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DHS Demographic and Health Surveys

Assessment of the Quality of Data Used for Direct Estimation of Infant and Child Mortality in DHS-II Surveys

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ASSESSMENT OF THE QUALITY OF DATA USED FOR DIRECT ESTIMATION OF INFANT AND CHILD MORTALITY IN DHS-II SURVEYS

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Chapter 1

Introduction

This report is an assessment of the quality of the data used for the direct estimation of infant and child mortality rates collected in surveys conducted under the second phase of the Demographic and Health Surveys program (DHS-II). The assessment covers all 22 DHS-II surveys plus 4 first-phase DHS surveys (DHS-I) that were conducted late in the DHS-I program so were not included in an earlier assessment of DHS-I infant and child mortality data (Sullivan et al., 1990). Of the 26 surveys included in this report, 12 are from sub-Saharan Africa, 8 are from Asia/the Near East/North Africa, and 6 are from Latin America and the Caribbean. The infant mortality rate (IMR) for the period 0-4 years before the survey ranges from 17 deaths per 1000 in Colombia to 134 deaths per 1000 in Malawi.

This study has three main objectives. The first objective is to identify errors that are repeated in a number of surveys which may indicate problems that need to be addressed in future surveys or changes that need to be made in DHS procedures. The second objective is to compare the quality of the infant and child mortality data obtained in the DHS-II with that obtained in DHS-I. The comparison will allow us to monitor progress in the improvement of data quality and to evaluate the impact of changes made in the DHS questionnaire and field procedures between Phase I and Phase II. The third objective is to provide users of DHS-II data with a comprehensive and comparable evaluation of the quality of data used for the analysis of infant and child mortality for all DHS-II surveys.

The report closely follows the earlier evaluation of the data used to estimate infant and child mortality rates in DHS-I surveys (Sullivan et al., 1990). This approach ensures some degree of continuity and comparability across the two studies. However, two additional chapters have been added in this evaluation. The first additional chapter provides a general review of the types of errors commonly found in retrospective survey data used for the direct estimation of infant and child mortality rates, and of the likely magnitude and impact of these errors. The second additional chapter contains a discussion of the sampling errors associated with DHS estimates of infant and child mortality rates. The analyses in this chapter include all the DHS-I and DHS-II surveys because the sampling errors for the mortality rates calculated from the DHS-I surveys were not available at the time of the earlier report.

The report takes the form of a comparative study. The same tests of data quality are applied to each survey so that the general quality of the infant and child mortality data can be assessed and surveys with particular problems can be identified. This approach enables common patterns and problems to be identified but does not provide an exhaustive evaluation for any individual survey. It begins with a review of the main types of data quality problems anticipated and their implications for DHS estimates of infant and child mortality. This is followed by an overview of DHS-II data collection procedures which also highlights changes that have been made in the second phase of the DHS program. Chapter 4, the first analysis chapter, presents sampling errors for neonatal, postneonatal, infant, child, and under-five mortality rates for all the DHS-I and DHS-II surveys. In Chapter 5 the date-of-birth data are examined, focusing on differentials by survival status in completeness of reporting and displacement of births out of the period covered by the health section of the questionnaire. Chapter 6 is an evaluation of the completeness and accuracy of the age-at-death data. Event underreporting is investigated in Chapter 7 first through analyses of internal consistency and second, by comparisons of the DHS-II data with data from earlier surveys in the same country, specifically from the DHS-I surveys and the World Fertility Surveys (WFS). The report finishes with a review of the main findings and some recommendations for future surveys.

Chapter 2

Errors in Data Used to Estimate Infant and Child Mortality Rates

2.1 Introduction

There are a number of different approaches to the collection of data for the estimation of infant and child mortality rates (Hill, 1991; United Nations, 1992). For the DHS surveys, a complete maternal or birth history approach is used to collect information for direct estimation of mortality rates. In this approach, women of reproductive age are asked the date of birth of every live birth they have ever had. They are then asked whether each child is still alive or not, and if it is dead they are asked the age at death (further details of the data collection procedures in DHS-II surveys are given in Chapter 3). In a recent review of approaches to the measurement of childhood mortality, Hill (1991) concluded that complete maternal histories generally provide good to excellent information on the level of mortality. Additionally, they can be used to estimate trends and differentials in childhood mortality, provide information on age patterns of mortality, and be combined with verbal autopsy questions to provide information on cause of death. The main disadvantages of the approach are that the quality of the data is very sensitive to the quality of the training and survey implementation, and that it is relatively expensive due to the amount of training required.

2.2 DHS Childhood Mortality Rates

The mortality rates presented in DHS survey reports and in this report are the probability of dying between two exact ages: birth and age one month for neonatal mortality, birth and age one year for infant mortality, age one and age five for child mortality, and birth and age five for under-five mortality. The postneonatal mortality rate is defined slightly differently; it is the difference between the infant mortality rate and the neonatal mortality rate. As such, it is not a mortality probability but it closely approximates the probability of dying between 1 month and 12 months of age.

All the rates presented in this report are period-specific, i.e., they are based on the deaths and exposure of children at a particular age during a specific time-period. The periods used to calculate the mortality rates in the DHS-I and DHS-II surveys have been changed slightly. In the DHS-I survey reports and in the report on the quality of the data collected on infant and child mortality in DHS-I surveys already cited (Sullivan et al., 1990), infant and child mortality rates were presented for various *calendar-year* periods before the survey. In both this and the DHS-II survey reports, infant and child mortality rates are calculated for *actual* five-year or ten-year periods prior to the survey date based on the difference between the date of survey and the date of death (e.g., 0-4 years or 0-9 years before the survey).

The data used to calculate mortality rates for the most recent period prior to the survey include a number of *censored* observations, i.e., children who have not been exposed to the risk of death for the full period of interest. For example, children who were born within a year of the survey will not have been exposed to the risk of death for a full year and hence will only contribute incomplete exposure to the infant mortality rate. Hence, DHS mortality rates are based on a life table or synthetic cohort approach that handles such censoring. Various methods can be used to calculate period life-tables for childhood mortality. The main differences among these methods are in the way exposure and events are allocated to different time-periods; these differences will result in slight differences in the estimates obtained. For the DHS surveys, a standard ISSA (Integrated System for Survey Analysis) program is used for the calculation of all childhood mortality rates, which implements the procedure developed by Somoza (1980) and modified by Rutstein

(1984). Technical details of this approach are given in Appendix A (taken from Appendix A of Sullivan et al., 1994).

2.3 Structural Biases

Structural biases are biases that occur due to the design of the survey and questionnaire. The first structural bias is a selection bias resulting from the fact that only surviving women can be interviewed in the survey. Consequently, no information is collected on the child mortality experience of women who have died. Since it is believed that the death of the mother increases the risk of death for her children, this selection bias is likely to reduce estimates of infant and child mortality. The magnitude of the selection bias will be larger for periods further back in time because mothers will be more likely to have died by the time of the survey. Hence, trends in mortality may also be distorted. Differentials in mortality may also be distorted in a similar way because mothers in the most disadvantaged groups (e.g., rural, uneducated) will be more likely to have died by the time of the survey than mothers in more advantaged groups. Although the magnitude of this bias is believed to be small because adult mortality is low in most countries, the problem could become increasingly important in populations badly affected by the AIDS virus since adult mortality will increase, resulting in a more biased sample. In addition, many deaths due to pediatric AIDS will be missed because the mother herself may have died from AIDS before the survey.

