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Estimating adult mortality rates in the context of the AIDS epidemic in sub-Saharan Africa: analysis of DHS sibling histories*

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Abstract

Recent efforts to model the demographic effect of the AIDS pandemic in sub-Saharan Africa have far outnumbered empirical studies of adult mortality levels and patterns in AIDS-affected countries of the region. There is still a paucity of population-based data on adult mortality for nearly all countries in the region. Using data from recent Demographic and Health Surveys (DHS) of six countries and one in-depth DHS, this paper examines the use of sibling histories to directly estimate rates of adult mortality. The countries studied include Uganda, Zambia, Central African Republic, Côte d'Ivoire, Zimbabwe, Malawi, and Tanzania.

Rates of adult male and female mortality are presented at the national level in comparison to estimates obtained from other published sources, where available, and for subnational areas where cohort and other mortality studies have been recently conducted. The results indicate surprising consistency with external data and, on the whole, underscore the expected but hitherto only sparsely documented association between residence in high HIV-prevalence areas and sharply elevated mortality risk during the relevant adult ages. The cases of Zambia and Uganda in particular provide clear evidence of very high adult mortality levels among both men and women. In general, the findings of the study demonstrate that DHS-type sibling histories represent a promising, relatively untapped source of data that will add to our understanding of adult mortality dynamics in Africa. The paper discusses some of the advantages and potential limitations of the data and derived mortality estimates.

Since the late 1970s, the estimation of childhood mortality levels in developing countries has been routinely accomplished through the use of data from large-scale national surveys and decennial censuses. In sub-Saharan Africa especially, in the 1980s and 1990s there has been an increasing reliance on data from the Demographic and Health Surveys (DHS) program for population-based assessment of changes in rates of infant and child mortality (Sullivan, Rutstein and Bicego 1994; Bicego and Ahmad 1996). Estimation of adult mortality in sub-Saharan Africa has received much less attention.

This is in part because the appropriate data are lacking or of very poor quality, which makes the derived estimates difficult to interpret consistently. Still, some notable efforts at interpretation using indirect techniques and adjustments to survey and census data have been made. Timaeus (1993) has shown that adult survivorship, in many countries in the region, had been improving steadily between the 1950s and 1970s. His results indicate a highly variable and changing relationship between early childhood and adult mortality and that, in many areas of sub-Saharan Africa, gains in adult survival have not been matched by improvements in

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child survival. More easily obtained information on the level of childhood mortality in a particular setting is thus not a good guide to the adult mortality level or pattern. This makes problematical the use of model mortality schedules, which posit a relationship between adult and child mortality.

The expanding AIDS epidemic means that an understanding of adult mortality levels and trends in the region will become at once increasingly important and more difficult to achieve over the next two decades. First, even assuming accurate, population-based measurement of mortality, attribution of trends at the national level will be confounded by concomitant and interacting effects of HIV/AIDS, variously paced social and economic changes, and the expansion, and sometimes the breakdown, of health systems. Indeed, for the foreseeable future, it should be acknowledged that causal interpretations of mortality trends at the national or large-area level will be limited to speculation. This situation could be improved should representative information on the changing cause-of-death structure of populations become available.

The immediate and practical issue regarding the effect of AIDS is one of reliable measurement of adult mortality at a geographic level and with time-specificity useful for policy analysis. At present, the existing data collection and analysis methodologies do not address this basic measurement issue. In this paper, a relatively untapped source of adult mortality data derived from DHS surveys is offered, and estimates are compared with data from other external sources where available. The base data sets used for estimation are all from recent DHS surveys in sub-Saharan countries experiencing intense HIV/AIDS epidemics.

Estimating adult mortality from sibling histories

To date, the assessment of adult mortality levels in sub-Saharan Africa has been an arduous and sometimes frustrating undertaking for a number of reasons, which have been discussed by Timaeus (1991). An essential problem in producing population-based estimates of adult survival has been the nature of the events under consideration (adult deaths) in relation to persons who would potentially provide information or histories of the events. In collecting data for estimating childhood mortality, a sample of mothers represents a convenient point of contact and communication from which to develop first-hand histories of recent events. The complete birth history first identifies all recent births, the units of exposure to risk (denominator data); collection of survival status and age-at-death information (numerator data) then allows a synthetic cohort of individuals to be followed through the age and calendar periods of exposure to risk. In sub-Saharan Africa, this approach is not viable for adult mortality estimation, since the relevant exposure to risk (ages 15+) occurs long after most respondent mothers have either died or have aged beyond reproductive years, severely truncating exposure data. Nevertheless, the first aim of demographers should still be to establish a genuine history of exposure events and deaths delineated on time and age dimensions, and to calculate death rates directly.

