An Assessment of the Consistency between Sibling Histories and Birth Histories in Sub-Saharan Africa

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Introduction

Background

- DHS sibling histories are increasingly being used to develop estimates of adult and maternal mortality, especially in sub-Saharan Africa (SSA).
- There is remarkably little research on recall biases in sibling data. The only systematic assessment was made by Stanton et al. [2000]. They showed that:

1. Data on reported events are remarkably complete in most surveys,
2. Compared with other estimates, DHS provide lower mortality rates,
3. The completeness of reporting of deaths tends to decline in the distant past,
4. The average number of siblings (sibsize) is decreasing or invariant with the respondents' increasing age in several DHS, which is apparently inconsistent with fertility declines that occurred in most African countries.

   → Here, I investigate further the consistency of sibsizes in DHS.

Research questions

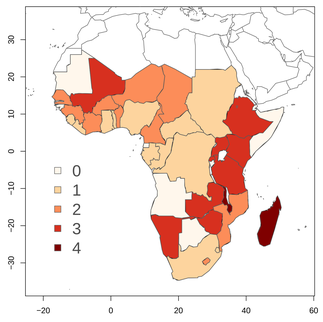
Q1. Are the average sibsizes reported in DHS consistent with the numbers of children ever born (CEB) reported in earlier surveys and censuses?

Q2. Are the sibsizes reported by young respondents consistent with the CEB reported by their mothers in the same DHS?

Data sources

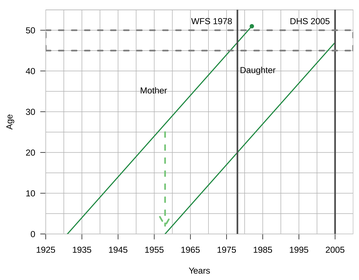
- 65 DHS with both birth and sibling histories from 33 SSA countries.
- Historical data on lifetime fertility from censuses and surveys.

Fig.1: Number of DHS sibling histories per country (1992-2012)



Q1. Average sibsizes and lifetime fertility of the preceding generation

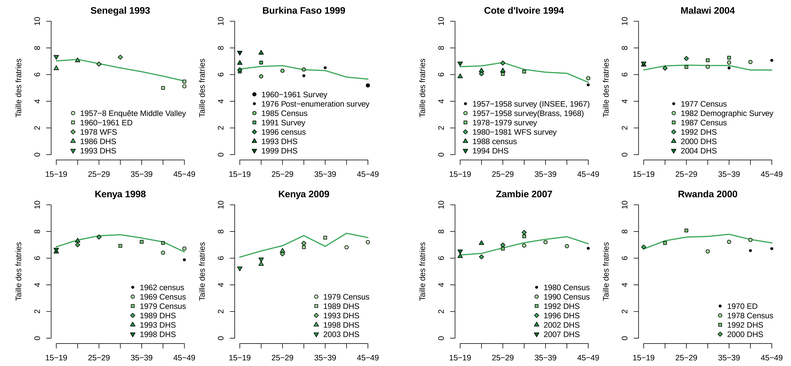
Strategy: For each 5-year age group, an expected sibsize is obtained through interpolation between CEB values, using the mean age at childbearing (MAC) prevailing at the time of the respondents' birth to identify the cohort of their mothers.



In Senegal, the MAC has been around 27.5 years over several decades. Respondents aged 45 to 49 years in 2005 were born to mothers who were approximately aged 45-49 years in 1978 (*Fig.2*). Their sibsize can be compared with the average number of CEB reported by women of the same age in 1978, after accounting for the variance of the distribution of lifetime fertility [Keyfitz and Caswell, 2005]. An estimate of the average CEB in 1978 is available from the World Fertility Survey. Likewise, mothers of women aged 35 to 39 years in 2005 were approx. aged 43 to 47 when the 1986 Senegalese DHS was conducted.