A second structural bias is truncation of data in the past because only women up to a certain age (usually 49) are interviewed. Hence, the sample of births becomes increasingly selective towards births to younger women further back in time. For example, women age 49 at the time of the survey would only be age 44 five years prior to the survey so births to women age 45 and over would not be included in the sample for this time-period. Similarly, only births to women under age 35 would be included in the sample of births 15 years prior to the survey. Childhood mortality generally exhibits a U- or J-shaped relationship with maternal age at the time of the birth. Thus, the estimated mortality rate will be either too high or too low depending on the number of years prior to the survey to which it refers. The magnitude of this bias will depend on the magnitude and form of the relationship between maternal age and childhood mortality in each population. Clearly, trend data will be affected by truncation bias. The only direct control for truncation bias is to restrict analysis to the mortality of children to women below the maximum age available in the most distant period of interest, for example, under age 30 for periods up to 19 years preceding the survey. However, this means discarding a lot of information from the most recent period and will not provide estimates of the total level of mortality in any period. Hence, this approach tends to be used only for specific types of analyses.

2.4 Sample Bias

Sample bias occurs if the sample design systematically omits certain groups of the population, such as shantytown dwellers. In such a situation the sample will not be representative of the whole population of interest. If the childhood mortality experience of the omitted sector of the population differs from that of the population represented by the sample, mortality rates will be biased. This bias may be in either direction depending on the nature of the sample bias. Sample bias should not be a problem if the sample is well designed and correctly implemented, and non-response is kept to a minimum.

2.5 Sampling Errors

Sampling errors are an inherent component of survey-based rates and indicate the amount of sampling variability associated with a particular estimate. Large sampling errors indicate that the estimate is not very precise and that the true population rate could be substantially higher or lower than the survey estimate.

Large sampling errors also distort trends and differentials in mortality rates because they lead to erratic patterns, making it difficult to distinguish genuine differences from sampling variation.

Sampling errors are an important concern in the analysis of mortality because death typically is a relatively rare event so the sampling errors associated with mortality rates can be substantial. The sampling errors associated with mortality rates are influenced by the sample size in the survey, the sample design, and the level of mortality in the population since at lower levels of mortality a particular sample size will produce fewer deaths than the same sample size in a high mortality population. A balance has to be sought between providing sufficiently accurate rates to meet the needs of users of the data and producing a practical, cost-effective sample within budget constraints. Hence, good sample design is a critical element in keeping sampling errors to an acceptable level.

2.6 Reporting Errors

Reporting errors refer to errors in the responses given by the respondents. Such errors include missing information for some questions, particularly date of birth and age at death, inaccurate reporting, such as misreporting of the age at death, and omission (or erroneous inclusion) of births and deaths. Each of these is discussed in turn below.

2.6.1 Missing Information

Missing information may occur because the respondent does not know the answer to a question and hence is unable to give a response, or because the interviewer makes a mistake such as forgetting to ask the question or forgetting to fill in the answer. Missing information on the date of birth and age at death of children is of particular concern for the estimation of childhood mortality rates.

Date-of-birth data are essential for any analysis of mortality by time period. Ignoring cases with missing information would cause downward biases in childhood mortality rates because typically information on the year and month of birth is more likely to be missing for children who have died than for children who are still alive (Chidambaram and Sathar, 1984; Sullivan et al., 1990). Trends and differentials in mortality rates would also be distorted because, in general, the date of birth is more likely to be missing for events further back in time and for children in certain subgroups of the population (Chidambaram and Sathar, 1984). In the DHS surveys, if the year or month of birth is missing, a value is imputed using a standard imputation procedure (Institute for Resource Development (IRD), 1987). The imputation procedure uses other information reported by the respondent to establish a logical time-period in which the birth probably occurred and then randomly assigns a date within that period. Hence, all children are included in the estimation of mortality rates. Thus, with a well-designed imputation program, the impact of missing date-of-birth information on mortality rates and trends is expected to be small. This is particularly true if only the month of birth has to be imputed because imputation then occurs within a one-year range.

Missing information on age at death causes problems because it is not possible to determine the allocation of the death and the exposure in the calculation of mortality rates. Simply ignoring cases with missing information would result in a downward bias in the mortality rates; this would be very severe if large numbers of children who died were missing an age at death. Hence, imputation is again used in DHS surveys so that all births are included in the estimation of mortality rates. The imputation process uses a hot deck procedure; specifically, the missing age at death is assigned the value from the last dead child with the same birth order. If omission of the age at death is systematically related to the age at death of the child, this imputation process could induce some distortion in the age pattern of mortality, although the overall under-five mortality rate is likely to be unaffected. Trends and differentials in age patterns of mortality would also be affected by this process if omission of the age at death was more common for deaths that occurred further back in time and in some subgroups of the population. If omission of the age at death is not systematically related to the age at death, the imputation process will have little impact on childhood mortality rates, although extensive imputation is cause for concern.

2.6.2 Accuracy of Reporting

Even when the response to a question is complete, it does not mean that the response is accurate. Errors may occur because the respondent does not know the answer to the question and hence the response represents either her best guess, the interviewer's best guess, or some outcome of negotiation between the respondent and the interviewer. The respondent may provide an incorrect answer, either unintentionally or intentionally. From the perspective of calculating mortality rates, inaccurate reporting of birth dates and age at death are of most concern. However, misreporting of background characteristics, such as the mother's age or education, could affect differentials in mortality rates.

Systematic misreporting of the birth dates of children would affect trends in mortality even if it were independent of survival status. If births generally tended to be moved forward in time in a context of declining childhood mortality, mortality rates would tend to be overestimated for the periods into which they were moved. If births tended to be misplaced backwards in time in the same context of declining childhood mortality, mortality rates would tend to be underestimated in the periods into which they were moved. The opposite would happen in a context of increasing childhood mortality, but this is much less common. If misplacement of births is related to the survival status of the birth, mortality levels and trends would be affected but the direction and magnitude of the bias would depend on the nature and extent of the differential misplacement.

A particular example of birth misplacement is the displacement of births from the fifth calendar year prior to the survey to the sixth calendar year, which has been noted in several DHS-I surveys (Arnold, 1990). This displacement is believed to be linked to the health section of the questionnaire, which includes a number of questions asked of each birth occurring after a cutoff date—usually January 1st of the fifth calendar year before the start of the survey. Interviewers might have displaced births from the fifth to the sixth calendar year before the survey in order to avoid having to ask these questions.

Such birth displacement can affect mortality rates if it occurs between reference periods for which the rates are calculated. In DHS-II survey reports and in this report, mortality rates are based on five-year periods prior to the survey date. Displacement of births from the fifth to the sixth calendar year moves some births and some deaths (depending on age at death) out of the most recent five-year period and into the earlier period. The potential for bias in mortality rates depends on the level of displacement and whether or not it is related to the survival status of the birth. If surviving and dead children are displaced equally there will be little effect on mortality rates in either period and hence little effect on mortality trends. If dead children are displaced more frequently, as occurred in several DHS-I surveys (Sullivan et al., 1990), infant and child mortality will be underestimated for the most recent period and overestimated for the earlier period. The opposite will occur if surviving children are displaced more frequently.

