

Sibling History Module: Maternal (pregnancy-related) mortality & adult mortality

Rationale

The sibling history module is a measurement instrument widely administered to estimate levels of pregnancy-related mortality (henceforth, maternal mortality) and for sex and age-specific levels of mortality including adult mortality.

- **Maternal mortality**

Maternal mortality, like infant and under-5 child mortality, is an indicator of socio-economic conditions. Its practical appeal, however, is its role as a ‘sentinel indicator’. That is, since maternal deaths are largely preventable through adequate pre-natal and delivery care, the level of maternal mortality is indicative of the effectiveness and quality of the health care system. A high level of maternal mortality likely reflects sub-par functioning of the health care system.

The WHO definition of a **maternal death** is the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and the site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management, *but not from accidental or incidental causes* ([ICD-10 Volume 2. Section 5.8](#)).

In surveys administering the sibling history module, however, information is collected on **pregnancy-related deaths**, which are used as a proxy for maternal deaths. A pregnancy-related death is the death of a woman while pregnant or within 42 days of termination of pregnancy, *irrespective of the cause of death* ([ICD-10 Volume 2. Section 5.8](#)). Bearing in mind the different definitions, the description of the sibling history module simply uses the term ‘maternal’ to refer to ‘pregnancy-related’.

- **Adult mortality**

Declining infant and under-5 mortality rates go hand-in-hand with an ageing population, and health specialists and demographers are turning more focus to patterns of adult mortality. Premature deaths, often defined as deaths under age 60 years, have effects on society both economically as well as socially when families are devastated by the early death of spouse or parent. International organizations including the World Bank and World Health Organization (WHO) monitor adult mortality between 15 and 59 years.

In settings where the vital registration system is not fully functioning, or does not produce reliable data, information from the sibling history module can provide reliable estimates of all-cause mortality for any age and sex group.

- **Causes of death**

In addition to the sibling history module that estimates levels of mortality, another mortality-related instrument useful in areas lacking physician-certified cause of death information is the

international standard verbal autopsy (VA).¹ The VA instrument can be administered to assess the causes of deaths, including causes of maternal mortality (as opposed to pregnancy-related mortality), as a rider on a national household survey or it can be administered separately in a population of interest. WHO is coordinating the development of automated algorithms to analyse verbal autopsy data that would automatically assign the most probable underlying cause of death for various age groups.² Further details on the VA instrument and the analytical algorithm can be found on the WHO Health statistics and information systems website: <http://www.who.int/healthinfo/statistics/verbalautopsystandards/en/>.

Experience and evidence

- Experience
 - The original maternal mortality measurement approach adapted for areas with inadequate data sources started in the late 1980s. First, the indirect sisterhood method was developed based on four questions and required a relatively small sample size in countries with high maternal mortality.³ Second, the DHS Project expanded and adapted the question set to allow direct estimates of maternal mortality from sibling history data.⁴ The direct method requires a larger sample than the indirect method, but entails fewer assumptions and provides estimates that are more precise and for a more recent time period.
 - Since the 1990s, the sibling history module is used as an add-on module in Demographic and Health Surveys (DHS), and more recently in Multiple Indicator Cluster Surveys (MICS) to compute direct estimates of maternal mortality.
- Evidence
 - Due to the large margin of error around the estimate, a relatively **large sample size** is needed especially in countries where the number of births is low.
 - The sibling history module used in standard DHS and MICS surveys, where the age criteria for individual respondents is 15-45 years, is not ideal for measuring **adult mortality** (15-59 years). That is because relative errors are very uncertain for ages 35+ and increasingly so with each 5-year age group. The precision of adult mortality estimates suffer from a downward bias.
 - Some degree of **under-reporting** of deaths to a women of reproductive age for different reasons occur for several reasons: 1) the respondent did not know that the deceased woman was pregnant, especially if the death happened early in the pregnancy; 2) the respondent feels the event of death was too sensitive to report; or 3) lack of recall of an event in the past.
 - An **analytical limitation** includes the fact that maternal deaths recorded in the module and cannot be linked to other household or individual-level information. In

¹ WHO, HMN, In-Depth Network. 2012. Verbal autopsy standards: The 2012 WHO verbal autopsy instrument Release Candidate 1.

