An Assessment of the Credibility of Child Mortality Declines Estimated from DHS Mortality Rates

(Working Draft; Revision 1, 10/29/08)

by

Jeremiah M. Sullivan

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Background

For many countries of the world lacking reliable vital registration system, childhood mortality estimates must be derived from surveys and censuses. One of several survey sources of mortality data is the Demographic and Health Survey (DHS) Program. Table 1 contains under-five mortality rates (U5MR) published in 22 DHS survey reports for recent consecutive surveys in 11 countries. The two surveys in each country were conducted within 4 to 7 years of each other and the percentage declines in mortality between each pair of surveys were between 16% and 41%. These percentage declines over relatively short time periods indicate rapid declines in mortality.

Table 1 U5MR estimates from 22 DHS surveys and from *Levels & Trends, 2006* (Rates per 1,000 live births)

	DHS Estimates			*Levels & Trends, 2006*		
	U5MR 1996-2000	U5MR 2003-2006	% Decline	U5MR 1995.5	U5MR 2000.5	% Decline
Egypt DHS 2000 & 2005	54.3	41.0	24.5	68.0	51.0	25.0
Peru DHS 2000& 2004	46.7	32.4	30.6	63.0	41.0	34.9
Nepal DHS 1996 & 2001	118.3	91.2	22.9	118.0	86.0	27.1
Bangladesh DHS 1997 & 2004	115.8	87.6	24.4	120.0	92.0	23.3
Mozambique DHS 1997 & 2003	200.9	152.4	24.1	212.0	178.0	16.0
Cambodia DHS 2000 & 2005	124.4	83.3	33.0	123.0	104.0	15.4
Malawi DHS 2000 & 2004	188.5	133.2	29.3	193.0	155.0	19.7
Niger DHS 1998 & 2006	273.7	193.9	27.9	295.0	270.0	8.5
Madagascar DHS 1997 & 2004	159.2	97.1	41.0	156.0	137.0	12.2
Burkina Faso DHS 1998 & 2003	219.1	183.7	16.2	194.0	194.0	0.0
Ethiopia DHS 2000 & 2005	166.2	123.5	25.7	179.0	151.0	15.6

Note: The U5MR estimates from the DHS surveys are for the 5-year period preceding the survey.
Sources: DHS estimates; Final reports from various surveys.
Levels and Trends in Child Mortality in 2006(Working Paper), UNICEF, WHO, The World Bank and UN Population Division, 2007.

The Interagency Group for Child Mortality Estimation has the mandate to produce consistent estimates on the levels and trends in child mortality worldwide based on mortality estimates from various sources.[1] Most prominent among these sources are survey-based mortality estimates from the DHS surveys and the Multiple Indicator Cluster Surveys (MICS surveys sponsored by UNICEF), although mortality estimates from other sources are included. The most recent "best estimates" from the Interagency Group are found in *Levels and Trends of*

[1] Member agencies of the Interagency Group for Child Mortality Estimation are UNICEF, WHO, The World Bank, and the UN Population Division.

Child Mortality in 2006, Working Paper (UNICEF, WHO, The World Bank, and the UN Population Division, 2007). The U5MR estimates for calendar years 1995 and 2000 are shown in Table 1 along with the DHS estimates. Although the two sets of estimate do not refer to precisely the same time periods, it is expected that the estimates of the percent decline in U5MR over similar time periods from both sources would bare a close resemblance. However, that is not the case for the last six countries listed in Table 1. For those countries, estimates of the pace of mortality decline are, on average, about twice as great according to the DHS rates than according to the Interagency Group rates.

It is important to identify the factors contributing to the differences in the estimates of the pace of mortality decline in Table 1. A first step toward this end is an assessment of the credibility of mortality declines implied by the U5MR estimated from the DHS surveys.

Objectives

This report conducts an assessment of the data collected for the estimation of U5MR for the 22 DHS surveys listed in Table 1 and the credibility of the mortality declines implied by those estimates. A reconciliation of the differences between the DHS and the *Level & Trends, 2006* estimates of mortality rates and mortality declines is beyond the scope of this report and is not attempted here.

DHS Questionnaires and the Calculation of Mortality Rates

The U5MR estimates presented in the DHS survey reports are based on retrospective reproductive histories reported by female respondents. These are usually full birth histories, although in some surveys respondents are asked to report in terms of their pregnancy histories (ORC Macro, 2001). For simplicity, in this report, the term birth history will be used in referring to both kinds of reproductive histories.

The mortality rates published in DHS reports are calculated by direct estimation procedures and represent mortality conditions in 5-year retrospective periods going back 15 or 20 years preceding a survey (Rutstein, S. O. and G. Rojas, 2003). The rates can be considered as estimates for 5-year retrospective periods preceding the midpoint of fieldwork for a survey. However, in the analysis to follow it will be convenient to refer to the mortality estimates as specific to a date. The date used for this purpose will be the midpoint of the time period to which an estimate applies. For example, the date for estimates for the five year period immediately preceding a DHS survey would be 2.5 years prior to the medium date on which the survey interviews were conducted.

Methodology

The most important quality issues concerning the mortality data collected in the DHS birth histories are of four kinds: errors in the recorded dates of birth of children, underreporting of deceased children, sampling problems (e.g., unrepresentativeness of the selected sample) and misreporting of age at death. A summary of the procedures for analyzing the impact of these factors is set forth below.

Errors in dates of birth: Birth transference. DHS questionnaires include a lengthy series of questions which are asked to mothers concerning maternal and child health—about 100 questions in the current version of the DHS questionnaire. This series of questions must be asked for all births listed in the respondent's reproductive history for which the date of birth is subsequent to a specified date—usually set as January of the fifth or sixth calendar year proceeding the year of the survey. It appears that interviewers learn that they can reduce their workload by incorrectly recording some births that actually occurred after the health cutoff date as occurring prior to that date.

In DHS surveys, this birth transference is always more pronounced for deceased than for surviving children. Interviewers appear to be particularly anxious to avoid asking the health questions about deceased children.

The effects of birth transference are evident in calendar year birth distributions. The analysis in the annexes to this report provides those single year birth distributions (separately for surviving and deceased children) for the 22 DHS surveys. Also provided is an index of the extent of transference: the ratio of number of births in the year prior to the health cutoff to the number in the year after the heath cutoff. A value substantially greater than one for this index indicates transference of births across the health cutoff date.

Figure 1 shows a box diagram with the median values of the index of transference for surviving and deceased children.[2] The median value for deceased children is 1.7 indicating, on average, a seventy percent difference in the number of deceased children in the years before and after the health cutoff. The medium value for surviving children is 1.2. The excessive transfer of births to deceased children to earlier time periods creates the potential for biasing the standard DHS mortality estimates. For estimates for the 5-year period immediately before the survey, there is potential for negative bias while, for the penultimate 5-year period, there is a potential for positive bias.[3]

[2] Many DHS surveys conducted in the 1990s collected maternal and child health data only for births in the three years preceding the survey. For those surveys, the health cutoff was set at January of the third full calendar year prior to the survey so that birth transference usually did not transfer births from across the 5-year boundary line for the last mortality estimation period. Four of the 22 surveys considered here followed that design and are excluded from Figure 1.

[3] The impact of birth transference on DHS mortality estimates depends on several factors: the magnitude of birth transfers, the relative magnitude of transfers of births to deceased and surviving children and, for deceased children, whether or not both the birth and the death of the child are transferred out of (or into) a defined estimation period. The last of these conditions explains why the effect of birth transference is greater on neonatal and infant mortality rates than on under-five mortality rates. Birth transference of children who die in early infancy transfers both the birth and the death out of the last estimation period. While birth transfer of children dying at ages 2, 3 or 4 may leave the death within the last estimation period so that the impact on the estimated U5MR is minimal.

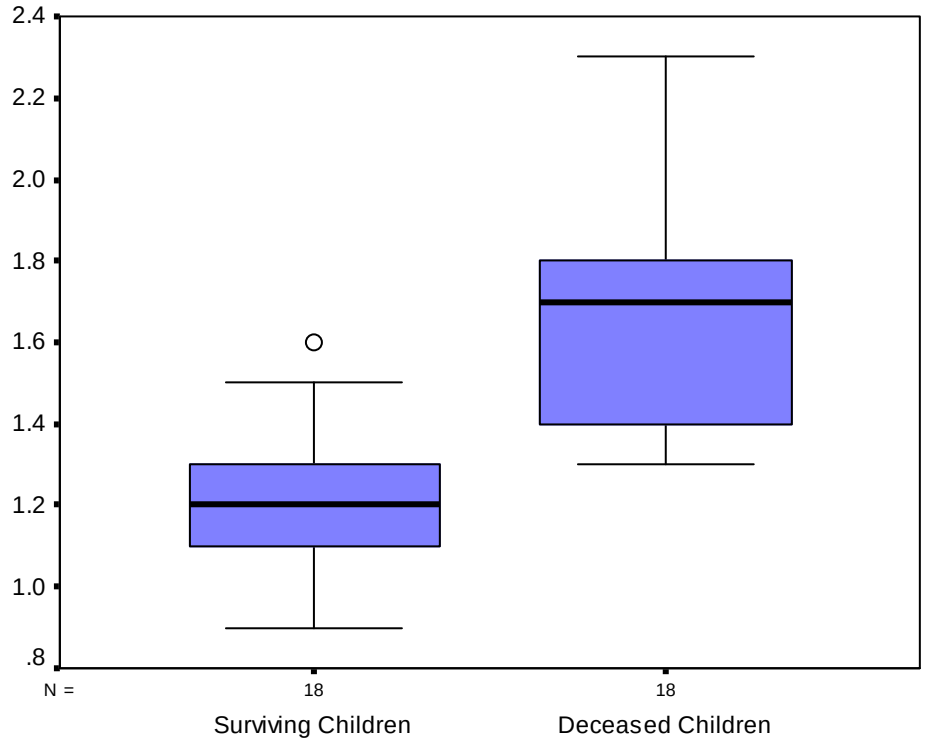

Figure 1 Box Plot of values of Index of Birth Transference

The presence of bias from birth transference can be investigated by redefining the time intervals for mortality estimation. Setting the earlier boundary date for the last mortality estimation period back to January of the year prior to the health cutoff locates most transferred births in the time period in which they (and any subsequent deaths) occurred. For this report, the last estimation period was redefined as beginning one year before the health cutoff and earlier estimation periods were redefined as 5-year calendar periods prior to the last estimation period.

The estimates for the redefined time periods are perfectly legitimate estimates.[4] However, in this report we are interested in a comparison with the DHS published estimates—especially the estimates for the last estimation period which are used in Table 1 to determine percentage declines in mortality. The estimates for the redefined time periods apply to calendar periods which are, on average, one or two years earlier in time than the published DHS estimates. To achieve comparability, it is necessary to project the redefined estimates forward to the date of the DHS estimates (e.g., in the case of estimates for the last estimation period, the projection is to a date 2.5 years before the median date of fieldwork for the DHS survey). This was accomplished by straight-line projection from the redefined estimates.

[4] For some purposes, mortality estimates for the redefined time periods could be used as estimated; e.g., as data points to the regression analysis used to track mortality levels and trends by the Interagency Group for Child Mortality Estimation.

In the remainder of this report, the term re-estimated rate is used to refer to the mortality rates which are projected forward in time and are comparable to the published DHS estimates.

When birth transference has biased the published DHS estimates, the re-estimated rates remove that bias. The expected result is an increase in the U5MR for the last estimation period and a decrease in the U5MR for the penultimate estimation period. For most of the surveys considered here, the effect of re-estimation on mortality estimates for the last estimation period was modest; an increase in the U5MR estimates of less than 5%. However, in several surveys the increase for the last estimation period was more pronounced: Cambodia DHS 2005 (11%), Ethiopia DHS 2000 (7%) and Malawi DHS 2004 (7%).[5]

Underreporting of deceased children. Underreporting of deceased children is a potential problem in any retrospective survey. For various reasons, respondents may be reluctant to report deceased children to survey interviewers. It is also possible that interviewers may intentionally fail to record births, particularly recent births of deceased children, in order to avoid asking the health questions.

Documenting underreporting of births and deaths in the DHS surveys would be an easy matter if reliable vital rate information were available. But that is not the case for the countries considered here, so the assessment of underreporting will be done with the tools available—by comparing U5MR estimates from each pair of surveys for a common reference period. The reference period chosen for rate calculation was typically a 10-year calendar period prior to the first of a pair of surveys. Also, to keep the analysis free of potential bias from compositional differences in mothers' age at birth, the analysis will be restricted to mortality rates for children who were born to women less than age 40 at the time of birth. In this analysis, underreporting of deceased children in a survey will be indicated by the percent to which the rate from one survey is exceeded by the rate from other.[6]

For 5 of the 11 pairs of surveys, the difference in the U5MR estimates for the common reference period was greater than 5% and ranged between 9% and 28%. In all five cases, it was the second survey or more recent survey where the shortfall occurred (Malawi DHS 2004, Niger DHS 2006, Ethiopia DHS 2005, Madagascar DHS 2004 and Burkina Faso DHS 2003). Underreporting of events in the more recent survey means that basing estimates of mortality declines on differences between the surveys overstates the true degree of mortality decline. The final step in adjusting for underreporting of events was to increase the U5MR

[5] The result of re-estimation on infant mortality estimates is not a focus of this report and those results are not shown in Annexes A through K. However, it is worth noting that the effect of re-estimation is greater on infant mortality than on U5MR estimates (see footnote 3). For the three surveys cited, the effect of re-estimation was to increases the infant mortality rate as follows: Cambodia DHS 2005 (16%), Ethiopia DHS 2000 (10%) and Malawi DHS 2004 (10%).

[6] There are limitations to this approach to the measurement of underreporting. This is a relative evaluation where the survey with the higher mortality estimate is considered the more accurate. But there is no guarantee that that survey is not an underestimate (or an overestimate). Additionally, the recall period for event reporting is shorter in the earlier of a pair of surveys. To the extent that completeness of reporting depends on the length of the recall period, the second survey is at a disadvantage. Nevertheless, the analysis is valid in terms of the findings for the common reference period. The more serious issue is whether or not the shortfall determined for the common reference period also applies to the period immediately preceding the more recent survey.

estimate for the last estimation period from the more recent survey by the percentage shortfall found for the common reference period.

Sampling problems. Sampling procedures for DHS surveys start with identifying an appropriately sampling frame (usually from the national statistical office), and include updating the frame, selection of sampling areas, mapping of sampling areas and selection of households to be included in the sample. The weakest link in this chain is probably the representativeness of the sampling frame. However, a detailed review of the sampling frames used for surveys (say, by comparison of population distributions with recent census materials) is beyond the scope of this report.

However, it should be stated that the sampling frames for all 22 surveys considered here were based on national population census materials. It is also pertinent that most of the surveys considered here were conducted less than 7 years apart, so that, for 8 of the 11 paired surveys, the sampling frames for both surveys were derived from the same national census materials. Only in Bangladesh, Mozambique and Niger were the sampling frames derived from different censuses.

In this report the assessment of sampling issues is in terms of a comparison the distributions of the population at risk to under-five mortality; i.e., birth distributions by urban/rural residence and by geographic regions for the five year period preceding a survey. For the most part, those distributions for each pair of surveys are very similar (see Table 5 in each country specific annex, Annexes A through K), indicating similar weighting of mortality conditions by geographic areas in both surveys.

Table 2 shows statistics on the percent of births occurring in urban areas for each pair of surveys. Two cases, Bangladesh and Mozambique, stand out in terms of an increase in the concentration of births in urban areas between surveys. In both countries urban mortality is lower than rural mortality so that, if the distributional changes were due to sampling error, there would be a tendency for exaggerating the true mortality decline.

Table 2 Births in urban areas as a percentage of all births in the five years preceding a survey, 22 DHS surveys

	Earlier survey	Later survey	Difference (later-earlier survey)
Egypt 2000 & 2005	38.5	36.4	-2.1
Peru 2000& 2004	58.2	58.1	-0.1
Nepal 1996 & 2001	7.0	6.4	-0.6
Bangladesh 1997 & 2004	8.9	19.9	11.0
Mozambique 1997 & 2003	21.6	29.9	8.3
Cambodia 2000 & 2005	13.1	14.0	-0.9
Malawi 2000 & 2004	12.3	13.2	0.9
Niger 1998 & 2006	15.8	15.1	-0.7
Madagascar 1997 & 2004	20.0	18.3	-1.7
Burkina Faso 1998 & 2003	9.9	12.8	2.9
Ethiopia 2000 & 2005	10.4	7.3	-3.1

The potential for sampling bias to overstate the mortality decline in these two cases was assessed by computing standardized mortality rates. For both Bangladesh and Mozambique, standardization reduced the observed mortality declines of Table 1 (24% for both countries) by one percentage point. The indication is that in the two instances where the urban/rural distributional differences were the greatest, even assuming that those differences were entirely due to sampling error, the result was negligible. We conclude that it is probable that sampling problems contributed in only a negligible way to the observed mortality declines considered in this report.

Misreporting of age at death. For the estimation of U5MR, the issue is whether or not there is digit preference in the reporting of age at death in favor of age five at the expense of ages less than five. [7] Most analyses of data quality are silent on this issue (Sullivan, Jeremiah M., et al., 1990: Curtis, Sian L.1995 and Pullum, Thomas, 2006). The analysis to follow confirms that this problem is not of great concern.

The analysis reviewed the reporting of deaths by single year of age up through age fifteen for the 22 surveys covered in this report. The potential impact which misreporting of deaths at age five can have on U5MR estimates is indicated by the ratio of deaths at age five to all deaths under age five. The mean value of that ratio for the 22 surveys was .025, indicating that if even half of the deaths at age 5 were in fact deaths under age 5, the U5MR would be increased by approximately 1%.

The potential impact of digit preference for age 5 in specific surveys can be obtained from the distributions of deaths by single year of age. Table 3 shows those distributions for the six surveys with the greatest values of the ratio of deaths at age five to deaths under age five. With the exception of Mozambique 1997 and Cambodia 2005, there is a steadily declining trend in the number of deaths by age. And even in those two cases, it is doubtful that a redistribution of deaths by curve fitting would increase an U5MR estimate by even half a point per 1,000. At least for the 22 surveys investigated in this report, this issue is not sufficient to be further considered.

[7] An entirely different and much more serious question for the assessment of the quality of mortality data is the impact of digit preference on estimates of infant mortality. In that case, the assessment would need to consider the problem of age at death misreporting at the boundary between infancy and age one. Because of digit preference and the rounding of ages to the nearest whole year, survey data frequently reflect over reporting of deaths at age one at the expense of late infancy. No generally accepted solution to this problem has emerged in the demographic literature. In the case of U5MR estimates, the problematic boundary between infancy and age one can be disregarded.

Table 3 Distributions of Deaths by Age for the Six DHS Surveys with the Highest Values of the Ratio of Deaths at Age 5 to Deaths under Age 5 (Weighted data)

	Ethiopia 2005	Ethiopia 2000	Mozambique 1997	Nepal 2006	Cambodia 2005	Cambodia 2000
	Ratio: Deaths age5/Deaths<age 5					
	.044	.039	.034	.034	.034	.033
Age	Deaths					
0	1,823	2,673	2,089	1,900	1,454	1,774
1	381	602	328	1,002	139	191
2	278	446	315	823	49	122
3	297	367	198	374	64	170
4	168	242	98	163	60	93
5	131	169	105	146	60	78
6	74	117	43	94	39	58
7	87	158	56	91	45	66
8	58	96	11	44	26	41
9	40	51	12	25	23	25

Results: Credibility of the Under-Five Mortality Declines

Details of the analysis for the 11 countries listed in Table 1 are shown in Annexes A through K. This section summarizes those results. As indicated in the Methodology Section, the main data defects found in the survey data were due to birth transference and underreporting of deceased children. Table 4 shows estimated mortality declines based on a) DHS published rates, b) rates adjusted for birth transference and c) rates adjusted for both birth transference and underreporting of deceased children.

In Table 4, the eleven countries are categorized into three groups. The three groups represent a trend of increasing problems with the survey data and larger revisions (downward) of the estimated declines in mortality between surveys.

Table 4 Percent mortality decline in U5MR between surveys: DHS rates, re-estimated rates and re-estimated rates adjusted for underreporting of deceased children

	DHS published rates		Estimated percent mortality decline based on: DHS Published rates	Re-estimated rates	Re-estimated rates adjusted for underreporting of deceased children
Group I: Five Countries					
Egypt 2000 & 2005	54.3	41.0	24.5	23.3	NA
Peru 2000& 2004	46.7	32.4	30.6	32.1	NA
Nepal 1996 & 2001	118.3	91.2	22.9	19.1	NA
Bangladesh 1997 & 2004	115.8	87.6	24.4	27.1	NA
Mozambique 1997 & 2003	200.9	152.4	24.1	23.9	NA
Group II: Three Countries					
Cambodia 2000 & 2005	124.4	83.3	33.0	27.0	NA
Malawi 2000 & 2004	188.5	133.2	29.3	24.1	17.8
Niger 1998 & 2006	273.7	197.3	27.9	26.9	20.3
Group III: Three Countries					
Madagascar 1997 & 2004	159.2	93.9	41.0	39.0	13.8
Burkina Faso 1998 & 2003	219.1	183.7	16.2	16.6	6.7
Ethiopia 2000 & 2005	166.2	123.5	25.7	28.4	11.9

Group I countries: Egypt, Peru, Nepal, Bangladesh and Mozambique.

In each country both surveys showed evidence of birth transference but the re-estimated rates made only marginal differences in the estimated mortality decline.[8] Also, for the surveys in Group I countries, there was no indication of significant underreporting of deceased children.

For these countries, the analysis confirmed the rapid mortality decline implied by the DHS published mortality rates.

Group II countries: Cambodia, Niger and Malawi

In the case of Cambodia, the adjustment for birth transference increased the U5MR for the 2005 survey (the second survey) by 11%. However, the analysis found no indication of underreporting of deceased children in the Cambodia surveys. The conclusion was that Cambodia experienced a substantial mortality decline, although the adjustment for birth transference reduced the estimated mortality decline from 33% to 27%.

[8] For example, the largest change in the estimated mortality decline due to adjustments for birth transference occurred in Bangladesh (from 24.3% to 27.1%). In this case, re-estimation produced a greater increase in the rate from the earlier survey than from the later survey resulting in a modest increase in the estimated percentage decline in mortality (see Annex D).

In the case of Malawi, re-estimation indicated that the U5MR for the 2004 survey (the second survey) was underestimated by 7%. The analysis of event omission indicated underreporting of deceased children by 9% in the 2004 survey. The combination of the two adjustments to the DHS U5MR estimates reduced the estimated mortality decline from 29% to 18%.

In the case of Niger, birth transference had almost no effect on the initial DHS estimates but underreporting of deceased children was found to underestimate the U5MR from the 2006 survey (the second survey) by 9%. The adjusted U5MR reduced the estimated mortality decline from 28% to 20%.

For these countries, the mortality declines implied by the adjusted U5MR estimates are considered credible. The rationale for this conclusion is that the adjustments of the U5MR were not large relative to the observed mortality declines, suggesting that serious error would not result from their acceptance.

Group III countries: Madagascar, Burkina Faso and Ethiopia

In the case of Madagascar, the birth transference adjustment for the 2004 survey (the second survey) was 3% which resulted in a marginal decrease in the estimated mortality decline between the surveys (41% to 39%). The more important finding was underreporting of deceased children at the 28% level in the 2004 survey. The adjustment for underreporting further reduced the estimated mortality decline from 39% to 14%.

For Burkina Faso, the adjustments for birth transference were negligible in both surveys. Again, the important finding was underreporting of deceased children at the 12% level in the 2003 survey (the second survey). The combined result of the adjustments to the U5MR estimates reduced the percentage mortality decline from 16% to 7%.

In the case of Ethiopia, the adjustment for birth transference increased the U5MR for both the 2000 survey (7%) and the 2005 survey (3%). These adjustments increased the percentage mortality decline between the surveys from 26% to 28%. However, the more significant finding was underreporting of deceased children at the 23% level in the 2005 survey. The combined result of the adjustments to the U5MR estimates reduced the percentage mortality decline from 26% to 12%.

For these countries, the analysis of underreporting of events indicated that the U5MR estimates from the second survey were substantially underestimated (28%, 12% and 23%). The adjustments for underreporting reduced the estimated mortality declines by about 60% for each country. Such large adjustments leave little doubt that the mortality declines based on initial DHS estimates are not valid. Although the mortality declines based on adjusted U5MR estimates are considered more realistic, the adjustments to the estimated rates are so large (relative to the mortality declines) that the final estimates of mortality decline can not be considered very precise.

Final Comments

The analysis of the DHS surveys presented here is focused on the credibility of the mortality decline implied by U5MRs of the DHS survey reports. For the most part, well-established methods of analysis were used— comparison of rates for a common reference period, comparison of birth distributions and standardization of rates. One new technique of analysis was used—the re-estimation of mortality rates to eliminate the effect of birth transference.

There are few surprises in the analysis although the analysis may offer firmer grounding for views prevalent in the demographic community concerning the quality of the mortality data in some DHS surveys. More interesting is the finding of no fault with the mortality estimates indicating rapidly declining mortality in the five Group I countries. Of additionally interest is the conclusion that, notwithstanding data defects, there were substantial and credible mortality declines in the three Group II countries.

The analysis presented here has not attempted to reconcile the problem which initially motivated this project—differences in the U5MR estimates from the DHS surveys and the rates estimated in *Levels and Trends, 2006 (Working Paper)*. That issue merits attention.

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Annex A: Egypt DHS 2000 and 2005

Mortality Decline: U5MR Estimates

Table 1 shows U5MR estimates from the 2000 and 2005 DHS survey reports and from *Levels & Trends, 2006*.[1] The decline in the DHS rates and *Levels & Trends, 2006* rates were over a period of about 5 years. The percentage decline in the DHS rates (24.4%) and the *Levels & Trends, 2006* rates (25.0%) were almost identical as were the average per year rates of decline.

There was however a difference in the magnitude of the estimated rates from the two sources, the *Levels & Trends, 2006* estimates being consistently higher. This is almost entirely explained by differences in the points in time to which the rates apply—the *Levels & Trends, 2006* rates pertain to points in time about two years earlier than the DHS rates. Projecting those rates forward to the dates of the corresponding DHS rate resulted in an estimate for 1997.7 of 60 per 1,000 and for 2002.9 of 45 per 1,000—i.e., more than half of the differences between the DHS and *Levels & Trends, 2006* estimates disappear when the time differences are removed.