Sullivan et al. (1990) used a simulation model to estimate the effect on mortality rates of excess displacement of dead children compared to surviving children in DHS-I surveys. They concluded that in the surveys in which this was identified as an important problem, infant mortality was underestimated by between 2.5 and 4 percent in the most recent period and overestimated by a similar amount in the earlier period. The impact was even greater in Trinidad and Tobago where the differential displacement of dead children was particularly pronounced. However, for a fixed level of displacement, the impact of birth displacement on the mortality estimates in DHS-II survey reports will be less than the impact on the mortality rates in DHS-I survey reports because the DHS-II estimates are based on five-year periods before the interview date, whereas the DHS-I estimates were based on five-year calendar periods before the survey. Consequently, the boundary for the two reference periods for the estimation of mortality rates in DHS-II surveys falls somewhere in the fifth calendar year before the survey (depending on the interview date), so not all of the displaced births and deaths will be transferred across the boundary of the reference period. In contrast, for DHS-I estimates the fifth calendar year before the survey always fell entirely within the first reference period, so all displaced births and some deaths were transferred to the earlier period. Therefore, the net effect of a given level of differential displacement will be less in DHS-II surveys than in DHS-I surveys unless the DHS-II fieldwork was conducted very early in the year in which case there will be little difference.

Age-specific mortality rates can be biased if misreporting of age at death results in net transfer of deaths from one age group to another one. In retrospective surveys, heaping of reported age at death at 12 months is common. If heaping at 12 months is due to rounding down the age of children who died shortly after their first birthday, infant and child mortality rates will be unaffected. If heaping is due to rounding up the age at death of children who died before their first birthday, infant mortality rates will be biased downwards and child mortality will be overestimated. Using a model that redistributed 25 percent of excess deaths at 12 months to infancy, Sullivan et al. (1990) concluded that adjusting the infant mortality rate for heaping at 12 months increased the rate by about five percent in DHS-I surveys in sub-Saharan Africa and by about two percent in other regions. The child mortality rate was correspondingly decreased by a slightly larger amount in most surveys.

2.6.3 Event Omission

Probably the most serious form of response error for the calculation of childhood mortality rates is omitting children who have died from the birth history. Such omission may be deliberate, because the respondent does not wish to talk about the death, or it may be due to recall errors or misunderstanding of the question, and can lead to serious underestimates of infant and child mortality rates. Omission of child deaths is believed to be more common for children who died shortly after birth, which could result in distortion of age patterns of mortality, particularly in underestimation of neonatal mortality. Underreporting of deaths is also believed to be more common for events that occurred further back in time, which would distort trends in mortality. Omission may be related to the sex of the child and to other background characteristics of the child and mother, which could distort differentials in mortality. The degree of distortion that occurs will depend on the extent of omission and on how strongly omission of deaths is related to the particular factor.

Omission of surviving children could also occur, but is believed to be rare. Similarly, erroneous inclusion of both surviving and dead children, for example adopted or foster children, could occur but this too is thought to be uncommon.

Chapter 3

Collection of DHS Infant and Child Mortality Data

3.1 Questionnaires

A standard DHS-II survey uses two questionnaires. The household questionnaire is administered to all selected households. It is used to obtain a complete list of all the usual household members and all visitors who slept in the household the preceding night, together with some background information on each person listed and on the household. The household listing is used to identify respondents for the individual questionnaire. In most surveys, all women age 15-49 who either slept in the household the preceding night or who were usual residents of the household were interviewed with the individual questionnaire. In Egypt, Indonesia, Jordan, Pakistan, and Yemen, only ever-married women who satisfied these criteria were interviewed.[1] For the analysis, only respondents who slept in the household the preceding night are included (*de facto* sample) except in Indonesia, Jordan, and Yemen where a *de jure* sample is used (usual residents only).

The procedures used to collect the data for calculating mortality rates in the DHS-II surveys are essentially the same as those used in the DHS-I surveys. The data are collected in the reproduction section in the individual questionnaire (see Appendix B). The respondent is asked to report all live births, including births of children who have died, first in terms of the aggregate number of children ever born (CEB), then in terms of specific questions about each live birth (birth history).

The CEB data are collected using a series of seven questions which determine the number of sons and daughters living at home, the number of sons and daughters living elsewhere, and the number of sons and daughters who have died. If a respondent reports that she has had no children who have died, she is asked if she ever gave birth to a baby who cried or showed signs of movement but is no longer alive.

The birth history data are collected in chronological order, starting with the first birth and ending with the most recent. Data are collected on the date of birth, sex, survivorship status, current age and whether the child is living with the mother (for living children), and age at death (for dead children), as in the DHS-I surveys. In the DHS-II surveys an additional question, "With whom did the child live?", was added to the birth history for surviving children under age 15 who did not live with their mother.[2] Following the birth history the interviewer checks the consistency of the CEB and birth history data and reconciles any differences.

Specific rules are applied to the collection of data on date of birth (year and month), current age, and age at death. In the case of year of birth, current age, and age at death, the rules state that a date or age must be recorded (i.e., the code for "don't know" is not acceptable). If a respondent cannot readily provide the information, probing techniques are used. As a last resort, interviewers are instructed to use whatever

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[1] The DHS-I survey in Sudan which is included in this report also used an ever-married sample.

[2] The questionnaire used in Yemen differs from a standard DHS-II questionnaire in many respects. In the birth history section the two questions about the residency of living children were not asked and an additional question was added to indicate whether the year of the child's birth was obtained from a document. Month of birth was permitted to be recorded in either Gregorian or Islamic months, and the season of birth was allowed as an acceptable response if the month of birth was not known.

information is available (e.g., birth dates of other children, number of years ago that the birth occurred) to estimate year of birth, current age, and age at death. In the case of month of birth, the rules for data collection are less stringent. Interviewers are instructed to utilize whatever information is available to determine the month of birth (e.g., season) but, when it is not possible to make a reliable estimate, it is acceptable to record the code for "don't know."

Instructions are included at the end of the birth history in virtually all DHS surveys. These remind the interviewer to check that the year of birth is recorded for all births, the current age is recorded for all surviving children, and the age at death is recorded for all dead children. Of the countries included in this report, only Kenya (DHS-I), Nigeria, and Yemen did not include these instructions at the end of the birth history. In the DHS-II core questionnaire an additional question was added at this stage asking the interviewers to check the exact age of death of children reported to have died at age 12 months in an attempt to reduce the incidence of heaping of age at death on 12 months. This question was included in all DHS-II surveys covered in this report except Nigeria and Yemen. In Northeast Brazil and Pakistan this question only specifically asked interviewers to probe deaths at one year. In Jordan, the interviewers were instructed to probe for the exact age at death in months of all dead children with a reported age at death under two years.

Interviewers are trained to probe birth intervals when the difference between the year of reported births is four or more in order to detect omitted births. If the respondent cannot provide a plausible explanation for a long interval between births (e.g., husband away, contraception), the interviewer is instructed to ask about births that occurred during the interval and might have survived only a short time. In Pakistan, a specific additional question was included at the end of the birth history asking the interviewers to check that an explanation had been given for all intervals longer than three years. A similar question was also included at the end of the birth history in the Egypt (DHS-II) questionnaire for intervals longer than four years.

3.2 Field Procedures

Interviewer training for the DHS surveys generally lasts three to four weeks. Particular emphasis is placed on the reproduction section of the individual questionnaire for two reasons: it is the source of the data for the direct estimation of fertility and mortality rates and it identifies the children about whom the health questions are asked later in the questionnaire.

For the same reasons, field editing focuses particularly on the data collected in the birth history. Questionnaires are edited while the interview team is working in a sampling point so that households can be revisited if necessary. Field editors are responsible for checking the completeness and consistency of the birth history data. Although standard procedures for conducting these checks are incorporated in the instruction manuals and training for each survey, the degree to which these procedures were followed undoubtedly varied between surveys.

