The predictive value of retrospective survey data on maternal mortality in sub-Saharan populations: results from a validation study in Eastern Senegal

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Short abstract

In most developing countries, maternal mortality ratios (MMR) are derived from survey data on the survival of a respondent's siblings (e.g., DHS). While siblings' survival histories are convenient to collect, they may underestimate mortality levels because 1) the survival of siblings is often correlated, 2) the number and timing of deaths are frequently misreported during surveys, and 3) the deaths attributable to maternal causes may be grossly misclassified by survey respondents. The extent of bias in survey-based MMR estimates due to misclassifications of maternal causes is unknown. We use a unique dataset linking survey reports of a sibling's death with prospective records of that sibling's death obtained from demographic surveillance in Eastern Senegal. The data from demographic surveillance are collected since the 1970's and include precise dates of pregnancies, deliveries and deaths, as well as information on causes of deaths from verbal autopsies. They allow calculating the specificity and sensitivity of reports of maternal deaths obtained during retrospective surveys.

Extended abstract

1. Background

Maternal mortality is a major cause of adult death among women in the developing world and its reduction constitutes one of the UN's Millenium Development Goals (MDG). In most developing countries, routine cause-specific mortality data that would allow monitoring maternal mortality do not exist. Verbal autopsies have been shown to provide accurate estimates of maternal mortality (**1**), but are collected only in small, often not representative populations. National estimates of maternal mortality ratios (MMR) are thus derived from retrospective data collected during household-based surveys, by asking respondents about the survival of their siblings (**2**).

The Demographic and Health Surveys (DHS), in particular, include a retrospective sibling survival history, which is a detailed account of the survivorship of all of the live-born children of the respondent's mother (i.e., maternal siblings). These data allow direct estimating overall adult mortality by sex, as well as maternal mortality, by using information on the age of surviving siblings, the age at death of siblings who died, and the number of years ago the sibling died. It allows estimating the number of person-years of exposure to mortality risk and the number of sibling deaths occurring in defined calendar periods. Rates of maternal mortality are obtained by dividing maternal deaths in a calendar period by person-years of exposure to death. Similarly, adult mortality rates are obtained by dividing female or male adult deaths in a calendar period by person-years of exposure to death.

While siblings' survival histories are inexpensive to collect and have produced valuable information on adult/maternal mortality, the estimates produced often underestimate mortality (**3**). This is the case because 1) indirect estimation methods rely on strong assumptions that are often violated in practice, 2) the number and timing of deaths are frequently misreported during retrospective surveys, and 3) deaths attributable to maternal causes may be grossly misclassified by survey respondents during retrospective interviews. Several studies have already attempted to compare maternal mortality rates derived from prospective surveillance to rates obtained from retrospective surveys conducted in the same populations (**4**). These studies have however been conducted at the aggregate level. As a result, they only allow crude comparisons of synthetic indexes of maternal mortality (e.g., maternal mortality ratios) and are unable to validate data from retrospective interviews (RI). This is the case because none of these studies have been based on a matched design that attempts to link, *at the individual level*, death records collected using different methodologies. Such matching designs have only been used by (**5**) in the study of African-American mortality, but have not been used in sub-Saharan populations.

The purpose of this study is to determine the extent of bias in estimates of maternal mortality attributable to 3). Indeed, data from retrospective interviews have not been validated against more objective certification of causes of death such as prospective records of events from demographic surveillance and verbal autopsies. We thus improve on prior studies by systematically comparing data from retrospective surveys to data on dates and causes of death collected prospectively in demographic surveillance site of Eastern Senegal (Bandafassi).

Validation studies of RI based on matched records designs are difficult to implement because they entail identifying and interviewing the siblings of an initial sample of (deceased) adults. The proposed project builds on unique data from the demographic surveillance site of Bandafassi in Eastern Senegal, in which data documenting kinship ties and VA data on all adult deaths in several small rural villages have been collected since 1993. We thus seize on this unique opportunity to assess the specificity and sensitivity of retrospective survey data on maternal mortality.