² The 2012 WHO verbal autopsy instrument.

<http://www.who.int/healthinfo/statistics/verbalautopsystandards/en/>

³ Graham, Brass and Snow. 1989. Estimating maternal mortality: the sisterhood method. *Stud Fam Plann.* 1989 May-Jun;20(3):125-35; WHO & UNICEF. 1997. The Sisterhood Method for Estimating Maternal Mortality: Guidance notes for potential users.

http://whqlibdoc.who.int/hq/1997/WHO_RHT_97.28.pdf?ua=1

⁴ Stanton C, Abderrahim N, Hill K. 1997. DHS Analytical Report No. 4. DHS Maternal Mortality Indicators: An Assessment of Data Quality and Implications for Data Use.

other words, it cannot be linked to other determinants hypothesized to influence maternal mortality, such as antenatal or delivery care, or socio-economic determinants; it cannot even be evaluated in terms of rural and urban since the module does not collect information on the place of residence of the siblings. In the 2010 Afghanistan Mortality Survey, however, the standard was slightly adapted to obtain information on residence: Where does he/she usually live (urban or rural residence)? When was the last time you had contact? This was an attempt to establish maternal mortality by residence, and to ascertain the reliability of the information by the time since last contact between the respondent and the respondent.

Core module

- The sibling history module from the DHS, last revised on August 6, 2013, is the standard sibling history module.⁵ In the DHS questionnaires from 1989-1995 there were some differences in the modules, for example, placing restrictions on data collection depending on the age that the sister that died.
- The module may be incorporated in both women's and men's individual questionnaires. Individual respondents are asked about all of their biological siblings and information is recorded for all siblings, regardless of age and year of death.
- The pooling of the data from male and female respondents yields a larger sample and therefore more precise estimates of maternal mortality (with smaller confidence intervals). The data collected from men and women were found to be equally reliable.⁶
- Indicators
 1. Maternal mortality ratio (MMR)- number of maternal deaths per 100 000 live births
 2. Adult mortality (45q15)- probability of dying 15-59 years, expressed per 1000 population
 3. Maternal mortality rate (MMRate)- number of maternal deaths per 1,000 women of reproductive age
 4. Adult lifetime risk of maternal death- probability of a 15-year-old woman eventually dying from a maternal (expressed in 1 in x number of births)
 5. Proportion of maternal deaths among all female deaths (PMDF)- number of maternal deaths divided by the total deaths among women aged 15–49 years
- Sibling history module (DHS, August 6, 2013)

⁵ Last revision (August 6, 2013) available from <http://dhsprogram.com/publications/publication-dhsm-dhs-questionnaires-and-manuals.cfm>

⁶ Merdad L, Hill K, and Graham W. 2013. Improving the Measurement of Maternal Mortality: The Sisterhood Method Revisited. DOI: 10.1371/journal.pone.0059834