An additional procedure that was introduced into the DHS-II surveys was the use of field-check tables to monitor data quality during data entry. A number of data quality tables, including several tables on the completeness and accuracy of information in the birth history, were run on the edited data at regular intervals during data entry. Because the tabulations were reported by interview team, any problems detected by these field-check tables could be reported back to the teams in the field. The degree to which the results were actually reported back to interview teams varied between surveys. Such checks should begin early in the fieldwork, otherwise their utility is greatly reduced, but this did not happen in all surveys.

3.3 Data Processing

Data from the survey questionnaires are transformed into the final raw data files following prescribed rules for data entry, editing, and imputation (IRD, 1987) The data processing and imputation procedures in DHS-I and DHS-II are very similar although some modifications have been made for DHS-II (Croft, 1991). The most significant change is in the way that inconsistent data are handled. In the DHS-I surveys, inconsistent data on dates of events and age at death were recoded to a "97" code and the original inconsistent data were discarded. The data were then treated in the same way as other missing data and a new consistent value was imputed. In the case of the data on age at death, only ages at death that were inconsistent with the interview date were treated in this way; other inconsistencies (e.g., with duration of breastfeeding) were left unchanged. In the DHS-II surveys, inconsistent data are retained unchanged in the data file and a flag variable has been added for dates of events and age at death that indicates the completeness of the original data and the type of inconsistency, if any. For the age-at-death data, several inconsistencies are flagged: inconsistent with date of interview, inconsistent with duration of breastfeeding, inconsistent with date of first breastfeeding, inconsistent with age at supplementation, and inconsistent with date of last vaccination. Note that these latter inconsistencies only apply to children born in the five calendar-years prior to the survey because the information on feeding and immunization is only collected for these children.

All analyses in this report use the final raw data files for the DHS-II surveys and the standard recode files for the DHS-I surveys. These data files include imputed dates of birth and ages at death for cases with missing information.

Chapter 4

Sampling Errors

4.1 Introduction

This chapter presents the sampling errors associated with neonatal, postneonatal, infant, child, and under-five mortality rates for the five-year period before the survey for each DHS-I and DHS-II survey. These sampling errors were not routinely published in the DHS-I and DHS-II survey reports or in the earlier evaluation of the quality of infant and child mortality data by Sullivan et al. (1990) because the software used to calculate them was developed only recently.[1] They are presented here to provide a reference for users of DHS mortality data and to set the context for the subsequent discussion of non-sampling errors. In addition, as discussed in Chapter 2, sampling errors are an important aspect of data quality that must be considered when using DHS childhood mortality rates.

Sample design and implementation are a crucial stage of the survey process; mistakes at this stage can make the results of the entire survey worthless. The sample designs of all DHS surveys follow a number of general principles to ensure consistent high-quality samples. In general, DHS samples are selected in two stages and are self-weighting, at least within reporting domains (e.g., urban and rural areas, geographical regions). However, individual sample designs have to be adapted to satisfy the data needs of the survey users, as well as budgetary and practical constraints. Consequently, individual survey designs do differ in size and complexity. It is beyond the scope of this report to provide a detailed discussion of the sample designs of each survey, but this information can be found in the individual survey reports. Further details of DHS sampling procedures, together with a comparative analysis of the sampling errors associated with estimates from DHS surveys, can be found in Lê and Verma (forthcoming).

The standard errors associated with DHS childhood mortality rates are calculated using a jackknife procedure (Wolter, 1985). Basically, the procedure creates a series of subsamples of the data by eliminating each cluster sequentially from the full sample. The childhood mortality rates are then estimated for each subsample, providing a sample of mortality estimates. The variance of this sample is then used to obtain the sampling errors. The procedure is implemented using the sampling errors module in ISSA.

4.2 Results

Table 4.1 presents the estimated infant mortality rate for the period 0-4 years before the survey for all DHS-I and DHS-II surveys, together with the approximate 95 percent confidence interval, the standard error, and the relative standard error associated with the rate. The lower bound of the confidence interval is calculated as the mortality rate minus two times the standard error of the rate. The upper bound is given by the rate plus two times the standard error of the rate. The relative standard error is defined as the standard error of the rate divided by the mortality rate. Therefore, it represents the standard error as a proportion of the total mortality rate, which is a more useful measure for comparisons across surveys that have very different levels of mortality. The sample size of each survey and the number of births 0-4 years before the survey are given in the final two columns of the table.

[1] Sampling errors for mortality rates will be routinely published in DHS-III survey reports.

Table 4.1 Infant mortality rates (IMRs) for the period 0-4 years prior to the survey, approximate 95 percent confidence intervals, standard error (SE), and relative standard errors, DHS-I and DHS-II surveys.

Country	IMR per 1000	95% confidence interval Lower bound	Upper bound	SE	Relative SE	Sample size	Number of births (weighted)
Sub-Saharan Africa							
DHS-I							
Botswana (BT)	38.4	29.6	47.2	4.41	0.115	4,368	3,301
Burundi (BU)	73.7	63.1	84.3	5.32	0.072	3,970	3,963
Ghana (GH)	77.2	66.5	87.9	5.35	0.069	4,488	4,137
Kenya (KE)	60.7	52.2	69.3	4.30	0.071	7,150	7,319
Liberia (LB)	144.3	129.5	159.1	7.39	0.051	5,239	5,232
Mali (ML)	105.1	90.1	120.0	7.46	0.071	3,200	3,462
Ondo State, Nigeria (OS)	58.3	48.4	68.2	4.95	0.085	4,213	3,316
Senegal (SN)	87.8	78.8	96.8	4.49	0.051	4,415	4,382
Sudan (SD)	70.0	62.3	77.6	3.84	0.055	5,860	6,729
Togo (TG)	77.3	67.7	86.9	4.80	0.062	3,360	3,166
Uganda (UG)	98.3	88.6	107.9	4.82	0.049	4,730	5,165
Zimbabwe (ZW)	49.1	40.6	57.6	4.26	0.087	4,201	3,455
DHS-II							
Burkina Faso (BF)	93.7	85.2	102.2	4.24	0.045	6,000	6,463
Cameroon (CM)	65.0	52.5	77.5	6.25	0.096	3,871	3,541
Madagascar (MD)	93.0	82.7	103.3	5.16	0.056	6,620	5,823
Malawi (MW)	134.3	121.2	147.5	6.56	0.049	4,850	4,668
Namibia (NM)	56.6	48.0	65.3	4.34	0.077	5,421	3,938
Niger (NI)	123.1	111.6	134.5	5.74	0.047	6,503	7,340
Nigeria (NG)	87.4	78.1	96.7	4.66	0.053	8,871	8,411
Rwanda (RW)	84.8	75.6	93.9	4.58	0.054	6,551	5,826
Senegal (SN)	68.0	59.9	76.2	4.07	0.060	6,500	5,766
Tanzania (TZ)	91.6	80.1	103.1	5.74	0.063	9,238	8,299
Zambia (ZM)	107.2	97.0	117.3	5.08	0.047	7,060	6,391
Asia/Near East/ North Africa							
DHS-I							
Egypt (EG)	73.2	65.0	81.3	4.07	0.056	8,911	8,898
Indonesia (ID)	67.4	58.0	76.8	4.70	0.070	11,884	8,522
Morocco (MA)	74.2	65.4	83.0	4.42	0.060	5,982	6,287
Sri Lanka (LK)	24.7	19.5	29.8	2.58	0.105	5,865	4,131
Thailand (TH)	35.2	25.9	44.6	4.69	0.133	6,775	3,787
Tunisia (TN)	48.0	40.2	55.8	3.90	0.081	4,184	4,562
DHS-II							
Egypt (EG)	61.5	55.1	67.9	3.19	0.052	9,864	8,915
Indonesia (ID)	67.8	60.6	75.0	3.58	0.053	22,909	14,950
Jordan (JO)	33.8	29.1	38.5	2.33	0.069	6,462	8,447
Morocco (MA)	57.3	49.1	65.6	4.13	0.072	9,256	5,325
Pakistan (PK)	86.0	74.2	97.8	5.88	0.068	6,611	6,599
Yemen (YE)	84.4	75.6	93.2	4.40	0.052	5,687	7,675