Results (Q1 - aggregate level)

Fig.3: Average parity of respondent's mother by respondent's age (8 DHS), compared with (adjusted) total number of children ever born reported by the preceding generation (various sources).



Declines or invariance in the number of siblings by age of respondent can reflect long-term trends in the number of CEB rather than disproportionate omissions by older respondents. This routine indicator of data quality should not be considered in isolation of data on lifetime fertility.

Q2. Mother's reports on CEB and daughters' reports on siblings ever born at the familial level

Strategy

- In 22 DHS surveys conducted in sub-Saharan Africa, questions on parental survival and residence were asked to children up to age 18 (15 in other DHS). As young women aged 15 to 18 are eligible to respond to the maternal mortality module, they provide data on both their siblings and parents. If they reside with a mother who is also eligible to the individual questionnaire (i.e. if she is under age 50), the sibling history they report can be linked with the birth history reported by their mother.
- The working hypothesis is that reports from mothers are more accurate than reports from sisters. Mothers are less likely to report a non-biological child as biological child, compared with daughters reporting a paternal half sibling as maternal sibling. In addition, daughters may not be aware of siblings who died before they were born or while they were young. A previous attempt to compare CEB data with sibling data concluded that reports from mothers were more accurate (the Barbados Experimental Migration Survey) [Zaba, 1987].
- The congruence in reports on the number of children/siblings is probably overestimated as mothers and daughters analyzed here are co-residing with each other.

Results (Q2 - familial level)

Survey	Year	n	CEB > sib.	CEB < sib.
Rwanda	2005	731	0.02	0.02
Sao Tome	2009	146	0.03	0.03
Chad	2004	436	0.03	0.01
Congo	2005	332	0.05	0.07
Zimbabwe	2006	396	0.13	0.02
Swaziland	2006	281	0.19	0.03
Sierra Leone	2008	181	0.20	0.10
Nigeria	1999	176	0.22	0.03

Table 1: Number of mother-daughter pairs and percentage with discrepancies on the number of children/siblings ever born (4 DHS with good agreement and 4 DHS with large discrepancies)

- Tables 2 and 3 are restricted to mother-daughter pairs in which at least one death was mentioned.
- Inconsistencies are observed in around 25% of the 4638 families with at least one child death. Sisters typically report less child deaths than do mothers.
- Discrepant numbers of recent adult deaths (10 years prior to the survey) are much more frequent; they concern about half of the mother-daughter pairs in which at least one recent adult death was mentioned. Mothers typically report less adult deaths than do sisters.
- All omissions will not distort mortality estimates: direct adult mortality rates are immune to omissions of siblings who died in childhood or many years prior to the survey.

- There is a considerable variation in the extent of concordance in the reported number of children/siblings.
- The percentages of mother-daughter pairs with discrepant reports range from 4% in the Rwanda 2005 DHS to 25% in Nigeria in 1999.
- Mother-daughter inconsistencies are predominantly attributable to lower sibship sizes reported by daughters. On average, daughters reported 0.13 fewer siblings than mothers. This difference reached 0.57 siblings in Nigeria 1999.

Survey	Year	nb. of pairs at least one death	nb. deaths with (sib) < nb. deaths (mother)	nb. deaths (sib) > nb. deaths (mother)
Nigeria	2008	703	168	30
Rwanda	2005	411	78	19
Madag.	2009	349	45	9
Tanzania	2004	314	33	9

Table 2: Mother-daughter pairs with at least one report of child death (4 DHS with largest numbers of mother-daughter pairs)

Survey	Year	nb. of pairs at least one death	nb. deaths with (sib) < nb. deaths (mother)	nb. deaths (sib) > nb. deaths (mother)
Rwanda	2005	97	4	66
Nigeria	2008	49	5	18
Chad	2004	30	3	13
Madag.	2009	27	4	3

Table 3: Mother-daughter pairs with at least one report of recent adult death

Conclusion

- The average parity of respondents' mother by respondents' age is an inadequate indicator of data quality of sibling histories.
- Linking sisters and mothers through the household roster provides evidence of omissions of adult deaths by mothers and omissions of child deaths by siblings.