MATERNAL MORTALITY

NO.		CODING CATEGORIES	SKIP
MM01	Now I would like to ask you some questions about your brothers and sisters, that is, all of the children born to your natural mother, including those who are living with you, those living elsewhere and those who have died. How many children did your mother give birth to, including you?	NUMBER OF BIRTHS TO NATURAL MOTHER 	
MM02	CHECK MM01: TWO OR MORE BIRTHS ☐ ONLY ONE BIRTH (RESPONDENT ONLY) ☐		NEXT SECTION →
MM03	How many births did your mother have before you were born?	NUMBER OF PRECEDING BIRTHS	
MM04	What was the name given to your oldest (next oldest) brother or sister?	(1) (2) (3) (4) (5) (6)	
MM05	Is (NAME) male or female?	MALE ¹ FEMALE ² MALE ¹ FEMALE ² MALE ¹ FEMALE ² MALE ¹ FEMALE ² MALE ¹ FEMALE ² MALE ¹ FEMALE ²	
MM06	Is (NAME) still alive?	YES ... ¹ NO ... ² DK ... ⁸ GO TO MM08 YES ... ¹ NO ... ² DK ... ⁸ GO TO (2) YES ... ¹ NO ... ² DK ... ⁸ GO TO (3) YES ... ¹ NO ... ² DK ... ⁸ GO TO (4) YES ... ¹ NO ... ² DK ... ⁸ GO TO (5) YES ... ¹ NO ... ² DK ... ⁸ GO TO (6) YES ... ¹ NO ... ² DK ... ⁸ GO TO (7)	
MM07	How old is (NAME)?	GO TO (2) GO TO (3) GO TO (4) GO TO (5) GO TO (6) GO TO (7)	
MM08	How many years ago did (NAME) die?		
MM09	How old was (NAME) when he/she died?	IF MALE OR DIED BEFORE 12 YEARS OF AGE GO TO (2) IF MALE OR DIED BEFORE 12 YEARS OF AGE GO TO (3) IF MALE OR DIED BEFORE 12 YEARS OF AGE GO TO (4) IF MALE OR DIED BEFORE 12 YEARS OF AGE GO TO (5) IF MALE OR DIED BEFORE 12 YEARS OF AGE GO TO (6) IF MALE OR DIED BEFORE 12 YEARS OF AGE GO TO (7)	
MM10	Was (NAME) pregnant when she died?	YES ... ¹ GO TO MM13 NO ... ² YES ... ¹ GO TO MM13 NO ... ² YES ... ¹ GO TO MM13 NO ... ² YES ... ¹ GO TO MM13 NO ... ² YES ... ¹ GO TO MM13 NO ... ² YES ... ¹ GO TO MM13 NO ... ²	
MM11	Did (NAME) die during childbirth?	YES ... ¹ GO TO MM13 NO ... ² YES ... ¹ GO TO MM13 NO ... ² YES ... ¹ GO TO MM13 NO ... ² YES ... ¹ GO TO MM13 NO ... ² YES ... ¹ GO TO MM13 NO ... ²	
MM12	Did (NAME) die within two months after the end of a pregnancy or childbirth?	YES ... ¹ NO ... ² YES ... ¹ NO ... ² YES ... ¹ NO ... ² YES ... ¹ NO ... ² YES ... ¹ NO ... ² YES ... ¹ NO ... ²	
MM13	How many live born children did (NAME) give birth to during her lifetime?		
IF MORE THAN 6 BROTHERS OR SISTERS, USE AN ADDITIONAL QUESTIONNAIRE. IF NO MORE BROTHERS OR SISTERS, GO TO NEXT SECTION.			

1. Deaths in the household (direct estimate)

In addition to the sibling history module, there are other approaches to measuring mortality from surveys. An example of another direct approach—i.e. computation of estimates that does not depend on models or assumptions-- is to administer a set of questions about deaths in the household in a defined period of time prior to the survey e.g., 2 or 5 years. A larger observation period will yield a larger number of deaths for more precise estimates (although the reference period will be less precise, and the recall bias larger, hence a trade-off).

- Household deaths module (2010 Afghanistan Mortality Survey)