Figure 4.1 presents the relative standard errors of the infant mortality rate plotted against the number of births in the 0-4 year period before the survey. The number of births 0-4 years before the survey is an approximate estimate of the number of births, and hence of the amount of exposure, on which the rate is based. As would be expected, the higher relative standard errors tend to occur in surveys in which the amount of exposure on which the rate is based is relatively low. In the majority of DHS surveys, the relative standard

Table 4.1—*cont.*

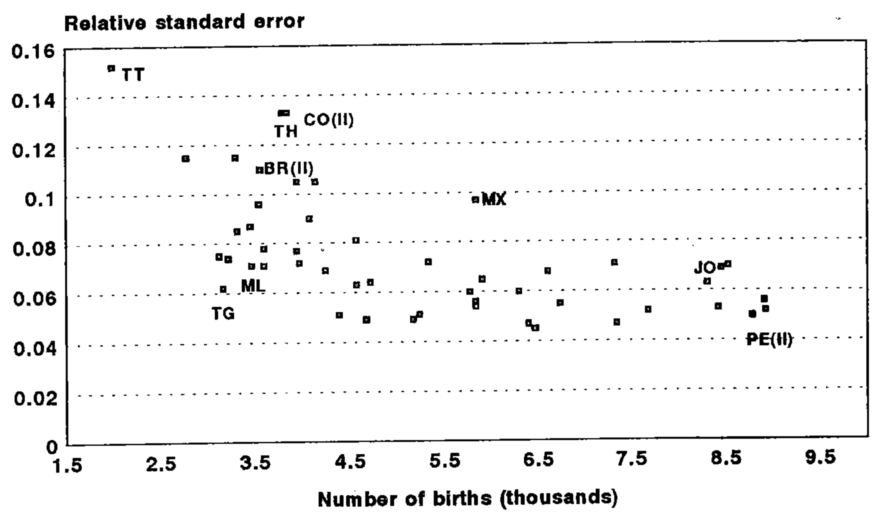
Country	IMR per 1000	95% confidence interval Lower bound	Upper bound	SE	Relative SE	Sample size	Number of births (weighted)
Latin America/Caribbean							
DHS-I							
Bolivia (BO)	81.9	71.3	92.6	5.31	0.065	7,923	5,891
Brazil (BR)	73.2	61.8	84.6	5.71	0.078	5,892	3,595
Colombia (CO)	32.3	24.9	39.7	3.70	0.115	5,329	2,774
Dominican Rep. (DR)	67.3	58.9	75.8	4.21	0.063	7,649	4,564
Ecuador (EC)	57.2	48.7	65.7	4.27	0.075	4,713	3,123
El Salvador (ES)	67.1	57.6	76.7	4.77	0.071	5,207	3,595
Guatemala (GU)	72.7	63.4	82.0	4.64	0.064	5,160	4,713
Mexico (MX)	47.4	38.2	56.6	4.61	0.097	9,310	5,829
Peru (PE)	75.1	64.0	86.2	5.56	0.074	4,999	3,220
Trinidad and Tobago (TT)	28.0	19.5	36.5	4.25	0.152	3,806	1,994
DHS-II							
NE Brazil (BR)	74.7	58.3	91.1	8.21	0.110	6,222	3,554
Colombia (CO)	16.7	12.2	21.1	2.23	0.133	8,644	8,835[a]
Dominican Rep. (DR)	43.0	34.0	52.0	4.49	0.105	7,320	3,940
Paraguay (PY)	33.5	27.5	39.5	3.01	0.090	5,827	4,069
Peru (PE[11])	54.5	49.0	60.0	2.74	0.050	15,882	8,772

[a]The sample weights in Colombia include an inflation factor to inflate the sample population up to the total population size. For this analysis the weighted number of births has been scaled down by a factor of 1,000.

error of the infant mortality rate is in the range 0.04 and 0.08 (i.e., the standard error is between four and eight percent of the infant mortality rate). This implies that the 95 percent confidence interval for the infant mortality rate generally is between 8 and 16 percent either side of the point estimate of the rate. At sample sizes above 4,500 births there is very little variability across surveys in the size of the relative standard error of the infant mortality rate; only Mexico has a relative standard error that exceeds 0.08. This reflects the consistent approach taken to sample design across surveys.

At sample sizes below 4,500 births there is more variability across surveys in the relative standard error of the infant mortality rate. This variability reflects the additional influences of the sample design and the level of mortality on sampling errors. For example, Togo has a lower relative standard error than other surveys with a similar number of births in the five years preceding the survey. The level of infant mortality in Togo is moderately high and the sample design appears to have been very efficient. In contrast, Northeast Brazil (DHS-II), which has a similar level of infant mortality and a similar sample size to Togo, presents a much larger relative standard error. This reflects the complex sample design that was used in the Northeast Brazil survey with sample weights at the cluster level which reduces the efficiency of the sample. Inefficiency in the sample design also explains the high relative standard error of the infant mortality rate in Mexico. In Colombia (DHS-II) and Thailand, the low level of infant mortality contributes to the high relative standard error of the infant mortality rate whereas in Mali the infant mortality is very high which compensates for the small sample size to some extent (Figure 4.2).

Figure 4.1
Relative standard error of the IMR by the IMR 0-4 years before DHS-I and DHS-II surveys



Note: Indonesia (DHS-II) is not shown on this figure.

Figure 4.2
Relative standard error of the U5MR by the U5MR 0-4 years before DHS-I and DHS-II surveys

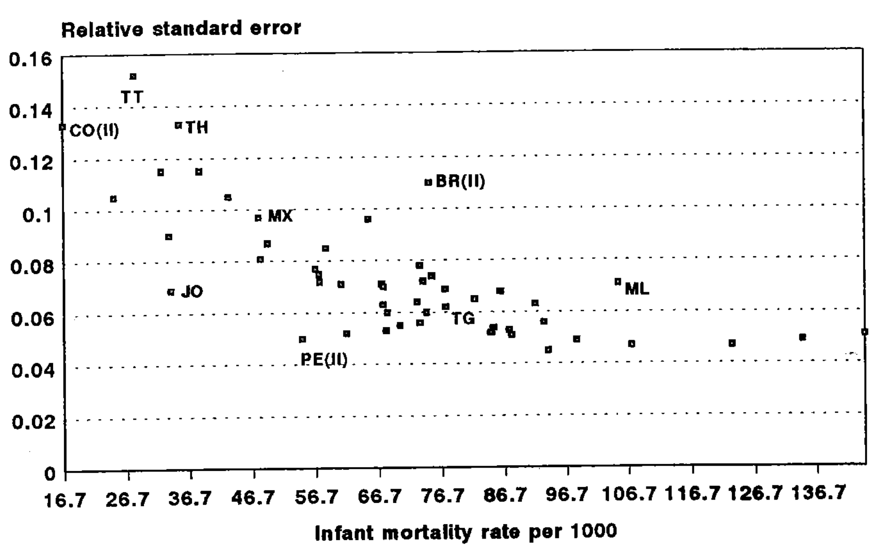


Table 4.2 presents the under-five mortality rate for the period 0-4 years before each survey, together with its approximate 95 percent confidence interval, standard error, and relative standard error. Again, the standard error generally is between four and eight percent of the mortality rate and tends to be higher in surveys in which the sample of births was below 4,500. As would be expected, the relative standard error associated with the under-five mortality rate is lower than the relative standard error associated with the infant

Table 4.2 Under-five mortality rates (U5MRs) for the period 0-4 years prior to the survey, approximate 95 percent confidence intervals, standard error (SE), and relative standard errors, DHS-I and DHS-II surveys.

