2.0 |
| **(chi sqaure – 22.6; p < 0.0001)** | | |
| **No. of antenatal visits** | **No. of maternal deaths** | **%age within group** |
| None (N – 1869) | 32 | 1.7 |
| 1 – 4 (N – 1857) | 15 | 0.8 |
| > 4 (N – 5416) | 32 | 0.6 |
| **(chi sqaure – 20.5; p < 0.0001)** | | |
| None (N – 1869) | 32 | 1.7 |
| ≥ 1(N – 7273) | 47 | 0.7 |
| **chi sqaure – 19.7; p < 0.0001)** | | |
| **Mode of delivery** | **No. of maternal deaths** | **%age within group** |
| Spontaneous (N – 7404) | 36 | 0.5 |
| Operative vaginal delivery (N – 450) | 9 | 2.0 |
| Elective caesarean section (N – 282) | 3 | 1.1 |
| Emergency CS – (N – 1062) | 28 | 2.6 |
| **(chi sqaure– 60.7; p < 0.0001)** | | |

Women were categorised as high risk if pregnancy or intra-partum complications (e.g. pre-eclampsia, eclampsia, diabetes mellitus, pre-labour rupture of membranes, post-term, intra-uterine growth restriction, vaginal bleeding etc) were identified. There were 2 283 (26.2%) high risk women. Although the majority of high risk pregnancies (1 671; 73.2%) were managed in secondary health facilities compared with tertiary institutions (73.2% vs. 26.8%), the proportion of high risk cases seen in the patient population of tertiary institutions were higher (41.9% vs. 23.0%). These differences were statistically significant ($p < 0.0001$). There was no significant difference in the number of deaths in tertiary health facilities and secondary health facilities. Although women older than 35 years had a higher risk of dying from complications of pregnancy and child birth compared with younger women, maternal age was not significantly associated with maternal death ($p > 0.05$).

Duration of schooling was significantly associated with the risk of maternal death. Risk of maternal death decreased with increased duration of schooling ($p < 0.01$) as shown in Table 4. Antenatal care was protective of maternal death, because the risk of maternal death decreased with the increased numbers of antenatal visits. Women who received no antenatal care were at increased risk of maternal death ($p < 0.0001$) as shown in table 4. Women who made at least one antenatal visit had a significantly reduced risk of death [chi square= 19.7; $p < 0.0001$, Relative Risk (RR) – 0.99, 95% CI (0.98 – 0.99)]. Unbooked status also increased risk of maternal death [chi square = 53.7; $p < 0.0001$; RR – 1.01, 95 % CI (1.01 – 1.03)]. Compared with women who had some education, women with no education were more likely to have been unbooked ($p < 0.0001$), as shown in table 5.

**Table 5: Education and referral for delivery**

| Duration of schooling (years) | No. referred for delivery | % age within group |
|---|---|---|
| None (N – 1886) | 282 | 15.0 |
| 1 – 6 (N - 1443) | 182 | 12.6 |
| 7 -12 (N – 3269) | 404 | 12.4 |
| ≥ 13 (N – 2513) | 242 | 9.6 |

**chi square – 22.9; p < 0.0001**

Grandmultiparity was shown to significantly increase the risk of maternal death (p < 0.0001). When compared with spontaneous onset of labour and women who had no labour, induction of labour significantly increased the risk of maternal death (p < 0.0001). Of 412 women who received oxytocin for induction of labour, there were 19 (4.6%) maternal deaths. Of 70 women who received misoprostol, there was no reported maternal death.

Regarding mode of delivery and maternal death, emergency caesarean section had the highest risk of death (p < 0.0001), as shown in table 4.

Multivariate regression analysis was used to assess independent predictors of maternal mortality. The variables that were significantly associated with maternal mortality were entered into the regression model. At the level of the patient, lack of/low level of education, high parity, need for emergency caesarean section, and high level of obstetric risk independently predicted maternal death (table 6). At the health facility level, availability of anaesthetists was the only variable independently predictive of maternal death.

**Table 6: Table of multivariate regression analysis**

| Variable | p-value | Odds ratio | 95% CI | |
|---|---|---|---|---|
| | | | Lower | Upper |
| **Duration of schooling** | 0.003 | | | |
| None | 0.001 | 4.99 | 1.90 | 13.08 |
| 1 – 6 | 0.001 | 4.76 | 1.97 | 11.52 |
| 7 – 12 | 0.051 | 2.22 | 0.99 | 4.96 |
| > 13 | | 1 | | |
| **Antenatal visits** | 0.226 | | | |
| None | 0.117 | 1.60 | 0.90 | 2.87 |
| 1 – 4 | 0.865 | 0.94 | 0.46 | 1.92 |
| > 4 | | 1 | | |
| **Parity** | 0.047 | | | |
| 0 | 0.041 | 2.17 | 1.03 | 4.55 |
| 1 – 2 | | 1 | | |
| 3 – 4 | 0.374 | 1.49 | 0.62 | 3.56 |
| > 4 | 0.010 | 2.91 | 1.30 | 6.52 |
| **Mode of delivery** | 0.000 | | | |
| Spontaneous | | 1 | | |
| Operative vaginal delivery | 0.094 | 2.01 | 0.89 | 4.56 |
| Elective caesarean section | 0.446 | 1.63 | 0.46 | 5.72 |
| Emergency caesarean section | 0.000 | 3.83 | 2.13 | 6.90 |
| **Level of facility** | | | | |
| Secondary | 0.101 | 0.55 | 0.27 | 1.12 |
| Tertiary | | 1 | | |
| **Partograph available** | | | | |
| No | 0.934 | 1.04 | 0.38 | 2.91 |
| Yes | | 1 | | |
| **Anaesthetist available** | | | | |
| No | 0.022 | 0.35 | 0.18 | 0.69 |
| Yes | | 1 | | |
| **Payment for delivery services** | | | | |
| No | 0.360 | 1.73 | 0.54 | 5.54 |
| Yes | | 1 | | |
| **Maternal risk level** | | | | |
| Low | | 1 | | |
| High | 0.000 | 3.16 | 1.82 | 5.49 |