Table 1 Egypt U5MR Estimates
(Rates per 1,000 live births)

Source	Date	Rate	Date	Rate	Absolute Decline	% Decline	Time Period (years)	Average Annual % Decline
DHS 2000 & 2005	1997.7	54.3	2002.9	41.0	13.3	24.5	5.2	4.7
Levels & Trends, 2006	1995.5	68	2000.5	51	17	25.0	5.0	5.0

Of course, the close agreement between the rates from the different sources does not substantiate their accuracy. Both sets of estimates are based on data from the DHS 2000 and 2005 surveys (and the DHS 2003 survey in the case of *Levels & Trends, 2006*) and data defects, particularly underreporting of deceased children in the 2005 survey, could result in both sources indicating a spurious mortality decline.

Birth Transference

In all DHS surveys there is a risk of birth transfer because of the extensive number of health questions which must be asked for births which occur after a specified cutoff date. Interviewers can reduce their work load by incorrectly recording a date of birth which is prior to the health cutoff for children who were actually born after that date. This has the potential of negatively biasing mortality estimates for the last estimation period prior to the survey and positively biasing estimates for the penultimate estimation period.

[1] *Levels and Trends of Child Mortality in 2006 (Working Paper)*, UNICEF, WHO, The World Bank and UN Population Division, 2007.

The cutoff dates for asking the health questions in the two Egypt surveys were January 1995 (2000 survey) and January 1999 (2005 survey). Birth transference occurred in both surveys, resulting in substantially more deceased children recorded as born in the year prior to the cutoff than in the year after the cutoff. The index of birth transference for deceased children was 1.94 for Egypt 2000 and 1.38 for Egypt 2005 (Table 2).

Table 2. Births by Calendar Year

Egypt 2000			Egypt 2005		
Calendar year	Child alive	Child deceased	Calendar year	Child alive	Child deceased
2000	646	20	2005	1,048	34
1999	2,316	92	2004	2,676	100
1998	2,200	109	2003	2,606	108
1997	2,188	97	2002	2,733	97
1996	2,134	105	2001	2,673	81
1995	1,898	98	2000	2,458	93
1994	2,322	191	1999	2,830	170
1993	2,007	156	1998	2,472	153
1992	1,811	221	1997	2,301	170
1991	1,940	189	1996	2,246	146
Index of birth transference	1.22	1.94		1.15	1.83

Note: The bold line indicates the date of the cutoff for asking health questions.

To investigate the effect of birth transference in the Egypt surveys, new estimates of U5MR were made for redefined time periods: 1) the earlier boundary for the last estimation period was set to begin one year before the health cutoff in each survey and 2) earlier estimation periods were earlier 5-year calendar periods. Because the new estimates apply to earlier time periods than the published DHS estimates, they were projected forward to the date of the DHS estimates by straight line projection (from the adjacent newly estimated rates). Results are shown in Table 3. The re-estimated rates differ little from the published DHS rates. For example, for the last estimation period preceding each survey, the DHS and re-estimated rates are 54.3 and 54.6 per 1,000 (2000 survey) and 41.0 and 41.9 per 1,000 (2005 survey). .

Table 3. Re-estimated U5MR*

Egypt 2000		Egypt 2005	
Date	U5MR	Date	U5MR
1997.7	54.6	2002.9	41.9
1992.7	81.4	1997.9	57.0
1987.7	104.0	1992.9	77.5
1982.7	144.0	1987.9	99.4

* Re-estimated and projected rates.

Figure 1 shows the trend in U5MR estimates published in the DHS reports and Figure 2 shows the trend of the re-estimated rates. Two points stand out. First, there is not much difference between the published DHS rates and the re-estimated rates. And second, for the time periods during which there is overlap between the two surveys, the rates are in close agreement—this is particularly so in the case of the re-estimated rates.

Figure 1
DHS U5MR: Egypt 2000 & 2005

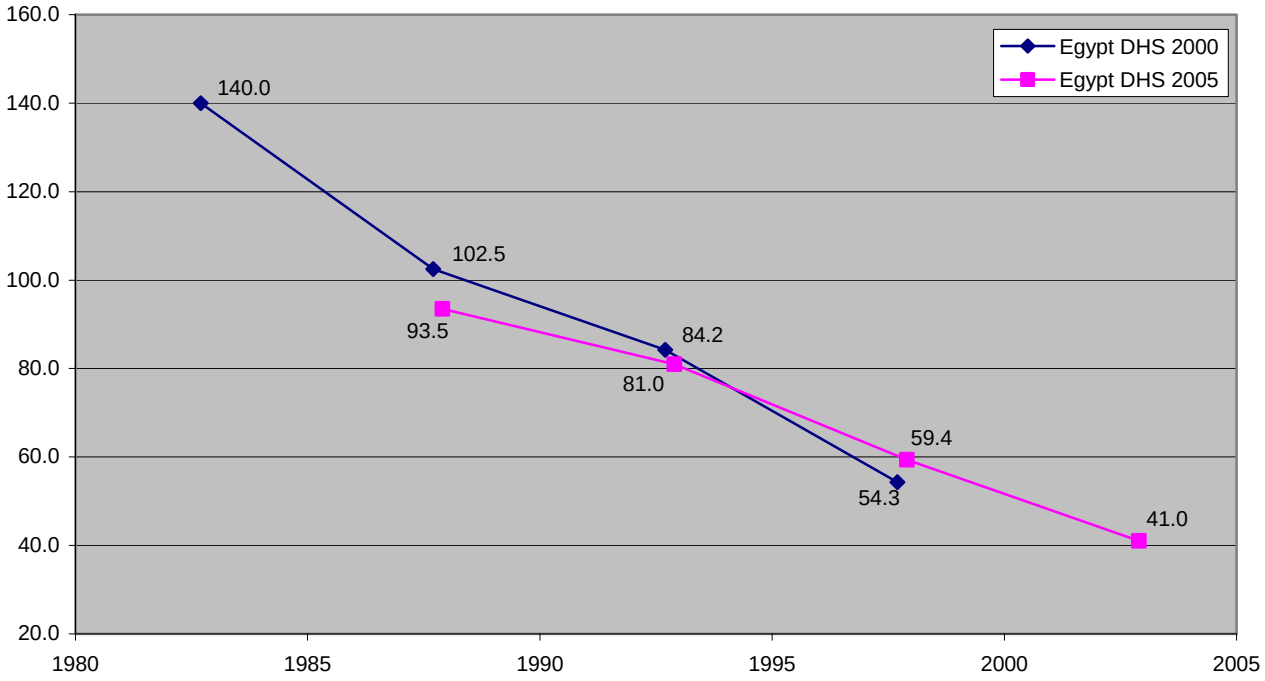
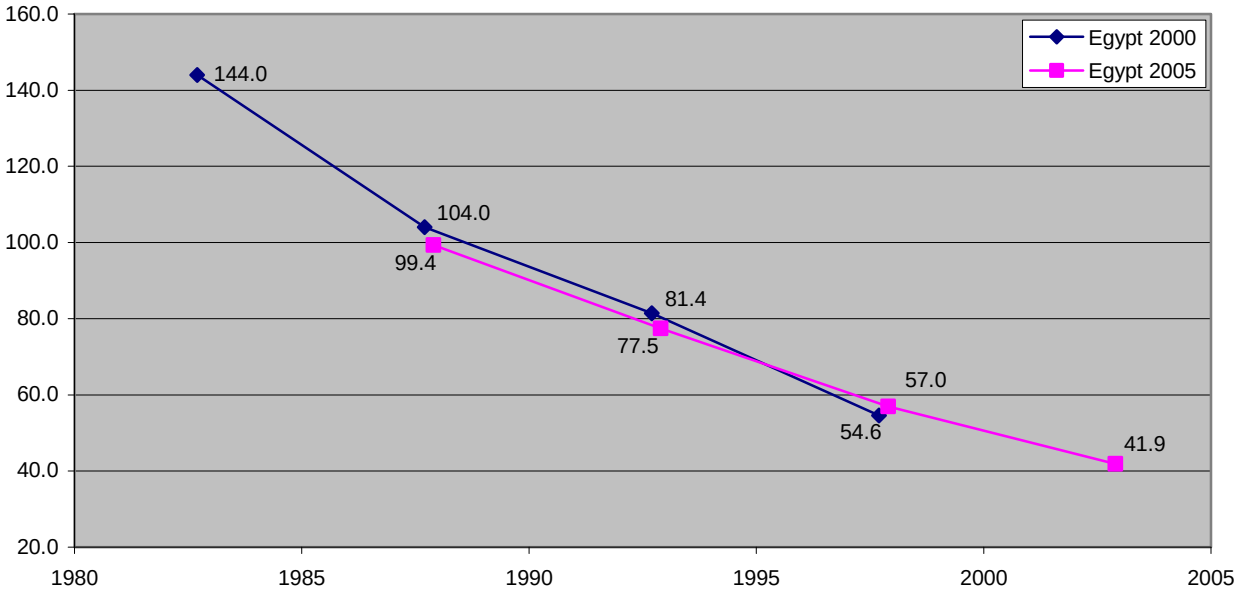


Figure 2
Re-estimated U5MR: Egypt 2000 & 2005



Mortality Decline: Re-estimated DHS Rates

As indicated above re-estimation for the 2000 and 2005 survey had little effect on the U5MR estimates for the last estimation period preceding each survey. So, Table 4 is little changed from Table 1.

Table 4 Egypt U5MR Estimates
Re-estimated DHS Rates
(Rates per 1,000 live births)

Source	Date	U5MR	Date	U5MR	Absolute Decline	Percent Decline	Time Period (years)	Average Annual % Decline
DHS 2000 & 2005	1997.7	54.6	2002.9	41.9	12.7	23.3	5.2	4.5
Levels & Trends, 2006	1995.5	68	2000.5	51	17	25.0	5.0	5.0

Underreporting of Deceased Children

The relative completeness of the 2000 and 2005 surveys in the reporting of deceased children can be analyzed for the 10-year common reference period from 1989 to 1998. This is a time period during which both surveys are free of bias resulting from birth transference. In this section, the analysis is restricted to births to women who were 15-39 at the time of birth.[2]

The U5MR estimate from the 2000 survey for the common reference period (72.9 per 1,000) is only marginally higher than the estimate from the 2005 survey (72.3 per 1,000). This comparison of mortality rates confirms the impression from the graphs and provides no evidence of significant underreporting of events in either survey.

Sample Issues

The samples for both the 2000 and 2005 Egypt surveys were based on enumeration areas created for the 1996 General Census of Population and Households. This sampling frame was updated for 2000 survey and more extensively updated for the 2005 survey. For the estimation of mortality and fertility rates, the objectives of both surveys were to provide estimates at the national and urban/rural levels and for six geographic areas. The overall response rates for female respondents (household x individual response rates) were good in both surveys; 98.7% (2000 survey) and 98.5% (2005 survey).

The percent distributions of births by sample domains for the two surveys are shown in Table 5 (urban/rural residence and major geographic areas). Overall, the distributions are very similar between surveys. The largest difference between surveys is for Upper Egypt which contributes 45% of births in the last five years in the 2005 survey, up from 41% in the 2000 survey. Upper Egypt is the area of the highest mortality in Egypt, according to both surveys. Thus, the increase in the proportion of births attributed to Upper Egypt could not have been

[2] This restriction is to avoid the effects of compositional differences in mothers age at time of birth on the estimated rates.

the cause of the observed mortality decline because this factor, considered by itself, would have minimized the observed decline in mortality. The overall conclusion is that sampling differences were minimal and did not contribute to the observed mortality decline.

Table 5. Distributions of Births Last Five Years by Sample Domains (Weighted)

	Number		% Distribution	
	Egypt 2000	Egypt 2005	Egypt 2000	Egypt 2005
Residence				
Urban	4,374	4,948	38.5	36.4
Rural	6,987	8,651	61.5	63.6
Major geographic areas				
Urban Governorates	1,813	1,879	15.9	13.8
Lower Egypt	4,679	5,399	41.2	39.7
Urban	1,230	1,297	10.8	9.5
Rural	3,448	4,101	30.4	30.3
Upper Egypt	4,690	6,153	41.3	45.2
Urban	1,227	1,669	10.8	12.2
Rural	3,463	4,484	30.5	33.0
Frontier Governorates	179	169	1.6	1.2
Total	11,361	13,600	100.0	100.0

Factors Influencing Mortality

Factors generally though to influence mortality risks are shown in Table 6 for the 2000 and 2005 Egypt surveys. The selected factors are admittedly arbitrary. We show these in order to see if they lend credibility to the substantial observed mortality declines documented by the 2000 and 2005 surveys. The trends of several factors were consistent with a decline in mortality: increased levels of education among mothers and increased levels of delivery at health facilities. Differences in the other indicators were relatively small. Overall, the health indices tend to support the credibility of the observed mortality decline.

Table 6. Egypt 2000 and 2005: Factors Impacting Under-Five Mortality

	Egypt 2000	Egypt 2005
% of mothers with primary + education (births last 5 years)	56%	69%
% of deliveries in a health facility (births last 5 years)	48%	65%
% of mothers received tetanus toxoid at least once during pregnancy (births last 5 years)	73%	79%
% of children received all childhood vaccines (children 12-23 months)	92%	89%
% of children ever breastfed (births last 5 years)	95%	95%
% received breastmilk first day (children ever breastfed)	88%	83%
% slept under any bednet last night (children under age 5 in HH last night)	na	na
% of children under age 5 wasted (below -2SD)	3% [a]	4% [a]
Among women age 15-19, the percentage who have given birth	6%	6%

[a] For the 2000 survey, this statistic was based on children of interviewed women who were available for measuring at the time of the women's interview. For the 2005 survey, this statistic was based on all children who slept in the household the night before the household interview and were available for measurement.

Credibility of the Mortality Decline in Egypt

The U5MR estimates from both the two DHS surveys and from *Levels & Trends, 2006* were substantial and approximately of the same degree (about 25%) over similar 5-year periods beginning about 1996. There was evidence that birth transference occurred in both the 2000 and 2005 DHS surveys. However, re-estimation of the rates indicated that birth transference had only a minor affect on the on the DHS estimates of U5MR. The analysis of event omission provided no evidence of defects in either survey. Analysis of differences in the birth distributions of the two surveys did not indicate that the mortality decline was in any part due to sampling problems.

There is no evidence that data defects have contributed to the declines in mortality indicated by the DHS U5MR estimates and the percentage decline indicated by those estimates is considered credible.

Annex B: Peru DHS 2000 and 2004-05

Mortality Decline: U5MR Estimates

Table 1 show U5MR estimates from the Peru DHS 2000 and 2004-05 surveys and from *Levels & Trends 2006.*[1, 2] The decline in the DHS estimates is 31% over a period of 4.2 years while the decline for the *Levels & Trends, 2006* estimates is 35% over a period of 5 years. The average annual percentage decline in mortality is about the same according to the DHS rates (7.3% per year) and the *Levels & Trends, 2006* rates (7.0% per year).

Table 1 Peru U5MR Estimates (Rates per 1,000 live births)

Source	Time	Rate	Time	Rate	Absolute Decline	% Decline	Time Period (years)	Average Annual % Decline
DHS 2000 & 2004-05	1998.2	46.7	2002.4	32.4	14.3	30.6	4.2	7.3
Levels & Trends, 2006	1995.5	63	2000.5	41	22	34.9	5.0	7.0

The pace of decline is similar for both sets of estimated rates, but the *Levels & Trends, 2006* estimates are consistently higher than the DHS estimates. This is virtually all explained by differences in the points in time to which the estimates apply—for the earlier pairing of rates, the DHS rates pertain to a point in time 2.7 years later than the *Levels & Trends, 2006* rates (1998.2 as opposed to 1995.5) and for the later pairing of rates, the time difference is 1.9 years (2002.4 as opposed to 2000.5). Projecting the *Levels & Trends, 2006* rates forward yields estimates for 1998.2 and 2002.4 of 51 and 33—i.e., more than three-fourths of the differences between the DHS and *Levels & Trends, 2006* estimates disappeares when the time differences are removed.

Of course, close agreement between the two sets of rates does not substantiate accuracy. Both sets of estimates are based on data from the DHS 2000 and 2004-05 surveys and data defects, particularly underreporting of deceased children in the 2004-05 survey, could result in a spurious mortality decline.

Birth Transference

[1] *Levels and Trends of Child Mortality in 2006 (Working Paper)*, UNICEF, WHO, The World Bank and UN Population Division, 2007.

[2] There is an important difference between the two DHS surveys. The Peru DHS 2000 was a standard DHS survey with data collected from 27,833 female respondents age 15-49 during the period from July through November 2000. The 2004-05 survey follows a continuous format in which a series of annual rounds are anticipated from 2004 to 2008. Each round collects data from a relatively small sample of women and the sample is replaced each year. The total number of female respondents in the 2004 and 2005 rounds of the survey was 12,465.

In all DHS surveys there is a risk of birth transfer because of the extensive number of health questions which must be asked for births which occur after a specified cutoff date. Interviewers can reduce their work load by incorrectly recording a date of birth which is prior to the health cutoff for children who were actually born after the cutoff. When birth transference occurs, it is always more sever for deceased children than for surviving children. Since the cutoff date in DHS surveys is usually January of the 6th year prior to the survey, birth transference tends to negatively bias the published DHS rates for the 5-year period immediately prior to the survey and positively bias rates for the penultimate 5-year period.

The cutoff dates for the health questions in the Peru surveys were January 1995 (2000 survey) and January 1999 and 2000 (2004 and 2005 rounds of the 2004-05 survey). Birth transference occurred in both surveys, and was more sever for births to deceased than surviving children (Table 2). It is also clear that birth transference for deceased children was much more sever in the 2000 survey than in the 2004-05 survey; the index of transference for the 2000 survey was 1.67 (202/121) while for 2004-05 survey it was 1.31 (29/38).

Table 2. Peru DHS 2000 and 2004-05: Births by Calendar Year

Peru 2000			Peru 2004-05		
Calendar Year	Child alive	Child deceased	Calendar year	Child alive	Child deceased
2000	1,532	45	2005	548	16
1999	2,327	66	2004	847	20
1998	2,326	83	2003	809	25
1997	2,344	112	2002	828	16
1996	2,562	130	2001	806	26
1995	2,402	121	2000	888	29
1994	2,604	202	1999	957	38
1993	2,667	185	1998	958	45
1992	2,640	195	1997	961	58
1991	2,248	178	1996	1,029	61
Index of birth transference	1.08	1.67		1.08	1.31

Note: The bold line indicates the date of the cutoff for asking health questions.

To investigate the effect of birth transference, new estimates of U5MR were made for redefined time periods: 1) the earlier boundary for the last estimation period was set to begin one year before the health cutoff in each survey and 2) the earlier estimation periods were the earlier 5-year calendar periods. Because the new estimates apply to earlier time periods than the published DHS estimates, they were projected forward to the date of the DHS estimates by straight line projection (from the adjacent newly estimated rates). Table 3 shows the results. In the case of the 2000 survey, re-estimation of U5MR for the last estimation period was only a marginal increase over the DHS published estimate (from 46.7 to 47.7 per 1,000) (Table 3). In the case of the 2004-05 survey, re-estimation did not produce the expected results and it was decided to leave the DHS estimates unchanged.[3]

[3] The re-estimates for the 2004-05 survey resulted in a marginal decrease in the ultimate U5MR estimate (32.4 to 28.6) and a marginal increase in the penultimate U5MR estimate (48.3 to 52.3). This is the opposite of what was expected.

Table 3. Re-estimated U5MR (2000 survey only)			
Peru 2000		Peru 2004-05	
Re-estimated rates		Published DHS Rates	
Date	U5MR	Date	U5MR
1998.2	47.7	2002.4	32.4
1993.2	72.0	1997.4	48.3
1988.2	92.5	1992.4	74.1
1983.2	110.7	1987.4	88.7

Figure 1 shows the trend of the U5MR as published in the DHS reports and Figure 2 shows re-estimated rates for the 2000 survey and the DHS rates for the 2004-05 survey. The only change between the two figures is the marginal differences in the rates for the last and the penultimate estimation periods for the 2000 survey, so the pattern of decline in the two figures is little changed.

Figure 1
DHS U5MR

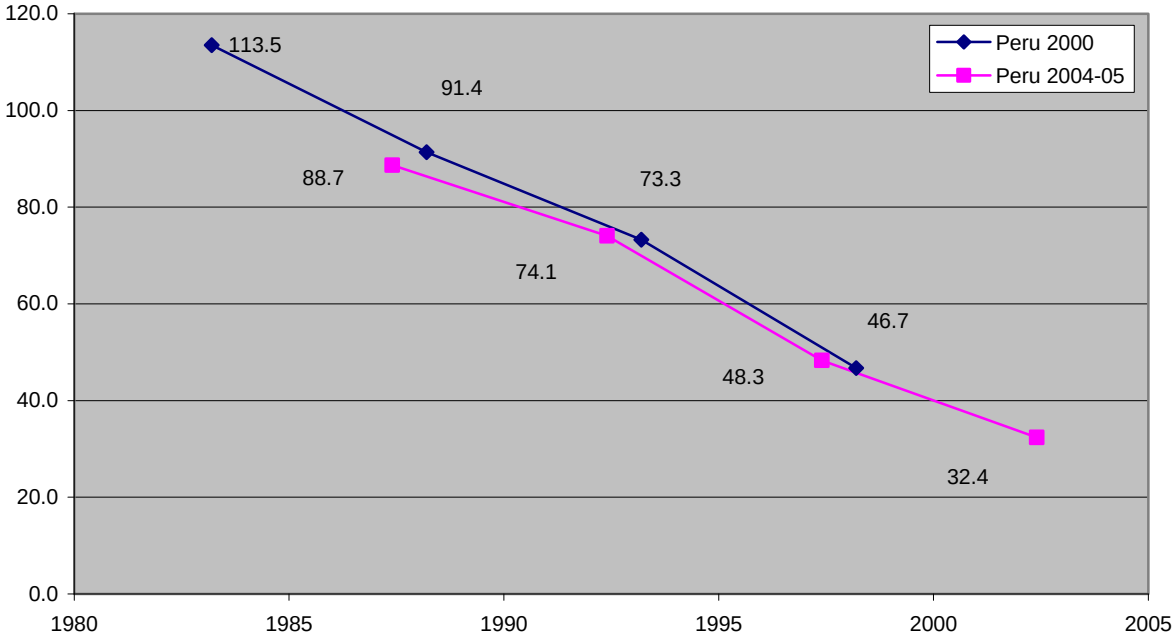
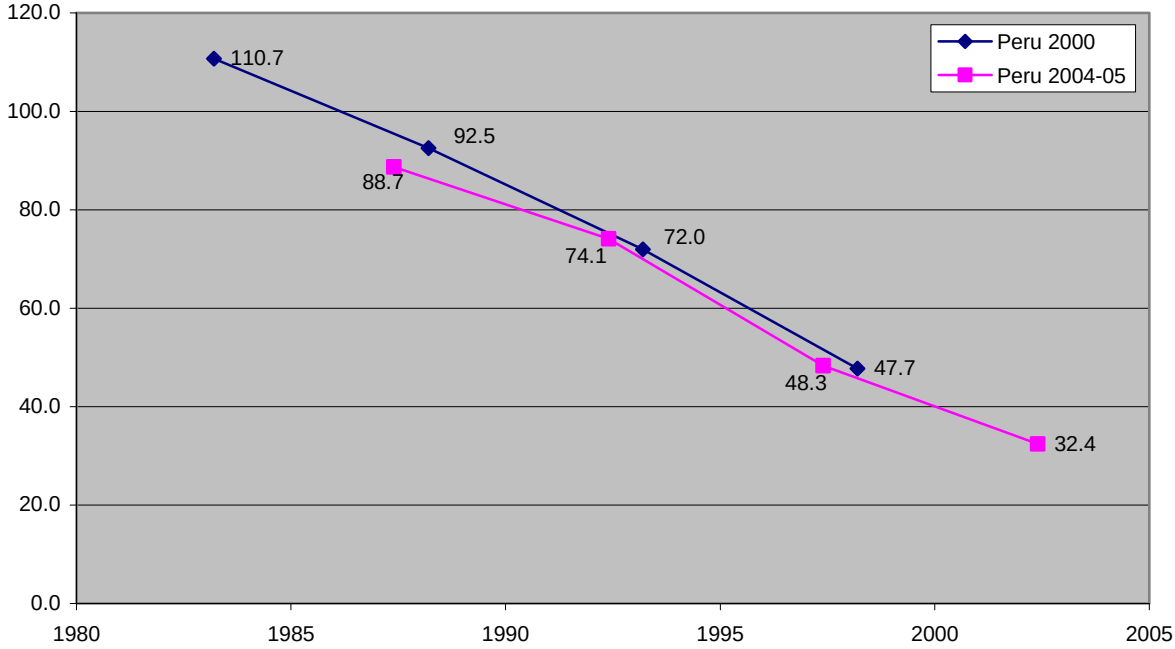


Figure 2
Re-estimated U5MR (2000 survey only)



Mortality Decline: Re-estimated DHS Rates (2000 survey only)

Table 4 compares the mortality declines based on the rates presented in Figure 2. the table indicates that the overall declines during similar durations of time (4.2 and 5.0 years) were similar according to the direct estimates based on DHS data and the *Levels & Trends, 2006* estimates (32% and 35%) as were the estimates of the average annual percentage declines (7.6% and 7.0%).

As was the case with the comparison of Table 1, the *Levels & Trends, 2006* rates are higher than the DHS estimates. But again those differences almost totally disappear if the *Levels & Trends, 2006* estimates are projected forward to the dates for the DHS estimates.

Table 4 Peru U5MR
Re-estimated DHS Rates (2000 survey only)
(Rates per 1,000 live births)

Source	Date	U5MR	Date	U5MR	Absolute Decline	% Decline	Time Period (years)	Average Annual % Decline
DHS 2000 & 2004-05	1998.2	47.7	2002.5	32.4	15.3	32.1	4.2	7.6
Levels & Trends, 2006	1995.5	63	2000.5	41	22	34.9	5.0	7.0

Event Omission

The relative completeness of reporting of deceased children in the 2000 and 2004-05 surveys was analyzed for the 10-year common reference period from 1989 to 1998. This is a time period during which both surveys are free of bias resulting from birth transference. In this section, the analysis is restricted to births to women 15-39 at the time of birth.[4]

For the common reference period, the U5MR from the two surveys were very similar; 68 per 1,000 for 2000 survey and 64 per 1,000 for the 2004-05 survey. This comparative analysis shows no indication of underreporting of deceased children in either survey.