Country	U5MR per 1000	95% confidence interval: Lower bound	95% confidence interval: Upper bound	SE	Relative SE	Sample size	Number of births (weighted)
Sub-Saharan Africa							
DHS-I							
Botswana	52.6	43.1	62.1	4.75	0.090	4,368	3,301
Burundi	152.6	133.8	170.9	9.27	0.061	3,970	3,963
Ghana	154.7	138.9	170.6	7.93	0.051	4,488	4,237
Kenya	89.8	77.2	102.4	6.30	0.070	7,150	7,319
Liberia	222.5	204.6	240.4	8.93	0.040	5,239	5,232
Mali	247.0	220.0	273.9	13.49	0.055	3,200	3,462
Ondo State, Nigeria	110.8	94.8	126.8	8.01	0.072	4,213	3,316
Senegal	194.6	178.7	210.4	7.93	0.041	4,415	4,382
Sudan	123.7	113.6	133.8	5.05	0.041	5,860	6,729
Togo	154.6	139.3	170.0	7.66	0.050	3,360	3,166
Uganda	176.8	162.9	190.7	6.95	0.039	4,730	5,165
Zimbabwe	70.6	59.8	81.4	5.39	0.076	4,201	3,455
DHS-II							
Burkina Faso	187.0	174.8	199.2	6.10	0.033	6,000	6,463
Cameroon	126.3	107.6	145.0	9.34	0.074	3,871	3,541
Madagascar	162.6	147.8	177.3	7.37	0.045	6,620	5,823
Malawi	233.8	216.6	251.0	8.60	0.037	4,850	4,668
Namibia	83.2	72.3	94.0	5.43	0.065	5,421	3,938
Niger	318.2	296.7	339.8	10.79	0.034	6,503	7,340
Nigeria	192.6	171.4	213.8	10.62	0.055	8,871	8,411
Rwanda	150.3	136.6	164.0	6.86	0.046	6,551	5,826
Senegal	131.4	119.5	143.3	5.96	0.045	6,500	5,766
Tanzania	141.2	128.1	154.3	6.56	0.046	9,238	8,299
Zambia	198.7	177.2	204.3	6.78	0.036	7,060	6,391
Asia/Near East/ North Africa							
DHS-I							
Egypt	101.8	91.8	111.8	5.00	0.049	8,911	8,898
Indonesia	98.1	86.4	109.7	5.81	0.059	11,884	8,522
Morocco	103.0	90.4	115.6	6.31	0.061	5,982	6,287
Sri Lanka	34.0	27.7	40.2	3.11	0.092	5,865	4,131
Thailand	44.0	33.9	54.2	5.09	0.116	6,775	3,787
Tunisia	61.8	52.7	70.8	4.52	0.073	4,184	4,562
DHS-II							
Egypt	84.8	76.7	92.9	4.07	0.048	9,864	8,915
Indonesia	97.4	87.7	107.1	4.86	0.050	22,909	14,950
Jordan	38.8	33.9	43.6	2.44	0.063	6,462	8,447
Morocco	76.1	65.5	86.8	5.34	0.070	9,256	5,325
Pakistan	112.3	99.3	125.2	6.48	0.058	6,611	6,599
Yemen	121.0	110.0	132.0	5.49	0.045	5,687	7,675

Table 4.2—*cont.*

Country	U5MR per 1000	95% confidence interval Lower bound	Upper bound	SE	Relative SE	Sample size	Number of births (weighted)
Latin America/Caribbean							
DHS-I							
Bolivia	129.4	115.4	143.3	6.97	0.054	7,923	5,891
Brazil	83.2	71.1	95.2	6.01	0.072	5,892	3,595
Colombia	41.2	32.8	49.6	4.20	0.102	5,329	2,774
Dominican Republic	88.2	78.3	98.1	4.94	0.056	7,649	4,564
Ecuador	80.6	70.0	91.7	5.42	0.067	4,713	3,123
El Salvador	85.4	74.1	96.8	5.67	0.066	5,207	3,595
Guatemala	109.1	97.6	120.7	5.77	0.053	5,160	4,713
Mexico	61.4	50.0	72.8	5.69	0.093	9,310	5,829
Peru	110.2	95.2	125.2	7.51	0.068	4,999	3,220
Trinidad and Tobago	31.6	22.8	40.5	4.42	0.140	3,806	1,994
DHS-II							
NE Brazil	85.5	67.6	103.5	8.97	0.105	6,222	3,554
Colombia	23.1	18.0	28.3	2.57	0.111	8,644	8,835[a]
Dominican Republic	59.5	49.1	69.9	5.20	0.087	7,320	3,940
Paraguay	42.5	35.4	49.7	3.58	0.084	5,827	4,069
Peru	77.5	70.8	84.3	3.39	0.044	15,882	8,772

[a]The sample weights in Colombia include an inflation factor to inflate the sample population up to the total population size. For this analysis the weighted number of births has been scaled down by a factor of 1,000.

mortality rate in almost every survey, reflecting the fact that the under-five mortality rate is based on more exposure than the infant mortality rate.

Tables 4.3 to 4.5 present the corresponding estimates for the neonatal, postneonatal, and child mortality rates for the period 0-4 years before each survey. In general, these component rates are somewhat lower than the infant and under-five mortality rates presented above and both the neonatal and postneonatal rates are based on less exposure, so the relative standard errors tend to be higher. In some surveys with very low mortality rates in particular age groups the relative standard errors are very high. For example, in Trinidad and Tobago the child mortality rate is only 3.7 per 1000 and the corresponding relative standard error is 0.372. This implies that the 95 percent confidence interval is 74.4 percent either side of the estimate, which corresponds to a range of 0.9 to 6.5 per 1000. This is a wide confidence interval relative to the mortality rate and will make it very difficult to draw any strong conclusions about trends and differentials in child mortality in Trinidad and Tobago.

To conclude, sampling errors for childhood mortality rates for the period 0-4 years before each DHS-I and DHS-II survey have been presented in this chapter. It should be noted that the sampling errors associated with rates based on subgroups of the population will tend to be higher than those presented here because the samples of births will be smaller. This effect will be particularly strong in low-mortality subgroups. The sample of births will also tend to be smaller for earlier five-year periods, but this may be compensated for to some extent by higher levels of mortality in these periods. The sampling errors for rates based on the per-

Table 4.3 Neonatal mortality rates (NNMRs) for the period 0-4 years prior to the survey, approximate 95 percent confidence intervals, standard error (SE), and relative standard errors, DHS-I and DHS-II surveys.