The work of Graham, Brass and Snow (1989) showed the advantages of collecting and analysing information from women on the survival of their siblings[1]. The original approach of the Sisterhood Method was a data-collection protocol combined with an analytical technique: collect aggregate-level information on adult sisters dying from maternal causes and analyse

[1] Hill and Trussell (1977) were the first to undertake careful comparative evaluation of the indirect methods of adult mortality estimation: widowhood, orphanhood, and sibling survivorship methods. Their results indicate that, of the three, the sibling survivorship method should be regarded as the most suitable method for non-cause-specific mortality in young adults.

the data by age group of the respondent, to produce a lifetime maternal mortality risk through use of adjustment factors based on model fertility and mortality schedules. Lifetime risk can be converted to a maternal mortality ratio using information on the prevailing fertility level and expressed in deaths per 100,000 live births. The DHS program expanded on this work by moving from aggregate data collection to collection of complete sibling histories, with ages and dates information elicited. Essentially, these are complete live birth histories of respondents' mothers. While these data continue to be used for the indirect estimation of maternal mortality, recently the emphasis has shifted to producing maternal mortality rates directly. Direct estimates are preferable since they allow rate calculation based on more recent events, which is superior on both substantive and data-quality grounds, and because models of demographic patterns are not required.

The DHS sibling histories also present a unique opportunity to evaluate overall male and female adult mortality rates. One of the key constraints in producing reliable maternal mortality rates has been the need for large sample sizes. Graham (1991) suggests that reports from 3000-6000 respondents are required to produce a sufficiently stable (single) rate. Since the number of overall female deaths is typically three to five times larger than the subset of maternity-related deaths, the relative standard error on an overall adult mortality rate is much smaller allowing, in many DHS surveys, sex-specific breakdowns by age or subnational area. As always, the ability to produce age-specific estimates of mortality is an important advantage of direct over indirect estimation techniques.

However, because this type of information has been widely collected only for the past few years, critical examination is still necessary to place the same level of confidence in derived adult mortality estimates as is placed in child mortality estimates from own birth histories. An underlying concern associated with use of sibling histories has been the implicit assumption of no relationship between sibship size and sibling survivorship[2]; but by limiting the exposure under observation to that upon reaching adulthood (15 years), the assumption is not an unreasonable one. Another potential problem is that information on brothers (births and deaths) may be less completely reported by the female respondents than information on sisters, since brothers will typically travel farther from their natal home and keep less in touch with their sisters. It should also be expected that fundamental data-quality problems of age and age-at-death reporting will be more pronounced than in 'own' birth histories, since the events are more removed from the observer. For example, in the typical high-fertility setting, large age differences between siblings may make even knowledge of an older brother's or sister's survival status questionable.

Data and methods

The following illustrative analyses use the sibling history data from DHS surveys recently conducted in six countries: Uganda, Zambia, Zimbabwe, Central African Republic, Côte d'Ivoire, and Malawi. The DHS sibling history, in all significant aspects, is identical to a conventional 'own' birth history, except that certain probes are used in the data collection process to ensure that only maternal siblings are included.

The estimation procedure is straightforward, and roughly follows the direct life table approach used to calculate childhood period mortality rates from survey-based birth histories (see Bicego and Ahmad 1996). However, mortality rates (${}_nm_x$) rather than life table probabilities (${}_nq_x$), are presented to allow easier comparisons with external estimates typically expressed as deaths per person-year. The rate estimates are produced for the time period 0-6

2 Brothers and sisters from large sibships have a greater chance of being included in the sample of sibling histories, and therefore are overrepresented.

years before the survey date, which keeps sampling error at an acceptable level and avoids potential distortions in the estimates caused by heaping at five-year increments of time and age. Currently, DHS is looking at age structural effects on the use of data for the more distant time periods; meanwhile, estimates of trend from the data of a single survey are not recommended.