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Notes accompanying my PAA 2012 poster

Abstract

Sibling histories are increasingly being used to develop estimates of adult and maternal mortality, especially in sub-Saharan Africa, where demographic data describing mortality remain scant and defective. However, little is known about recall biases in sibling data. In this paper, data on siblings collected in DHS are compared with information on the children of women of the preceding generation, both at the aggregate and individual level. Firstly, the mean sibship size declared by women in DHS surveys is compared with the average number of children ever born reported in earlier surveys. Contrary to a common assumption, declines in the number of siblings by respondents' age are not necessarily a sign of larger recall errors by older respondents. Secondly, in a subsample of DHS surveys, sibling histories of young women aged 15 to 17 who reside with their mother are evaluated against birth histories reported by these mothers. Mothers-daughters inconsistencies are frequent. Overall, daughters tend to report fewer siblings than expected from data from their mothers, but more recent adult deaths.

INTRODUCTION

In the late 1980s, in an attempt to better estimate maternal mortality with the sisterhood method, an equivalent of birth histories for the survival of siblings was included as part of a "maternal mortality" module in some Demographic and Health Surveys (DHS). DHS are nationally-representative household surveys with two main questionnaires; a roster with basic information on all household members and a detailed individual questionnaire administered to women of reproductive ages[1]. To date, the "maternal mortality" module has been included in about 60 DHS conducted in more than 30 countries of sub-Saharan Africa. Sibling histories are also collected in other international survey programs, such as World Health Surveys, UNICEF's Multiple Indicator Cluster Surveys, the Pan-Arab

[1]In a subsample of households, adult men are also being administered an individual questionnaire, sometimes including the maternal mortality module.

Project for Family Health Surveys, and US Centers for Disease Control and Prevention Reproductive Health Surveys. In most cases, a standardized set of questions is used to elicit an exhaustive list of siblings born to the same mother by birth order. Information is collected about their gender and survival status. Current age is recorded for surviving siblings, while age at death and years since death are asked for the deceased. Some additional questions are aimed at identifying pregnancy-related deaths. Thus, sibling histories provide both deaths distributed by age and calendar period and the corresponding person-years of exposure, allowing for the calculation of annual age-specific mortality rates. Pooling all surveys together in a regression model makes it possible to smooth noisy trends and bring out the salient patterns of mortality increases due to AIDS (Timaeus and Jasseh 2004). In sub-Saharan Africa, where there is a dearth of demographic data describing adult survival, sibling histories have become a cornerstone of estimates for both adult and maternal mortality (Bradshaw and Timaeus 2006, Rajaratnam et al. 2010, Hogan et al. 2010).

However, sibling histories are deemed to result in underestimates of mortality (Hill et al. 2005, Gakidou et al. 2004). One of the most pervasive problems is the underreporting of deaths. Several studies have assessed the extent of such underreporting by comparing mortality rates from successive surveys whose reference periods overlap (Timaeus and Jasseh 2004, Obermeyer et al. 2010, Reniers et al. 2011). Compared with the three years immediately prior to the survey, the completeness of reporting of female deaths was evaluated at 83% six to nine years prior to the survey. Male deaths are significantly underreported as early as three to six years prior to the survey (91%), and past that point, completeness of death reporting drops to less than 75% (Reniers et al. 2011). These are only estimates of the *relative* underreporting, and there is little doubt that the most recent reports are incomplete as well.

Pinning down the reasons behind such pervasive underreporting is a prerequisite to developing adjustments or improving the survey design. It is thus necessary to identify (1) which siblings are most likely to go underreported, (2) which respondents are most likely to provide inaccurate sibling histories, and (3) which surveys are characterized by the largest recall errors. There is remarkably little research on this question.