Country	NNMR per 1000	95% confidence interval: Lower bound	Upper bound	SE	Relative SE	Sample size	Number of births (weighted)
Sub-Saharan Africa							
DHS-I							
Botswana	22.5	14.9	30.1	3.78	0.168	4,368	3,301
Burundi	35.2	28.0	42.5	3.62	0.103	3,970	3,963
Ghana	43.3	35.4	51.2	3.93	0.091	4,488	4,237
Kenya	27.8	23.1	32.4	2.33	0.084	7,150	7,319
Liberia	67.9	58.4	77.3	4.73	0.070	5,239	5,232
Mali	51.1	40.9	61.2	5.07	0.099	3,200	3,462
Ondo State, Nigeria	26.3	20.1	32.6	3.11	0.118	4,213	3,316
Senegal	45.8	38.7	52.8	3.54	0.077	4,415	4,382
Sudan	43.8	38.0	49.6	2.89	0.066	5,860	6,729
Togo	39.7	32.6	46.8	3.55	0.089	3,360	3,166
Uganda	43.0	35.7	50.2	3.61	0.084	4,730	5,165
Zimbabwe	26.6	20.6	32.6	3.00	0.113	4,201	3,455
DHS-II							
Burkina Faso	43.2	36.2	50.2	3.49	0.081	6,000	6,463
Cameroon	33.1	24.7	41.5	4.20	0.127	3,871	3,541
Madagascar	38.9	32.4	45.5	3.27	0.084	6,620	5,823
Malawi	40.8	33.7	48.0	3.56	0.087	4,850	4,668
Namibia	31.5	25.2	37.8	3.16	0.100	5,421	3,938
Niger	40.7	34.1	47.4	3.32	0.081	6,503	7,340
Nigeria	42.2	36.4	48.0	2.90	0.069	8,871	8,411
Rwanda	38.6	32.5	44.8	3.07	0.079	6,551	5,826
Senegal	34.9	29.3	40.4	2.77	0.080	6,500	5,766
Tanzania	37.9	30.6	45.3	3.65	0.096	9,238	8,299
Zambia	42.5	36.7	48.3	2.91	0.068	7,060	6,391
Asia/Near East/ North Africa							
DHS-I							
Egypt	38.3	32.4	44.1	2.93	0.077	8,911	8,898
Indonesia	27.2	21.5	32.8	2.81	0.103	11,884	8,522
Morocco	41.5	35.5	47.5	2.98	0.072	5,982	6,287
Sri Lanka	16.3	12.0	20.5	2.13	0.131	5,865	4,131
Thailand	20.2	13.7	26.7	3.24	0.160	6,775	3,787
Tunisia	26.2	20.4	31.9	2.88	0.110	4,184	4,562
DHS-II							
Egypt	32.8	27.9	37.7	2.46	0.075	9,864	8,915
Indonesia	31.7	26.8	36.5	2.42	0.076	22,909	14,950
Jordan	21.4	17.6	25.2	1.88	0.088	6,462	8,447
Morocco	31.4	25.5	37.3	2.96	0.094	9,256	5,325
Pakistan	48.9	40.5	57.3	4.19	0.086	6,611	6,599
Yemen	40.9	34.9	46.9	3.00	0.073	5,687	7,675

iod 0-9 years before the survey will tend to be lower than for the corresponding rate for the 0-4 year period because the sample of births will be larger. Hence, mortality rates for subgroups of the population are frequently based on the 10-year period before the survey to obtain sufficient sampling precision in the estimates to enable meaningful analysis. However, this approach increases the chance of non-sampling errors affecting the rates due to truncation effects and the longer recall period.

Table 4.3—*cont.*

Country	NNMR per 1000	95% confidence interval Lower bound	Upper bound	SE	Relative SE	Sample size	Number of births (weighted)
Latin America/Caribbean							
DHS-I							
Bolivia	36.3	28.9	43.6	3.68	0.102	7,923	5,891
Brazil	33.1	25.5	40.7	3.80	0.115	5,892	3,595
Colombia	18.9	13.2	24.5	2.84	0.151	5,329	2,774
Dominican Republic	39.9	32.8	47.0	3.56	0.089	7,649	4,564
Ecuador	35.3	28.0	42.7	3.66	0.104	4,713	3,123
El Salvador	27.3	21.1	33.6	3.14	0.115	5,207	3,595
Guatemala	33.1	27.3	38.8	2.89	0.087	5,160	4,713
Mexico	26.9	21.1	32.6	2.88	0.107	9,310	5,829
Peru	34.6	27.0	42.2	3.80	0.110	4,999	3,220
Trinidad and Tobago	22.9	14.8	31.1	4.08	0.178	3,806	1,994
DHS-II							
NE Brazil	26.1	18.6	33.7	3.76	0.144	6,222	3,554
Colombia	10.8	7.5	14.1	1.66	0.153	8,644	8,835[a]
Dominican Republic	23.7	16.3	31.2	3.74	0.158	7,320	3,940
Paraguay	19.4	14.4	24.3	2.48	0.128	5,827	4,069
Peru	25.3	21.8	28.7	1.75	0.069	15,882	8,772

[a]The sample weights in Colombia include an inflation factor to inflate the sample population up to the total population size. For this analysis the weighted number of births has been scaled down by a factor of 1,000.

Table 4.4 Postneonatal mortality rates (PNMRs) for the period 0-4 years prior to the survey, approximate 95 percent confidence intervals, standard error (SE), and relative standard errors, DHS-I and DHS-II surveys.

Country	PNMR per 1000	95% confidence interval Lower bound	Upper bound	SE	Relative SE	Sample size	Number of births (weighted)
Sub-Saharan Africa							
DHS-I							
Botswana	15.9	10.8	21.0	2.55	0.160	4,368	3,301
Burundi	38.5	31.5	45.4	3.48	0.090	3,970	3,963
Ghana	33.9	26.9	40.8	3.47	0.102	4,488	4,237
Kenya	33.0	26.1	39.9	3.45	0.104	7,150	7,319
Liberia	76.4	65.3	87.6	5.56	0.073	5,239	5,232
Mali	54.0	43.8	64.2	5.10	0.094	3,200	3,462
Ondo State, Nigeria	31.9	25.2	38.7	3.38	0.106	4,213	3,316
Senegal	42.0	35.6	48.5	3.21	0.076	4,415	4,382
Sudan	26.1	21.9	30.4	2.11	0.081	5,860	6,729
Togo	37.6	29.1	46.1	4.24	0.113	3,360	3,166
Uganda	55.3	48.4	62.2	3.43	0.062	4,730	5,165
Zimbabwe	22.4	16.0	28.9	3.24	0.144	4,201	3,455
DHS-II							
Burkina Faso	50.5	44.0	57.0	3.24	0.064	6,000	6,463
Cameroon	31.9	24.9	38.9	3.50	0.110	3,871	3,541
Madagascar	54.1	46.4	61.8	3.85	0.071	6,620	5,823
Malawi	93.5	81.4	105.6	6.07	0.065	4,850	4,668
Namibia	25.2	19.7	30.6	2.70	0.107	5,421	3,938
Niger	82.3	72.4	92.3	4.96	0.060	6,503	7,340
Nigeria	45.2	38.5	52.0	3.38	0.075	8,871	8,411
Rwanda	46.1	39.4	52.8	3.35	0.073	6,551	5,826
Senegal	33.2	27.6	38.7	2.77	0.084	6,500	5,766
Tanzania	53.7	45.7	61.6	3.98	0.074	9,238	8,299
Zambia	64.7	57.1	72.2	3.76	0.058	7,060	6,391
Asia/Near East/ North Africa							
DHS-I							
Egypt	34.9	30.2	39.6	2.37	0.068	8,911	8,898
Indonesia	40.2	33.7	46.8	3.26	0.081	11,884	8,522
Morocco	32.7	27.0	38.4	2.86	0.087	5,982	6,287
Sri Lanka	8.4	5.5	11.3	1.46	0.174	5,865	4,131
Thailand	15.0	9.5	20.5	2.75	0.183	6,775	3,787
Tunisia	21.9	17.2	26.5	2.34	0.107	4,184	4,562
DHS-II							
Egypt	28.7	24.1	33.2	2.26	0.079	9,864	8,915
Indonesia	36.1	31.5	40.8	2.32	0.064	22,909	14,950
Jordan	12.4	9.9	14.9	1.24	0.100	6,462	8,447
Morocco	25.9	20.8	31.0	2.55	0.098	9,256	5,325
Pakistan	37.1	30.1	44.1	3.50	0.094	6,611	6,599
Yemen	43.4	37.5	49.4	2.98	0.069	5,687	7,675