Where feasible, estimates are produced for subnational regions. For these, it is best to regard the estimates for the overall 15-49-years age range and the broad age-pattern of mortality, rather than any single age-specific estimate which will have a large relative sampling error.

Adult mortality levels

Table 1 and Figure 1 show directly calculated rates of adult mortality by sex for the six DHS countries; for comparison, rates for the United Kingdom in 1990 are also presented (OPCS 1992). For females aged 15-49, the estimates range from 11 per 1000 (Zambia) to 4 per 1000 (Zimbabwe); for males aged 15-49, the estimates tend to be higher and range from 11 per 1000 (Zambia) to 5 per 1000 (Zimbabwe). Compared to the UK, females experience 8 to 21 times and males 5 to 11 times higher rates of dying during these ages. In the Central African Republic and Malawi, overall female mortality is as high as male mortality, which may reflect unusually high female mortality conditions in those countries, an underreporting of male relative to female mortality, or a combination of the two. Male mortality exceeds female mortality by 7, 13, 19, and 28 per cent in Zambia, Uganda, Côte d’Ivoire and Zimbabwe, respectively.

The estimated age patterns of mortality are plausible, with fairly smooth, incremental rises in risk occurring with increases in age. Although departures from this pattern may be the result of age-selective underreporting, as with mortality in the 45-49-years age group in Côte d’Ivoire, it is incautious to jump to this broad-based conclusion. For instance, in the case of Zambia lower female mortality at ages 40-49 may simply be the result of genuine rises in mortality during ages 25-39 (see Figure 1). There is evidence of heaping of ages at death at 30 and 40 in a few countries, which, if associated only with age-at-death misreporting, and not omission of deaths, will not significantly affect the estimates for the overall 15-49 age range.

Uganda

Table 2 looks specifically at the Uganda DHS estimates in comparison to published mortality rates from two population-based cohort HIV/AIDS studies conducted in Rakai district (Sewankambo et al. 1994) and neighbouring Masaka district (Mulder et al. 1993), both located in the high HIV-prevalence area of the Central region. Three points emerge from the comparisons.

Table 1
Age and sex-specific mortality rates 15-49 years (deaths per 1000 person-years) for six countries of sub-Saharan Africa, and the United Kingdom for 0-6 years before the survey.

Age	Zambia 1996	Uganda 1995	Central African Rep. 1994-95	Malawi 1992	Côte d' Ivoire 1994	Zimbabwe 1994	United Kingdom 1990
Females							
15-19	4.3	3.9	4.4	5.3	2.0	2.1	0.3
20-24	7.7	7.5	6.8	3.6	3.6	3.0	0.3
25-29	13.9	9.0	7.8	6.8	4.5	4.5	0.4
30-34	15.3	12.7	9.2	7.2	5.9	4.8	0.5
35-39	16.5	11.5	9.7	9.0	6.1	5.7	0.9
40-44	14.7	11.1	13.8	8.9	11.1	5.4	1.3
45-49	14.5	17.6	17.1	9.6	7.3	5.4	2.2
15-49[a]	10.6	9.0	8.4	6.6	4.8	3.9	0.5
Males							
15-19	3.4	3.0	3.5	3.8	2.5	1.7	0.7
20-24	5.4	5.1	5.5	4.1	3.4	3.1	0.9
25-29	11.7	10.8	7.6	6.8	5.3	4.3	0.9
30-34	17.5	16.4	9.3	8.4	9.1	6.4	1.0
35-39	22.2	14.5	12.1	7.6	7.8	6.0	1.4
40-44	22.5	19.7	14.2	10.1	11.0	10.1	2.0
45-49	21.3	21.2	17.2	9.7	8.5	13.6	3.4
15-49[a]	11.3	10.1	8.3	6.5	5.7	5.0	1.0

[a] age adjusted

First, the DHS data describe a gradient in mortality rates (sexes combined, age 15-49) from very high mortality of over 14 deaths per 1000 in the four high HIV-prevalence districts that include Rakai and Masaka[3], and about 13 per 1000 for the whole of the Central region, to 8 per 1000 (still high) in the remaining North, West, and Eastern regions where the HIV/AIDS problem is generally less severe. Second, the DHS estimate for the four high HIV-prevalence districts combined (14 per 1000) is much lower than the rate calculated from the entire Rakai study population (32 per 1000), where adult HIV prevalence was estimated at 20 per cent. The DHS estimate, however, is much higher than in the Masaka study population (10 per 1000) where adult prevalence was estimated to be eight per cent. Third, the mortality rate calculated from the adult HIV-negative population of Rakai (8 per 1000) is comparable to the DHS rate for the non-high HIV-prevalence areas. But the observed Masaka rate for the HIV-