SECTION 3. HOUSEHOLD DEATHS

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES			SKIP
301A	Now I would like to ask you a few more questions about your household. Has any usual resident of your household died since 1 Hammal 1384?	YES 1	NO 2	DON'T KNOW 8	→ 301C
301B	Was there any birth since 1 Hammal 1384 where the baby showed signs of life at birth (such as crying, breathing, or movement) but died soon after?	YES 1	NO 2	DON'T KNOW 8	
301C	Was there any pregnancy since 1 Hammal 1384 that ended in a stillbirth- that is, where the baby never showed any signs of life (such as crying, breathing, or movement)?	YES 1	NO 2	DON'T KNOW 8	
	CHECK Q.301A, 301B, and 301C: IF ANY YES CODE '1' CIRCLED ☐	IF ALL NO OR DON'T KNOW CODE '2' OR '8' CIRCLED ☐			→ 401
302	ASK Qs. 304-308 AS APPROPRIATE FOR EACH PERSON WHO DIED. IF THERE WERE MORE THAN 3 DEATHS, USE ADDITIONAL QUESTIONNAIRE(S).				
303	COLUMN NO.	1	2	3	
304	What was the name of the person who died most recently (before him/her)?				
305	How old was (NAME) when he/she died? IF '1' YEAR PROBE: How many months old was (NAME) when he/she died? IF '1' MONTH PROBE: How many days old was (NAME) when he/she died? IF STILLBIRTH CIRCLE '1' AND RECORD AGE IN DAYS AS '00'. RECORD DAYS IF LESS THAN 1 MONTH; MONTHS IF LESS THAN 1 YEAR, AND COMPLETED YEARS IF 1 YEAR OR MORE	DAYS ... 1 MONTHS ... 2 YEARS ... 3	DAYS ... 1 MONTHS ... 2 YEARS ... 3	DAYS ... 1 MONTHS ... 2 YEARS ... 3	
306	Was (NAME) male or female?	MALE 1 FEMALE 2	MALE 1 FEMALE 2	MALE 1 FEMALE 2	
307	CHECK Q.305: WHICH VERBAL AUTOPSY QUESTIONNAIRE SHOULD BE ADMINISTERED.	0 - 28 DAYS 1 29 DAYS TO 11 YRS 2 12 YRS AND ABOVE 3	0 - 28 DAYS 1 29 DAYS TO 11 YRS 2 12 YRS AND ABOVE 3	0 - 28 DAYS 1 29 DAYS TO 11 YRS 2 12 YRS AND ABOVE 3	
308	NAME AND LINE NUMBER OF THE MOTHER FROM Q.101 AND Q.102. IF SHE IS NOT LISTED IN THE HOUSEHOLD, RECORD '00'.	LINE NUMBER (NAME)	LINE NUMBER (NAME)	LINE NUMBER (NAME)	
309	Has any other member of your household died since 1 Hammal 1384?	YES 1 GO TO Q.304 IN NEXT COLUMN NO 2 DK 8	YES 1 GO TO Q.304 IN NEXT COLUMN NO 2 DK 8	YES 1 GO TO Q.304 ON NEW QUEST. NO 2 DK 8	
TICK HERE IF ADDITIONAL QUESTIONNAIRES USED ☐					
310	CHECK Q.304 AND SUM ALL PERSONS LISTED HERE AND ON CONTINUATION SHEET, IF ANY. TOTAL NUMBER OF PERSONS IN HOUSEHOLD WHO DIED SINCE 1 HAMMAL 1384.				
311	CHECK Q.310: IF 1 OR MORE DEATHS ☐	IF NO DEATHS ☐			→ 401
READ TO THE RESPONDENT: After this interview we would like to get more information on the circumstances surrounding this/these death(s) so that the government can provide health services to help reduce these deaths.					

- The household deaths recorded may furthermore be linked to a verbal autopsy questionnaire, to collect information on signs and symptoms leading to death, and using this to assign a probable underlying cause of death. This module can be used for estimating mortality by age and sex, including adult mortality. It is not appropriate, however, for estimating early childhood mortality since information on exposure time of surviving infants is not collected. The Household death module may also serve to measure maternal mortality (and pregnancy-related mortality separately) if it is linked to the verbal autopsy questionnaire.