Sampling Issues

The samples for both the 2000 and 2004-05 surveys were based on the enumeration areas created for the 1993 Population Census and updated for the 2000 Population Census. The overall response rates (the product of household and woman's response rate) were good in both surveys: 93% and 97% for the 2000 and the 2004-05 surveys.

The percent distributions of births by sample domains (urban/rural residence and primary geographic regions) for the two surveys are shown in Table 5. The distributions for each

[4] This restriction is to avoid the effects of compositional differences in mothers' age at the time of birth on the estimated rates.

survey are very similar indicating consistent weighting of mortality experience across sample domains.

Table 5. Distributions of Births (Weighted) during the Five Years preceding the Surveys by Sample Domains

	Number		% Distribution	
	Peru 2000	Peru 2004-05	Peru 2000	Peru 2004-05
Residence				
Urban	5,551	1,995	58.2	58.1
Rural	3,984	1,437	41.8	41.9
Regions				
Metropolitan Lima	2,253	803	23.6	23.4
Coastal	2,184	781	22.9	22.8
Sierra	3,738	1,277	39.2	37.2
Selva	1,361	570	14.3	16.6
Total	9,535	3,431	100.0	100.0

Factors Influencing Child Mortality

Factors generally though to influence mortality risks are shown in Table 6 for both surveys. The selected factors are admittedly arbitrary. We show these in order to see if they lend credibility to the substantial observed mortality declines documented by the 2000 and 2004-05 surveys. Most factors show little improvement or even show a decline in coverage; e.g., mothers receiving tetanus toxoid declined from 80% to 73 % between the two surveys.

However, one factor showed notable improvement; the percentage of births delivered in a health facility (from 58% to 70%). The improvement in this factor was much more pronounced in rural areas (from 24% to 42%) than urban areas (82% to 90%).[5] This is significant because it was also the rural areas that were responsible for the major part of the mortality decline at the national level (Table 7).

Table 6. Factors Influencing Child Mortality

	Peru 2000	Peru 2004-05
Education level of mother for births in last 5 years (% primary +)	92%	95%
Percentage of all births delivered in a health facility (last 5 years)	58%	70%
Mother received tetanus toxoid (at least once during pregnancy)	80%	73%
Children received all childhood vaccines (children 18-29 months)	67%	66%
Percent of children ever breastfed (children born in last 5 years)	98%	98%
Percent received breastmilk first day (children ever breastfed)	84%	88%
Percent slept under a bednet last night (children under age 5)	na	na
Percent of children under age 5 wasted (below -2SD)	1%	1%
Among women age 15-19, the percentage that have given birth	11%	11%

[5] See Peru survey reports, Table 9.5 in both reports.

Table 7 U5MR by Area of Residence, DHS 2000 and 2004-05			
	DHS 2000	DHS 2004-05	Percent decline
Urban Areas	32.4	26.2	19%
Rural Areas	63.6	40.0	37%
Total	46.7	32.4	31%

Note: The estimates are for the 5-year period preceding each survey. Thus, they differ from the urban/rural estimates in the survey reports which are for a 10-year period preceding each survey.

Credibility of the Mortality Decline in Peru

The comparison of the rates estimated by the 2000 and 2004-05 surveys is complicated by the fact that the survey formats were quite different: a standard retrospective survey for the former survey and a continuous format for the later survey (see footnote 2). Additionally, data were only available for the first two rounds of five planned rounds for the 2004-05 survey, so that the sample size is less than half the size of the 2000 survey.

The U5MR estimates derived by direct estimation from the DHS 2000 and 2004-05 surveys and the estimates from *Levels & Trends, 2006* show substantial mortality declines. Re-estimates of the rates from the DHS 2000 survey (to compensate for birth transference) made no difference in the overall impression of substantial mortality decline. The evaluation of event omission in the two surveys showed no evidence that the 2004-05 survey suffered from event omission.

The analysis showed no indication that the substantial mortality declines documented for Peru should not be accepted.

Annex C: Nepal DHS 1996 and 2001

Mortality Decline: U5MR Estimated

Table 1 shows U5MR from Nepal DHS 1996 and 2001 survey reports and from *Levels & Trends, 2006*.[1] The decline in the DHS estimates is 27% during a 5-year period while the decline in the *Levels & Trends, 2006* estimates is 32% also during a 5-year period. In terms of the average per annum decline, the pace of decline is somewhat less according the DHS estimates (4.5% per year) than the *Levels & Trends, 2006* estimates (5.4% per year). Thus, both sources indicate a fairly rapid and relatively consistent pace of mortality decline over a similar period (i.e., approximately the period 1994-95 to 1999-2000).

Table 1 Nepal U5MR Estimates (Rates per 1,000 live births)

Source	Date	U5MR	Date	U5MR	Absolute Decline	% Decline	Time Period (years)	Average Annual % Decline
DHS 1996 & 2001	1993.8	118.3	1998.8	91.2	27.1	22.9	5.0	4.5
Levels & Trends, 2006	1995.5	118	2000.5	86	32	27.1	5.0	5.4

There is an important difference in the data used for the DHS and the *Levels & Trends, 2006* estimates of Table 1. The *Levels & Trends, 2006* estimates incorporate information from the Nepal 2006 DHS survey (both direct and indirect U5MR estimates) while the DHS estimates do not. This does not invalidate the finding that the mortality declines indicated in Table 1 are relatively consistence: it just means that the *Levels & Trends, 2006* estimates include more recent survey data. Of course, the relative agreement between the estimates of Table 1 does not establish their accuracy.

Birth Transference

In the Nepal DHS questionnaires the date used to indicate the cutoff for asking health questions was in terms of the national calendar. The Nepali national calendar is 56 years and 8 months ahead of the Western calendar.

The first month of the year in the Nepali calendar is Baisakl. The cutoff dates for asking the health questions in the Nepal surveys were Baisakl 2049 for the 1996 survey and Baisakl 2052 for the 2001 survey. Table 2 shows tabulations of reported births for several years preceding each survey by year of birth and survivorship status in terms of the Nepali calendar. Birth transference occurred in both surveys, resulting in substantially more deceased children recorded as born in the year prior to the health cutoff than in the year after

[1] *Levels and Trends of Child Mortality in 2006 (Working Paper),* UNICEF, WHO, The World Bank and UN Population Division, 2007.

the cutoff. The index of birth transference for deceased children was 1.6 (222/138) for the 1996 survey and also 1.6 (203/128) for the 2001 survey.

However, the potential impact of birth transference on mortality estimates was quite different in the two surveys. In the 1996 survey health data were collected for only a three year retrospective period so that birth transference was primarily within (rather than out of) the last estimation period for standard DHS mortality estimation. Thus, there was no justification for re-estimating mortality rates and that procedure was not followed. In the case of the 2001 survey, health data were collected for a six year retrospective period and birth transference had the potential for effecting mortality estimation.

Table 2. Nepal 1996 and 2001: Births by Calendar Year

Nepal 1996			Nepal 2001		
Nepali Calendar Year	Child alive	Child deceased	Nepali Calendar Year	Child alive	Child deceased
2052	1282	83	2057	1259	73
2050	1361	117	2056	1321	87
2049	1327	96	2055	1259	97
2048	1322	138	2054	1319	125
2047	1261	222	2053	1288	132
2046	1276	197	2052	1321	128
2045	1187	231	2051	1250	203
2044	1240	209	2050	1261	190
Index of birth transference	.95	1.6		.95	1.6

Note: Bold line marks the first month of the year of the cutoff for asking the health questions.

To investigate the effect of birth transference in the Nepal 2001 DHS, new estimates of U5MR were made for redefined time periods: 1) the earlier boundary for the last estimation period was set to begin one year before the health cutoff and 2) earlier estimation periods were earlier 5-year calendar periods. Because the new estimates apply to earlier time periods than the published DHS estimates, they were projected forward to the date of the DHS estimates by straight line projection (from the adjacent newly estimated rates). Results are shown in Table 3. The overall effect of the re-estimation was to increase the rate for the last estimation period by about 5% (91.2 to 95.6 per 1,000).

Table 3. Re-estimated U5MR*

Nepal 2001	
Date	U5MR
1998.8	95.6
1993.8	122.2
1988.8	157.0
1983.8	179.6

*Re-estimated, projected rates

Figure 1 shows the trend in U5MRs from the DHS reports and Figure 2 shows re-estimated rates for the 2001 survey and the rates as in Figure 1 for the 1996 survey. Two points stand out. First, both figures indicate sharply declining mortality over time. And second, in both figures, the estimates for the time periods common to both surveys are in close agreement.

Figure 1
DHS U5MR Estimates: Nepal 1996 & 2001

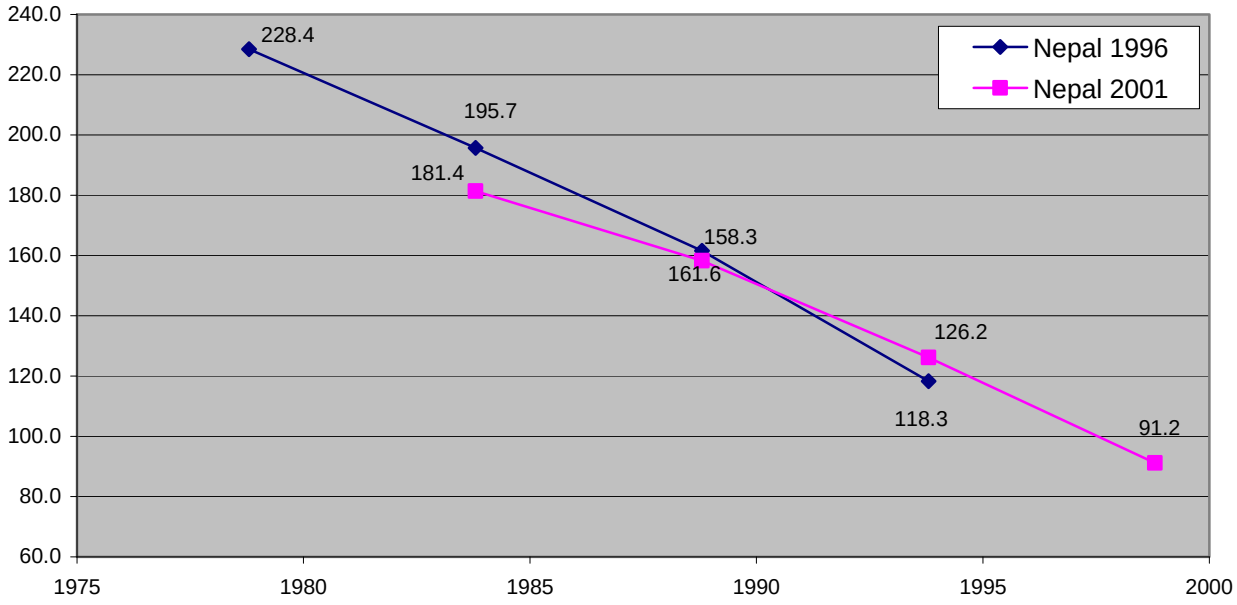
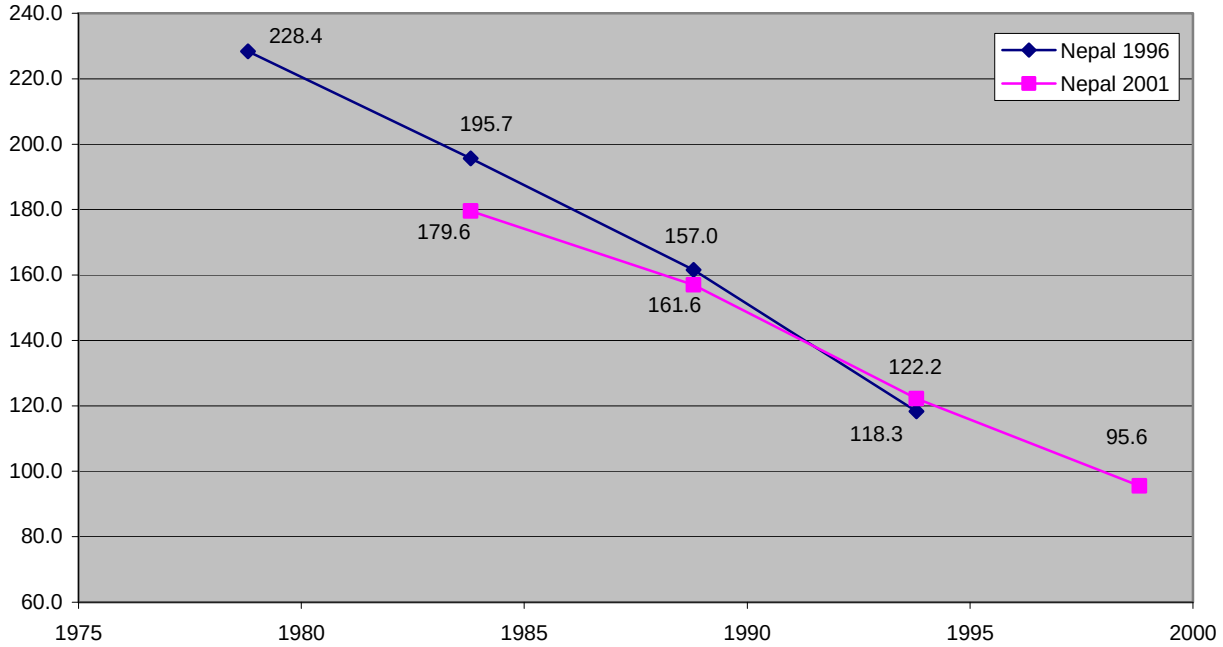


Figure 2
Re-estimated U5MR: Nepal 2001 Survey



Mortality Decline: Re-estimated DHS Rates (2001 survey only)

Table 4 differs from Table 1 in that re-estimated DHS rates are shown for the 2001 survey. As indicated above, re-estimation of the rates increased the U5MR estimate for the final estimation period. So Table 4 indicates somewhat less of a decline in mortality between the DHS 1996 and 2001 surveys than Table 1. Accordingly, the difference between the re-estimated DHS rates and *Levels & Trends, 2006* in the estimated pace of mortality decline has increased: the estimated annual percentage decline is 3.8% according to the revised DHS estimates and 5.4% according to the *Levels & Trends, 2006* estimates.

Table 4 Nepal U5MR Estimates
(Re-estimated rates for the 2001 DHS Survey)
(Rates per 1,000 live births)

Source	Date	U5MR	Date	U5MR	Absolute Decline	% Decline	Time Period (years)	Average Annual % Decline
DHS 1996 & 2001	1993.8	118.3	1998.8	95.6	22.7	19.1	5.0	3.8
Levels & Trends, 2006	1995.5	118	2000.5	86	32	27.1	5.0	5.4

Underreporting of Deceased Children

The difference between the 1996 and 2001 surveys in the reporting of deceased children can be analyzed for the 10-year common reference period from 1985 to 1994. This is a time period free of biases resulting from birth transference in both surveys. In this section, the analysis is restricted to births to women 15-39 at the time of birth.[2]

For the common reference period, the U5MR estimate from the 1996 survey (148.0 per 1,000) is essentially identical to the rate from the 2001 survey (148.4 per 1,000). These results indicate that reporting of events was equally complete in both surveys, at least for the 1985-94 period and does not support an assertion of underreporting of deceased children in either survey.

Sampling Issues

The sampling frames for both the 1996 and 2001 DHS surveys were based on enumeration areas created for the 1991 National Population Census. A complete household listing was conducted for the sample units selected in each survey. The overall response rates for female respondents (household x individual response rates) were equally good in both surveys (98% in each).

[2] This restriction is to avoid the effects of compositional differences in mother's age at time of birth on the estimated rates.

Percent distributions of births by sample domains (urban/rural residence and major geographic divisions of Nepal) are shown in Table 5. The distributions are similar for the two surveys indicating consistent weighting of mortality experience across sample domains.

Table 5. Distributions of Recent Births by Sample Domain (Weighted)*

	Number		% Distribution	
	Nepal 1996	Nepal 2001	Nepal 1996	Nepal 2001
Residence				
Urban	332	278	7.0	6.4
Rural	4,414	4,097	93.0	93.6
Subregions				
Eastern Mountain	74	69	1.6	1.6
Central Mountain	122	121	2.6	2.8
Western Mountain	166	147	3.5	3.4
Eastern Hill	347	313	7.3	7.2
Central Hill	484	492	10.2	11.2
Western Hill	521	525	11.0	12.0
Mid-western Hill	405	357	8.5	8.1
Far-western Hill	223	175	4.7	4.0
Eastern Terai	681	542	14.3	12.4
Central Terai	930	821	19.6	18.8
Western Terai	393	356	8.3	8.1
Mid-western Terai	222	273	4.7	6.2
Far-western Terai	179	184	3.8	4.2
Total	4,745	4,375	1.00	1.00

*Births in the last 3 years for DHS 1996 and in the last 5 years for the 2001 survey.

Factors Influencing Child Mortality

Factors generally though to influence mortality risks are shown in Table 6. The selected factors are admittedly arbitrary. We show these in order to see if they are consistent with the substantial observed mortality declines documented by the 1996 and 2001 surveys.

Table 6. Factors Influencing Child Mortality

	Nepal 1996	Nepal 2001
Percentage of mothers with primary + education (births last 5 years)	21% [a]	26%
Percentage of deliveries in a health facility (births last 5 years)	8% [a]	9%
Mother received tetanus toxoid last birth last five years (at least once during pregnancy)	33% [a]	55%
Percent of children received all childhood vaccines (children 12-23 months)[b]	36%	60%
Percent of children ever breastfed (births last 5 years)	98 %[a]	98%
Percent received breastmilk first day (children ever breastfed)	58 %[a]	65%
Percent slept under a bednet last night (children under age 5)	na	na
Percent of children under age 3 wasted (below -2SD)	11%	14%
Among women age 15-19, the percentage that have given birth	18%	16%

[a] Births in the last 3 years

[b]BCG, measles, and three doses each of DPT and Polio vaccine (excluding polio vaccine given at birth)

The 2001 survey showed substantial gains over the 1996 survey in three health indicators: mothers that received tetanus toxoid vaccinations during pregnancy (from 33% to 55%), children who received all basic childhood vaccinations (from 36% to 60%) and children who were breastfed within one day of birth (58% to 65%). The remaining indicators differ little between the surveys or, in the case of nutrition status (wasting), show a worsening trend.

Overall Assessment of the Credibility of Mortality Decline in Nepal

There was evidence that birth transference occurred in the 2001 Nepal survey. Re-estimation of the rates increased the U5MR for the final estimation period by almost 5%. The analysis of event omission did not indicate underreporting of events in either the 1996 or the 2001 survey. The review of sampling distributions of recent births in the two surveys did not indicate any sampling problems.

The basic finding from the published DHS estimates of a fairly rapid decline in under-five mortality—by approximately 23% over 5 years (Table 1). Measured with the re-estimated U5MR for the 2001 survey, the decline was modestly reduced—to approximately 19% over 5 years (Table 4). No evidence was found to contradict these findings.

Remaining Difference between DHS and *Levels & Trends, 2006* Mortality Decline

The difference between the declines calculated from the 1996 and 2001 surveys (23%) and the higher decline implied by the *Levels & Trends, 2006* estimates—approximately 27%, over 5 years—may be due to the inclusion in the *Levels & Trends, 2006* estimation procedure of data points from the 2006 DHS survey.

Annex D: Bangladesh DHS 1997 and 2004

Mortality Decline: U5MR Estimates

Table 1 shows U5MR estimates from the Bangladesh from the 1997 and 2004 DHS surveys and from *Levels & Trends, 2006*.[1] The DHS estimates are separated by a period of about 7 years while the *Levels & Trends, 2006* estimates span a period of five years. When indexed in terms of the average per annum decline, the pace of mortality decline is somewhat less according the DHS rates (3.3% per year) than according to the rates from *Levels & Trends, 2006* (4.7 % per year), but both indicate a fairly rapid rate of mortality decline.

In additional to the general agreement between sources in the pace of mortality decline, the individual estimates are fairly close, particularly the DHS for 2001.8 (88 per 1,000) and the *Levels & Trends, 2006* estimate for 2000.5 (92 per 1,000). Projecting the *Levels & Trends, 2006* estimate forward to 2001.8, by straight-line projection, results in closer agreement (85 per 1,000).

Of course, because both sets of estimates rely on the data from the 1997 and 2004 DHS surveys, data defects, particularly underreporting of deceased children in the 2004 survey, could result in both sources indicating a spurious mortality decline.

Table 1 Bangladesh U5MR Estimates
(Rates per 1,000 live births)

Source	Date	U5MR	Date	U5MR	Absolute Decline	% Decline	Time Period (years)	Average Annual % Decline
DHS 1997 & 2004	1994.5	115.8	2001.8	87.6	28.2	24.4	7.3	3.3
Levels & Trends, 2006	1995.5	120	2000.5	92	28.0	23.3	5.0	4.7

Birth Transference

In all DHS surveys there is a risk of birth transfer because of the extensive number of health questions which must be asked for births which occur after a specified cutoff date. Interviewers can reduce their work load by incorrectly recording a date of birth which is prior to the health cutoff for children who were actually born after that date. This has the potential of negatively biasing mortality estimates for the last estimation period prior to the survey and positively biasing estimates for the penultimate estimation period.

The cutoff dates for asking the health questions in the two Bangladesh surveys were April 1991 (1997 survey) and June 1998 (2004 survey). Birth transference occurred in both surveys, resulting in more deceased children recorded as born in the one-year period prior to the health cutoff than in the one-year period after the cutoff. The ratio of deceased births in

[1] *Levels and Trends of Child Mortality in 2006 (Working Paper),* UNICEF, WHO, The World Bank and UN Population Division, 2007.

those two time periods is 1.27 (201/158) for Bangladesh 1997 and 1.30 (154/118) for Bangladesh 2004 (Table 2).

Table 2. Bangladesh 1997 and 2004: Births by One Year Time Period

Bangladesh 1997			Bangladesh 2004		
One year time period	Child alive	Child deceased	One year time period	Child alive	Child deceased
4/1996-3/1997	935	52	6/2003-5/2004	1,092	55
4/1995-3/1996	1,121	94	6/2002-5/2003	1,264	95
4/1994-3/1995	1,079	110	6/2001-5/2002	1,351	101
4/1993-3/1994	1,140	148	6/2000-5/2001	1,322	122
4/1992-3/1993	1,141	142	6/1999-5/2000	1,287	118
4/1991-3/1992	1,087	158	6/1998-5/1999	1,296	118
4/1990-3/1991	1,242	201	6/1997-5/1998	1,222	154
4/1989-3/1990	1,280	195	6/1996-5/1997	1,419	145
4/1988-3/1899	1,297	212	6/1995-5/1996	1,315	158
Index of birth transference	1.14	1.27		.94	1.30

Note: Bold line indicates the cutoff for asking the health questions.

To investigate the effect of birth transference in the Bangladesh surveys, new estimates of U5MR were made for redefined time periods: 1) the earlier boundary for the last estimation period was set to begin one year before the health cutoff in each survey and 2) earlier estimation periods were earlier 5-year calendar periods. Because the new estimates apply to earlier time periods than the published DHS estimates, they were projected forward to the date of the DHS estimates by straight line projection (from the adjacent newly estimated rates).

Results are shown in Table 3. The re-estimated rates were little different from the DHS published rates indicating that birth transference had little effect on mortality estimation.

Table 3. Re-estimated U5MR*

Bangladesh 1997		Bangladesh 2004	
Date	U5MR	Date	U5MR
1994.5	118.1	2001.8	86.1
1989.5	138.8	1996.8	107.3
1984.5	168.4	1991.8	126.6
1979.5	193.2	1986.8	161.4

* Re-estimated, projected rates.

Figure 1 shows the trend in U5MRs as published in the DHS reports and Figure 2 shows the re-estimated rates. The two figures are practically identical indicating that re-estimation had almost no effect on the U5MR estimate. Additional, it is clear from Figures 1 and 2, that there is little difference between comparable estimates for time periods covered by both surveys.