[3] This includes an area comprising the contiguous districts of Rakai, Masaka, Mpigi, and Kampala (STD/AIDS Control Programme 1994).

negative population (1-2 per 1000) indicates a problem with underreporting of deaths, at least in this segment of their study population.

Figure 1
Male and female adult mortality by age group, 0-6 years before survey, 6 DHS countries and United Kingdom

Table 2
Comparison of age-specific mortality rates (deaths per 1000 person-years) of 1995 Uganda DHS data 0-6 years before the survey with cohort studies in Uganda, sexes combined.

	Small area cohort studies (Uganda)				DHS sibling history data		
Age Group	Rakai study	Rakai-HIV only	Masaka study[a]	Masaka HIV only[a]	4 High-risk Districts in Central Region[b]	Central Region-Uganda	Rest of Uganda (WNE regions)
15-19	4.8	2.7	7.3	1.9	3.6	3.4	3.4
20-24	35.5	5.0	↓	↓	12.0	10.2	4.8
25-29	↓	↓	14.6	1.6	15.3	14.6	8.0
30-34	45.5	10.4	↓	↓	22.4	19.9	12.4
35-39	↓	↓	7.9	0.0	23.5	19.9	10.3
40-44	46.6	22.2	↓	↓	25.2	21.1	13.0
45-49	↓	↓	8.4	1.6	24.0	22.8	18.1
15-49 (age adj.)	32.1	8.1	10.4	1.5	14.4	12.9	8.1

Sources: Rakai data, Sewankambo et al. (1994); Masaka data, Mulder et al. (1994)

[a] Age groups are 13-24, 25-34, 35-44, and 45-49 years. The 45-49 group was estimated as the interpolated value of the mortality rates during age groups 35-44 and 45-54.

[b] Rakai, Masaka, Mpigi, Kampala districts.

Table 3 shows the sex-specific DHS-based estimates of adult mortality for the high HIV-prevalence districts relative to the estimates for the rest of Uganda. Overall residence in the high HIV-prevalence areas is associated with about 71 per cent excess risk for females and 86 per cent excess risk for males. Figure 2 shows that for both men and women, mortality during age 15-19 does not differ between high HIV-prevalence districts and other districts, but that from age 20-24 onwards, mortality is considerably higher in the high HIV-risk districts. Taken together these results indicate that the Uganda DHS sibling histories do capture differential mortality associated with the geographic spread of HIV/AIDS.

Côte d'Ivoire

Table 4 looks at DHS subnational estimates for Côte d'Ivoire and estimates reported by Garenne, Madison and Tarantola (1994) for the capital city of Abidjan based on vital registration data. Abidjan, like many cities of sub-Saharan Africa, has experienced a rapid spread of HIV infection. The authors of the Abidjan study carefully examined changes in the cause-of death structure and concluded that the upward trend in overall adult mortality between 1983-87 and 1988-92 (40%) was due primarily to increases in AIDS-related deaths. They also suggest that this is probably an underestimate of AIDS impact, because of changes in underreporting and residence shifts.

Table 3
Excess mortality risk associated with residence in high HIV-prevalence area: age-specific mortality rates (15-49 yrs) by sex for 0-6 year period before the survey, 1995 Uganda DHS.