2. Orphanhood method (indirect estimate)

An example of an indirect adult mortality measurement is the orphanhood method, also called the parental survivorship method. During data collection, the method involves recording information in the household roster from two simple questions on whether the household member's biological mother and father was alive: "Is your (biological) mother still alive?" and "Is your (biological) father still alive?" The proportion of mothers (or fathers) surviving among respondents of a given age then represents an average of survival probabilities from the mother's age at the birth (or father's age at the conception) to the age of the respondents. The procedures used to assess the orphanhood data are described in detail in the United Nations Methods for Estimating Adult Mortality⁷ and the Manual X Indirect Techniques for Demographic Estimation.⁸

- Household roster with orphanhood questions (2010 Afghanistan Mortality Survey) (see column header, 'survivorship of biological parents')

⁷ United Nations. 2002. Methods for estimating adult mortality. Working Paper No. ESA/P/WP.175. http://www.un.org/esa/population/techcoop/DemEst/methods_adultmort/methods_adultmort.html

⁸ United Nations. 1983. Manual X: Indirect techniques for demographic estimation. New York: United Nations Department of International Economic and Social Affairs.

HOUSEHOLD SCHEDULE										
LINE NO.	USUAL RESIDENTS AND VISITORS	RELATIONSHIP TO HEAD OF HOUSEHOLD	SEX	RESIDENCE		AGE	SURVIVORSHIP AND RESIDENCE OF BIOLOGICAL PARENTS			
1	2	3	4	5	6	7	8	9	10	11
	Please give me the names of the persons who usually live in your household and guests of the household who stayed here last night, starting with the head of the household. AFTER LISTING THE NAMES AND RECORDING THE RELATIONSHIP AND SEX FOR EACH PERSON, PROBE FOR ADDITIONAL PERSONS TO BE SURE THAT THE LISTING IS COMPLETE. THEN ASK APPROPRIATE QUESTIONS IN COLUMNS 5-11 FOR EACH PERSON.	What is the relationship of (NAME) to the head of the household? SEE CODES BELOW.	Is (NAME) male or female?	Does (NAME) usually live here?	Did (NAME) stay here last night?	How old is (NAME)? IF 95 OR MORE, RECORD '95'.	Is (NAME)'s natural mother alive?	Does (NAME)'s natural mother usually live in this household or was she a guest last night? IF YES: What is her name? RECORD MOTHER'S LINE NUMBER. IF NO, RECORD '00'.	Is (NAME)'s natural father alive?	Does (NAME)'s natural father usually live in this household or was he a guest last night? IF YES: What is his name? RECORD FATHER'S LINE NUMBER. IF NO, RECORD '00'.
01			M F 1 2	Y N 1 2	Y N 1 2	IN YEARS 	Y N DK 1 2 8 ↓ GO TO 10		Y N DK 1 2 8 ↓ NEXT LINE	

Indicator definitions

The main indicators from the sibling history module are the maternal mortality rate (MMR) and adult mortality rate (AMR). The additional indicators measured using the sibling history module are mainly related to maternal mortality: Maternal mortality rate (MMRate); Lifetime risk of maternal death; and Proportion of maternal deaths among all female deaths (PMDf). And, given sufficient sample size, levels of all-cause mortality can be computed for any age group.

Detailed descriptions of these indicators are in the MMEIG joint publications.⁹

• Main indicators

Maternal mortality. The Millennium Declaration adopted MMR as an indicator of maternal health and set the Millennium Development Goal (MDG 5) of reducing maternal mortality from the 1990 level by 75 percent before 2015. The MMR is the preferred measure maternal mortality because it measures the risk of death per risky event, or per birth. The best measure would be per pregnancy, but reliable information on pregnancies are not generally available. Although MMRs are not strictly comparable across countries because they not age-standardized

⁹ WHO, UNICEF, UNFPA, WB. 2012. Trends in Maternal mortality 1990 to 2010

(the probability of maternal death varies by age, with youngest and oldest mothers at the greatest risk), but it is more comparable than the maternal mortality rate (MMRate) since this measure is confounded by fertility levels.

