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Article

Maternal mortality in northern Nigeria: findings of a health and demographic surveillance system in Zamfara State, Nigeria

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SUMMARY The aim of this study was to estimate: (1) the lifetime risk (LTR) of maternal death; and (2) the maternal mortality ratio (MMR) in the Zamfara State of northern Nigeria. Data from the Nahuche Health and Demographic Surveillance System were utilized using the 'sisterhood method' for estimating maternal mortality. Female respondents (15–49 years) from six districts in the surveillance area were interviewed, creating a retrospective cohort of their sisters who had reached the reproductive age of 15 years. Based on population and fertility estimates, we calculated the LTR of maternal death and the MMR. A total of 17,087 respondents reported 38,761 maternal sisters of whom 3592 had died and of whom 1261 were maternal-related deaths. This corresponded to an LTR of maternal death of 8% (referring to a period of about 10.5 years prior to the survey) and an MMR of 1049 deaths per 100,000 live births (95% confidence interval, 1021–1136). The study provides documented evidence of high maternal mortality in the study area and the state as a whole. Thus, there is a need to improve the health system with an emphasis on interventions that will accelerate reduction in MMR such as the availability of skilled birth attendants and emergency obstetric care, promotion of facility delivery and antenatal care attendance. This can be achieved through a holistic approach and is critical in order to accelerate progress in meeting the Millennium Development Goal of maternal mortality reduction.

Introduction

Maternal mortality – defined in this study as the death of women during pregnancy, childbirth or in the 42 days after delivery – is one of the major challenges to health systems worldwide and in sub-Saharan Africa (SSA) in particular.[1] In order to speed up the efforts to address this challenge, maternal mortality reduction became one of the eight goals of the Millennium Development Goals (MDG 5). The target of MDG 5 is to reduce the maternal mortality ratio (MMR) by three-quarters, from 1990 to 2015.[2]

A number of studies[3,4] have documented that the progress needed to reduce maternal mortality has generally been slow and, in many places, non-existent. In Nigeria, Hogan *et al.*[1] reported the MMR in 2008 to be 608 deaths/100,000 live births (95% confidence interval [CI], 372–946). This was an increase from an MMR of 473 (95% CI, 306–703) in 1990. Despite maternal mortality being very difficult to measure, the need for accurate monitoring of maternal mortality is a priority for many countries, including Nigeria. Accurate measurements are essential for planning and monitoring the outcomes or the impact of interventions. Recently, Nigeria expressed reservations about the accuracy and methods used to obtain the figures quoted and the bases for such estimates.[5]

Several efforts have been made in many countries to improve the quality of information about maternal mortality, such as: the incorporation of sibling history modules in large scale household surveys; determining whether recent deaths in censuses were related to pregnancies; and the use of record linkage or confidential inquiry to identify under-registration of (maternal) deaths in vital registration systems.[6] Despite these efforts, registration is virtually non-existent in Nigeria.

Where efforts to study maternal mortality in rural SSA do exist, they are often met with challenging issues (i.e. a large sample size is required for these events, a majority of maternal deaths occur at home and follow-up studies take up a lot of time). The 'sisterhood method' for estimating MMR is an ideal method in such settings since a smaller number of respondents is required compared with the vital registration and cohort studies. Data collection procedures for this method are retrospective, simple, quick and based on information about maternal deaths among sisters of the respondents.[7] However, a disadvantage of this method is that it is not used to measure progress towards safe motherhood in the short term nor does it evaluate the programme impact.[8]

In this paper, we estimate the lifetime risk (LTR) of maternal death and, from that, the MMR. This method has

been used and validated elsewhere.[9,10] We collected maternal and child health data from women of reproductive age (15–49 years) as part of a health and demographic surveillance system (HDSS) in Nahuche emirate in the Bungudu Local Government Area (LGA) of Zamfara State in northern Nigeria. The estimation of MMR has generally been motivated by: (1) the lack of reliable estimates of the level of maternal mortality in the study area; and (2) efforts to get an approximate level of maternal mortality for advocacy purposes and to draw attention to the problem.

Materials and methods

Study area

The Nahuche HDSS, a longitudinal health and population registration system, was implemented in 2009 by the Partnership for Reviving Routine Immunization in Northern Nigeria and the Maternal Newborn and Child Health Initiative (PRRINN-MNCH) Programme and the Zamfara State Ministry of Health (SMOH) to monitor the health and demographic dynamics. The HDSS was established with funding from the Norwegian Government and UKaid from the Department for International Development (DFID) to support studies aimed at assessing the wider progress and impact of strengthening health systems by monitoring the health and demographic events and the populations at risk over time.