	Females			Males		
Age	High-HIV area [a]	All other areas	Excess mortality (/1000)	High-HIV area [a]	All other areas	Excess mortality (/1000)
15-19	4.4	3.9	0.5	2.9	2.9	0.0
20-24	14.5	5.7	8.8	9.4	3.8	5.6
25-29	12.7	7.7	5.0	18.1	8.4	9.7
30-34	16.3	12.0	4.3	29.9	12.9	17.0
35-39	20.4	9.7	10.7	26.8	11.0	15.8
40-44	20.6	8.1	12.5	29.8	18.3	11.5
45-49	20.8	15.4	5.4	27.4	20.9	6.5
15-49 (age adj.)	13.2	7.7	5.5	16.0	8.6	7.4

[a] Rakai, Masaka, Mpigi, and Kampala Districts

The DHS estimates indicate relatively small geographic differentials in adult survival chances. The DHS estimate for Abidjan (which is centred in time a bit later than the most recent vital registration estimate) is in line with the rising mortality documented in the Abidjan study . A rise in AIDS-related urban mortality in recent years has apparently erased urban-rural differentials. These results need to be qualified by the fact that retrospective survey data, but especially sibling histories, can potentially suffer from residential misclassification. There is no way to correct for this in these data, but it is probably true generally that the estimation of an urban-rural differential will be biased towards zero when internal migration flows are significant, for example when the place of occurrence of a large proportion of sibling events—exposure and deaths—differs from the geographic domain of sampling and interview.

Zambia

The HIV/AIDS situation in Zambia is one of the most dire in the region and thus in the world, as was reflected in the enormously high national-level adult mortality rates shown in Figure 1. In Table 5, subnational DHS estimates are presented along with urban-rural estimates published from the 1990 national census. The census data show the expected (pre-AIDS) rural excess in mortality risk. The DHS estimates covering the 1990-1996 period on the other hand show higher mortality in urban areas, especially in the large urban areas in the capital of Lusaka and the Copperbelt where HIV prevalence estimates among antenatal clinic attenders typically exceeded 25 per cent in 1994 (Fylkesnes 1995). While the census estimates are probably not directly comparable because of different methodologies, if taken at face value, urban adult mortality has roughly doubled during the 1990s while rural mortality has risen by about 25 per cent. Again, residential misclassification may operate to understate the urban-rural differential. It should be noted that, unusually by regional standards, Zambia has a large urban population, 40 per cent (Central Statistical Office, Zambia 1995).

Figure 2
Male and female adult mortality by age group, high HIV-prevalence districts risk and other districts, 1995 Uganda DHS

Table 4
Comparison of age-specific mortality rates (deaths per 1000 person-years) of 1994 Côte d'Ivoire DHS data 0-6 years before the survey with vital registration estimates, Côte d'Ivoire, sexes combined.

				DHS sibling history data (1988-94)			
Age	Abidjan Vital Registr. 1983-87	Abidjan Vital Registr. 1988-92	Abidjan DHS 1988-94	Other Urban South	Rural South	Urban North	Rural North
15-19	1.7	1.9	2.9	1.3	2.0	1.6	2.9
20-24	2.0	2.7	4.2	2.9	3.6	3.2	2.9
25-29	2.6	3.9	5.4	5.3	4.4	5.7	4.6
30-34	3.4	5.1	7.2	7.2	7.7	6.9	7.5
35-39	5.1	6.9	6.9	5.7	7.8	6.5	6.0
40-44	6.6	9.1	9.5	13.9	14.0	5.6	7.1
45-49	8.4	9.5	4.2	9.1	9.7	8.4	7.3
15-49 (age adj)	3.3	4.6	5.1	4.7	5.7	4.3	5.0

Source vital registration-based estimates: Garenne et al. (1994)

Table 5
Comparison of age-specific mortality rates (deaths per 1000 person-years) of 1996 Zambia DHS data 0-6 years before the survey with estimates from the Zambia 1990 National Census, sexes combined.

	DHS Sibling History Data (1990-96)			1990 Census	
Age	Large urban[a]	Other urban	Rural	Urban	Rural
15-19	4.0	3.4	3.8	4.4	5.4
20-24	8.3	7.0	5.3	5.8	7.1
25-29	15.9	15.2	10.2	6.4	7.8
30-34	20.5	14.8	14.2	7.1	8.6
35-39	25.8	18.7	15.7	8.0	9.8
40-44	20.0	21.0	15.9	9.4	11.4
45-49	23.1	21.0	15.7	11.0	13.2
15-49 (age adj)	13.1	11.5	9.5	6.2	7.5

[a] Includes urban areas of Lusaka and Copperbelt Provinces.