Previous assessments of the quality of sibling data in DHS have been of two types. Firstly, a handful of studies have evaluated mortality rates derived from sibling histories with estimates from the United Nations (Gakidou et al. 2004) or incomplete civil registration data (Feeney 2001). For example, Reniers et al. (2011) showed that sibling estimates of the life table probability ${}_{45}q_{15}$ were on average lower than UN estimates, especially in countries that are not severely affected by HIV, such as the Sahelian countries (Niger, Senegal and Mali). They speculated about the reasons for this and suggested that recall lapse could be more pervasive in Western Africa because of greater complexity of family structures (due to higher fertility rates and polygyny). Another plausible explanation is that sibling histories underestimate mortality irrespective of the region, but this is obfuscated in countries affected by HIV/AIDS, because UN estimates could be themselves biased downwards in HIV settings.

A second approach to assess the quality of sibling histories was taken by Stanton et al. (2000), who examined the internal characteristics of the data, focusing on the completeness of reports and the plausibility of sibship sizes. Using 14 DHS conducted between 1989 and 1995, they showed that the data on reported events was complete in most surveys, and presented no strong indications of differential quality by sex of siblings or time period prior to the survey. Their analysis did suggest, however, that older respondents could disproportionately omit siblings and siblings' deaths; in many surveys, the size of sibships (henceforth referred to as sibsize) was invariant or decreasing with respondents' increasing age. At first sight, this pattern is inconsistent with the fertility declines that occurred in most African countries over the last decades. The average parity of respondent's mother by respondent's age is also used as a routine indicator of data quality in several DHS reports.

In this analysis, the quality of sibling data is assessed by analyzing the consistency between *sibling histories* reported by one generation of women and *birth histories* reported by the generation of their mothers. First, at the aggregate level, the average sibsize reported in DHS is compared with the average number of children ever born from previous surveys and censuses. Then, at the individual level, mothers' reports on children are linked to daughters' reports on siblings in a subsample of households where women aged 15 to 17 still reside with their mother.

COMPARISONS BETWEEN SIBSIZES AND LIFETIME FERTILITY OF WOMEN OF THE PRECEDING GENERATION

Surveys conducted in Senegal in 1993 and Madagascar in 1992 offer a particularly egregious example of the decline of sibsizes with the respondent's age (Fig. 1). In these surveys, the 45- to 49-year-olds reported about 20% fewer siblings than 15- to 19-year-olds. However, the pattern is gradually shifted over time; in the DHS carried out in 2009 in Madagascar, older respondents reported even more siblings than younger respondents. Does it follow from this that earlier surveys in Senegal and Madagascar were plagued with more recall errors than more recent surveys?

My contention is that it does not, because the average parity of respondents' mother by respondents' age is an inadequate indicator of data quality. Declines in the number of siblings by age of respondent can be observed in the absence of recall errors. To demonstrate this, I opted for the following approach:

1. For each 5-years age group, the birth cohort of mothers of respondents is estimated by subtracting from their own years of birth the *mean age at childbearing* prevailing at the time of their birth. For example, the mean age at childbearing calculated from DHS in Senegal has remained fairly stable over the last 20 years; it ranged between 27.5 years in 1986 and 27.9 years in 2005. Thus, respondents aged 45 to 49 years in 2005 were born to mothers who were approximately aged 45-49 years in 1978.