Figure 1
DHS U5MR: Bangladesh 1997 & 2004

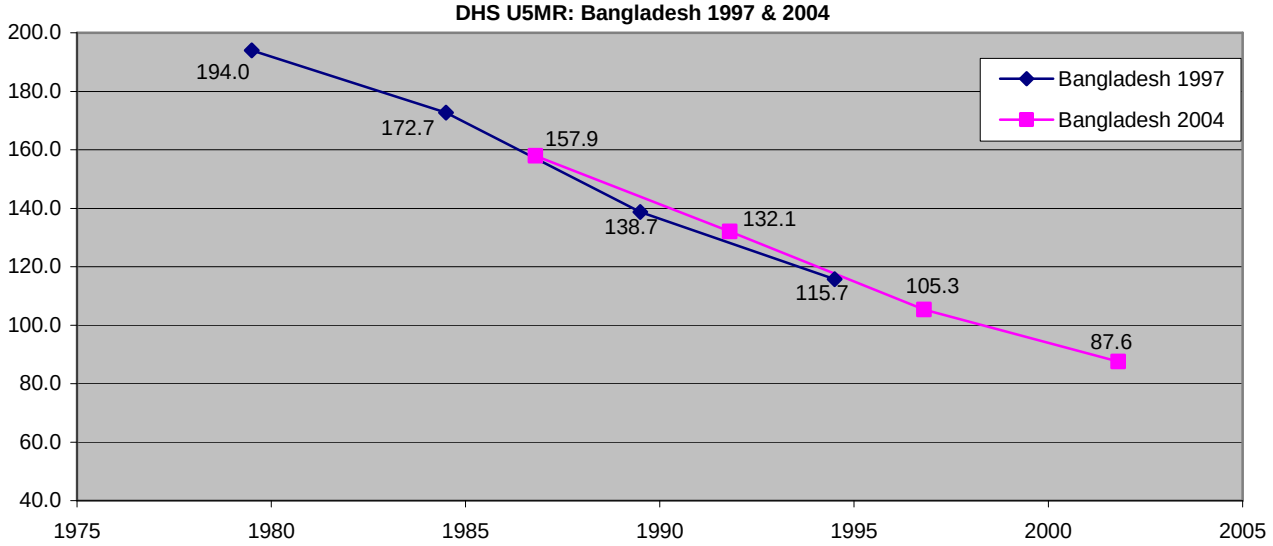
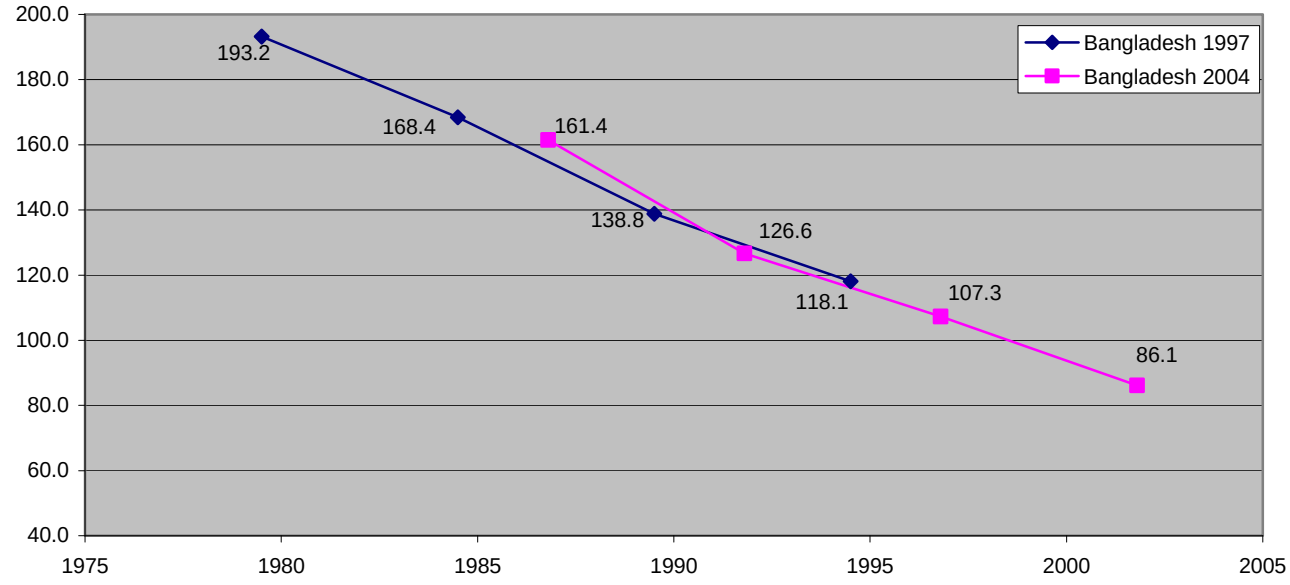


Figure 2
Re-estimated U5MR: Banglsdesh DHS 1997 & 2004



Mortality Decline: Re-Estimated DHS Rates

Table 4 is a revised version of Table 1. However, as indicated above, re-estimation had only a minor effect on the estimated mortality rates. The estimated average per year mortality decline according to the DHS rates increased moderately (from 3.3 % in Table 1 to 3.7 % in Table 4). Accordingly, the difference between the DHS estimate of the mortality decline and the *Levels & Trends, 2006* estimate in Table 1 (3.3% versus 4.7%) was little diminished in Table 4 (3.7% versus 4.7%).

Table 4 Bangladesh U5MR Estimates
Re-estimated DHS Rates
(Rates per 1,000 live births)

Source	Date	U5MR	Date	U5MR	Absolute Decline	% Decline	Time Period (years)	Average Annual % Decline
DHS 1997 & 2004	1994.5	118.1	2001.8	86.1	32.0	27.1	7.3	3.7
Levels & Trends, 2006	1995.5	120	2000.5	92	28.0	23.3	5.0	4.7

Underreporting of Deceased Children

The relative completeness of the 1997 and 2006 Bangladesh surveys in the reporting of deceased children can be analyzed for the 10-year common reference period from 1987 to 1996. This is a time period during which both surveys are free of bias resulting from birth transference. In this section, the analysis is restricted to births to women 15-39 at the time of birth.[2]

The U5MR estimate from the 1997 survey for the common reference period (125.9 per 1,000) is virtually identical to the estimate from the 2004 survey (126.3 per 1,000). This comparison of mortality estimates confirms the impression from the graphs and provides no evidence of underreporting of events in either survey.

Sample Considerations

The sampling frame for the 1997 Bangladesh survey was derived from the Integrated Multi-Purpose Master Sample (IMPS) based on the 1991 National Population Census. The frame for the 2004 survey was the list of enumeration areas created for the 2001 National Population Census. The overall response rates for female respondents (household x individual response rates) were good in both surveys: 97% for the 1997 survey and 98% for the 2004 survey.

Percent distributions of births by sample domains (urban/rural residence and district) for the two surveys are shown in Table 5. The distributions by district are very similar but those by urban/rural residence differ markedly: the percentage of births occurring in urban areas is

[2] This restriction is to avoid the effects of compositional differences in mothers age at time of birth on the estimated rates.

twice as great in the 2004 survey (9%) as in the 1997 survey (20%). Such a change is large but possible over a period of 10 years (the sampling frames on which the two samples are based differ by 10 years). For this analysis, the issue is could faulty sampling between the two surveys have contributed to the observed mortality declines. The issue was addressed by standardizing the urban/rural mortality rates for the five year period preceding the 1997 survey by the urban/rural birth distribution of the 2004 survey.[3] This resulted in a very marginal decrease in the national-level 1997 U5MR (from 115.8 per 1,000 of Table 1 to 113.4 per 1,000) and a reduction in the percentage decline in the U5MR from 24.4% (Table 1) to 22.8%.[4] The conclusion is that the differences in the urban/rural distribution of the births between the two surveys contributed hardly at all to the observed mortality decline.

Table 5. Distributions of Births (Last Five Years) by Sample Domains (Weighted)

	Number		% Distribution	
	Bangladesh 1997	Bangladesh 2004	Bangladesh 1997	Bangladesh 2004
Residence				
Urban	557	1,392	8.9	19.9
Rural	5,673	5,610	91.1	80.1
District				
Barisl	408	410	6.5	5.8
Chittagong	1,541	1,527	24.7	21.8
Dhaka	1,902	2,175	30.5	31.1
Khulna	614	731	9.9	10.4
Rajshahi	1,331	1,560	21.4	22.3
Sylhet	434	599	7.0	8.6
Total	6,230	7,002	100.0	100.0

Factors Influencing Child Mortality

Factors generally though to influence mortality risks are shown in Table 6 for both surveys. The selected factors are admittedly arbitrary. We show these in order to see if they lend credibility to the substantial observed mortality declines documented by the 1997 and 2004 surveys.

The trend of several factors is consistent with a decline in mortality. The 2004 survey shows increases in the percent of mothers that received of tetanus toxoid (75% versus 85%), the percent of children who have received all childhood vaccinations (54% versus 83%) and the

[3] It was decided to standardize the rate from the 1997 survey on the urban/rural birth distribution from the 2004 survey (rather than standardize the rate from the 2004 survey) because of an oddity in the 2004 data. In the DHS survey reports, mortality rates by urban/rural residence are published for the 10-year period prior to the survey. The relatively long interval is to reduce sampling error. In all four of the standard DHS Bangladesh surveys (1993, 1997, 1999 and 2004), urban rates for the 10-year period are lower than rural rates. However, in the 2004 survey the rate for the 5-year period preceding the survey was higher for urban areas than for rural areas. So, it made more sense to conduct the standardization on the 1997 survey rate where, the urban/rural rates for the 5-year period preceding the survey followed the predominant pattern (urban rates lower than rural rates).

[4] U5MR for the 5-year period preceding the 1997 were 96.3 for urban areas and 117.6 for rural areas. Those rates weighted by the urban/rural birth distribution of the 2004 survey (Table 5), result a rate of 113.4 per 1,000.

percent of children who breastfed within one day of birth (58% versus 83%) and children who are classified as wasted is lower (18% versus 13%). The remaining indicators show little difference between the surveys. So, there is a clear indication improvement in preventive health care of mothers and children.

Table 6. Factors Influencing Child Mortality

	Bangladesh 1997	Bangladesh 2004
Percentage of mothers with primary + education (births last 5 years)	58%	62%
Percentage of deliveries in a health facility (births last 5 years)	4%	9%
Mother received tetanus toxoid last birth last five years (at least once during pregnancy)	75%	85%
Children received all childhood vaccines (children 12-23 months)	54%	73%
Percent of children ever breastfed (births last 5 years)	97%	98%
Percent received breastmilk first day (children ever breastfed)	58%	83%
Percent slept under a bednet last night (children under age 5)	na	na
Percent of children under age 5 wasted (below -2SD)	18%	13%
Among women age 15-19, the percentage that have given birth	36%	33%

Credibility of the Mortality Decline in Bangladesh

The analysis began with the U5MR estimates from the 1997 and 2004 DHS surveys of 115.8 (1994.5) and 87.6 (2001.8) for a 24.3% decline over 7.3 years. There was evidence of birth transference across the health cutoff in both the 1997 and 2004 surveys but in nether case was there much impact on mortality estimates so that the pace of mortality decline was little changed when measured with re-estimated rates (27.1% over the 7.3 year period).

The analysis of underreporting of deceased children (on the basis of U5MR estimates for the common reference period, 1987-1976**)** found no evidence of underreporting in either survey. The analysis of birth distributions by sample domains found a notable increased in the percentage of birth occurring in urban areas (from about 9% to about 20%). The increase is large but not implausible considering that the sampling frames for the two surveys were based on different sets of census materials. Moreover, it was shown by computing a standardized rate for the 1997 survey (the urban/rural rates of the 1997 survey were standardized on the urban/rural birth distribution of the 2004 survey) that, even if the increase were entire due to sampling error, this would accounted for less than 2 percentage points of the observed mortality decline.

DHS Surveys in 1999 and 2001

Two additional national-level surveys for Bangladesh, which were conducted about midway between the 1997 and 2004 DHS surveys, are pertinent here; the 1999 DHS survey and the Bangladesh Maternal Health Services and Maternal Mortality Survey 2001. Both of those surveys were conducted with technical assistance from the DHS Program and included a full birth history from which U5MR were obtained using direct estimation. Although the quality of the data for those surveys is not examined in this report, it should be stated that the U5MR

estimates from both surveys (94 and 95 per 1,000 live births, respectively) track well with the estimates from the 1997 and 2004 surveys.

The analysis of the data provided no reasons to suspect the credibility of mortality estimates derived from the 1997 and 2004 DHS surveys, although there is a preference for the national-level mortality decline indicated by the re-estimated DHS rates (27.1%)—a marginal change from the pace of mortality decline indicated by the published DHS rates (24.3%).

Discrepancy between Estimates of the Mortality Decline

The analysis leaves a difference between the DHS and the *Levels &Trends, 2006* estimates of the pace of the mortality decline in Bangladesh unexplained. However, both estimates indicate a fairly rapid mortality decline and the difference is of secondary importance. About all that can be said is that the mortality declines from the two sources are based on overlapping but not identical sets of data. In particular, the *Levels &Trends, 2006* estimates incorporates data points from the Bangladesh Sample Registration System which shows a marked decrease in U5MR between 1995-1998 and 1999-2001. The data points reflecting the abrupt change in mortality are included as input data for the first segment of the *Levels &Trends, 2006* regression line and that may be the source of the differences between the two estimates of the pace of mortality decline.

Annex E: Mozambique DHS 1997 and 2003

Mortality Decline: U5MR Estimated

Table 1 shows recent U5MR from DHS reports and from *Levels & Trends, 2006*.[1] The decline in the DHS estimates was 24.1% during a period of about six and a half years while the decline in the *Levels & Trends, 2006* estimates was 16% during a five-year period. The average annual decline was somewhat greater according DHS estimates (3.8% per year) than the *Levels & Trends, 2006* estimates (3.2 % per year). In addition to the slower rate of decline indicate by the estimates from *Levels & Trends, 2006*, those rates are consistently higher than the DHS estimates.

Table 1 Mozambique U5MR Estimates (Rates per 1,000 live births)

Source	Date	U5MR	Date	U5MR	Absolute Decline	% Decline	Time Period (years)	Average Annual % Decline
DHS 1997 & 2003	1994.9	200.9	2001.3	152.4	48.5	24.1	6.4	3.8
Levels & Trends, 2006	1995.5	212	2000.5	178	34	16.0	5.0	3.2

Birth Transference

In all DHS surveys there is a risk of birth transfer because of the extensive number of health questions which must be asked for births which occur after a specified cutoff date. Interviewers can reduce their work load by incorrectly recording a date of birth which is prior to the health cutoff for children who were actually born after that date. This has the potential of negatively biasing mortality estimates for the last estimation period prior to the survey and positively biasing estimates for the penultimate estimation period.

The cutoff dates for asking the health questions for the Mozambique surveys were January 1994 (1997 survey) and January 1998 (2003 survey). Birth transference occurred in both surveys (Table 2), resulting in substantially more deceased children recorded as born in the year prior to the cutoff than in the year after the cutoff. The ratio of deceased births in those two years is 3.4 (474/139) for Mozambique 1997 and 1.6 (484/304) for Mozambique 2003.

Although there was birth transference in both surveys, its impact was quite different in the two surveys. Health data were collected for only a three year retrospective period in the 1997 survey so that birth transference was primarily within (rather than out of) the last estimation period for standard DHS mortality estimation. So, there was no justification for re-estimation of mortality rates and that procedure was not followed. In the 2003 survey, health data were collected for a six year retrospective period and birth transference may have been across the boundary date for mortality estimation, justifying re-estimation.

[1] *Levels and Trends of Child Mortality in 2006 (Working Paper)*, UNICEF, WHO, The World Bank and UN Population Division, 2007.

Table 2. Mozambique 1997 and 2003: Births by Calendar Year

Mozambique 1997			Mozambique 2003		
Calendar Year	Child alive	Child deceased	Calendar Year	Child alive	Child deceased
1997	610	43	2003	1,839	114
1996	1,395	163	2002	1,960	209
1995	1,206	127	2001	1,717	260
1994	1,125	139	2000	1,997	311
1993	1,453	474	1999	1,749	292
1992	1,160	301	1998	1,478	304
1991	1,094	308	2000	1,856	484
1990	1,038	432	1999	1,634	414
1989	1,063	371	1998	1,585	472
Index of birth transference	1.3	3.4		1.3	1.6

Note: Bold line marks January of the year of the cutoff for asking the health questions.

To investigate the effect of birth transference in the Mozambique DHS 2003 survey, new estimates of U5MR were made for redefined time periods: 1) the earlier boundary for the last estimation period was set to begin one year before the health cutoff in each survey and 2) earlier estimation periods were earlier 5-year calendar periods. Because the new estimates apply to earlier time periods than the published DHS estimates, they were projected forward to the date of the DHS estimates by straight line projection (from the adjacent newly estimated rates).

Results are shown in Table 3. The overall effect of re-estimation was as expected to increase the rate for the last estimation period and to decrease the rate for the penultimate period. However, the change in the estimate for last estimation period was small (less than 1%, from 152.4 per 1,000 to 152.9 per 1,000) while the change in the estimate for penultimate period was somewhat greater (about 3%, from 205.9 to 199.2)

Table 3. Re-estimated U5MR*

Mozambique 2003	
Date	U5MR
2001.3	152.9
1996.3	199.2
1991.3	225.8
1986.3	240.2

*Re-estimated, projected rates

Figure 1 shows the trend in U5MRs as published in the DHS reports and Figure 2 shows the re-estimated rates. Two points stand out. First, both the 1997 and the 2003 surveys indicate declines in mortality—rather sharp declines—from about 1990 onward. And second, both Figures 1 and 2 make clear that, for the period of overlap from about 1986 onward estimates from the two surveys do not differ greatly.

Figure 1
DHS U5MR Estimates

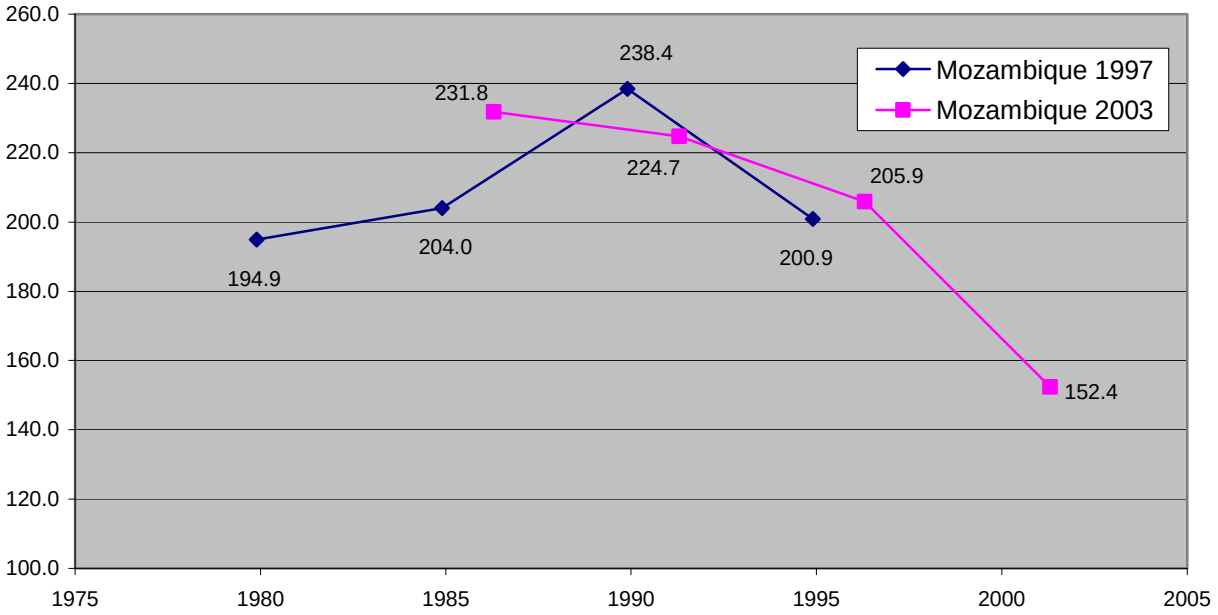
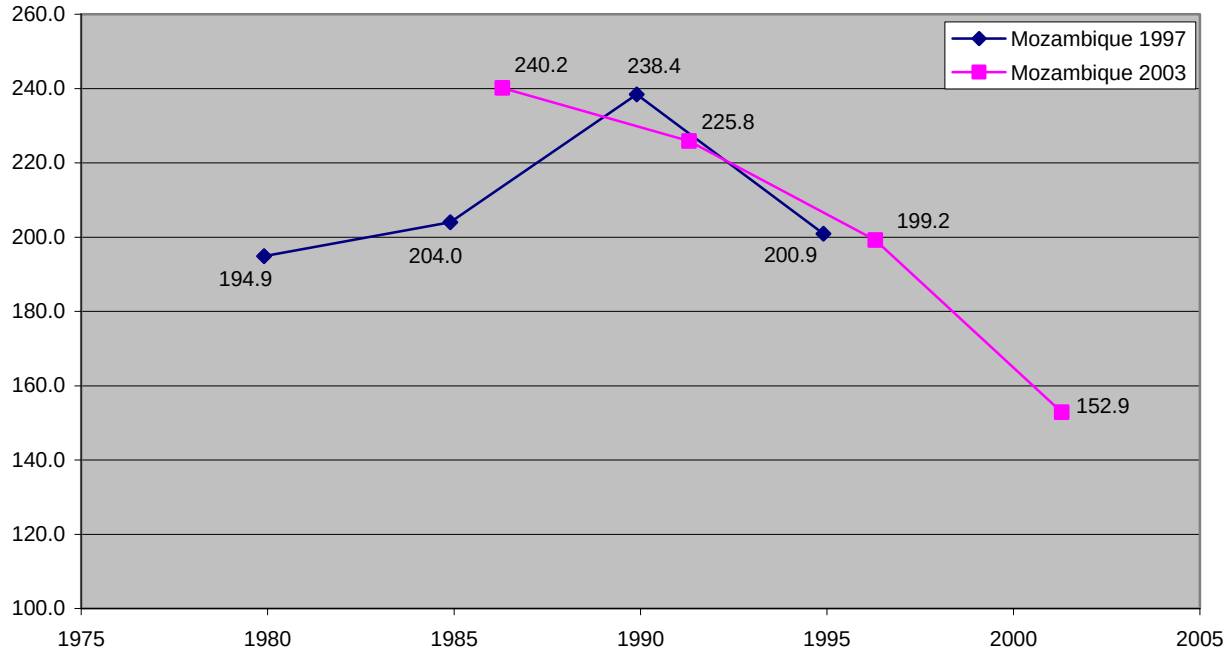


Figure 2
Re-estimated U5MR



Mortality Decline: Re-estimated DHS Rate (2003 survey only)

As indicated above, re-estimation of rates for the 2003 survey only modestly increased the U5MR estimate for the last estimation period. Accordingly, the estimate of the average annual percent decline in U5MR remained greater according to the DHS rates (3.7%) than that LEVELS & TRENDS, 2006 rates (3.2%).

Table 4 Mozambique U5MR Estimates
Re-estimated DHS Rate (2003 Survey only)
(Rates per 1,000 live births)

Source	Date	U5MR	Date	U5MR	Absolute Decline	% Decline	Time Period (years)	Average Annual % Decline
DHS 1997 & 2003	1994.9	200.9	2001.3	152.9	48.0	23.9	6.4	3.7
Levels & Trends, 2006	1995.5	212	2000.5	178	34	16.0	5.0	3.2

Underreporting of Deceased Children

The difference between the 1997 and 2003 surveys in the reporting of deceased children can be analyzed for the 10-year common reference period from 1986 to 1995. This is a time period during which both surveys are free of bias resulting from birth transference. In this section, the analysis is restricted to births to women age 15-39 at the time of birth.[2]

The U5MR estimate for the common reference period for the 1997 survey (226.8 per 1,000) marginally exceeds the estimate for the 2003 survey (224.3 per 1,000). These results provide no reason for suspecting underreporting of deceased children was a problem in either survey.

Sampling Issues

The sampling frame for the 1997 survey was based on enumeration areas created for the 1987 National Population Census and updated for the survey. The frame for the 2003 survey was based on enumeration areas created for the 1997 National Population Census. The overall response rates for female respondents (household x individual response rates) were about 7 or 8 points lower than in the other DHS surveys considered in this report and were about the same in the two surveys: 87.8 (1997 survey) and 86.2 (2003 survey).

The percent distributions of births by sample domains (urban/rural residence and major geographic divisions of Mozambique) for the two surveys are shown in Table 5. The distributions by residence, in particular, are not very similar—the percent of births in urban areas being about 22% in 1997 and about 30% in 2003. However, if sampling problems rather than actual changes in the distribution of population were the cause of the urban/rural

[2] This restriction is to avoid the effects of compositional differences in the age of mothers at the time of birth.

distributional differences between surveys that would erroneously exaggerate the observed mortality decline, since mortality levels are lower in urban areas than in rural areas. However, standardization of the 2003 urban/rural rates on the 1997 distributions indicates that such an affect would be small—increasing the DHS published U5MR from 152.4 to 153.9 and decreasing the mortality decline of Table 1 from 24% to 23%). We conclude that that even if sampling problems existed in one or the other survey; that had little affect on the magnitude of the observed mortality decline.

Table 5. Distributions of Births (Last Five Years) by Sample Domains (Weighted)

	Number		% Distribution	
	Mozambique 1997	Mozambique 2003	Mozambique 1997	Mozambique 2003
Residence				
Urban	910	3,087	21.6	29.1
Rural	3,297	7,533	78.4	70.9
Province				
Niassa	230	527	5.4	5.0
Cabo Delgado	233	968	5.5	9.1
Nampula	675	2,250	16.0	21.2
Zambezia	632	1,622	15.0	15.3
Tete	197	1,096	4.7	10.3
Manica	307	820	7.3	7.7
Sofala	632	794	15.0	7.5
Inhambane	372	822	8.8	7.7
Gaza	479	539	11.4	5.1
Maputo	247	667	5.9	6.2
Maputo Cidade	204	516	4.8	4.8
Total	4,207	10,620	100.0	100.0

Factors Influencing Child Mortality

Factors generally though to influence mortality risks are shown in Table 6 for both the 1997 and 2003 surveys. The selected factors are admittedly arbitrary. We show these in order to see if they lend credibility to the substantial observed mortality declines documented by the 1997 and 2003 surveys.

The trend of two factors is consistent with a decline in mortality. Relative to the 1997 survey, the 2003 survey shows remarkable increases in mothers who received at least one tetanus toxoid vaccination (from 34% to 76%) and substantial increases in children who received all childhood vaccinations (from 47% to 63%). The remaining indicators show little differences between the surveys.

Table 6. Factors Influencing Child Mortality		
	Mozambique 1997	Mozambique 2003
Percentage of mothers with primary + education (births last 5 years)	60%[a]	54%
Percentage of deliveries in a health facility (births last 5 years)	44%[a]	48%
Mother received tetanus toxoid last birth last five years (at least once during pregnancy)	34%[a]	76%
Percent of children received all childhood vaccines (children 12-23 months)	47%	63%
Percent of children ever breastfed (births last 5 years)	95%[a]	98%
Percent received breastmilk first day (children ever breastfed)	95%[a]	92%
Percent slept under a bednet last night (children under age 5)	na	10%
Percent of children under age 3 wasted (below -2SD)	8%	5%
Among women age 15-19, the percentage that have given birth	30%	34%

[a] Births in the last 3 years

It is worth noting that the increases in vaccination coverage occurred particularly in rural areas (Table 7, Panels A and B). Thus, it was the rural areas where most of the population resides that primarily caused the increases in the national coverage rates and it was the rural areas where the largest declines in mortality occurred (Table 7, Panel C)—a consistency which supports the credibility of the mortality decline implied by the DHS data.

Table 7 Selected Health Indicators and U5MRs by Urban/Rural Residence, DHS 1997 and 2003			
	DHS 1997	DHS 2003	Absolute Change
Panel A: Percent of Mothers Receiving Tetanus Toxoid			
Urban Areas	58.1	86.4	+28.3
Rural Areas	26.8	70.9	+44.1
Total	33.6	75.7	+42.1
Panel B: Percent of Children Receiving All Basic Immunizations			
Urban Areas	85.0	80.5	- 4.5
Rural Areas	36.4	56.0	19.6
Total	47.3	63.3	16.0
Panel C: U5MR[a]			
Urban Areas	174.3	138.2	-36.1
Rural Areas	208.5	158.7	-49.8
Total	200.1	152.4	-47.7

[a] The estimates are for the 5-year period preceding each survey. Thus, they differ from the urban/rural estimates in the survey reports which are for a 10-year period preceding each survey.