Malawi

Table 6 shows geographic differentials in adult mortality in Malawi based on the 1992 DHS sibling histories. On the basis of these estimates, adults (age 15-49) in the Northern region have much better survival prospects (4 per 1000) than do adults in the Central and Southern regions (7 per 1000), which is consistent with the patterns of social development shown by education and employment levels, and differentials in childhood mortality (NSO 1994). Adult mortality in the urban areas, mainly Blantyre, Lilongwe, Mzuzu, and Zomba, was estimated to be higher by some 30 per cent than mortality in all rural areas combined. Given the vast difference in access to tertiary health-care services between urban and rural Malawi, this suggests either significant urban-rural differences in underreporting in the sibling histories, or higher morbidity in adults of this age in urban centres. Malawi is thought to be facing one the of worst AIDS epidemics in the world, with sharp differences in HIV prevalence between the major urban centres of Blantyre and Lilongwe on one hand and rural areas on the other (US Bureau of Census 1996).

Table 6
Comparison of age-specific mortality rates (deaths per 1000 person-years) of 1992 Malawi DHS data 0-6 years before the survey with estimates from the Malawi 1987 Family Formation Survey, sexes combined.

	DHS Sibling History Data						
Age	Urban	Rural	South rural	Centre rural	North rural	Malawi 1986-92 DHS	Malawi 1983-84 FFS[a]
15-19	3.9	4.6	4.1	6.3	1.7	4.5	2.4
20-24	6.5	3.4	2.6	4.4	3.3	3.8	2.9
25-29	8.5	6.5	6.7	7.1	4.1	6.8	3.7
30-34	8.9	7.7	7.4	9.1	4.2	7.8	5.2
35-39	9.0	8.2	8.1	8.8	5.9	8.3	6.4
40-44	14.5	8.9	11.0	7.0	5.3	9.5	8.8
45-49	18.7	8.6	10.5	6.3	8.9	9.6	10.2
15-49 (age adj)	8.1	6.3	6.5	6.8	3.9	6.5	4.7

[a] Based on deaths reported in the last 12 months

The Malawi DHS took place in 1992, and consequently would not capture most of the expected AIDS-related rise in adult mortality during the 1990s. This may explain the lower than expected national-level mortality rate for Malawi seen in Figure 1.

Central African Republic

Table 7 shows variation in adult mortality across designated health regions (HR) in the Central African Republic. Overall mortality (age 15-49) ranges from 7 per 1000 in the East (HRs IV and V), to 10 per 1000 in HR I which surrounds the capital city of Bangui. In Bangui itself, mortality is 8 per 1000. This pattern is consistent with geographic variation in under-five mortality except that Bangui's adult mortality level is substantially higher than expected on the basis of childhood mortality reported by Ndamobissi, Mboup and Nguelebe (1995). Little is known about the geographic distribution of HIV/AIDS in the Central African Republic, except for evidence of high and rising HIV prevalence rates in the capital city (US Bureau of Census 1996).

Zimbabwe

Estimates of adult mortality for subnational areas in Zimbabwe are given in Table 8. Mortality is lowest in Matabeleland (3 per 1000) and highest in Mashonaland and urban areas outside the major centres of Harare and Bulawayo (5 per 1000). This pattern is roughly consistent with provincial variation in childhood mortality (CSO, Zimbabwe 1995). In the major cities of Harare and Bulawayo, the adult mortality rate is 4 per 1000. Given the very high level of employment-related internal and external migration flows in Zimbabwe, the potential for residential misclassification is significant (see above regarding Côte d'Ivoire), making the interpretation of urban-rural differences problematical. Compared with the model-based estimate from the 1987 Intercensal Demographic Survey, national-level estimates suggest an increase of about 30 per cent in the rate of mortality during ages 15-49 since the mid to late 1980s.

Table 7
Comparison of age-specific mortality rates (deaths per 1000 person-years) of 1994-95 Central African Republic (CAR) DHS data 0-6 years before the survey with estimates from the 1988 CAR national census, sexes combined.