The Maternal Mortality Estimation Inter-agency Group (MMEIG) was established to produce updated series for countries and territories using a standard approach. Inputs into their data models included estimates from the DHS using the standard sibling history module.¹⁰

Name	Maternal mortality ratio (MMR)
Definition	Number of maternal deaths per 100 000 live births
Numerator	Age-adjusted* maternal mortality rate times 100
Denominator	Age-adjusted* GFR
Reference period**	0-6 years prior to the survey, or 0-4 years if there are enough cases

** Age adjustment for maternal mortality rate (numerator)– Age adjustment is made by multiplying the unadjusted age-specific maternal mortality rates by the percentage of female household members 15-49 in each 5-year age group between 15-49, where the sum of the percentages equals 100%. Similar adjustment is made for GFR, where age-specific fertility rates are multiplied by the percentage of female household members 15-49 in each 5-year age group between 15-49.*

*** The reference period can be made shorter if the relative errors of the age-specific mortality rates are less than 15-20%. The reference period needs to be longer if the relative errors are more than 15-20%. The relative errors can be estimated by: the square root of the rate multiplied by one minus the rate, divided by the number of exposure years, all divided by the rate times 100. This approach does not adjust for complex sample design, which would increase the relative error.*

Adult mortality. The international definition of the adult mortality rate is the probability of dying between the ages of 15 and 60--that is, the probability of a 15-year-old dying before reaching age 60, if subject to current age-specific mortality rates between those ages.¹¹

Name	Adult mortality (AMR)
Definition	Expressed per 1000 population, probability of dying 15-59 years (45q15)
Numerator	Age adjusted* mortality rates times 1000
Denominator	Number of siblings in the age group
Reference period**	0-6 years prior to the survey (7-13 years)

** Age adjustment for adult mortality– Age adjustment is made by multiplying the unadjusted sex and age-specific mortality rates by the percentage of household members age 15-49 in each 5-year sex and age group between 15-49, where the sum of the percentages equals 100%.*

*** The reference period can be made shorter if the relative errors of the age-specific mortality rates are less than 15-20%. The reference period should be longer if the relative errors of the age-specific mortality rates are more than 15-20%. The relative error is the square root of the rate multiplied by one minus the rate, divided by the number of exposure years, all divided by the rate times 100. Note that the relative errors are usually substantially larger for age groups 50-*

¹⁰ Maternal Mortality Estimates, UN Maternal Mortality Estimation Inter-agency Group
<http://www.maternalmortalitydata.org/publication.html>

¹¹ United Nations Population Division. World Population Prospects. New York, United Nations, Department of Economic and Social Affairs

54 and 55-59, simply due to the way the survey is designed i.e., age criteria for individual respondents is 15-49, so cases in older age groups are increasingly rare. These estimates are therefore bracketed in the report to indicate less reliability.

- **Additional indicators**

The MMRate measures the risk of death per person potentially exposed to the risk, and is therefore not a pure measure of risk. For example, if the risk of maternal death per birth is the same in two countries but one country has a higher birth rate, then the MMRate will be higher than the other country with a lower birth rate. Similarly, the risk of maternal death per birth in a country could be low, but if fertility is high then the MMRate will be high.

Name	Maternal mortality rate (MMRate)
Definition	Number of maternal deaths in a given period per 100 000 women of reproductive age
Numerator	Number of maternal-related deaths
Denominator	Woman-years of exposure
Reference period	Usually matches the MMR period

Name	Lifetime risk of maternal death
Definition	Probability of a 15-year-old woman eventually dying from a maternal cause (expressed in 1 in x number of births)
Formula	$\frac{T15 - T50}{\ell15} \times \text{MMRate}$ Where $\ell15$ equals the probability of survival from birth until age 15 years, and $(T15 - T50)/\ell15$ equals the average number of years lived between ages 15 and 50 years (up to a maximum of 35 years) among survivors to age 15 years. The values for $\ell15$, T15 and T50 are life-table quantities for the female population during the period in question.
Reference period	Usually matches the MMR period

Name	Proportion of maternal deaths among all female deaths (PMDf)
Definition	Number of maternal deaths in a given time period divided by the total deaths among women aged 15–49 years.
Numerator	Number of maternal deaths
Denominator	Number of deaths of women of reproductive age
Reference period	Usually matches the MMR period