Credibility of the Mortality Decline in Mozambique

There is persuasive evidence that birth transference occurred in the 2003 Mozambique survey. However, re-estimation of the rates had only a minor effect on the estimates. The analysis of event omission indicated that, for the common reference period (1987-1996), U5MR estimates from the two DHS surveys were very similar (226.8 and 224.3 per 1,000). There were differences in the distributions of births by geographic sampling domains between the two surveys, but standardization of the rates from the 2003 survey on the distribution of births in the 1997 survey indicated that the distributional differences had little effect on the national estimates.

The analysis found no serious data problems in the two surveys. There is no reason to reject the DHS indication of a 24% decline in under-five mortality as indicated by the 1997 and 2003 DHS surveys

Annex F: Cambodia DHS 2000 and 2005

Mortality Decline: U5MR Estimates

Table 1 shows U5MR estimates from the 2000 and 2005 DHS survey reports and from *Levels & Trends, 2006*.[1] The DHS rates apply to dates 5.6 years apart while the *Levels & Trends, 2006* rates apply to dates 5.0 years apart. In terms of the average annual decline, the pace of decline is much greater according DHS rates (6% per year) than the *Levels & Trends, 2006* rates (3% per year).

Table 1 Cambodia U5MR Estimates (Rates per 1,000 live births)

Source	Date	U5MR	Date	U5MR	Absolute Decline	% Decline	Time Period (years)	Average Annual % Decline
DHS 2000 & 2005	1997.8	124.4	2003.4	83.3	41.1	33.0	5.6	5.9
Levels & Trends, 2006	1995.5	123	2000.5	104	19.0	15.4	5.0	3.1

Birth Transference

In all DHS surveys there is a risk of birth transfer because of the extensive number of health questions which must be asked for births which occur after a specified cutoff date. Interviewers can reduce their work load by incorrectly recording a date prior to the cutoff for of children who were actually born after the cutoff. It is almost always the case that, in DHS surveys which suffer from birth transfer, it is more sever for deceased children than for surviving children. Since the cutoff date in DHS surveys is usually January of the 6th year prior to the survey, birth transference has the potential for negatively biasing estimates for the for the 5-year period immediately prior to the survey (i.e., the last estimation period) and positively biasing estimates for the penultimate estimation period.

The cutoff dates for asking the health questions about recent births in the two Cambodia surveys were January 1995 (2000 survey) and January 2000 (2005 survey). Birth transference occurred in both surveys, resulting in more deceased children recorded as born in the year prior to the health cutoff than in the year after the cutoff (Table 2). The index of birth transference was 1.74 (354/204) for Cambodia 2000 and 1.32 (263/198) for Cambodia 2005.

To investigate the effect of birth transference in the Cambodia surveys, new estimates of U5MR were made for redefined time periods: 1) the earlier boundary for the last estimation

[1] *Levels and Trends of Child Mortality in 2006 (Working Paper),* UNICEF, WHO, The World Bank and UN Population Division, 2007.

period was set to begin one year before the health cutoff in each survey and 2) earlier estimation periods were earlier 5-year calendar periods. Because the new estimates apply to earlier time periods than the published DHS estimates, they were projected forward to the date of the DHS estimates by straight line projection (from adjacent newly estimated rates).

Table 2. Births by Calendar Year and Survival Status

Cambodia 2000			Cambodia 2005		
Calendar year	Child alive	Child deceased	Calendar year	Child alive	Child deceased
2000	587	44	2005	1449	61
1999	1492	141	2004	1454	87
1998	1320	125	2003	1469	114
1997	1470	201	2002	1422	99
1996	1541	206	2001	1378	166
1995	1424	204	2000	1569	198
1994	2176	354	1999	1504	263
1993	2001	295	1998	1457	247
1992	1881	295	1997	1457	196
Index of birth transference	1.52	1.73		.95	1.32

Note: The bold line indicates the date of the cutoff for asking health questions.

Results of re-estimation are shown in Table 3. The overall effect was, as expected, to increase the rates for last estimation period preceding each survey and decrease the rate for the penultimate estimation period. For the 2000 survey, the estimate for the last estimation period increased by 2% (from 124.4 to 127.2 per 1,000) while, for the 2005 survey, the estimate increased by 11% (from 83.3 to 92.8 per 1,000). Particularly for the 2005 survey, re-estimation significantly altered the trend of the estimated rates.

Table 3. Re-estimated U5MR*

Cambodia 2000		Cambodia 2005	
Date	U5MR	Date	U5MR
1997.8	127.4	2003.4	92.8
1992.8	117.9	1998.4	115.7
1987.8	115.8	1983.4	125.2
1982.8	144.3	1988.4	121.2

*Re-estimated, projected rates.

Figure 1 shows the trend in U5MRs as published in the DHS reports and Figure 2 shows the re-estimated rates. Two points stand out. First, the differences between the DHS published rates and the re-estimated rates were relatively small for the 2000 survey but more substantial for the 2005 survey.[2] Second, the overall, the pattern of decline in the mortality estimates differs significantly between Figures 1 and 2. The very sharp decline in U5MR depicted in

[2] This occurred in spite of the larger value for the index of transference for deceased children in the 2000 survey (1.73) than the 2005 survey (1.32). The explanation lies in that fact that surviving children were transferred almost to the same extent as deceased children in the 2000 survey but not in the 2005 survey.

Figure 1 by the rates from the 2005 survey (from 127.2 to 83.3 per 1,000) is much reduced by the re-estimates of Figure 2 (from 115.7 to 92.8 per 1,000).

Figure 1
DHS U5MR Estimates: Cambodia 2000 & 2005

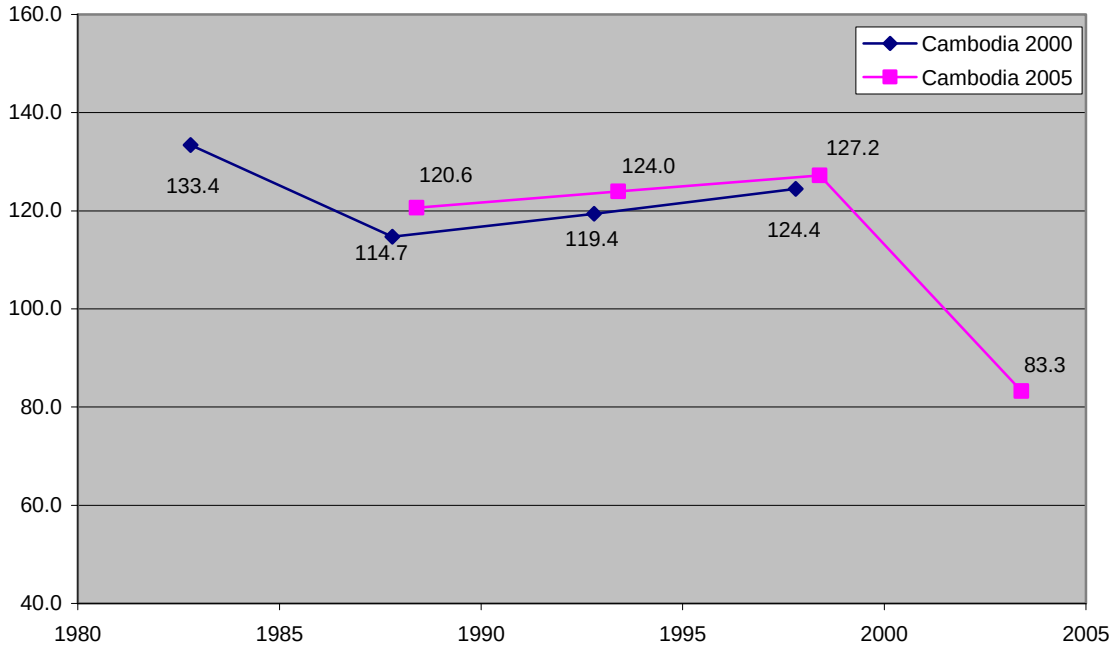
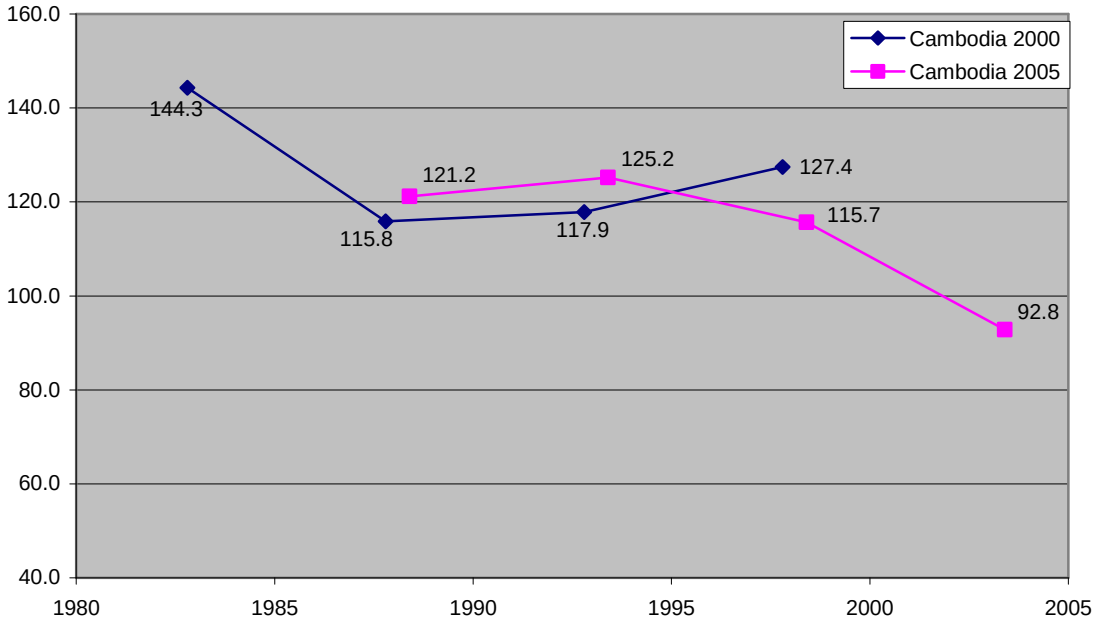


Figure 2
Re-estimated U5MR: Cambodia DHS 2000 & 2005



Mortality Decline: Re-estimated DHS Rates

The Re-estimated rates for the last estimation period before the two DHS surveys show somewhat smaller U5MR declines than the DHS published rates. As a result, the pace of the annual rate of mortality decline based on the re-estimated rates is smaller in Table 4 (5 % per year) than in Table 1 (6% per year). Additionally, the difference between the pace of decline implied by the DHS and *Levels & Trends, 2006* rates of Table 1 (6% versus 3%) is reduced in Table 4 (5% versus 3%).

Although the pace of the mortality decline in Table 4 differs between data sources, the later estimates from the two sources are quite close when the time differences are considered. Projecting the *Levels & Trends, 2006* estimate of 104 per 1,000 forward 2.9 years to the time of the 2005 DHS estimate (by straight line projection) yields an estimated rate of 94.6 per 1,000--- quite close to the re-estimated DHS rate of 92.8.

Table 4 Cambodia U5MR Estimates
DHS Re-estimated Rates
(Rates per 1,000 live births)

Source	Date	U5MR	Date	U5MR	Absolute Decline	% Decline	Time Period (years)	Average Annual % Decline
DHS 2000 & 2005	1997.8	127.2	2003.4	92.8	34.4	27.0	5.6	4.8
Levels & Trends, 2006	1995.5	123	2000.5	104	19.0	15.4	5.0	3.1

Underreporting of Deceased Children

The relative completeness of the 2000 and 2005 surveys in the reporting of deceased children can be analyzed for the 10-year common reference period from 1989 to 1998. This is a time period during which both surveys are free of bias resulting from birth transference. In this section, the analysis is restricted to births to women age15-39 at the time of birth.[3]

For the common reference period, the U5MR from the 2000 survey (119 per 1,000) is somewhat lower than from the 2005 survey (123 per 1,000). However, the difference between the two rates is well within sampling error so, form this comparison, there is no basis for asserting that event omission was a problem in either survey. In any case, the primary interest here is the credibility of the observed mortality decline and the comparison made here indicates that event enumeration was at least as complete in the 2005 survey as in the 2000 survey.

[3] This restriction is to avoid the effects of compositional differences in mothers' age at time of birth on the estimated rates.

Sample Issues

The samples for both the 2000 and 2005 surveys were based on the materials developed for the 1998 Cambodia General Population Census. The 1998 census materials were updated prior to constructing the sampling frame for the 2005 DHS survey. The objectives of the two surveys were virtually identical—requiring mortality estimates at the national and urban/rural levels and for 16 sample domains (provinces or groups of provinces).

The percent distributions of births by sample domains for the two surveys are shown in Table 5. The distributions are very similar between surveys indicating consistent weighting of geographic mortality experience across sample domains.

The overall response rates for female respondents (household and individual rates) were good in both surveys: 98.3% for the 2000 DHS and 94.8% for the 2005 survey.

Table 5. Distributions of Births (Last Five Years) by Sample Domains (Weighted)

	Number		% Distribution	
	Cambodia 2000	Cambodia 2005	Cambodia 2000	Cambodia 2005
Residence				
Urban	1,076	1,093	13.1	14.0
Rural	7,098	6,696	86.9	86.0
Province				
Banteay Mean Chey	418	334	5.1	4.3
Kampong Cham	1,135	929	13.8	12.0
Kampong Chhnang	385	317	4.7	4.1
Kampong Speu	478	468	5.8	6.0
Kampong Thom	441	401	5.4	5.1
Kandal	700	681	8.6	8.7
Kratie, Preah Vihear, Steung Treng	371	412	4.5	5.3
Phnom Penh	433	614	5.3	7.8
Prey Veng	599	618	7.3	7.9
Pursat	276	219	3.4	2.8
Siem Reap, Otdar Mean Chey	619	766	7.8	9.8
Svay Rieng	323	256	3.9	3.3
Takeo	610	491	7.4	6.3
Battambang, Krong Pailin	633	532	7.7	6.8
Kampot, Krong, Krong Preah,	614	593	7.5	7.6
All other provinces	140	158	1.7	2.0
Total	8,175	7,789	100.0	100.0

Factors Influencing Child Mortality

Factors generally though to influence mortality risks are shown in Table 6 for 2000 and 2005 surveys. The selected factors are admittedly arbitrary. We show these in order to see if they lend credibility to the substantial observed mortality declines documented by the 2000 and 2005 surveys—substantial even with the re-estimated rates.

The trends of all the factors were consistent with a decline in mortality between the surveys. Particular improvement occurred for several factors: mother's receipt of tetanus toxoid

vaccination during pregnancy (from 45% to 67%), children 12-23 months that received all vaccines (40% to 67%), new births receipt of breastmilk within one day of birth 24% to 68%) and nutritional status of children under age five (wasting was reduced from 15% to 7%). These trends are strong evidence that health conditions of children improved between the two surveys.

Table 6. Factors Influencing Child Mortality

	Cambodia 2000	Cambodia 2005
Education level of mother for births in last 5 years (% primary +)	67%	75%
Percentage of all births delivered in a health facility (last 5 years)	10%	22%
Mother received tetanus toxoid at least once (last birth last 5 years)	45%	67%
Children received all childhood vaccines (children 12-23 months)	40%	67%
Percent of children ever breastfed	96%	97%
Percent received breastmilk first day (children ever breastfed)	24%	68.3
Percent slept under a bednet last night (children under age 5)	na	88%
Percent of children under age 5 wasted (below -2SD)	15%	7%
Among women age 15-19, the percentage that have given birth	5.6%	5.2%

Credibility of the Mortality Decline in Cambodia

There was evidence of birth transference in both the 2000 and 2005 DHS surveys of Cambodia. Re-estimation increased the rates for the final estimation period before each survey; only by 2% in the case of the 2000 survey but by 11% in the case of the 2005 survey. As a result, the decline in U5MR measured by the rates for the final estimation period in each survey decreased from 33% (124 to 83 points per 1,000) to 27% (127 to 93 points per 1,000). The analysis of event omission by comparison of U5MR estimates for the 10-year common reference period provided no evidence of event underreporting in either survey. The distributions of births across sampling domains were very similar indicating consistent weighting of geographic mortality experience in the two surveys.

The analysis indicated that the decline in U5MR documented in the published reports of 2000 and 2005 DHS surveys overstated the magnitude of the recent mortality decline in Cambodia but that there has been a very substantial decline in U5MR—on the order of 27% over a period of about five and a half years.

Annex G: Malawi DHS 2000 and 2004

Mortality Decline: U5MR Estimates

Table 1 shows U5MR estimates from the 2000 and 2004 DHS surveys and from *Levels & Trends, 2006*.[1] The decline in the DHS estimates is 29% during a period of 4.2 years while the decline in the *Levels & Trends, 2006* estimates is 20% during a period of 5.0 years. In terms of the average annual percent decline, the pace of decline is almost twice as great according DHS rates (7.0% per year) than the *Levels & Trends, 2006* rates (3.9 % per year).

The U5MR estimates from the two sources also differ in terms of level; the *Levels & Trends, 2006* estimates being notable higher. However, much of the differences in the level of the rates is due to the different points in time (about 2 or 3 years) to which each set of estimates pertains; e.g., the earlier of the two DHS estimates applies to a point in time 2.7 years later than the comparable *Levels & Trends, 2006* estimate (1998.2 versus 1995.5). Projecting the estimates to a common point in time would eliminate most of the differences in level.

Table 1 Malawi U5MR Estimates
(Rates per 1,000 live births)

Source	Date	U5MR	Date	U5MR	Absolute Decline	% Decline	Time Period (years)	Average Annual % Decline
DHS 2000 & 2004	1998.2	188.5	2002.4	133.2	55.3	29.3	4.2	7.0
Levels & Trends,2006	1995.5	193	2000.5	155	38	19.7	5.0	3.9

Note: The analysis in *Levels & Trends (Working Paper) , 2006* for Malawi does not include the Malawi 2006 MICS.

Birth Transference

In all DHS surveys there is a risk of birth transference because of the extensive number of health questions which interviewers must be asked for all births which occur after a specified cutoff date. Interviewers can reduce their work load by incorrectly recording the date of birth for a child which, in fact, was born after the health cutoff as occurring prior to the health cutoff. When birth transference occurs, it is almost always more sever for deceased children than for surviving children. The common explanation for this is that interviewers are particularly anxious to avoid asking respondents detailed questions concerning health practices for children that are deceased.

Since the cutoff date in DHS surveys is usually January of the 6th year prior to the survey and the standard DHS practice is to estimate mortality rates for 5-year periods prior to a survey, birth transference tends to negatively bias DHS mortality estimates for the period immediately prior to the survey and to positively bias estimates for the penultimate period.

[1] *Levels and Trends of Child Mortality in 2006 (Working Paper),* UNICEF, WHO, The World Bank and UN Population Division, 2007.

The health cutoff dates for the Malawi surveys were January 1995 (Malawi 2000) and January 1999 (Malawi 2004). Birth transference occurred in both surveys, resulting in substantially more deceased children recorded as born in the year prior to the cutoff than in the year after the cutoff (Table 2). The ratio of deceased births in those two years is 2.08 (599/288) for Malawi 2000 and 1.82 (424/233) for Malawi 2004. Moreover, there is an excess of deceased births in the second year preceding the health cutoff in both surveys.

Table 2. Births by Calendar Year

Malawi 2000			Malawi 2004		
Calendar Year	Child alive	Child deceased	Calendar Year	Child alive	Child deceased
2000	1,795	147	2004	2,160	114
1999	2,373	293	2003	2,239	166
1998	2,117	355	2002	1,723	191
1997	2,069	375	2001	1,738	230
1996	1,767	403	2000	1,816	285
1995	1,460	288	1999	1,342	233
1994	2,159	599	1998	1,718	424
1993	1,586	488	1997	1,482	359
1992	1,650	430	1996	1,417	310
Index of birth transference	1.5	2.1		1.3	1.8

Note: The bold line indicates the date of the cutoff for asking health questions.

To investigate the effect of birth transference in the Malawi surveys, new estimates of U5MR were made for redefined time periods: 1) the earlier boundary for the last estimation period was set to begin two years before the health cutoff in each survey and 2) earlier estimation periods were earlier 5-year calendar periods. Because the new estimates apply to earlier time periods than the published DHS estimates, they were projected forward to the date of the DHS estimates by straight line projection (from adjacent newly estimated rates).

The results of re-estimation are shown in Table 3. The re-estimated rates for the 2000 survey differed little from the DHS published rates: the re-estimated rates for both the last estimation period before the survey and for the penultimate estimation period differed from the DHS published rates by less than 1%. However, for the 2004 survey the re-estimated rates differed significantly from the DHS published rates: rate for the last estimation period prior to the survey increased by 7% (from 133.2 per 1,000 to 142.8 per 1,000) and the rate for the penultimate estimation period decreased by 9% (from 187 per 1,000 to 170 per 1,000).

Table 3. Re-estimated U5MR*

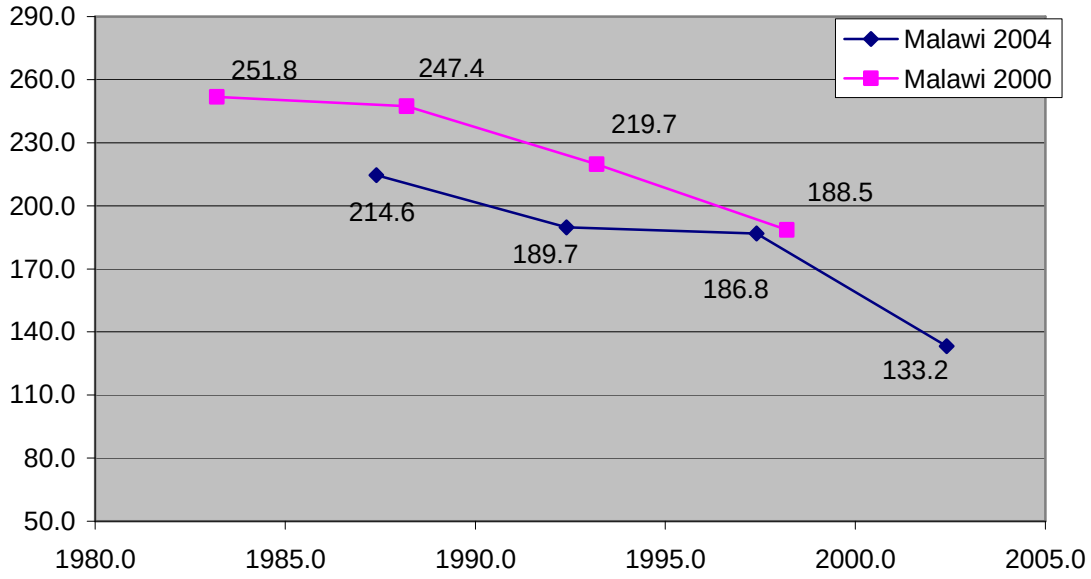
Malawi 2000		Malawi 2004	
Date	U5MR	Date	U5MR
1998.2	188.2	2002.4	142.8
1993.2	218.3	1997.4	170.1
1988.2	242.9	1992.4	194.8
1983.2	253.6	1987.4	209.6

*Re-estimated, projected rates.

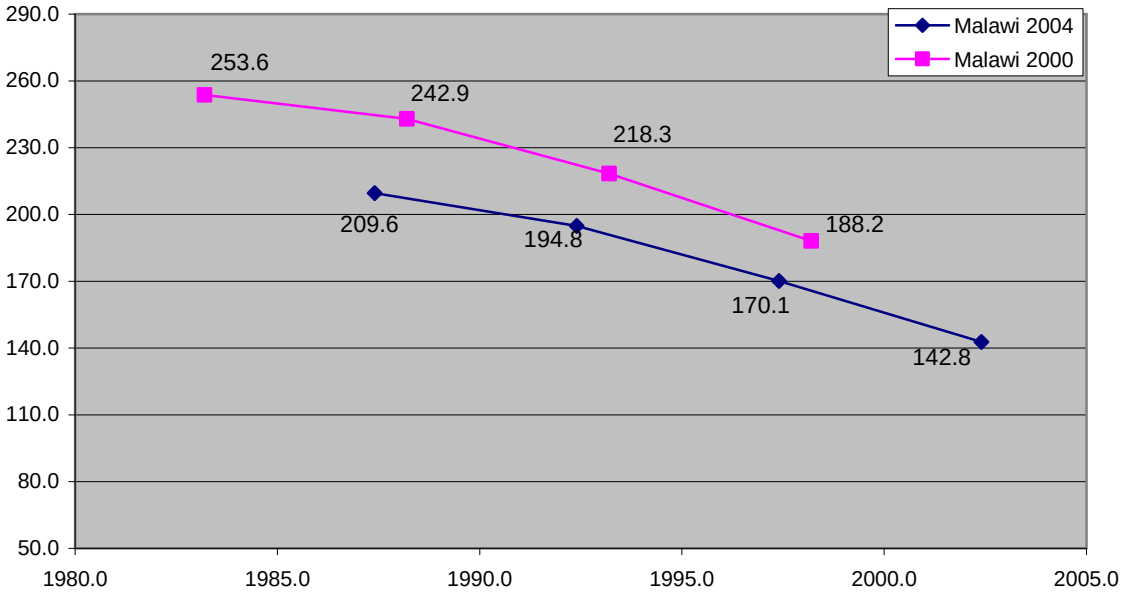
The U5MR estimates published in the DHS reports are shown in Figure 1 and the re-estimated rates are shown in Figure 2. Two points stand out. First, for the time period immediately prior to the 2004 survey, the re-estimated rate (142.8 per 1,000) is substantially higher than the DHS published rate (133.2 per 1,000) while, for the penultimate time period, the re-estimated rates (170.1 per 1,000) is substantially lower than the DHS rate (186.8 per 1,000). Removing the biases of birth transference has substantially changed the profile of the mortality decline preceding the 2004 survey.

Second, Figure 2 makes clear that, for the common reference period for the two surveys, estimates from the 2004 survey are consistently lower than those from the 2000 survey. On the assumption that survey respondents did not over report deceased children in the 2000 survey, the difference appears to be underreporting of deceased children in the 2004 survey.