The study site is 32 km from the state capital, Gusau, and constitutes six districts: Bella, Gada, Karakai, Nahuche Keku, Nahuche Ubandawaki and Rawayya. Virtually all members in the study area are Hausa by ethnicity and practice subsistence farming. The surveillance area covers 306 villages and the infrastructure remains substandard with a virtually non-existent power supply, poor sanitation, erratic water supply and poor road network. All villages have at least a primary and a junior secondary school. Temporary male labour migration is common due to high unemployment. Generally, economic and health indicators are poor. Birth deliveries often take place at home without a skilled birth attendant.[11]

A detailed description of Nahuche HDSS in terms of design, data management and control and ethical clearance (obtained from the Zamfara SMOH) has been described in detail elsewhere.[12] In brief, the Nahuche HDSS involves the continuous monitoring of the health and demographic (births, deaths, migration) events of the entire population of the surveillance area. As part of the initial HDSS activities, a baseline census was conducted between September and December 2010 on a population of 125,149 (62,389 males; 62,760 females) individuals residing in 19,193 households. Beginning in January 2011, interviewers visited households in the surveillance area in 180-day work cycles (i.e. update rounds) recording events in registers and reporting data to the Nahuche Health Research Centre for computerization and processing.

Data collection

During the first update round (January to June 2011), data were collected from women of reproductive age in 17,173 households using a structured questionnaire which focused on a number of maternal and child health seeking behaviour topics as well as the sisterhood questions (using the definition of 'maternal death' provided in the introduction section). Interviewers, both female and male, were fluent in the local language, Hausa.

The inclusion criteria for reported sisters were that they were born to the same mother as the respondent and had reached the reproductive age (15 years). The specific questions were as follows: (1) How many sisters have you ever had who reached reproductive age (15 years)? (2) How many of these sisters are alive? (3) How many of these sisters are dead? (4) How many of these sisters died during pregnancy, labour or within 42 days after the delivery? Interviewers checked that the sum of questions two and three was equal to the total in question one. Migration of women in the study area is insignificant, an important factor since migration can compromise the completeness of the information gathered by failing to report dead sisters who had migrated.

Analysis

The data on sibling histories were disaggregated into five-year age groups. For each age group, the number of sisters exposed to the risk of maternal death and the duration of their exposure (i.e. the number of reproductive years) was calculated by multiplying the number of sisters by an age-specific adjustment. For example, a respondent above 65 years would have a factor of 1.0, implying that all of her sisters had been observed for their entire reproductive period. The adjustment factor assumes the independence of location.

The LTR of maternal death was calculated using the total number of maternal deaths divided by the estimated total number of sisters exposed. An estimate of total fertility rate (TFR) was obtained from the 2008 Demographic and Health Survey.[13] In 2008, the TFR for Zamfara State was 7.5. The formula used to calculate and approximate the MMR from the LTR[7] was: $MMR = 1 - [(1\text{-}LTR)^{*}(1/TFR)]$. Ninety-five percent CIs for the MMR were calculated based on the formula outlined by Hanley *et al.*[14]

Results

A total of 17,087 respondents reported 38,761 maternal sisters of whom 3592 were reported dead; 1261 of those dead were maternal related deaths. Table 1 shows the sister's vital status by five-year age groups, the LTR of maternal death in Bungudu Local Government Area (LGA) and the estimated LTR for the entire cohort. The total LTR of maternal death was 8% (referring to a period about 10.5 years prior to the survey) and, using 7.5 as the TFR for Zamfara State, the estimated MMR for the surveillance site was 1049 deaths per 100,000 live births (95% CI, 1021–1136).

The results in Table 1 also show a common trend of high maternal mortality in the age groups 20–24, 25–29 and 30–34 in which at least 15% of the deaths reported by surviving sisters were as a result of maternal death. The LTR among the age groups is relatively stable and is declining (Table 1).