2. If we assume that women aged 40 to 45 have reached their lifetime fertility, the sibsize reported by respondents aged 40 to 45 in 2005 should be close to the average

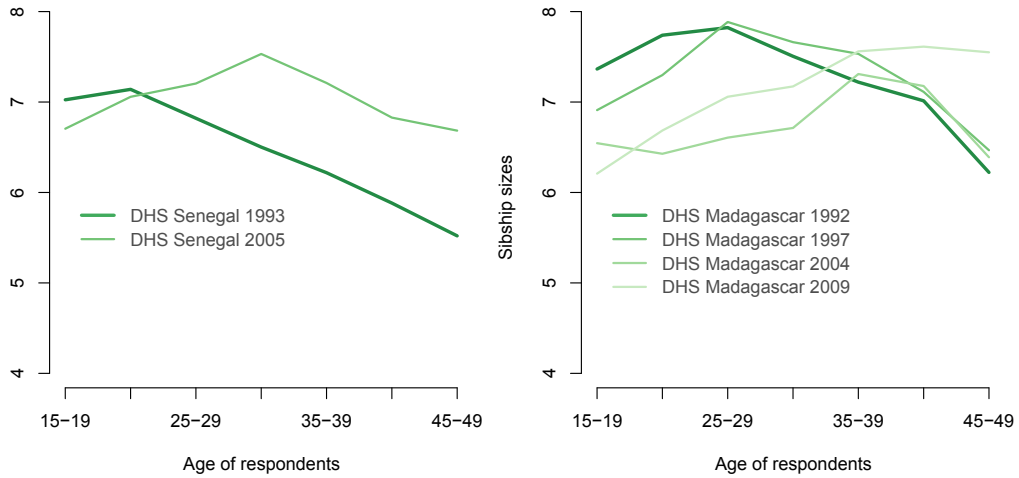

Figure 1. Average parity of respondents' mother by respondents' age - DHS conducted in Senegal and Madagascar

number of children ever born (CEB) reported by women of the same age in 1978, after accounting for the *variance of the distribution of lifetime fertility*. As demonstrated by Keyfitz and Caswell (2005), the average number of children ever born (denoted G) corresponds to the sum of the average sibsize (denoted F) and the variance of the distribution of children ever born (σ^2) divided by the mean:

$$F = G + \frac{\sigma^2}{G} \tag{1}$$

To approximate σ^2, I calculated the variance of the number of children ever born among women aged 45-49 in 88 DHS conducted in sub-Saharan Africa. This variance equals on average 5.9, and I apply this value to all surveys. Trends in the mean age at childbearing are derived from age-specific fertility rates and age structures of the United Nations (2009).
In the case of Senegal, an estimate of the average CEB in 1978 is available from the World Fertility Survey.

3. Women aged 35 to 39 years in 1978 had not yet reached their lifetime fertility, making it difficult to compare their average CEB with the sibsizes reported by women of their daughters' generation in 2005. But this cohort can be followed through time until 1986, when the first DHS is carried out in Senegal; they are then aged between 43 and 47 years. With some interpolations, the 1986 survey thus provides an estimate of the expected sibship size of respondents aged 35 to 39 in 2005. This procedure can be repeated for the 1993 DHS survey to yield estimates for younger respondents.

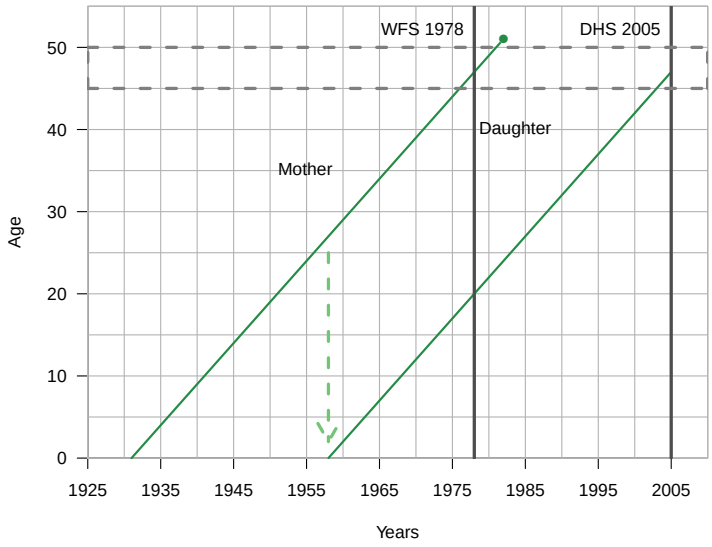

Figure 2. An example of two generations of women aged 45-49 in two successive surveys conducted in Senegal : WFS 1978 and DHS 2005