Malawi DHS U5MR
DHS 2000 & 2004



Malawi Re-estimated U5MR
DHS 2000 & 2004



Mortality Decline: Re-estimated DHS Rates

Table 4 is a revised version of Table 1in which re-estimated rates are substituted for the published DHS estimates. The pace of the mortality declined derived from the published DHS estimates (7.0% per year in Table 1) is reduced when measured by the re-estimated rates (5.7% per year in Table 4).

Nevertheless, in Table 4 the average annual decline based on re-estimated rates (5.7%) remains distinctly higher than the pace of decline implied by the UNICF estimates 3.9%).

Table 4 Malawi U5MR Estimates
Re-estimated DHS Rates
(Rates per 1,000 live births)

Source	Date	U5MR	Date	U5MR	Absolute Decline	% Decline	Time Period (years)	Average Annual % Decline
Malawi 2000 & 2004	1998.2	188.2	2002.4	142.8	45.4	24.1	4.2	5.7
Levels & Trends, 2006	1995.5	193	2000.5	155	38	19.7	5.0	3.9

Underreporting of Deceased Children

The issue of underreporting of deceased children in the 2000 and 2004 Surveys can be investigated by comparing U5MR estimates from the two surveys for the 10-year common reference period 1990-99. This is a time period free of biases resulting from birth transference in both surveys. In this section, the analysis is restricted to births to women 15-39 at the time birth.[2]

For the common reference period, the U5MR estimate from the 2000 survey (202.9 per 1,000) exceeds the estimate from the 2004 survey (186.8 per 1,000) by about 8.6%. It is not clear if the relatively poor performance of the 2004 survey is a reflection of underreporting of deaths in all time periods or if underreporting was restricted to the 1990-99 period.[3] Nevertheless, this finding indicates that the DHS U5MR for the last estimation period from the 2004 survey may be underestimated by as much as 8.6%.

Additional insight into the possibility differential completeness in the reporting of events in the Malawi surveys can be obtained by considering the quality of the age at death data in the two surveys. The standard procedure in all DHS surveys is that, for deaths occurring at one year of age, interviewers must record age at death in term of months of age. Field editors assigned to each survey team are responsible for ensuring that this procedure is followed.

[2] This restriction is to avoid the estimated rates from the two surveys being differentially affected by compositional differences in mothers age at the time of birth.

[3] The rationale for thinking that underreporting of events in the 2004 survey may not extend to the period immediately preceding the survey is due to the difference in the recall period over which respondents must report events. The respondents in the 2004 survey have a relatively long recall period when reporting events for the years 1990-1999 (approximately 9 or 10 years, on average) while their recall interval for events immediately before the survey is short (approximately 2 or 3 years, on average).

The issue here is whether or not the interviewing teams were appropriately trained and appropriately supervised so that fieldwork was conducted according to standard procedures.[4]

In most DHS surveys the rules for collecting age at death data are followed and the great majority of deaths occurring at age one are recorded in terms of months of age. The performance of the 2000 Malawi survey was acceptable in this regard: only 8% of deaths at age one were incorrectly recorded as occurring age one. On the other hand, the performance of the 2004 survey was unacceptable: 50% of deaths at age one were incorrectly recorded as occurring at age one. This indicates that in the 2004 survey interviewers did not follow the instructions given during their training and that field editors failed in their supervisory responsibilities--as least with respect to the mortality data.

Sampling Issues

The samples for both the 2000 and 2004 surveys were based on the enumeration areas created for the 1998 National Housing and Population Census. The objectives of the two surveys were identical—calling for providing estimates at the national level, for urban/rural areas and for a set of 10 "emphasis" districts. The overall response rates were good for both the 2000 and 2004 surveys (97% and 94%, respectively).

The percent distributions of births by sample domains are shown in Table 5 (urban/rural residence and district). The distributions are very similar between surveys indicating consistent weighting of mortality conditions across sample domains.

Table 5. Birth Distributions by Sample Domains (Births Last Five Years, Weighted)

	Number of Births		% Distribution	
	Malawi 2000	Malawi 2004	Malawi 2000	Malawi 2004
Residence				
Urban	1,502	1,425	12.3	13.2
Rural	10,698	9,347	87.7	86.8
District				
Blantyre	881	724	7.2	6.7
Kasungu	489	525	4.0	4.9
Lilongwe	1,829	1,489	15.0	13.8
Machinga	469	441	3.8	4.0
Mangochi	637	636	5.2	5.9
Mulanje	553	437	4.5	4.1
Mzimba	562	676	4.6	6.3
Salima	293	312	2.4	2.9
Thyolo	566	575	4.6	5.3
Zomba	727	544	6.0	5.1
All other districts	5,195	4,414	42.6	41.0
Total	12,201	10,771	100.0	100.0

[4]The reason that DHS requires the collection of age at death data in this manner is explained in the Methodological Section and is not repeated here.

Factors Influencing Child Mortality

Factors which influence mortality risks are shown in Table 6 for both surveys. The selected factors are admittedly arbitrary. We show these in order to see whether or not they lend credibility to a mortality decline.

The trends of several factors are consistent with a decline in mortality – relative to the 2000 survey, the 2004 survey recorded a higher level of mothers attending primary school (36% versus 44%), a greater proportion of births delivered at health facilities (45% versus 57%) and an increase in the percentage of children sleeping under a bednet (8% versus 20%). The remaining indicators show little difference between the surveys. So, there are indications of improvement in the health factors, but the evidence is not strong.

Table 6. Factors Influencing Child Mortality

	Malawi 2000	Malawi 2004
Education level of mother for births in last 5 years (% primary +)	36%	44%
Percentage of all births delivered in a health facility (last 5 years)	45%	57%
Mother received tetanus toxoid (at least once during pregnancy)	85%	85%
Children received all childhood vaccines (children 12-23 months)	70%	64%
Percent of children ever breastfed	98%	98%
Percent received breastmilk first day (children ever breastfed)	97%	97%
Percent slept under a bednet last night (children under age 5)	8%	20%
Percent of children under age 5 wasted (below -2SD)	6%	5%
Among women age 15-19, the percentage that have given birth	25%	25%

Credibility of the Mortality Decline in Malawi

There was evidence of birth transference in both the 2000 and 2004 Malawi DHS surveys. However, re-estimation of the U5MR had virtually no effect on the estimate for the last estimation period preceding the 2000 survey but produced a notable increase in the estimate for the last estimation period preceding the 2004 survey (7%, from 133.2 to 142.8 per 1,000 live births). The analysis of event omission indicated underreporting of deceased children in the 2004 survey–by as much as 8.6 percent. There was no indication of sampling problems in the two surveys.

It is likely that the published DHS U5MR estimates overstate the mortality decline (29% in 4.2 years, Table 1). However, adjusting the 2004 DHS published estimate upward by 7.0% to eliminate birth transfer bias to 142.5 (133.2 x 1.070) and another 8.6% to compensate for underreporting of deceased children results in an U5MR estimate for 2002.4 of 154.7 per 1,000 (142.5 x 1.086). That estimate represents a decline of about 17.8% from the under-five estimate from the 2000 survey (188.2 per 1,000 of Table 4). A decline of approximately 18% over the 4.2 year period (or an average annual decline of 4.2%) is probable close to the true pace of mortality decline in Malawi and does not differ greatly from the estimate from the *Levels and Trends, 2006* estimate of 3.9 % per year (Tables 1 and 4).

The Malawi MICS 2006

The Malawi 2006 MICS should be mentioned here. The Malawi 2006 MICS employed the birth history approach to the collection of mortality data and direct estimates of U5MR are reported in the Preliminary Report (Table 7).

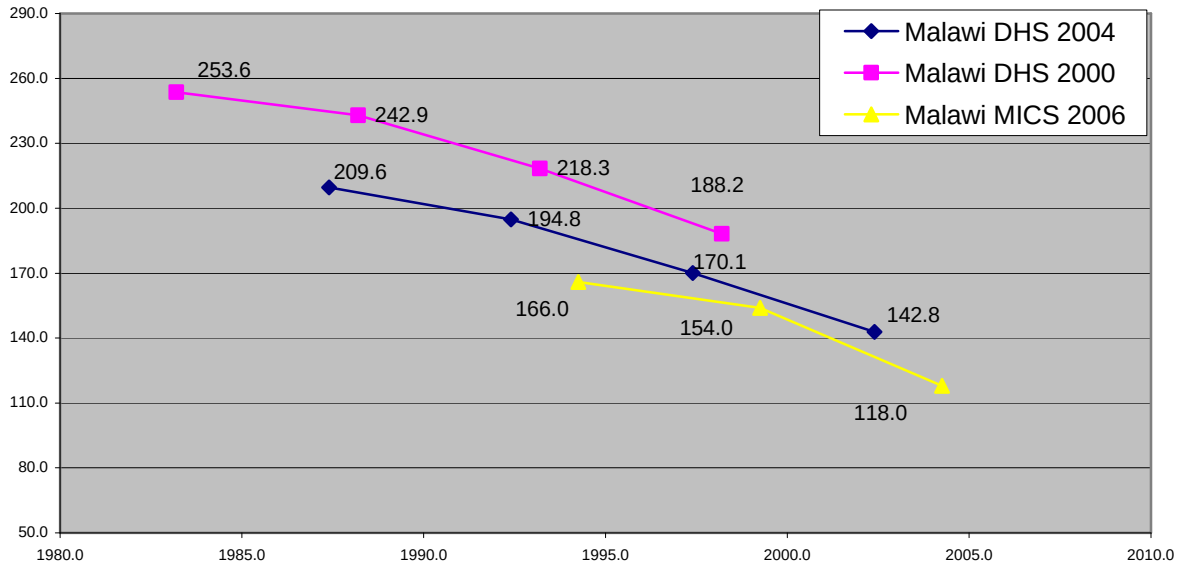
Table 7 U5MR from the Malawi 2006 MICS (direct estimation with birth history data)

Calendar period	Midpoint of period	U5MR
2002-2006	2004.2	118
1997-2001	1999.2	154
1992-1996	1994.2	166

Source: Malawi Multiple Indicator Cluster Survey 2006, Preliminary Report, National Statistical Office, Zombia & UNICEF, Malawi, 2007.

For the time periods where comparison is possible (for the MICS estimates of 1994.2 and 1999.2), the estimates from MICS 2006 are lower than from either DHS 2000 or DHS 2004 (Figure 3). Following the rationale applied earlier to conclude that there was underreporting of deceased children in DHS 2004, it appears that there was underreporting in MICS 2006.[5] Thus, the MICS survey can not be considered confirmation of the mortality estimates from DHS 2004.

Figure 3
Malawi: Re-estimated DHS U5MR and MICS 2006 U5MR



[5] It should be noted that, if anything, Figure 3 understates the shortfall between the MICS estimates for 1994.2 and 1999.2 and the DHS estimates. Figure 3 presents DHS re-estimated rates because those estimates are considered more reliable than the published DHS estimates. However, the MICS rates in Figure 3 are the published rates; i.e., unadjusted for any birth transfer bias.

Annex H: Niger DHS 1998 and 2006

Mortality Decline: U5MR Estimates

Table 1 shows recent U5MR from 1998 and 2006 survey reports and from *Levels & Trends, 2006*.[1] The decline in the DHS estimates is 28% during an eight-year period while the decline in the *Levels & Trends, 2006* estimates is about 9% during a five-year period. In terms of the average annual decline, the of decline is twice as great according DHS rates (3.5% per year) than the *Levels & Trends, 2006* rates (1.7% per year).

Table 1 Niger U5MR Estimates (Rates per 1,000 live births)

Source	Date	U5MR	Date	U5MR	Absolute Decline	% Decline	Time Period (years)	Average Annual % Decline
DHS 1998 & 2006	1995.8	273.7	2003.7	197.3	76.4	27.9	7.9	3.5
Levels & Trends, 2006	1995.5	295	2000.5	270	25.0	8.5	5.0	1.7

Note: The analysis in *Levels & Trends,(Working Paper) 2006* does not include the results of Niger 2006 DHS survey.

It should be noted that the *Levels & Trends, 2006* estimates of Table 1 were made without using mortality estimates from the Niger 2006 survey.[2] The most recent data points used in the *Levels & Trends, 2006* regression procedures were U5MR estimates from MICS 1996 (indirect estimates), DHS 1998 (direct and indirect estimates) and the MICS 2000 (indirect estimates). Thus, the survey data, which are the basis for the two sets of estimates in Table 1, differ substantially.

Birth Transference

The cutoff dates for asking the health questions for the Niger surveys were January 1995 (Niger 1998) and January 2001 (Niger 2006). Birth transference occurred in both surveys (Table 2), resulting in substantially more deceased children recorded as born in the year prior to the cutoff than in the year after the cutoff. The ratio of deceased births in those two years was 1.54 (471/305) for Niger 1998 and 2.34 (673/287) for Niger 2006.

The impact of birth transference on mortality estimates was quite different in the two surveys. Health data were collected for only a three year retrospective period in the 1998 survey so that birth transference was primarily within (rather than out of) the first 5-year retrospective period for DHS mortality estimation. Thus, there was no justification for re-estimation of mortality rates that procedure was not followed. In the case of the 2006 survey, health data were collected for a five year retrospective period and birth transference was across the boundary date for mortality estimation, justifying re-estimation of mortality rates.

[1] *Levels and Trends of Child Mortality in 2006 (Working Paper),* UNICEF, WHO, The World Bank and UN Population Division, 2007.
[2] See the analysis for Niger on the Childinfo.org website.

Table 2. Niger 1998 and 2006: Births by Calendar Year

Niger 1998			Niger 2006		
Calendar Year	Child alive	Child deceased	Calendar Year	Child alive	Child deceased
1998	656	37	2006	623	19
1997	1,606	146	2005	2,060	154
1996	1,364	217	2004	1,682	192
1995	1,192	305	2003	1,650	287
1994	1,324	471	2002	1,763	353
1993	1,110	462	2001	1,273	287
1992	1,142	530	2000	1,959	673
1991	1,013	464	1999	1,544	439
1990	1,154	563	1998	1,703	537
Index of birth transference	1.1	1.5		1.5	2.34

Note: Bold line marks January of the year of the cutoff for asking the health questions.

To investigate the effect of birth transference in the Niger 2006 DHS survey, new estimates of U5MR were made for redefined time periods: 1) the earlier boundary for the last estimation period was set to begin one year before the health cutoff and 2) earlier estimation periods were earlier 5-year calendar periods. Because the new estimates apply to earlier time periods than the published DHS estimates, they were projected forward to the date of the DHS estimates by straight line projection (from the adjacent newly estimated rates).

The results of re-estimation are shown in Table 3. The overall effect was as expected to increase the rate for the estimation period immediately preceding the 2006 survey and to decrease the rate for the penultimate period. However, the effects were small, for example the U5MR for the last estimation period changed from 197 per 1,000 to 200 per 1,000. For all practical purposes, re-estimation did not change the estimated rates.

Table 3. Re-estimated U5MR*

Niger 2006	
Date	U5MR
2003.7	200.0
1998.7	237.5
1993.7	278.6
1988.7	306.6

*Re-estimated, projected rates

Figure 1 shows the trend in U5MRs as published in the DHS reports and Figure 2 shows the re-estimated rates. Two points stand out. First, both the 1998 and the 2006 indicate declines in mortality from about 1990 onward. And second, both Figures 1 and 2 make clear that, for the overlap period between surveys, the estimates from Niger 2006 are lower than those from Niger 1998, suggesting underreporting of deceased children in the 2006 survey.

Figure 1
DHS U5MR

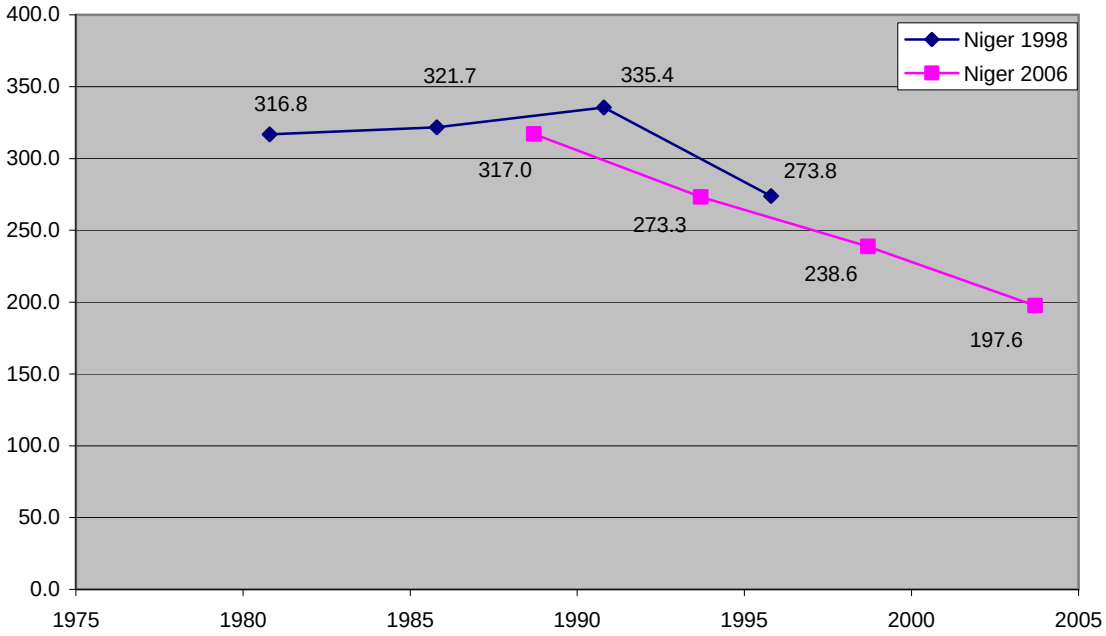
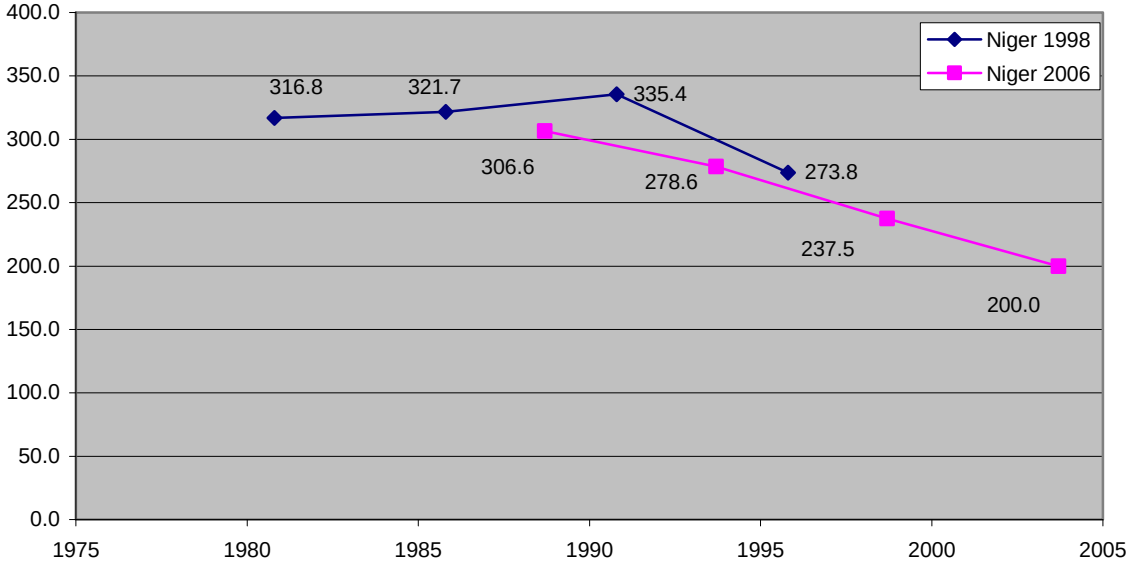


Figure 2
NIGER U5MR: Re-estimated rates for 2006 DHS only



Mortality Decline: Re-estimated DHS Rates (2006 survey only)

Table 4 is a revised version of Table 1. As indicated above, re-estimation was not done for the 1998 survey and re-estimation had little effect on the U5MR estimates for the 2006 survey. Accordingly, Table 4 is little unchanged from Table 1.

Table 4 Niger: DHS U5MR Estimates
Re-estimated DHS Rates (2006 survey only)
(Rates per 1,000 live births)

Source	Date	U5MR	Date	U5MR	Absolute Decline	% Decline	Time Period (years)	Average Annual % Decline
DHS 1998 & 2006	1995.8	273.7	2003.7	200.0	73.7	26.9	7.9	3.4
Levels & Trends, 2006	1995.5	295	2000.5	270	25.0	8.5	5.0	1.7

Note: The *Levels & Trends, 2006* analysis does not include the results of Niger 2006 DHS survey.

Under Reporting of Deceased Children

The difference between the 1998 and 2006 surveys in the completeness of reporting deceased children can be analyzed for the 10-year common reference period from 1988 to 1997. This is a time period free of biases resulting from birth transference in both surveys. In this section, the analysis is restricted to births to women 15-39 at the time of birth.[3]

For the common reference period, the U5MR estimate from the 1998 survey (303 per 1,000) exceeds the estimate from the 2003 survey (279 per 1,000) by about 9%. It is not clear if the poor performance of the 2006 survey is a reflection of underreporting of deaths in all time periods or if underreporting is restricted to the 1988-97 period.[4] Nevertheless, this finding indicates that the DHS U5MR for last estimation period preceding the 2006 survey may be underestimated by as much as 9%.

Sampling Issues

The sampling frame for the 1998 survey was based on enumeration areas created in 1987/88 for the 1988 National Population Census and updated for the survey. The frame for the 2006 survey was based on enumeration areas created for the 2001 National Population Census. The overall response rates for female respondents (household x individual response rates) were good in both surveys; 95% for the 1998 survey and 93% for the 2006 survey.

[3] This restriction is to avoid the effects of compositional differences in mothers age at time of birth on the estimated rates.

[4] The rationale for thinking that underreporting of events in the 2003 survey may not extend to the period immediately preceding the survey is due to the differential in the recall time for which respondents must report events. The respondents in the 2003 survey have a relatively long recall interval when reporting events for the years 1988-1997 (approximately ten years, on average) while their recall interval for events immediately before the survey is short (approximately 2 or 3 years, on average).

The percent distributions of births by sample domains (urban/rural residence and major geographic divisions) for the two surveys are shown in Table 5. The distributions are similar for the two surveys indicating consistent weighting of mortality experience across sample domains.

Table 5. Distributions of Births (Last Five Years) by Sample Domain (Weighted)

	Number		% Distribution	
	Niger 1998	Niger 2006	Niger 1998	Niger 2006
Residence				
Urban	1,504	792	15.8	15.1
Rural	8,451	4,214	84.2	84.9
District				
Niamey	274	589	5.5	5.9
Dosso	565	1,382	11.3	13.9
Maradi	1,254	2,215	25.0	22.3
Tahoua/Agadez	934	2,220	18.7	22.3
Tillaberi	790	1,299	15.8	13.0
Zinder/Diffa	1,189	2,249	23.7	22.6
Total	5,007	9,955	100.0	100.0

Factors Influencing Child Mortality

Factors generally though to influence mortality risks are shown in Table 6 for both surveys. The selected factors are admittedly arbitrary. We show these in order to see if they lend credibility to the substantial observed mortality declines documented by the 1988 and 2006 surveys.

Table 6. Factors Influencing Child Mortality

	Niger 1998[a]	Niger 2006
Percentage of mothers with primary + education (births last 5 years)	12% [a]	13%
Percentage of deliveries in a health facility (births last 5 years)	18% [a]	17%
Mother received tetanus toxoid last birth last five years (at least once during pregnancy)	35% [a]	42%
Children received all childhood vaccines (children 12-23 months)	18%	29%
Percent of children ever breastfed (births last 5 years)	97% [a]	98%
Percent received breastmilk first day (children ever breastfed)	42%	64%
Percent slept under a bednet last night (children under age 5)	na	15%
Percent of children under age 3 wasted (below -2SD) [b]	21%	13%
Among women age 15-19, the percentage that have given birth	36%	33%

[a]Births in the last 3 years
[b]Children under age 3

Credibility of the Mortality Decline in Niger

There is evidence that birth transference occurred in the 2006 Niger survey. However re-estimation of the mortality rates indicated that birth transference had little effect on the U5MR estimate for the last estimation period preceding the survey. The analysis of event omission indicated that for the common reference period, 1988-1977, mortality estimates from the 2006 may have been underestimated by as much as 9%. There was no indication of sampling problems in the two surveys.

It is likely that there was underreporting of deceased children in the 2006 DHS survey and that the mortality decline implied by the DHS estimates 27.9% (Table 1) and the rates adjusted for birth transference 26.9% (Table 4) are overestimates. Increasing the estimated U5MR from the 2006 survey by 9% (an amount justifiable from the analysis of event omission) would increase the U5MR Table 4 from 200.0 to 218.0 per 1,000. This in turn would decrease the mortality decline between the two surveys from 27.9% to 20.3% ((273.7-218.0)/273.7). We conclude that between the 1998 and 2006 surveys (a period of about eight years), there was a substantial mortality decline in Niger, probably on the order of about 20% between 1995.8 and 2003.7 or, on average, 2.6% per year.

Discrepancy between Estimates of the Mortality Decline

The average per year percent decline of 2.6% based on adjusted DHS rates estimates is almost twice as great as the per year decline of 1.7% per year based on rates from *Levels and Trends, 2006*. Some part of that difference may be due the fact that mortality estimates from the Niger 2006 DHS survey were not included as data points in the *Levels and Trends, 2006* regression analysis.

Annex I: Madagascar DHS 1997 and 2004

Mortality Decline: U5MR Estimates

Table 1 shows U5MR estimates from the 1997 and 2004 DHS survey reports and from *Levels & Trends, 2006*.[1] The decline in the DHS estimates is 41% during a six-year period while the decline in the *Levels & Trends, 2006* estimates is 12% during a five-year period. In terms of the average decline per year, the pace of decline is more than twice as greater according DHS rates (6.6% per year) than those of *Levels & Trends, 2006* (2.4 % per year).

Table 1 Madagascar U5MR Estimates (Rates per 1,000 live births)

Source	Date	U5MR	Date	U5MR	Absolute Decline	% Decline	Time Period (years)	Average Annual % Decline
DHS 1997 & 2004	1995.4	159.2	2001.6	93.9	65.3	41.0	6.2	6.6
Levels & Trends, 2006	1995.5	156	2000.5	137	19	12.2	5.0	2.4

There has been considerable controversy about the completeness of the reporting of deceased children the Madagascar 2004 DHS survey, with the consensus opinion being that underreporting of deceased children has resulted in underestimated mortality rates.