Table 1 Responses of 17,087 respondents about their sister's vital status and the lifetime risk of maternal death in Zamfara State

Age group of respondent	*No. of respondents (%)*	*No. of sisters*	*No. of sisters who died (%)*	*No. of maternal deaths (%)*	*Adjustment factor*	*Sisters exposed (Col.3*Col.6)*	*Lifetime risk (Col.5/Col.7)*
15–19	1862 (10.9)	3957	349 (9.7)	116 (9.2)	0.107	423	0.27
20–24	3550 (20.8)	7313	496 (13.8)	198 (15.7)	0.206	1506	0.13
25–29	3700 (21.7)	8235	758 (21.1)	270 (21.4)	0.343	2825	0.10
30–34	4291 (25.2)	10095	1041 (29.0)	334 (26.5)	0.503	5078	0.07
35–39	1880 (11.0)	4663	467 (13.0)	170 (13.5)	0.664	3096	0.05
40–44	1610 (9.4)	4050	433 (12.1)	162 (12.8)	0.802	3248	0.05
45–49	194 (1.1)	448	48 (1.3)	11 (0.9)	0.900	403	0.03
Total	17,087 (100.0)	38,761	3,592 (100.0)	1,261 (100.0)		16,580	0.08

MMR, 1,049/100,000 live births; 95% CI, 1021–1136

In order to obtain an MMR estimate for the most recent period, we replicated the analysis in Table 1 for women aged below 30 years based on the World Health Organization guidelines (1997).[8] A total of 9112 respondents reported 19,509 sisters of whom 1603 died. Of those who died, 584 (36.4%) were maternal deaths. The MMR estimate for this age group was 1732 deaths per 100,000 live births (95% CI, 1554–1826) with an LTR of 12%, referring to a period of about 7.5 years prior to the survey.

Discussion

The MMR of 1049 deaths per 100,000 live births from the study area (and the estimate based on respondents aged 30 years and below of 1732 deaths per 100,000 live births) underscores the fact that the maternal mortality situation in the rural areas of northern Nigeria is one of the worst worldwide. This is largely due to dysfunctional health systems, low antenatal care attendance and a high prevalence of home deliveries.[11]

Our study provides evidence-based data on maternal mortality in a northern Nigerian setting and compliments some of the previous MMR figures which have generally been speculative, i.e. MMR reported as being 'over 1000 deaths/100,000 live births'.[15] The findings from this study provide an indication of the challenges faced by the rural areas in Nigeria which are often characterized by poor infrastructure, poorly equipped health facilities and poor attitudes to health care seeking. Efforts to improve the infrastructure and access to health services in the rural areas will probably have a great impact on improving maternal health. Furthermore, the implementation of an Emergency Transport Scheme (ETS) for emergency obstetric cases by the PRRINN-MNCH Programme in selected remote areas such as those under Nahuche surveillance system will further help to reduce the high level of maternal mortality.

There is a greater burden of maternal death on the youngest age groups than other age groups. This may be due to the generally low age at marriage, a typical occurrence in rural northern Nigerian settings. Although this could not be ascertained since age misreporting is one of the challenges experienced in the surveillance areas and the absence of indicators to capture the age at death of the deceased, early marriages in this part have been documented elsewhere.[16,17] This confirms the fact that delaying pregnancy could be an effective intervention in minimizing LTR of maternal death.

Out-migration, which may have an effect on MMR in settings with substantial migration rates, is unlikely to affect the MMR estimate for the study area since the observed migrations were within the surveillance areas – mostly due to marriages. Also, deaths due to abortion, which may have been classified as deaths due to causes unrelated to pregnancy or childbirth and thus led to underestimate of the MMR, does not have an effect in this study area as there are no or minimal cases of out-of-wedlock pregnancies or births.

This study has two key limitations. First, the study comes from a surveillance area in an LGA spanning the Nahuche emirate and is subject to the prevailing conditions, although they are probably fairly similar to other parts of rural Zamfara State. However, variations in health service delivery and accessibility limit the generalization of our results to other rural areas. Secondly, we had no information on the residence of the sisters in the cohort and proxied it with the respondent's village or district. Despite the estimates of LTR to a period of about 10.5 years prior to the survey, our results call for intensification of a health service delivery that takes into consideration the terrain of the study area and seasonality of accessibility.

Conclusion

Our results indicate a need for the Government of Nigeria and other partners to focus *inter alia* on the improvement of the health system with an emphasis on interventions that will accelerate the reduction of MMR such as: availability of skilled birth attendants; availability of emergency obstetrics care; promotion of facility delivery; and antenatal care attendance. The implementation of an ETS scheme in hard-to-reach rural areas in the country will also help to accelerate the attainment of MDG 5.

Some of the planned activities for the Nahuche HDSS include conducting verbal autopsy (VA) interviews in order to determine individual causes of death and cause-specific mortality fractions. The VA method is useful in populations that do not have a complete vital registration system. VAs will assist the PRRINN-MNCH Programme and the Zamfara SMOH in getting real-time estimates of maternal mortality as well as assist in efforts to understand why women are dying of pregnancy-related causes. These estimates will enable us to assess the effect of any interventions in the long term.

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