Preliminary results

Fig. 3 displays the results of the comparison between sibsizes and lifetime fertility of women of the preceding generation, for 8 DHS surveys chosen because we have several point estimates of past values of CEB. The DHS carried out in Senegal in 1993 is presented in the upper left corner of the graph. The mean number of CEB generally follows quite closely the trend outlined by the sibship sizes. The same observation can be made in Burkina Faso (1999), Côte d'Ivoire (1994) or Malawi (2004). What was perceived as a problem of data quality partly stems from past trends in fertility.

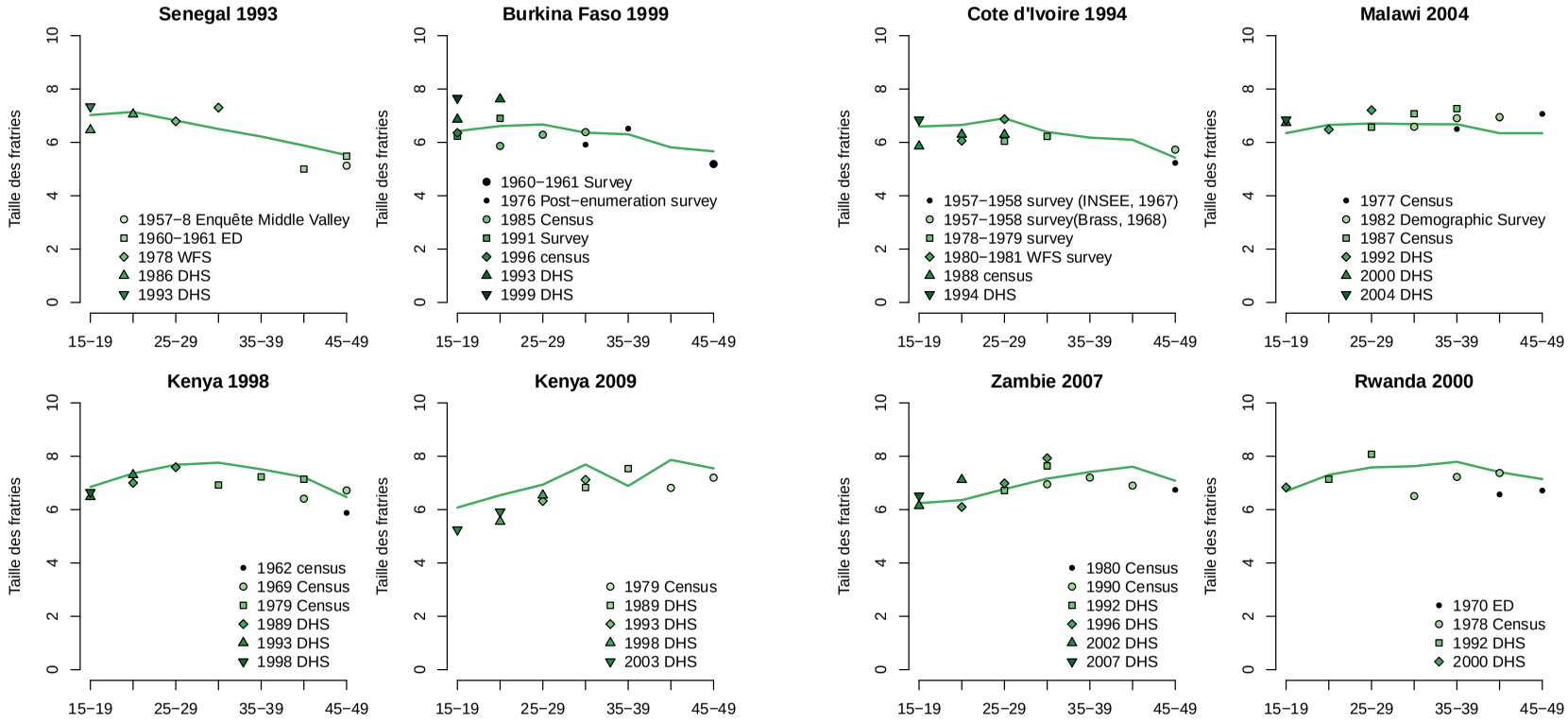

Figure 3. Average parity of respondent's mother by respondent's age (DHS), compared with total number of children ever born of the previous generation (various sources)

LINKING MOTHERS' REPORTS ON CHILDREN AND DAUGHTERS' REPORTS ON SIBLINGS AT THE INDIVIDUAL LEVEL

Since the early 1990s, questions on the survival status of biological parents and their residence status have been included in DHS questionnaires for children recorded in the households. These questions aim at identifying orphans, and allow for the analysis of fostering practices and co-residence with surviving parents (Monasch and Boerma 2004). When the mothers reside in the same household as the children, the interviewer writes down their line number in the roster of household members.

In 22 DHS surveys conducted in sub-Saharan Africa, questions on parental survival and residence have been extended to children under age 18 (Palermo and Peterman 2009). Since young women aged 15 to 18 are eligible to respond to the maternal mortality module, they provide data on both their siblings and parents. If they reside with a mother who is also eligible to the individual questionnaire (i.e. if she is under age 50), the sibling history they report can be compared with the birth history reported by their mother.