It should be noted here that to avoid the problems of the 2004 DHS survey, the analytic procedures used for making mortality estimates in Madagascar in *Levels & Trends, 2006 (Working Paper)* departed from the standard procedures. Instead of including mortality estimates from the 2004 survey as data points in the regression analysis, the regression line was fitted on data points only from surveys prior to the 2004 survey. Then, the trend of mortality from the 2004 survey was affixed to the regression line to estimate mortality rates for years going forward from about 1998. This composite procedure produced higher mortality estimates after 1998 than would have resulted if the DHS published rates from the 2004 survey been included in the regression analysis.

Birth Transference

The cutoff dates for asking the health questions for the Madagascar surveys were January 1994 (1997 survey) and January 1998 (2004 survey). Birth transference occurred in both surveys (Table 2), resulting in substantially more deceased children recorded as born in the year prior to the health cutoff than in the year after the cutoff. The indices of transference for deceased births in the 1997 and 2004 surveys were 1.5 (249/161) and 1.7 (178/103).

The impact of birth transference on mortality estimates was quite different in the two surveys. Health data were collected for only a three year retrospective period in the 1997

[1] *Levels and Trends of Child Mortality in 2006(Working Paper)*, UNICEF, WHO, The World Bank and UN Population Division, 2007.

survey so that birth transference was primarily within (rather than out of) the first 5-year retrospective period for DHS mortality estimation. Thus, there was no justification for re-estimation of mortality rates and that procedure was not followed. In the case of the 2004 survey, health data were collected for a six year retrospective period and birth transference had the potential for effecting mortality rates.

Table 2. Madagascar 1997 and 2004: Births by Calendar Year

Madagascar 1997			Madagascar 2004		
Calendar Year	Child alive	Child deceased	Calendar Year	Child alive	Child deceased
1997	1,126	61	2003	1,251	87
1996	1,248	112	2002	1,262	79
1995	1,035	168	2001	1,021	82
1994	1,004	161	2000	1,240	125
1993	1,167	249	1999	1,074	70
1992	1,060	201	1998	897	103
1991	1,052	199	2000	1,403	178
1990	948	211	1999	1047	180
1989	860	203	1998	1010	178
Index of birth transference	1.2	1.5		1.6	1.7

Note: Bold line marks January of the year of the cutoff for asking the health questions.

To investigate the effect of birth transference in the Madagascar 2004 DHS survey, new estimates of U5MR were made for redefined time periods: 1) the earlier boundary for the last estimation period was set to begin one year before the health cutoff and 2) earlier estimation periods were earlier 5-year calendar periods. Because the new estimates apply to earlier time periods than the published DHS estimates, they were projected forward to the date of the DHS estimates by straight line projection (from the estimated rates for the redefined periods).

The results of re-estimation are shown in Table 3. The overall effect was as expected to increase the U5MR for the period immediately preceding the 2004 survey and to decrease the rate for the penultimate period. However, the effects on the U5MR estimate were modest for the period immediately before the survey (an increase of 3% from 93.9 to 97.1 per 1,000).

Table 3. Re-estimated U5MR*

Madagascar 2004	
Date	U5MR
2001.6	97.1
1996.6	121.6
1991.6	135.8
1986.6	136.8

*Re-estimated, projected rates

Figure 1 shows the trend in U5MRs from the DHS reports and Figure 2 shows the re-estimated rates. Two points stand out. First, after removing the birth transfer bias from the estimates for the 2004 survey, the graphs for the 1997 and the 2004 surveys in Figure 2 indicate similar patterns of declining mortality from about 1990 onward. And second, for the

period of overlap period between the two surveys, estimates from the 2004 survey are substantially lower than those from 1997 survey.

Figure 1
DHS U5MR Estimates

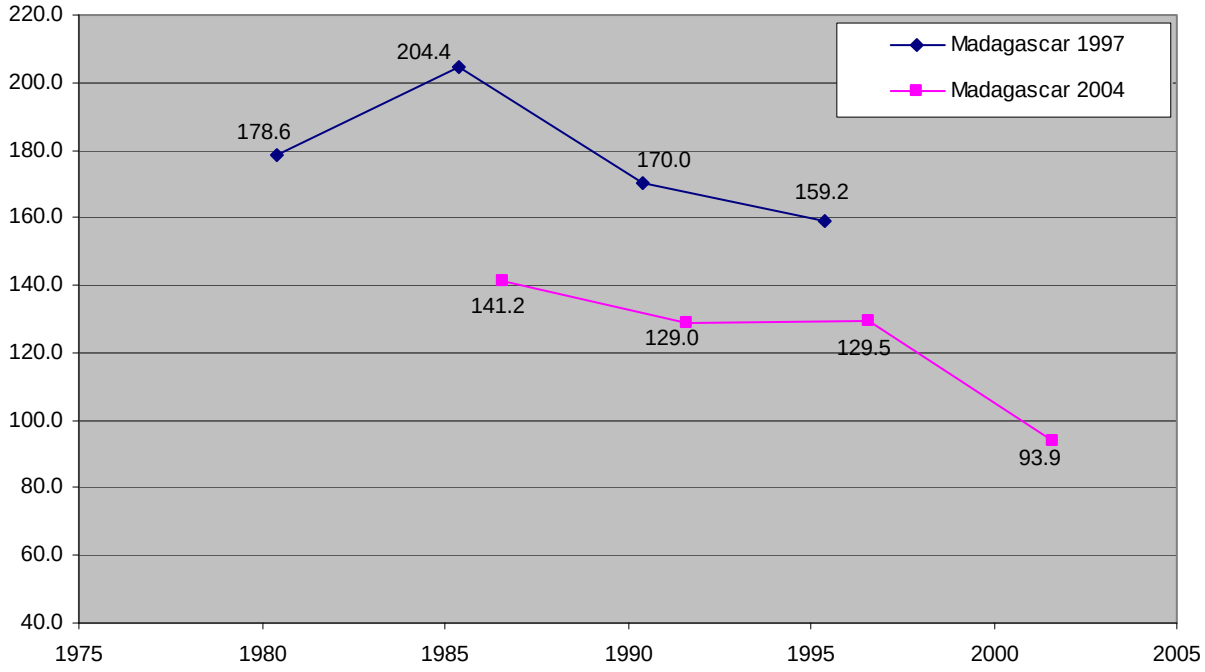
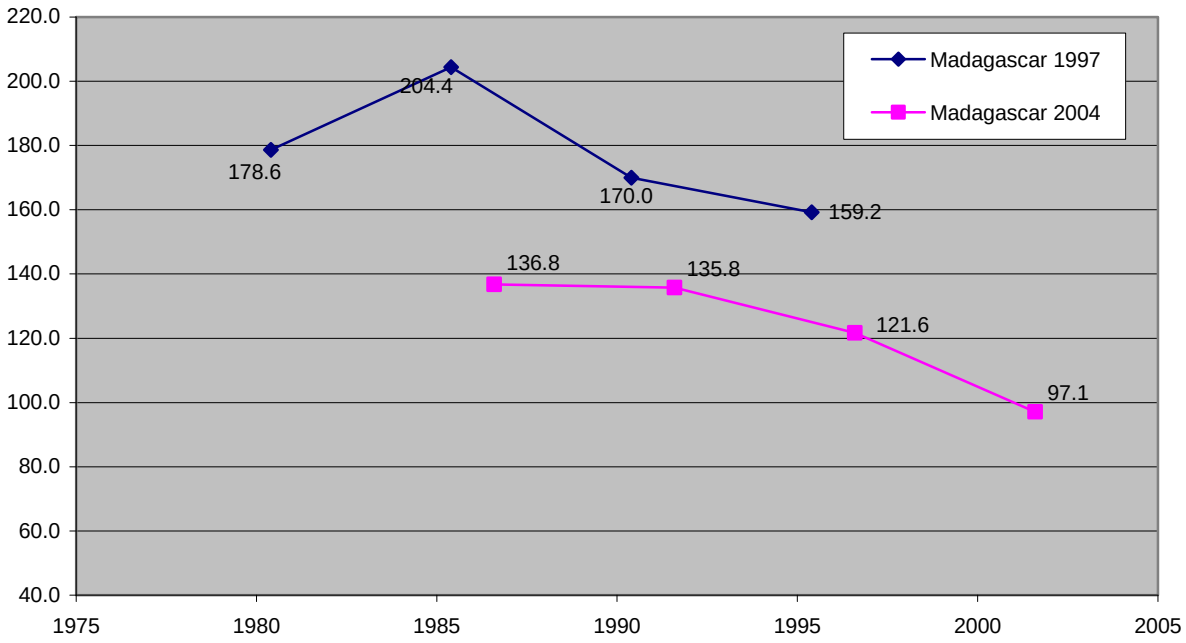


Figure 2
Re-estimated U5MR for Madagascar DHS 2004



Mortality Decline: Re-estimated DHS Rates (2004 survey only)

Table 4 differs from Table 1 in that re-estimated DHS rates are shown fro the 2004 survey. As indicated above, re-estimation of the rates only modestly increased the U5MR estimate for the last estimation period. So Table 4 is little changed from Table 1 and the average per year mortality decline based on the DHS data remains substantially greater than that based on the rates from *Levels & Trends, 2006* (6.3 % versus 2.4%).

Table 4 Madagascar U5MR Rates
Re-estimated DHS Rates (2004 survey only)
(Rates per 1,000 live births)

Source	Date	Rate	Date	Rate	Absolute Decline	Percent Decline	Time Period (years)	Average Annual % Decline
DHS 1997 & 2004	1995.4	159.2	2001.6	97.1	62.1	39.0	6.2	6.3
Levels & Trends, 2006	1995.5	156	2000.5	137	19	12.2	5.0	2.4

Underreporting of Deceased Children

The difference between the 1997 and 2004 surveys in the completeness of reporting deceased children can be analyzed for the 10-year common reference period from 1986 to 1995. This is a time period free of birth transfer biases in both surveys. In this section, the analysis is restricted to births to women 15-39 at the time of birth.[2]

For the common reference period, the U5MR estimate from the 1997 survey (173 per 1,000) exceeds the rate from the 2004 survey (135 per 1,000) by 28%, indicating that the deceased children were underreported in the 2004 survey to that extent. It is not clear if the relatively poor performance of the 2004 survey is a reflection of underreporting of deaths in all time periods (including the last estimation period) or if underreporting was restricted to the 1986-1995 period.[3] Nevertheless, this is strong evidence of underreporting of deceased children in the 5 to 6 years immediately prior to the 2005 survey.

The Madagascar 2000 MICS is also relevant here because it provides evidence of event omission in the 2004 DHS for time periods which are later than the time periods covered by the 1997 DHS. However, comparison between the 2004 DHS and the MICS must be done in terms of statistics on the proportion dead of children ever born. Those statistics for the 2004 DHS and the 2000 MICS are shown in Table 5 by five-year age group of women. The

[2] This restriction is to avoid the effects of compositional differences in mother's age at time of birth on the estimated rates.

[3] A possible argument that the poor performance of the 2004 survey does not extend to the period immediately preceding the survey is that, when reporting events for the 1986-95 period, respondents to the 2004 survey had a longer recall interval (13 years, on average) than when reporting events for the 5 or 6 years immediately preceding the survey (2 to 3 years, on average). However, it seems unreasonable to blame a 28% shortfall in event reporting on differential recall error, which weakens the argument that the shortfall is limited to the 1986-95 time period.

statistics for the 2004 DHS are for women who were in the relevant age groups as of January 2001.[4] In every age group the MICS 2000 statistics exceed the DHS 2004 statistics—by as much as 20 or 30 percent (women 25-29 and 30-34). This is evidence that underreporting of deceased children occurred for the time period immediately preceding the DHS survey.

Table 5 Proportion Dead of Children Ever Born by Age Group of Women, Madagascar 2000 MICS and 2004 DHS

Age group	MICS 2000	DHS 2004 [a]
20-24	.120	.114
25-29	.145	.111
30-34	.158	.133
35-39	.180	.151
40-44	.205	.150
45-49	.205	.165

[a] The proportion dead statistics for the 2004 DHS are as of 2001 which is close to the midpoint of the fieldwork for 2000 MICS (2000.7)

Other problems are evident in the mortality data from Madagascar DHS 2004 survey (not evident in the data from the DHS 1997 survey) which indicates inadequate supervision of interviewers and may have contributed to incomplete data collection. In all DHS surveys the rules for age at death data require that deaths at one year of age be recorded in terms of months of age.[5] Field editors assigned to each interviewing team are responsible for checking each questionnaire to ensure the correct recording of these data. The correct recording procedures were followed in the 1997 Madagascar survey where an acceptable percentage of deaths at age one were not recorded in terms of months of age (3%). However, in the 2004 survey approximately 74% of deaths at age one were not correctly recorded in terms of months of age (i.e., were recorded as occurring at age one rather than in terms of months of age). At least with respect to mortality data, the interviewers for the 2004 survey did not follow standard procedures and field editors almost totally failed their data collection responsibilities.

Sampling Issues

The sampling frames for both the 1997 and 2004 Madagascar surveys were taken from the master sample maintained the department of Demography and Social Statistics of the

[4] The midpoint of the fieldwork for the Madagascar MICS 2000 was 2000.7. Proportion dead statistics for points in time prior to a DHS survey were produced with the "birth record" standard recode files on the DHS web site. The analysis required creating new variables reflecting the age of women as of 2000.7, the survivorship of their children at that date (from data on dates of birth and ages at death) and deleting from the data file births occurring after that date.

[5] In DHS surveys there are standard procedures for the collection of data on age at death. Interviewers are trained to collect those data in terms of days for deaths in the 1st month of life; in terms of months for deaths in the post neonatal period of infancy and for deaths at one year of age; and in terms of years for deaths at age 2 and older. If a death is reported as occurring at age one, the interviewer must probe to determine an approximate age at death in terms of months. Field editors on each interviewing team are responsible for checking each completed questionnaire to ensure the correct recording of age at death data.

National Institute of Statistics based on the 1993 General Census of the Population. The overall response rates for female respondents (household x individual response rates) were good in both surveys: 92.8% for the 1997 survey and 93.7% than for the 2004 survey.

The percent distributions of births by sample domains (urban/rural residence and major geographic divisions of Madagascar) for the two surveys are shown in Table 5. The distributions are similar for the two surveys indicating consistent weighting of mortality experience across sample domains.

Table 5. Distributions of Births (Last Five Years) by Sample Domains (Weighted)

	Number		% Distribution	
	Madagascar 1997	Madagascar 2004	Madagascar 1997	Madagascar 2004
Residence				
Capital City	161	204	4.1	3.2
Other Urban	619	949	15.9	15.1
Rural	3112	5131	80.0	81.7
District				
Antananarivo	1,142	1,698	29.3	27.0
Fianarantsoa	919	1,389	23.6	22.1
Toamasina	533	969	13.7	15.4
Mahajanga	536	926	13.7	14.7
Toliary	520	869	13.4	13.8
Antsiranana	244	422	6.2	6.7
Total	3,893	6,283	100.0	100.0

Factors Influencing Child Mortality

Factors generally though to influence mortality risks are shown in Table 6 for both surveys. The selected factors are admittedly arbitrary. We show these in order to see if they lend credibility to the substantial observed mortality declines documented by the 1997 and 2004 surveys.

Table 6. Factors Influencing Child Mortality

	Madagascar 1997	Madagascar 2004
Percentage of mothers with primary + education (births last 5 years)	77% [a]	73%
Percentage of deliveries in a health facility (births last 5 years)	34% [a]	32%
Mother received tetanus toxoid last birth last five years (at least once during pregnancy)	48% [a]	54%
Percent of children received all childhood vaccines (children 12-23 months)	36%	53%
Percent of children ever breastfed (births last 5 years)	97 [%a]	98%
Percent received breastmilk first day (children ever breastfed)	79 [%a]	88%
Percent slept under a bednet last night (children under age 5)	na	36%
Percent of children under age 3 wasted (below -2SD)	7%	14%
Among women age 15-19, the percentage that have given birth	36%	34%

[a] Births in the last 3 years

The trend of two factors is consistent with a decline in mortality. Relative to the 1997 survey, the 2004 survey shows a substantial increase in children who have received all childhood vaccinations (from 36% to 53%) and an increase in children who were breastfed within one day of birth (79% to 88%). The remaining indicators differ little between the surveys or, in the case of nutrition status (wasting), show a worsening trend.

Credibility of the Mortality Decline in Madagascar

There is evidence that birth transference occurred in the 2004 DHS survey. However, re-estimation of the rates had only a minor effect on the estimate for the last estimation period prior to the 2004 survey (an increase of 3%). The analysis of event omission indicated that the data from the 2004 survey substantial underestimates mortality rates. For the common reference period 1986-1995, the U5MR from the 1997 DHS survey exceeded the estimate from the 2004 survey by 28%. Additional evidence of underreporting of deaths in the 2004 survey was provided by comparison with statistics from the MICS 2000 on the proportion dead of children ever born. There was no indication of sampling problems in the DHS 2004 survey.

The evidence is strong that, due to underreporting of deceased children in the 2004 survey, the mortality declines of Table 1 (41%) and Table 4 (39%) are substantially overstated. Adjusting the U5MR mortality rate of Table 4 for the 2004 survey by 28% to compensate for underreporting would change the estimate from 97.1 per 1,000 to 124 .2 per 1,000 (97.1 x 1.28). This would reduce the overall percent decline in mortality between the two DHS surveys to 13.8% ((159.2-124.2)/ 159.2) which is quite similar to the percent decline over a similar time period based on the rates from *Levels and Trends, 2006 (Working Paper)* (12%, Tables 1 and 4).[6]

The adjusted U5MR for the 5-year period preceding the 2004 DHS survey of 124.2 per 1,000 (and the resulting estimated mortality decline of 13.8%) must be considered approximate estimates. When confronted with underreporting of events to the extent found in 2004 survey, any procedure for correcting the observed mortality rates must be interpreted with caution. Nevertheless, the above analysis provides evidence from two surveys (the 1997 DHS survey and the 2000 MICS survey) that there was substantial under reporting of deceased children in the 2004 DHS survey. Accordingly, the adjusted U5MR of about 124 per 1,000 is considered more realistic than the published DHS estimate of 97.1 per 1,000.

[6] These results have been reached by different but very similar procedures for circumventing the shortcomings of the DHS 2004 survey--the UNICEF estimates do so by using the composite estimation approach described in the first section of this annex while the DHS estimates do so by directly adjusting for underestimation with a 28% inflation factor. The similarity of the two approaches means that they can not be considered as independent confirmation of results.

Annex J: Burkina Faso DHS 1998 and 2003

Mortality Decline: U5MR Estimates

Table 1 shows U5MR estimates from the 1998 and 2003 DHS survey reports and from *Levels & Trends, 2006*.[1] The decline in the DHS estimates is 16% over a period of 4.7 years while the there is no decline in the estimates from *Levels & Trends, 2006* during a 5-year period. In terms of the average annual decline, the pace of decline is much greater according DHS rates (3.4 % per year) than those of *Levels & Trends, 2006* (0.0% per year).

Table 1 Burkina Faso U5MR Estimates
(Rates per 1,000 live births)

Source	Date	U5MR	Date	U5MR	Absolute decline	Percent decline	Time period (years)	Average per year % decline
DHS 1998 & 2003	1996.5	219.1	2001.2	183.7	35.4	16.2	4.7	3.4
Levels & Trends, 2006	1995.5	194	2000.5	194	0.0	0.0	5.0	0.0

Birth Transference

The cutoff dates for asking the health questions in the Burkina Faso surveys were January 1993 (1998 survey) and January 1998 (2003 survey). Birth transference occurred in both surveys, resulting in substantially more deceased children recorded as born in the year prior to the cutoff than in the year after the cutoff (Table 2). The ratios of deceased births in the year prior to the cutoff to the year after the cutoff are 1.38 (Burkina Faso 1998) and 1.78 (Burkina Faso 2003).

Table 2. Births by Calendar Year

Burkina Faso 1998			Burkina Faso 2003		
Calendar year	Child alive	Child deceased	Calendar year	Child alive	Child deceased
1998	1227	97	2003	1611	83
1997	1005	150	2002	1984	193
1996	974	175	2001	1704	220
1995	1086	241	2000	1956	385
1994	993	287	1999	1858	422
1993	840	267	1998	1571	326
1992	1046	371	1997	1885	581
1991	967	281	1996	1811	450
Index of birth transference	1.24	1.38		1.20	1.78

Note: Bold line marks January of the year of the cutoff for asking the health questions.

[1] *Levels and Trends of Child Mortality in 2006 (Working Paper)*, UNICEF, WHO, The World Bank and UN Population Division, 2007.

To investigate the effect of birth transference in the Burkina Faso surveys, new estimates of U5MR were made for redefined time periods: 1) the earlier boundary for the last estimation period was set to begin one year before the health cutoff and 2) earlier estimation periods were earlier 5-year calendar periods. Because the redefined estimates apply to earlier time periods than the published DHS estimates, they were projected forward to the date of the DHS estimates by straight line projection (from the redefined estimated rates).

The results of re-estimation are shown in Table 3. As expected, re-estimation increased the U5MR estimates for the last estimation period prior and decreased the estimates for the penultimate period. However, the effects for the last estimation period prior to each survey were modest: an increase from 219 to 222 per 1,000 (1998 survey) and from 184 to 186 per 1,000 (2003 survey). The effects for the penultimate estimation period were larger: from 229 to 217 per 1,000 (1998 survey) and from 203 to 197 per 1,000 (2003 survey).

Table 3. Re-estimated U5MR*

Burkina Faso 1998		Burkina Faso 2003	
Date	U5MR	Date	U5MR
1996.5	222.4	2001.2	185.5
1991.5	217.8	1996.2	197.1
1986.5	227.6	1991.2	195.3
1981.5	252.6	1986.2	207.9

* Re-estimated, projected rates.

The trend in U5MR estimates published in the DHS reports is shown in Figure 1 and the trend of the re-estimated rates is shown in Figure 2. Two points stand out. First, the overall pattern the published DHS estimates (Figure 1) is less consistent between surveys than the pattern of the re-estimated rates (Figure 2), where the time trends are more parallel. And second, both Figures 1 and 2 make clear that, for the common reference period covered by both surveys, the estimates from the 2003 survey are lower than those from 1998 survey. On the assumption that survey respondents do not over report deceased children, the differences between surveys suggests underreporting of deceased children in the 2003 survey, at least for the period common to both surveys.

Figure 1
DHS U5MR Estimates

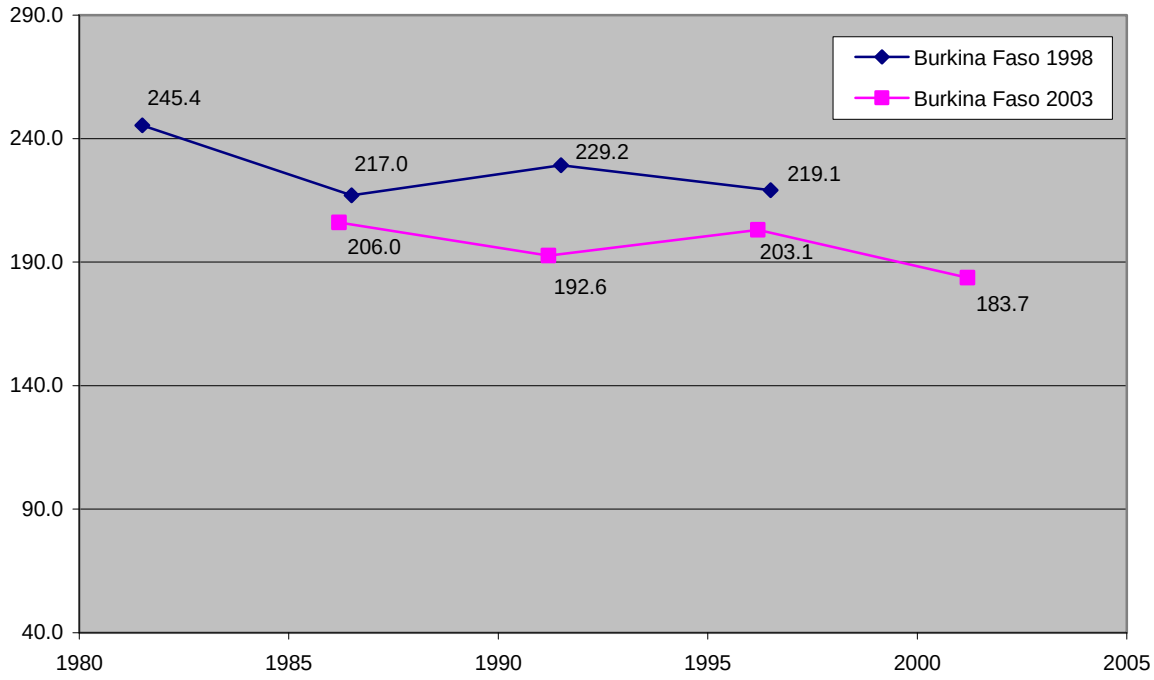
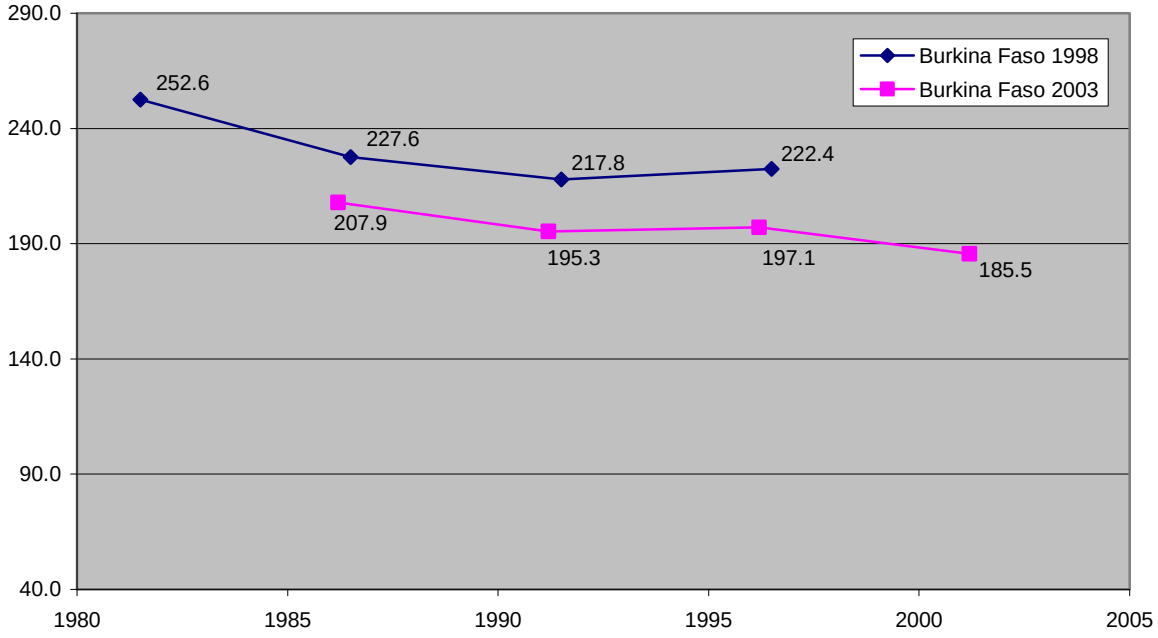


Figure 2
Re-estimated U5MR



Mortality Decline: Re-estimated DHS Rates

As indicated above, re-estimation of mortality rates for the last estimation period prior to the 1998 and 2003 surveys had little effect on the U5MR estimates. As a result, Table 4 is little change from Table 1. The average per annum mortality decline between the late 1990s and the early years of 2000 was 3.5% according to re-estimated DHS rates and zero according to *Levels & Trends, 2006*.