	DHS Sibling History Data (1989-95)						
Age	Bangui	Health Region 1 (except Bangui)	Health Region 2 (West)	Health Region 3 (N.west)	Health Regions 4 & 5 (East)	CAR DHS 1989-95	CAR Census 1988
15-19	3.9	4.1	4.1	4.5	3.8	3.9	4.9
20-24	5.8	7.9	4.1	8.6	4 .6	6.1	6.4
25-29	6.5	10.4	6.2	8.4	7.1	7.7	8.5
30-34	7.8	11.6	10.7	8.2	8.3	9.3	9.1
35-39	14.9	8.5	11.5	12.5	7.5	10.9	10.5
40-44	15.1	18.3	12.2	14.4	9.5	14.0	13.0
45-49	15.2	20.7	15.8	20.7	13.2	17.1	19.3
15-49 (age adj)	7.7	10.1	8.0	9.5	6.8	8.4	8.7

Table 8
Comparison of age-specific mortality rates (deaths per 1000 person-years) of 1994 Zimbabwe DHS data 0-6 years before the survey with estimates from the 1987 Zimbabwe Intercensal Demographic Survey (ICDS), sexes combined.

	DHS Sibling History Data						
Age	Harare/ Bulawayo	Other urban	Mashona -land rural	Matabele-land rural	Other rural	Zimbabwe 1989-94 DHS	Zimbabwe 1987 ICDS[a]
15-19	1.6	2.1	2.6	1.6	1.5	1.9	2.1
20-24	2.4	3.5	3.7	2.1	3.2	3.0	3.0
25-29	4.1	6.8	5.4	1.8	4.1	4.4	3.3
30-34	6.0	4.4	5.8	3.5	6.0	5.6	3.8
35-39	4.3	6.3	6.8	5.8	5.8	5.8	4.7
40-44	11.5	12.1	8.6	4.8	4.3	7.7	5.9
45-49	6.3	9.0	9.0	9.1	12.6	9.5	8.0
15-49 (age adj)	4.1	5.1	5.2	3.3	4.4	4.5	3.5

[a] Intercensal Demographic Survey, model-based using estimated under-five mortality

Mwanza Region, Tanzania

An in-depth study of mortality estimation was conducted during 1995 in Kwimba district of the Mwanza region in northwestern Tanzania (Bicego et al. 1997). The Sumve Survey on Adult and Childhood Mortality (SACM), undertaken with the principal aim of assessing the feasibility of collecting reliable birth histories by proxy (from sisters), also produced DHS-type sibling history data from which adult mortality rates were estimated for the period 1989-95. No HIV prevalence estimate is available for the study area, but it was likely to be 1-3 per cent during this reference period.[4] The mortality estimates obtained from these data are compared to mortality rates estimated from two cohort studies also undertaken in the Mwanza region. One of these, based in 12 scattered rural villages in various districts, was a population-based longitudinal study focusing on STD treatment as a means of reducing the spread of HIV (Todd et al. 1997). HIV prevalence was estimated to be four per cent in 1991-92.

The second study is continuing and aims to assess the causes and consequences of the HIV/AIDS epidemic in Kisesa Ward, Magu District (Boerma et al. 1997). The mortality data come from a two-year demographic surveillance of 20,000 individuals. HIV prevalence was found to be over ten per cent in the 40 per cent of the study population living in a trading centre along the main road leading to southern Kenya, and four per cent in the remaining rural population.

Table 9
Comparison of age-specific mortality rates (deaths per 1000 person-years) from three studies in Mwanza region,Tanzania.

Age	Coale-Demeny North Model: at q(5) of 134/1000	Sumve, Kwimba district 1989-95 All	Mwanza Region (rural) 1992-94 HIV only	Mwanza Region (rural) 1992-94 All	Kisesa, Magu District 1994-96 All
15-19	3.3	1.3	3.0	3.1	4.7
20-24	4.5	3.1	3.0	5.9	↓
25-29	4.9	4.1	3.8	8.4	9.9
30-34	5.5	7.2	6.2	10.2	↓
35-39	6.2	6.5	↓	↓	14.3
40-44	7.5	8.7	6.1	9.5	↓
45-49	8.9	8.2	8.4[a]	10.4[a]	15.2[a]
15-49[b]	5.1	4.6	4.5	7.2	8.7

Sources: Todd et al. (1997); Boerma et al. (1997). [a] Weighted interpolation of published rates for the age groups 35-44 and 45-54. [b] Standardized on the Sumve age structure

Figure 3
Adult mortality (age 15-49) in Mwanza Region Tanzania.

[4] Two studies undertaken in rural parts of Mwanza region estimated HIV prevalence of about 4 per cent. The Sumve area, where the SACM study was conducted, is on the whole more remote than the other two study areas. It thus seems unlikely that prevalence was as high as 4 per cent, and it was likely to have been much less for the 1989-95 reference period.