## Discussion

The WHO Global Maternal and Perinatal Health Survey was implemented with the objective of establishing a network of health facilities globally that will serve as focal points for obtaining vital information on maternal and prenatal health that may assist policymakers in evaluating access to and the impact of interventions. This report confirms its successful implementation in Nigeria. The main strength of the approach lies in the prospective collection of data.

Given that a large proportion of all maternal deaths take place in hospitals in most settings[20], establishment of effective mechanisms for registration of all deaths within the health care system will offer great potentials for monitoring trends and evaluating the impact of interventions. For this reason, models such as this global survey need to be implemented and strengthened.

The reported maternal mortality ratio in the current study (927 maternal deaths per 100 000 live births) is higher than the value of 545 maternal deaths per 100 000 live births estimated for Nigeria in the recent demographic and health surveys[13]. The differences are understandable since the demographic and health survey was a community survey employing the sisterhood method of estimating maternal mortality[21] whereas this study was health facility based. Reports of either method should be interpreted with caution bearing in mind their inherent limitations. Whereas the sisterhood method estimates maternal mortality within the preceding seven - eight years prior to the survey, health facility based surveys may not fully reflect the reality within the community. In addition, the figures in the current study may have under-estimated the true rates as the women were not subsequently followed up after discharge from the hospital. Thus women who might have died elsewhere within the first 42 days after childbirth have not been accounted for.

The maternal mortality ratio derived from this study was similar to the estimated maternal mortality ratio of 900 per 100,000 live births in 2005 by the World Health Organization[1]. This lends credence to this study. However, the prospective nature of the present study confers an important advantage over many studies on maternal mortality which are often retrospective in nature. Our findings therefore reflect current reality within the Nigerian health system. The crucial issue however should be the identification of effective interventions to enhance maternal health.

Recent reports, including the demographic and health surveys confirm, high incidence of maternal mortality[22, 23]. Figures from the current study support the contention that maternal mortality is unacceptably high in Nigeria[12]. These high figures cast doubt on the feasibility of achieving the health components of the MDGs in Nigeria. The report on maternal mortality estimates between 1990 and 2008 showed that Nigeria had made insufficient progress towards achieving these components[1].

Risk factors for maternal mortality identified in this study had also been previously described as the major predictors for maternal mortality in health facility based studies in Nigeria. Young age, older women, unbooked status and grandmultiparity were the significant predictors of maternal mortality reported by Ujah et al[22]. Non-utilization of maternity services, low literacy, and poverty were important predictors of maternal mortality reported from Benin, Nigeria[23]. Some of these predictors were confirmed in this study. Maternal education, for example, conferred protection against maternal death as the risk of maternal death decreased with increasing duration of schooling. Our data also revealed that women with higher levels of education tended to require referral less compared with less educated women. Implicit in this finding was that the more educated woman would probably receive quality care in standard facilities. Therefore promotion of female education and universal access to sexual and reproductive health remain key interventions that hold the key to solving the riddle of maternal mortality in developing countries.

The study reveals the pivotal role of access to antenatal care in reduction of maternal mortality. About a fifth of all women in the study received no antenatal care. Almost 60% of women made at least four visits to the antenatal clinic. These findings differ from those of the recent demographic and health surveys[13]. In the demographic and health surveys, 36.3% of Nigerian women received no antenatal care while about 45% had at least four antenatal visits. These differences are probably due to the fact that most of the participating health facilities in the current study were in urban centres. It is remarkable, however, that maternal deaths among women who received no antenatal care were almost triple the rate among women who had more than four antenatal visits. Additionally, deaths among women with no antenatal care was about two and a

half times higher than in women who had at least one antenatal visit.

Our findings also revealed, albeit indirectly, certain deficiencies in the health care system. Previous authors reported that the unbooked mother tended to arrive in moribund condition[22, 23], reflecting a weak referral system and inadequate facilities for emergency obstetric care. The trend noted in this study whereby the need for intensive care was strongly associated with maternal mortality similarly reflects poor health infrastructure. Only half of all participating health facilities had qualified anaesthesiologists who could provide quality intensive care. The significant association between maternal mortality and lack of anaesthsiologists reinforces this contention.

## Conclusion

High rates of maternal mortality in Nigeria have multiple predictors among, which are socio-cultural determinants and deficiencies in the health care system. Although achieving the health related MDGs by 2015 may be a mirage, the current impetus should serve as catalyst for mobilization of a sustained political will that will lay a strong foundation committed to ensuring equitable social development and universal access to sexual and reproductive health. Maternal mortality remains unacceptably high in Nigeria. Low levels of maternal education, lack of antenatal care, poor quality intra-partum care and deficiencies in the health care system are the major predisposing factors to maternal mortality. Strategies aimed at reducing the high maternal mortality figures must incorporate interventions directed at these root causes in order to be effective.

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