Estimating

Maternal Mortality Differentials Using Census Data

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Abstract

High levels of maternal mortality in developing countries are considered a major public health problem. Over the past decade several international conferences on health have stated the necessity to reduce maternal mortality in developing countries. This is a challenge not only in terms of achieving it but also from the point of view of monitoring it. I use national population censuses to measure maternal mortality and study regional and socioeconomic differentials in three countries (Nicaragua, Honduras, and Mozambique), which identified maternal mortality in their most recent census. I use standard demographic methods to evaluate the census data quality and to correct for mortality under-registration.

Introduction

High levels of maternal mortality in developing countries are considered a major public health problem. The United Nations Millennium Development Goal 5 is to improve maternal health, and one of the the specified target is to reduce the Maternal Mortality Ratio (MMR, maternal deaths per 100,000 live births) by three-quarters between 1990 and 2015. This is a challenging target, not only from the point of view of achieving it but also from the point of view of monitoring progress towards it. The MMR is measured by dividing the number of maternal deaths in a period by the live births in the same period. However, the MMR is difficult to measure accurately even in developed countries because maternal deaths are frequently not well-reported. In the developing world, studies of maternal mortality are even more complicated because of lack of quality vital registration systems and other difficulties in data collection (Stanton, 2001).

One approach to measurement of the MMR has been the “sisterhood” method, using Demographic and Health Surveys (DHS). In this survey, individuals are asked about the survival of their sisters, and for sisters who died during the reproductive ages additional questions are asked about whether the sister was pregnant or within 2 months of delivery at the time of death (Graham, 1989). The main limitation with this approach is that sampling errors are large even for surveys of 10,000 households or more, and research has raised doubt about the validity of the estimates produced using DHS. Another possibility is to estimate maternal mortality indirectly from sex-specific death rates. The main idea behind this approach is to study deviations from a regular pattern of ratios of female to male mortality by age (Bhat, 1995). This approach uses information that is regularly collected in registration systems, surveys and censuses. However, the method remains very sensitive to variations in external causes of death; requires extra data, and raises questions as to which age pattern of the sex-ratio of deaths to chose.

An alternative approach used to estimate adult mortality in countries lacking accurate vital registration has been the use in population censuses of questions about household deaths in a defined, recent period before the census (Stanton, 2001). A number of countries included the necessary questions in their 1990 census round; and several also included

additional questions for deaths of women of reproductive age as to whether they were pregnant or within two months of delivery at the time of death, permitting the estimation of pregnancy-related mortality (Hill, 2001). A larger number of national censuses are expected to include the questions in the 2010 census round because of a stronger endorsement of the approach in the most recent U.N. Principles and Recommendations. One of the main advantages of census data is the sample size, a large sample size allows some analysis of differentials (regional and/or socioeconomic). To my knowledge, the research on estimating maternal mortality using census data has not yet made use of this advantage. However, the level of socioeconomic differentials and regional disparities are large in most of the developing world what might also reflect in maternal mortality differentials across regions and socioeconomic groups.

The main objective of the paper is study trends (when possible) and levels of maternal mortality considering regional and socioeconomic differentials on Honduras, Nicaragua and Mozambique using their most recent census data. The more specific objectives are: assess data quality (both population census and mortality); and estimate levels and trends of mortality.

Data

Estimating maternal mortality (pregnancy-related) using population censuses rather than vital registration requires some specific information. In the 2000 census round, a large number of countries included questions on household deaths and timing of death relative to pregnancy, including Honduras, Nicaragua, and Mozambique. The data needed are as follows (Hill, 2001):

1. Two population age and sex distributions from successive censuses separated by not more than about 15 years;
2. An age and sex distribution of household deaths reported for some relatively short time period prior to at least one (and preferably both) of the censuses;
3. For deaths of women of reproductive age, information on whether the woman was pregnant, in childbirth, or within 6 weeks (or 2 months) of delivery at the time of death.
4. Information (typically births by age of mother reported for some relatively short reference period before one or both of the censuses, together with similar information on numbers of children ever born) to estimate the number of births in the reference period covered by the deaths.