Table 9 and Figure 3 show the age-specific rates of death from these three studies against the Coale-Demeny North Model rates (Coale and Demeny 1983) implied by an under-five mortality rate of 134 per 1000 measured in the 1995 SACM study for the 1991-95 period. The rates from the SACM sibling history data are surprisingly consistent with rates produced from data of the Mwanza Region study (rural, HIV-negative population) and with levels implied by the model rates. The Kisesa rates are higher than the rates from the Sumve and Mwanza studies, with the greatest percentage differences occurring between ages 25 and 44. The overall adult mortality rate of 7 per 1000 for the entire Mwanza region study population, i.e., including HIV-positive individuals (4% HIV prevalence), reflects the intermediate position of this population with regard to the AIDS epidemic in the region.

These results should be interpreted in context. The Sumve and Mwanza region populations are located in more remote areas, and are probably on average less exposed to high HIV-risk, than individuals in the Kisesa study area. Further, the Kisesa reference period (1994-96) is later than the Mwanza region reference period (1992-94), and considerably later than the Sumve reference period (1989-95). If this region is on an upward trajectory regarding the spread of HIV, then the Kisesa estimates, *ceteris paribus*, are expected to be higher.

Discussion

It is important to emphasize what this study of survey-based adult mortality estimation was and was not intended to accomplish. It was not meant to quantify trends in adult mortality. Confidence assessment of demographic trends should generally involve more than one data source, especially given the relatively rapid deterioration in survival chances predicted for adults in much of the region. Unfortunately, to date, no country has held more than one national survey that included sibling-history data.

Nor was the study intended to suggest that direct estimates of adult mortality from survey-based sibling histories should supplant or substitute for continuing population-based indirect estimation, longitudinal studies, or demographic surveillance systems. The DHS sibling histories are a new source of information that should be viewed critically. The second rounds of surveys will allow more in-depth assessment of the quality of sibling history-derived mortality estimates. At this time, it is clear that these data suffer from some imprecision in age and age-at-death reporting which makes age patterns of mortality difficult to establish with confidence. It is however equally clear that, especially in the absence of cause-of-death information, age-specific estimates of adult mortality are very helpful in interpreting mortality level estimates in the context of AIDS and should be viewed as a priority.

This paper was intended to demonstrate that direct mortality estimates from sibling histories provide an additional tool to complement estimates derived from longitudinal and other cross-sectional mortality data in the evaluation of AIDS impact. Their particular advantages include the following.

1. As typically implemented, DHS-type survey data are population-based and the estimates refer to geographic domains of practical interest to national planners; as opposed to cohort study and sentinel surveillance data, from which it is often difficult to extrapolate to larger geographically-representative domains.

2. Although not emphasized in this paper, direct analysis of full sibling histories allows estimates for a more recent, and therefore relevant, reference period than is now possible with indirect estimation techniques. A national estimate of adult mortality by sex for a reasonably recent two-to-three-year period immediately before the survey is feasible from a sample of about 5000 women aged 15-49; the average DHS sample in sub-Saharan Africa now exceeds 6000 respondents. Subnational estimates are possible at the same sample size, but at the cost of extending the retrospective reference period, and with the potential of producing misleading results due to residential misclassification of reference events. The latter problem should be carefully examined; it should be feasible to include current residence information in the sibling histories and use post-stratification procedures to re-weight the estimates.

3. Upcoming second rounds of DHS surveys will permit estimates of trends. The standardized nature of DHS data collection instruments, processing, and analysis facilitates comparability of estimates over time and between countries. With the experience gained from validation studies of verbal autopsies, it may also be feasible to incorporate additional questions on causes of deaths. This may allow a classification of deaths into broad categories useful for drawing inferences regarding the composition of changes in mortality levels.

The results of this study indicate a good deal of consistency with externally derived estimates of adult mortality and on the whole underscore the expected, but hitherto sparsely documented, association between residence in high HIV-prevalence areas and very high mortality risk during the relevant adult ages. In general, these findings indicate that DHS sibling histories represent a promising, relatively untapped source of data that will add to our understanding of adult mortality dynamics in Africa during the 1990s.

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