2. Data and Methods
    a. Study Context: Bandafassi in Eastern Senegal

        i. Study area and population

Bandafassi is a rural area located in Senegal in the department of Kedougou, in the region of Tambacounda, close to the borders with Guinea and Mali. The population of the area, 11,522 inhabitants on January 1, 2005, comprises three ethnic groups living in separate villages : Bedik (28% of the population), Mandinka (16%) and Fula (57%).The area is a rather remote one in Senegal: Dakar, the capital city of Senegal, is 700 km away; Tambacounda, the regional capital, is 250 km away; and Kedougou, the closest town, is 14-60km away from the villages.

        ii. Demographic surveillance and mortality levels

The population of Bandafassi has been under demographic surveillance since 1970 (**6**). After an initial census where each compound was visited and baseline information was collected, every village has been visited once a year. At each visit, the list of people present at the preceding visit has been checked, and information collected on new births, deaths, marriages, migrations. For each death, information has been collected on the cause of death using verbal autopsy.
In the 1990's, life expectancy at birth was estimated from the demographic surveillance data as 46 years for men and 49 years for men, and maternal mortality ratio as 826 deaths per 100,000 live births (**7**).

        iii. Genealogical data collection

The initial census of the Bandafassi population included a genealogical survey, to collect genealogies going up to known ascendants and then down to living collateral relatives (**8**). For each new inhabitant who entered the population afterwards, either as new child born to a woman resident in the area, or as a person born outside and who immigrated, information has been collected at the round following his/her entrance in the population on his/her father and mother identities (and on known ascendants and collaterals relatives if an immigrant). This information was matched afterwards with genealogies yet collected.

    b. Study design
        i. General approach

The proposed study is a validation study of RI collected during household surveys. It is thus concerned with determining the frequency of false negatives (deaths classified as non maternal when in fact they

were) and false positives (deaths classified as maternal deaths when in fact they were attributable to other causes) in such reports. In order to estimate these parameters, we conduct RI (using the questionnaires used during the Demographic and Health surveys) with respondents constituting three different samples:

- Sisters of women who are still alive, to estimate the frequency of false positives (General sample)
- Sisters of women who have died from non-maternal causes, to estimate the frequency of false positives (Non-maternal Sample)
- Sisters of women who have died from maternal causes, to estimate the frequency of false negatives (Maternal Sample)

Information collected during the study thus allows us constituting the following classification of death reports (Table 1).

ii. Identification of relatives of deceased

The genealogies collected at the initial census and completed during the surveillance allow identifying with high precision the biological siblings of a population member. Each individual in the BDSS database is attributed a Mother ID #, which solely identifies the biological mother of a population member. Two individuals with the same mother ID # are thus maternal siblings. Very few individuals included in the BDSS database are missing their mother ID #.

iii. Tracking of migrant sisters of deceased individuals

The Bandafassi DSS database also includes detailed information on the destination and contacts of out-migrants: district, village and compound of destination, possibly contact number, and spouse's name if migration is due to marriage. As a result, it is possible to trace and enroll migrant sisters of deceased women who currently reside outside of the DSS zone. This population is particularly important because recall of sibling survival may be affected by separation and distance. The quality of retrospective data could be particularly low among migrants who have been living away from their siblings for extended periods of time. We visited all such sisters who have migrated out of the zone and now reside in neighboring regions of Kedougou and Tambacounda in Southeastern Senegal. We also sought to enroll sisters having migrated to the greater Dakar region. For convenience and due to budget constraints, we did not attempt to trace sisters having migrated to other parts of Senegal.

Sibling histories	**Demographic surveillance (date of events and Verbal Autopsies)**		
	Maternal cause	Non-Maternal cause	
Maternal cause	True positive	False positive	**Positive predictive value (PPV)**
Non-maternal cause	False negative	True negative	**Negative predictive value (NPV)**
	Sensitivity =TP/(FN+TP)	**Specificity =TN/(FP+TN)**	

Table 1: Study design

3. Initial results

In total, we aimed to enroll 362 women whose sister had died, when she was in-between 15 and 49 years of age, from maternal or non-maternal causes during the period 1981 – 2010. 275 were interviewed (76%). Among those who were not interviewed, 1 refused, 16 had died before the interview, 7 could not be found, 7 were temporarily away on the day of the survey, 19 had permanently migrated internationally or to non-neighboring regions of Senegal (e.g., Saint-Louis in the North of the country) and 35 had temporarily migrated to agricultural zones that could not be reached by the study team due to floods. 85 women in our sample were migrants residing in the neighboring Tambacounda and Kedougou regions or in Dakar. 48 of these were successfully traced and interviewed (56%).

The mean age of respondents in our sample is 37.1 years. 90% of the respondents were married at the time of the survey, whereas 5% had never been married and 5% were widowed, divorced or separated. The population is ethnically diverse: two thirds of the respondents were Fulani, while 20% were bedik and 15% were Mandinka. The level of schooling among respondents is low: 81% had never attended school, and among those who attended school, 85% had only attended primary school grades. As a result, close to 80% of respondents declared not being able to read in any particular language.

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