Our working hypothesis here is that reports from mothers are more accurate than reports from siblings. For example, women are less likely to report a non-biological child as biological child, compared with daughters reporting a paternal half sibling as maternal sibling. In addition, daughters may not be aware of siblings who died before they were born or while they were young. Contacts with siblings residing elsewhere may also be less frequent than contacts with children. A previous attempt to compare CEB data with sibling data concluded that reports from mothers were consistently more accurate (the Barbados Experimental Migration Survey) (Zaba 1987).

Preliminary results

Table 1 displays, for 22 DHS, the number of mother-daughter pairs retained in this analysis (column 3), the percentage of sibships for which the number of *children* ever born reported by mothers is higher (4) or lower (5) than the number of *siblings* reported by their daughters, and the percentage of inconsistencies on the number of survivors (6) and deaths (7). There is a considerable variation in the extent of concordance in the reported sibship sizes. The percentages of inconsistent reports range from 4% in the Rwanda 2005 survey to 25% in Nigeria in 1999, a survey known for its poor data quality (Pullum 2008). Mother-daughter inconsistencies are predominantly attributable to lower sibship sizes reported by daughters. On average, daughters reported 0.13 fewer siblings than mothers and this difference reached 0.57 siblings in the 1999 Nigeria survey. There is no evidence that sisters are disproportionately omitted (results not shown here).

All omissions will not distort the mortality estimates: the direct approach is immune to omissions of siblings who died in childhood or many years prior to the survey. By contrast, indirect estimates will be biased by differential omissions of deceased siblings, even if the deaths occurred in the distant past (Hill and Trussell 1977). Timaeus et al. (2001) developed a method to restrict the calculation to adult deaths, thus limiting the