This paper analyzes the data from three countries (Honduras, Nicaragua & Mozambique), exploring regional and socioeconomic differences, to draw lessons regarding the feasibility of this approach. The question on household deaths referred to deaths in the calendar year prior to the census. This question identifies a clearly defined reference period, but risks increasing recall error relative to a question on deaths in the 12 months before the census.

The census approach to estimate maternal mortality has a number of advantages: he number of events reported will be large, allowing some analysis of differentials, and the data lend themselves to the application of formal evaluation methods developed for incomplete vital registration data. The methodology has also a series of disadvantages: the data on numbers of deaths from all causes are often biased downwards, censuses are conducted infrequently and therefore cannot be used for regular monitoring purposes, and that the questions on timing of death identifies all pregnancy-related deaths (all those occurring during pregnancy or in the 6 weeks thereafter), including deaths incidental to the pregnancy as well as true maternal deaths (Hill, 2001).

However, previous research has shown that collecting information on deaths for women in their pregnancy period in population censuses is a feasible way to estimate maternal mortality in developing countries (Stanton, 2001). Although data sources such as DHS have improved our knowledge of process indicators related to maternal mortality, such as institutional delivery or skilled attendant at delivery, the estimates of maternal mortality have been disappointing. It seems from the findings in the literature that data collected from Census provide a unique opportunity to study regional and, in some cases, socioeconomic differentials in maternal mortality.

Methods

Estimating the pregnancy-related mortality ratio (PRMR) using the census requires three types of data: numbers of deaths of women of reproductive age, the proportion of those deaths that are pregnancy-related, and number of births in the period covered by the deaths). The estimation also requires the application of a variety of evaluation methods and a key assumption that reported pregnancy-related deaths approximate true maternal deaths.

Several methods based upon equations of population dynamics have been developed

to evaluate the coverage of reported deaths relative to populations. The death distribution methods (DDM) are commonly used to estimate adult mortality in a non-stable population (Hill, 1997). A stable population is one in which the birth and death rates are unchanging over a long period of time. The DDM methods compare the distribution of deaths by age with the age distribution of the living and provide age patterns of mortality in a defined reference period. There are two major approaches: the General Growth Balance Methods, and the Synthetic Extinct Generation method.

In this paper, I use the General Growth Balance method (GGB). The method is derived from the basic demographic balancing equation, which expresses the identity that the growth rate of the population is equal to the difference between its entry rate and exit rate. This identity holds for open-ended age segments *x*+, and in a closed population the only entries are through birthdays at age *x*. The "birthday" rate *x*+ minus the growth rate *x*+ thus provides a residual estimate of the death rate *x*+. If the residual estimate can be calculated from population data from two population censuses and compared to a direct estimate using the recorded deaths, the completeness of death recording relative to population recording can be estimated. Hill (1987) shows that

$$\frac{\left({}_5N1_{x-5} * {}_5N2_x\right)^{0.5}}{5*\left(N1_{x+} * N2_{x+}\right)^{0.5}} - \frac{1}{t}\ln\left(\frac{N2_{x+}}{N1_{x+}}\right) \approx \frac{1}{t}\ln\left(\frac{k_1}{k_2}\right) + \frac{\left(k_1 * k_2\right)^{0.5}}{c} * \frac{D(x+)}{t*\left(N1_{x+} * N2_{x+}\right)^{0.5}}$$

where *N1* and *N2* are population counts at two time points separated by *t* years, *D* are recorded intercensal deaths, and k_1, k_2, and *c* are respectively the completeness, assumed invariant by age, of the first and second population counts and the intercensal deaths.

The method has some strong and key assumptions are that: the population is closed to migration; the completeness of recording of deaths is constant by age; the completeness of recording of the population is constant by age; and ages of the living and dead are reported without error (United Nations, 1997).

No formal methods exist for evaluating the proportion of deaths reported to be pregnancy related. Evaluation is therefore based on assessing the plausibility of the pattern of the proportions of pregnancy-related deaths by age of woman. Since the risk of dying in pregnancy or shortly thereafter is related to the proportion of women who are pregnant during

the reference period, the proportions should follow approximately the age pattern of fertility in the population (Hill, 2001).

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