Table 4 Burkina Faso U5MR Estimates
Re-estimated DHS Rates
(Rates per 1,000 live births)

Source	Date	U5MR	Date	U5MR	Absolute Decline	% Decline	Time Period (years)	Average Annual % Decline
DHS 1998 & 2003	1996.5	222.4	2001.2	185.5	36.9	16.6	4.7	3.5
Levels & Trends, 2006	1995.5	194	2000.5	194	0.0	0.0	5.0	0.0

Event Omission

The difference between the 1998 survey and the 2003 survey in the completeness of reporting deceased children can be analyzed for the 10-year common reference period 1987-96. This is a time period free of biases resulting from birth transference in both surveys. In this section, the analysis is restricted to births to women 15-39 at the time birth.[2]

For the common reference period, the U5MR estimate from the 1998 survey (221 per 1,000) exceeds the estimate from the 2003 survey (197 per 1,000) by about 12%. It is not clear if the poor performance of the 2003 survey is a reflection of underreporting of deaths in all time periods or if underreporting is restricted to the 1988-97 period.[3] Nevertheless, this finding indicates that the DHS U5MR for last estimation period from the 2003 survey may be underestimated by as much as 12%.[4]

[2] This restriction is to avoid the estimated rates from the two surveys being affected by compositional differences in mothers' age at the time of birth.

[3] A possible argument that the poor performance of the 2003 survey does not extent to the period immediately preceding the survey is that, when reporting events for the 1987-96 period, respondents to the 2003 survey had a longer recall interval (12 years, on average) than when reporting events for the 5 or 6 years immediately preceding the survey (2 to 3 years, on average). However, it seems unreasonable to blame the entire 12% shortfall in event reporting on differential recall error, which weakens the argument that the shortfall is limited to the 1987-96 time period.

[4] It could be argued the estimates from the 1998 survey for the common reference period may also be underestimates and that the measurement of the mortality decline with two underestimates from consecutive surveys should stand as observed. This argument is unconvincing because an analysis of the mortality estimates for a common reference period prior to the 1993 and 1998 Burkina Faso surveys (not shown here) does not indicate underreporting in the 1998 survey.

Sampling Issues

The samples for both the 1998 and 2003 Burkina Faso surveys were based on enumeration areas created for the 1996 General Census of Population and Households. The overall response rates for female respondents were good in both surveys: 96 % in both surveys.

The percent distributions of births by urban/rural sample domains for the Burkina Faso surveys are shown in Table 5.[5] There is a somewhat greater concentration of births in the urban areas in the 2003 survey than in the 1998 survey (13% versus 10%). However, even if this increase was due to a sampling defect in one or the other of the surveys (and in fact there was no change in the urban/rural birth distributions), the effect would be a negligible contribution to the observed mortality decline. This can be shown by standardizing the urban/rural U5MRs from the 2003 survey by the 1998 urban/rural distribution of births. The result is a rate of 185.7 per 1,000 as opposed to the observed rate of 183.7 per 1,000. Thus, standardization reduces the percent decline between the two surveys only slightly, from 16% (Table 1 and 4) to 15%. Sampling differences between the two surveys were not the source of the observed mortality decline.

Table 5. Distributions of (Births Last Five Years) by Sample Domains (Weighted)

	Number		% Distribution	
	Burkina Faso 1998	Burkina Faso 2003	Burkina Faso 1998	Burkina Faso 2003
Residence				
Urban	612	1,386	9.9	12.8
Rural	5,605	9,466	90.1	87.2
Total	6,218	10,852	100.0	100.0

Factors Influencing Child Mortality

Factors generally though to influence mortality risks are shown in Table 6 for the 1998 and 2003 surveys. The selected factors are admittedly arbitrary. We show these in order to see if they lend credibility to the substantial observed mortality declines documented by the 1998 and 2003 surveys.

The trends of several factors are consistent with a decline in mortality –increased levels of education among mothers (10% t0 22%), increase levels of pregnant women receiving tetanus toxoid immunization (54% to 64%), increased levels of childhood immunization (34% to 44%), and increased levels of breastfeeding in the first day following birth (48% to 63%). The remaining indicators show little difference between surveys. So, there is an indication of improvement in several the health factors.

[5] It is not feasible to compare the distributions of births by major regions in the two surveys as the provincial composition of the regions changed between the two surveys.

Table 6. Burkina Faso 1998 and 2003: Factors Impacting Under Five Mortality		
	Burkina Faso 1999	Burkina Faso 2003
% of mothers with primary + education (births last 5 years)	10%	22%
% of deliveries in a health facility (births last 5 years)	32%	38%
% of mothers received tetanus toxoid at least once during pregnancy (last birth last 5 years)	54%	64%
% of children received all childhood vaccines (children 12-23 months)	34%	44%
% of children ever breastfed (births last 5 years)	99%	98%
% received breastmilk first day (children ever breastfed)	48%	63%
% slept under any bednet last night (children under age 5 in HH last night)[a]	na	20%
% of children under age 5 wasted (below -2SD)[b]	13%	11%
Among women age 15-19, the percentage who have given birth	20%	17%

Credibility of the Mortality Decline in Burkina Faso

The published U5MR estimates from the 1998 and 2003 survey indicated a mortality decline over about a 5-year period of 16.2%. There is evidence that birth transference occurred in both the 1998 and 2003 surveys. Re-estimation of the U5MR to compensate for birth transference modestly increased the U5MR estimates for the last estimation period prior to each survey but did not change the amount of decline between the surveys. The analysis of event omission indicated underreporting of deceased children in the 2003 survey on order of 12%, for a 10-year reference period common to both surveys. There was no indication that sampling problems significantly contributed to the observed mortality decline.

It is likely that due to underreporting of deceased children in the 2003 survey, the under-five mortality rates from that survey of Table 1 (183.7 per 1,000) and Table 4 (185.5 per 1,000) are underestimates. Increasing the estimated U5MR from Table 4 by 12% (an amount justifiable from the analysis of event omission) results in a rate of 207.7 per 1,000 (185.5 x 1.12). This in turn would decrease the mortality decline between the two surveys from 16.2% to 6.7% ((222.4-207.7)/222.4). We conclude that there was a modest decline in mortality between the 5-year periods preceding the 1998 and 2003 surveys: a decline probably on the order of about 7%.

Annex K: Ethiopia DHS 2000 and 2005

Mortality Decline: Re-estimate DHS Rates

Table 1 shows U5MR estimates from the DHS 2000 and DHS 2005 survey reports and from *Levels & Trends, 2006*.[1] The decline in the DHS estimates is 26% during an approximately five-year period (from 1997.8 to 2003.0) while the decline in the *Levels & Trends, 2006* estimates is about 16%, also during a five-year period. In terms of the average annual decline, the decline is greater according to DHS rates (4.9% per year) than those from *Levels & Trends, 2006* (3.1% per year).

In addition to the differences in the rates of decline, the *Levels & Trends, 2006* rates are higher than the DHS rates. However, those differences are in large part due to differences in the dates to which the estimates apply; the DHS estimates applying to points in time about 2.5 years later than the *Levels & Trends, 2006* estimates.[2]

Table 1 Ethiopia U5MR Estimates (Rates per 1,000 live births)

Source	Date	U5MR	Date	U5MR	Absolute Decline	Percent Decline	Time Period (years)	Average Annual % Decline
DHS 2000 & 2005	1997.8	166.2	2003.0	123.5	42.7	25.7	5.2	4.9
Levels & Trends, 2006	1995.5	179	2000.5	151	28.0	15.6	5.0	3.1

Birth Transference

For the Ethiopia DHS surveys, dates of birth of children and the date used in the questionnaire to indicate the cutoff for asking health questions were indicated in terms of the national calendar. The Ethiopian national calendar is the Orthodox or Julian calendar, the first month of which is Meskerem. The cutoff dates for asking the health questions in the Ethiopian surveys were Meskerem 1987 (2000 survey) and Meskerem 1992 (2005 survey). Table 2 shows tabulations of reported births by year of birth and survivorship status for the years preceding each survey in terms of the Orthodox calendar.

Birth transference occurred in both surveys, resulting in substantially more deceased children recorded as born in the year prior to the cutoff than in the year after the cutoff. The ratio of deceased births in those two years is 1.6 (559/357) for the 2000 survey and 1.9 (397/209) for the 2005 survey.

[1] *Levels & Trends of Child Mortality in 2006 (Working Paper)*, UNICEF, WHO, The World Bank and UN Population Division, 2007.

[2] Straight line projection of the UNICEF rate for 1995.5 to 1997.8 (the date of the DHS estimate) results in a rate of 166.1 per 1,000 which is virtually identical to the DHS rate (166.2 per 1,000). Similarly, projection of the *Levels & Trends, 2006* rate for 2000.5 (151 per 1,000) to 2003.0 (the date for the DHS estimate) results in a rate of 137.0 per 1,000 which is much closer to the DHS rate (123.5 per 1,000) than is the UNICEF estimate for 2000.5 (151 per 1,000).

Table 2. Ethiopia 2000 and 2005: Births by Calendar Year

Ethiopia 2000			Ethiopia 2005		
Orthodox Calendar	Child alive	Child deceased	Orthodox Calendar	Child alive	Child deceased
1992	1395	113	1997	1934	124
1991	2135	254	1996	1947	228
1990	2170	269	1995	1898	183
1989	2284	367	1994	1998	191
1988	2037	370	1993	2120	289
1987	1836	357	1992	1700	209
1986	1957	559	1991	2255	397
1985	1817	472	1990	2190	388
1984	1719	528	1989	1985	388
Index of birth transference	1.1	1.6		1.3	1.9

Note; Bold line indicates the cutoff for asking health questions about each live birth.

To investigate the effect of birth transference in the Ethiopia surveys, U5MRs were re-estimated 1) for a time period beginning one year before the health cutoff in each survey and 2) for earlier 5-year calendar periods.[3] Because these estimates apply to slightly earlier time periods than the published DHS estimates, they were projected forward to the date of the DHS estimates (by straight line projection from the newly estimated rates). Table 3 shows the re-estimated rates for the same point in time as the DHS published rates. For the 2000 survey, re-estimation increased the U5MR for last estimation period by 7% (166.2 to 178.4 per 1,000) while, for the 2005 survey, the increase was 3% (123.5 to 127.7 per 1,000).

Table 3. Re-estimated U5MR*

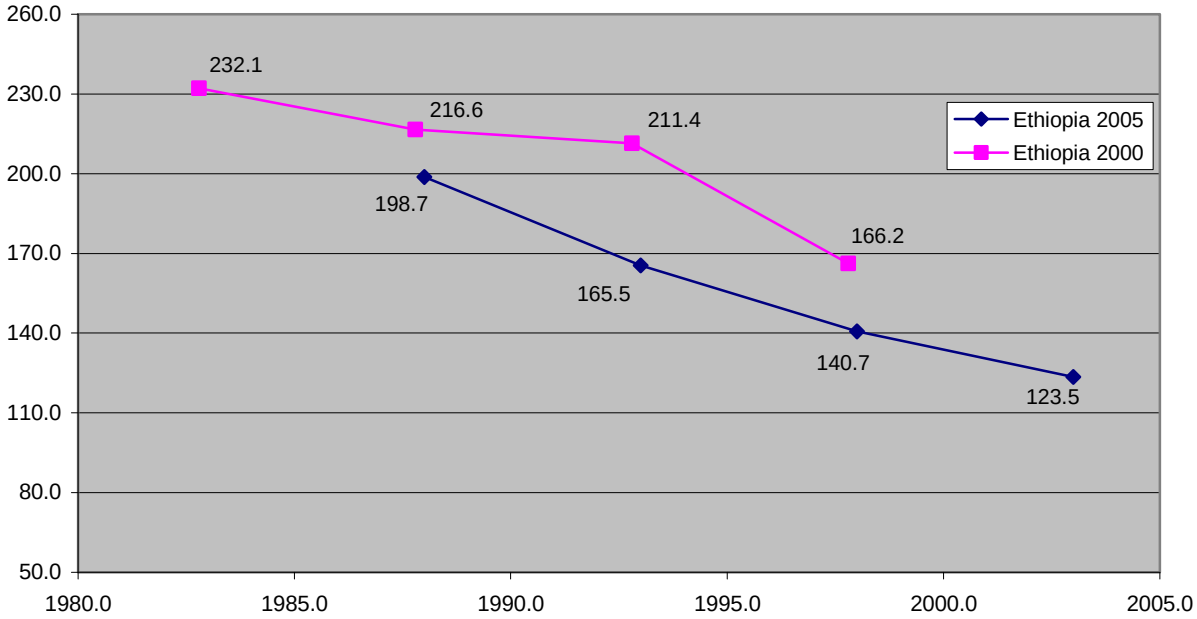
Ethiopia 2000		Ethiopia 2005	
Date (Western Calendar)	U5MR	Date (Western Calendar)	U5MR
1997.8	178.4	2003.0	127.7
1992.8	201.8	1998.0	136.7
1987.8	219.8	1993.0	168.3
1982.8	237.1	1988.0	192.1

* Re-estimated and projected rates.

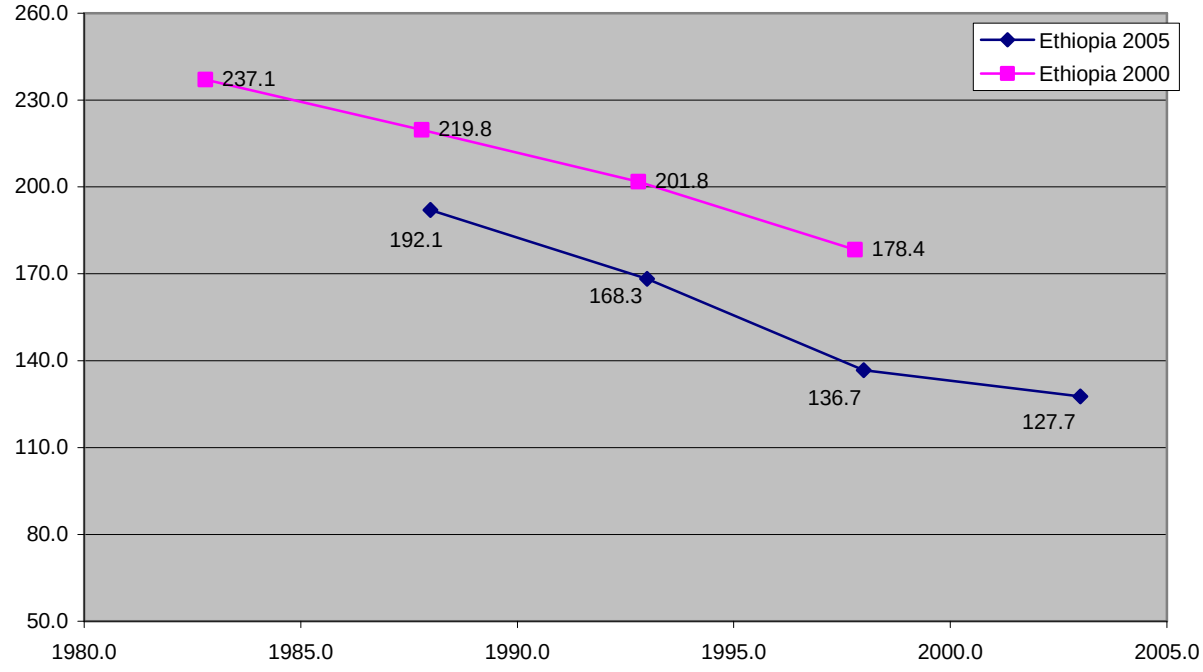
Figure 1 shows the trend in U5MRs as published in the DHS reports and Figure 2 shows the re-estimated rates. Two points stand out. First, both Figures show a declining trend in mortality. However the two trend lines are more parallel in Figure 2 where the biases of birth transference have been removed. Second, both Figures 1 and 2 indicate that, for the time periods covered by both surveys, the estimates from the 2005 survey are lower than those from the 2000 survey. On the assumption that survey respondents do not over report deceased children, the difference appears to be underreporting of deceased children in the 2005 survey.

[3] These time periods were dated in terms of the Orthodox calendar. Thus, the boundary dates for the last estimation period were Meskerem 1986 for DHS 2000 and Meskerem 1991 for DHS 2005.

Ethiopia DHS U5MR
DHS 2000 & 2005



Ethiopia Re-estimated U5MR
DHS 2000 & 2005



Mortality Decline: Re-estimated DHS Rates

Re-estimation of the DHS rates produced higher U5MR estimates for the estimation period immediately preceding both Ethiopian surveys, but the effect was greater for the 2000 survey than the 2005 survey. Thus, the difference in the average annual decline estimated by the re-estimated DHS rates and *Levels & Trends, 2006* is somewhat greater in Table 4 (5.5% versus 3.1%) than in Table 1 (5.0% versus 3.1%).

Table 4 Ethiopia U5MR Estimates
Re-estimated DHS Rates
(Rates per 1,000 live births)

Source	Date	U5MR	Date	U5MR	Absolute Decline	Percent Decline	Time Period (years)	Average Annual % decline
DHS 2000 & 2005	1997.8	178.4	2003.0	127.7	50.7	28.4	5.2	5.5
Levels & Trends, 2006	1995.5	179	2000.5	151	28.0	15.6	5.0	3.1

Underreporting of Deceased Children

The difference between the 2000 and 2005 surveys in the completeness of reporting deceased children can be analyzed for the 10-year common overlap period prior to the 2000 survey (from September 1989 to August 1998, in terms of the Western calendar). For that period, the U5MR from the 2000 survey (193.6 per 1000) exceeds than that from the 2005 survey (157.9 per 1000) by 23%. It is not clear if the relatively poor performance of the 2005 survey is a reflection of generalized underreporting of deaths in all time periods preceding the survey or if underreporting was restricted to the 1988-1997 period.[4] Nevertheless, this is strong evidence that there was underreporting of events in the 2005 survey and that the estimates for the last estimation period prior to the 2005 survey are negatively biased, by as much as 23%

There are other problems with the data from Ethiopian 2005 survey suggesting inadequate supervision of field work, at least with respect to the mortality data. In all DHS surveys the rules for collecting age at death data require that deaths at one year of age be recorded in terms of months of age.[5] Field editors assigned to each interviewing team are responsible for

[4] A possible argument that the poor performance of the 2006 survey does not extend to the period immediately preceding the survey is that, when reporting events for the 1989-98 period, respondents to the 2005 survey had a longer recall interval (12 years, on average) than when reporting events for the 5 or 6 years immediately preceding the survey (2 to 3 years, on average). However, it seems unreasonable to blame a 23% shortfall in event reporting on differential recall error, which weakens the argument that the shortfall is limited to the 1989-98 time period.

[5] In DHS surveys there are standard procedures for the collection of data on age at death. Interviewers are trained to collect those data in terms of days for deaths in the 1st month of life; in terms of months for deaths in the post neonatal period of infancy and for deaths at one year of age; and in terms of years for deaths at age 2 and older. If a death is reported as occurring at age one, the interviewer must probe to determine an approximate age at death in terms of months. Field editors on each interviewing team are responsible for checking each completed questionnaire to ensure the correct recording of age at death data.

checking each completed questionnaire to ensure the correct recording of age at death data. These procedures for collecting age at death data are correctly followed in the majority of DHS surveys and were followed in the 2000 Ethiopia DHS survey, where an acceptable percentage of deaths at age one were not recorded in terms of months of age (9%). However, in the 2005 survey approximately 50% of deaths at age one were not recorded in terms of months of age (i.e., were recorded as deaths at age one). With respect to mortality data, interviewers and field editors in the 2005 survey failed their data collection responsibilities.

Sampling Issues

The sampling frame for both the 2000 and 2005 Ethiopia surveys was derived from enumeration areas created for the 1994 National Population and Housing Census. Before each survey, the census sampling frame was updated to capture newly populated areas and a new household listing was conducted in the selected sample areas. The overall response rates for female respondents (household x individual response rates) were good in both surveys; 97% for the 2000 survey and 94% for the 2005 survey.

The percent distributions of births in the five years preceding each survey by sample domain (urban/rural residence and regions of Ethiopia) are shown in Table 5. Overall, the distributions are quite similar in the two surveys. The most obvious difference is in the urban/rural distributions: the sample of births being more concentrated in urban areas in the 2000 survey (10%) than in the 2005 survey (7%). The magnitude of this distributional differential is small. Moreover, it could not have played a role in creating a spurious mortality decline. Mortality rates were about 25% lower in urban than in rural areas in both surveys, so the smaller concentration of births in the urban areas in the 2005 survey tended to reduce rather contribute to the observed mortality decline.

Table 5. Distributions of Births (Last Five Years) by Sample Domains (Weighted)

	Number		% Distribution	
	Ethiopia 2000	Ethiopia 2005	Ethiopia 2000	Ethiopia 2005
Residence				
Urban	1,277	815	10.4	7.3
Rural	10,981	10,348	89.6	92.7
Regions				
Tigray	788	698	6.4	6.2
Amhara	3202	2,621	26.1	23.5
Oromiya	4997	4,411	40.8	39.6
Southern Nations, and Nationalities & Peoples	2602	2,500	21.3	22.4
Affar	126	107	1.0	0.9
Somali	142	477	1.2	4.3
Benishangul-Gumuz	124	105	1.0	0.9
Gambela	29	31	0.2	0.3
Harari	25	22	0.2	0.2
Addis Ababa	182	153	1.5	1.4
Dire Dawa	40	37	0.3	0.3
Total	12,258	11,163	100.0	100.0

Factors Influencing Child Mortality

Factors generally though to influence mortality risks are shown in Table 6 for both surveys. The selected factors are admittedly arbitrary. We show these in order to see if they lend credibility to the observed mortality decline documented by the 2000 and 2005 surveys.

Three child health indicators showed improvement between the two surveys conditions. These were mother's receipt of tetanus toxoid during pregnancy (from 26% to 31%) , children receiving all childhood vaccines (14% to 20%) and children receiving breastmilk within a day following birth (from 75% to 86%). So, there was some improvement in the health factors, although the improvements two of the three factors (vaccine levels of mothers and children) were modest (less than 6 percentage points showing improvement.

Table 6. Factors Influencing Child Mortality

	Ethiopia 2000	Ethiopia 2005
Percentage of mothers with primary + education (births last 5 years)	18%	21%
Percentage of deliveries in a health facility (births last 5 years)	5%	5%
Mother received tetanus toxoid last birth last five years (at least once during pregnancy)	26% [a]	31%
Children received all childhood vaccines (children 12-23 months)	14%	20%
Percent of children ever breastfed (births last 5 years)	96%	96%
Percent received breastmilk within 1day (children ever breastfed, born in last 5 years)	75%	86% [b]
Percent slept under a bednet last night (all children in household under age 5)	na	2%
Percent of children under age 5 wasted (below -2SD)	11%	11%
Among women age 15-19, the percentage that have given birth	13%	14%

[a] All births in the last five years
[b] Last born child ever breastfed in the five years preceding the survey

Credibility of the Mortality Decline in Ethiopia

There is evidence that birth transference occurred in the Ethiopia DHS 2000 and 2005 surveys. Re-estimation resulted in a greater increase in the rate for the last estimation period for the 2000 survey (7%) than for the 2005 survey (3%). Accordingly, the mortality decline measured by the re-estimated rates 28% (Table 4) is greater than that measured by the DHS published rates 25% (Table 1). The analysis of event omission indicated that for the 10-year common reference period 1989-98, the U5MR estimate from the 2000 survey exceeded the estimate from the 2005 survey by 23%. This is a strong indication of underreporting of deceased children in the 2005 survey. The analysis birth distributions by sample domain indicated that the mortality declines implied by the DHS rates were not the result of sampling problems.

It is likely that there was underreporting of deceased children in the 2005 DHS survey and that the mortality declines of Table1 (24%) and Table 4 (28%) are overestimates. Increasing the estimated U5MR from the 2005 survey by 23% (an amount justified by the analysis of event omission), would increase the U5MR estimate from the 2005 survey in Table 4 from

127.7 to 157.1 per 1,000. This in turn would decrease the mortality decline between the two surveys in Table 4 from 28.4% to 11.9% ((178.4-157.1)/178.4). We conclude that between the two Ethiopia surveys, there was some decline in mortality, probably on the order of about 12% over 5.2 years or, on average, 2.3% per year.

Implication for Estimates in *Levels & Trends, 2006*

Underreporting of deceased children at the 23% level in the 2005 DHS survey has implications for the *Levels & Trends, 2006* of U5MRs. The *Levels & Trends, 2006* estimates are based on a regression line fitted to data points (indirect and direct U5MR estimates) which are derived from the 2000 and 2005 DHS surveys. The *Levels & Trends, 2006* estimate for 2000.5 is almost exclusively determined by data points derived from the DHS 2005 survey and if, as argued above, those data points suffer from substantial underreporting of deceased children, the *Levels & Trends, 2006* estimate for 2000.5 is very likely an underestimate and the implied mortality decline between the 1995.5.and 2000.5 (16% over 5 years or, on average 3.1% per year, Tables 1 and 4) is likely an overestimate.