Survey	Year	n (3)	CEB > sib. (4)	CEB < sib. (5)	CEB ≠ sib. Surv. (6)	CEB ≠ sib. Deaths (7)
Rwanda	2005	731	0.02	0.02	0.04	0.05
Sao Tome	2009	146	0.03	0.03	0.04	0.05
Chad	2004	436	0.03	0.01	0.03	0.04
Congo	2005	332	0.05	0.07	0.05	0.07
Madagascar	2009	1034	0.05	0.01	0.04	0.04
Tanzania	2004	583	0.05	0.02	0.03	0.06
Malawi	2004	496	0.06	0.01	0.03	0.07
Benin	2006	762	0.07	0.02	0.06	0.08
Zambia	2007	383	0.07	0.02	0.04	0.09
DR Congo	2007	485	0.08	0.04	0.07	0.10
Mozambique	2003	513	0.08	0.00	0.02	0.08
Lesotho	2004	334	0.09	0.03	0.06	0.11
Lesotho	2009	342	0.10	0.07	0.09	0.12
Nigeria	2008	1459	0.10	0.02	0.07	0.11
Guinea	1999	92	0.11	0.02	0.08	0.12
Liberia	2007	311	0.11	0.04	0.10	0.10
Namibia	2007	376	0.11	0.06	0.09	0.10
Uganda	2006	513	0.12	0.05	0.12	0.09
Zimbabwe	2006	396	0.13	0.02	0.09	0.11
Swaziland	2006	281	0.19	0.03	0.08	0.16
Sierra Leone	2008	181	0.20	0.10	0.24	0.15
Nigeria	1999	176	0.22	0.03	0.22	0.13

Table 1. Percentage of mother-daughter pairs with discrepant reports on the number of children/siblings ever born, broken down by survival status

effect of recall errors. Any omission of maternal death will bias the estimates obtained from the sisterhood method (Graham et al. 1989).

As expected, the discrepancies between daughters' and mother's reports are in most cases larger for dead siblings. However, much of the agreement between mothers and daughters on the number of deaths is attributable to their relative rarity. A more precise view is obtained by restricting the analysis to mother-daughter pairs with at least one mention of a death.

Table 2 presents the total number of families in which at least one child death was reported, along with the distribution of sibships in which mothers and daughters disagreed on the number of these deaths. Inconsistencies are observed in around 25% of the 4638 families with at least one child deaths. Sisters typically report less child deaths than do mothers. Differences in reporting of recent adult deaths (that occurred in the 10 years prior to the survey) are much more frequent; they concern about half of the mother-daughter pairs in which at least one recent adult death was mentioned. However, in this case, mothers report less adult deaths than sisters.

		Child deaths			Recent adult deaths		
Survey	Year	n	sib<moth	sib>moth	n	sib<moth	sib>moth
Rwanda	2005	411	78	19	97	4	66
Sao Tome	2009	46	11	4	10	1	6
Chad	2004	259	26	8	30	3	13
Congo	2005	134	18	15	10	1	5
Madagascar	2009	349	45	9	27	4	3
Tanzania	2004	314	33	9	17	1	4
Malawi	2004	278	40	8	21	1	5
Benin	2006	368	57	15	19	2	6
Zambia	2007	187	39	6	20	1	7
DR Congo	2007	239	62	19	17	4	4
Mozambique	2003	256	45	5	21	3	2
Lesotho	2004	104	28	10	21	4	5
Lesotho	2009	80	32	10	7	1	1
Nigeria	2008	703	168	30	49	5	18
Guinea	1999	60	11	2	2	0	1
Liberia	2007	139	33	8	15	2	6
Namibia	2007	92	27	7	13	1	2
Uganda	2006	302	36	32	21	4	4
Zimbabwe	2006	89	41	7	19	4	4
Swaziland	2006	88	45	2	20	5	5
Sierra Leone	2008	78	23	14	11	4	6
Nigeria	1999	62	24	2	1	0	1

Table 2. Total mother-daughter pairs with at least one report of child death or recent adult death, and distribution of discrepant reports on these numbers

Further analysis will evaluate if the level of agreement within mother-daughter pairs varies with the daughters' education level, the mothers' education level, the birth order of daughters, the age of mothers, the wealth index, and the urban-rural residence.

Any suggestions are welcome (bruno.masquelier@ined.fr).

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