Table 4.4—*cont.*

Country	PNMR per 1000	95% confidence interval Lower bound	Upper bound	SE	Relative SE	Sample size	Number of births (weighted)
Latin America/Caribbean							
DHS-I							
Bolivia	45.7	38.3	53.0	3.68	0.080	7,923	5,981
Brazil	40.1	31.8	48.3	4.13	0.103	5,892	3,595
Colombia	13.4	9.2	17.7	2.12	0.158	5,329	2,774
Dominican Republic	27.5	22.4	32.5	2.51	0.091	7,649	4,564
Ecuador	21.8	15.9	27.8	3.00	0.137	4,713	3,123
El Salvador	39.8	32.4	47.2	3.69	0.093	5,207	3,595
Guatemala	39.6	33.2	46.1	3.23	0.082	5,160	4,713
Mexico	20.5	15.0	26.1	2.77	0.135	9,310	5,829
Peru	40.4	34.2	46.6	3.09	0.076	4,999	3,220
Trinidad and Tobago	5.1	2.1	8.1	1.52	0.297	3,806	1,994
DHS-II							
NE Brazil	48.5	34.6	62.4	6.95	0.143	6,222	3,554
Colombia	5.9	3.1	8.7	1.39	0.236	8,644	8,835[a]
Dominican Republic	19.2	13.9	24.6	2.67	0.139	7,320	3,940
Paraguay	14.1	10.4	17.9	1.87	0.133	5,827	4,069
Peru	39.2	25.3	33.1	1.95	0.067	15,882	8,772

[a]The sample weights in Colombia include an inflation factor to inflate the sample population up to the total population size. For this analysis the weighted number of births has been scaled down by a factor of 1,000.

Table 4.5 Child mortality rates (CMRs) for the period 0-4 years prior to the survey, approximate 95 percent confidence intervals, standard error (SE), and relative standard errors, DHS-I and DHS-II surveys.

Country	CMR per 1000	95% confidence interval: Lower bound	95% confidence interval: Upper bound	SE	Relative SE	Sample size	Number of births (weighted)
Sub-Saharan Africa							
DHS-I							
Botswana	14.7	10.0	19.5	2.37	0.161	4,368	3,301
Burundi	84.9	71.1	98.7	6.91	0.081	3,970	3,963
Ghana	84.0	72.9	95.2	5.58	0.066	4,488	4,237
Kenya	30.9	24.0	37.8	3.46	0.112	7,150	7,319
Liberia	91.4	79.4	103.3	5.97	0.065	5,239	5,232
Mali	158.6	136.3	180.8	11.12	0.070	3,200	3,462
Ondo State, Nigeria	55.8	44.9	66.7	5.46	0.098	4,213	3,316
Senegal	117.0	103.5	130.6	6.79	0.058	4,415	4,382
Sudan	57.7	50.2	65.3	3.77	0.065	5,860	6,729
Togo	83.8	71.7	95.8	6.02	0.072	3,360	3,166
Uganda	87.1	76.7	97.4	5.18	0.060	4,730	5,165
Zimbabwe	22.7	16.5	28.8	3.08	0.136	4,201	3,455
DHS-II							
Burkina Faso	103.0	92.5	113.4	5.23	0.051	6,000	6,463
Cameroon	65.6	54.1	77.0	5.71	0.087	3,871	3,541
Madagascar	76.7	67.2	86.1	4.73	0.062	6,620	5,823
Malawi	114.9	100.9	128.9	7.02	0.061	4,850	4,668
Namibia	28.1	21.1	35.2	3.54	0.126	5,421	3,938
Niger	222.6	203.8	241.3	9.38	0.042	6,503	7,340
Nigeria	115.3	95.3	135.3	10.00	0.087	8,871	8,411
Rwanda	71.6	62.0	81.2	4.82	0.067	6,551	5,826
Senegal	68.0	59.4	76.6	4.29	0.063	6,500	5,766
Tanzania	54.6	47.1	62.1	3.74	0.069	9,238	8,299
Zambia	93.6	84.6	102.5	4.48	0.048	7,060	6,391
Asia/Near East/ North Africa							
DHS-I							
Egypt	30.9	26.1	35.8	2.43	0.079	8,911	8,898
Indonesia	32.9	27.3	38.4	2.78	0.085	11,884	8,522
Morocco	31.1	23.8	38.5	3.68	0.118	5,982	6,287
Sri Lanka	9.5	5.9	13.1	1.81	0.190	5,865	4,131
Thailand	9.1	5.8	12.5	1.67	0.183	6,775	3,787
Tunisia	14.4	10.5	18.3	1.95	0.135	4,184	4,562
DHS-II							
Egypt	24.8	20.8	28.9	2.04	0.082	9,864	8,915
Indonesia	31.7	26.7	36.8	2.50	0.079	22,909	14,950
Jordan	5.1	3.4	6.9	0.87	0.169	6,462	8,447
Morocco	20.0	14.4	25.6	2.80	0.140	9,256	5,325
Pakistan	28.8	21.6	35.9	3.58	0.125	6,611	6,599
Yemen	40.0	33.4	46.6	3.30	0.082	5,687	7,675

Table 4.5—*cont.*

Country	CMR per 1000	95% confidence interval Lower bound	Upper bound	SE	Relative SE	Sample size	Number of births (weighted)
Latin America/Caribbean							
DHS-I							
Bolivia	51.7	43.2	60.2	4.25	0.082	7,923	5,891
Brazil	10.7	7.1	14.3	1.80	0.168	5,892	3,595
Colombia	9.2	5.8	12.7	1.72	0.186	5,329	2,774
Dominican Rep.	22.4	16.9	27.8	2.72	0.122	7,649	4,564
Ecuador	25.1	18.8	31.4	3.14	0.125	4,713	3,123
El Salvador	19.6	13.9	25.4	2.88	0.147	5,207	3,595
Guatemala	39.3	32.1	46.4	3.57	0.091	5,160	4,713
Mexico	14.7	10.2	19.2	2.25	0.153	9,310	5,829
Peru	38.0	28.7	47.3	4.66	0.123	4,999	3,220
Trinidad and Tobago	3.7	0.9	6.5	1.38	0.372	3,806	1,994
DHS-II							
NE Brazil	11.7	7.4	16.1	2.18	0.186	6,222	3,554
Colombia	6.5	3.8	9.3	1.37	0.209	8,644	8,835[a]
Dominican Rep.	17.3	11.4	23.3	2.97	0.172	7,320	3,940
Paraguay	9.3	6.4	12.3	1.49	0.159	5,827	4,069
Peru	24.4	20.8	27.9	1.78	0.073	15,882	8,772

[a]The sample weights in Colombia include an inflation factor to inflate the sample population up to the total population size. For this analysis the weighted number of births has been scaled down by a factor of 1,000.

Chapter 5

Date-of-birth Data

As discussed in Chapter 2, date-of-birth data are essential for any analysis of mortality by time period. However, the impact of data quality problems in the date-of-birth data on analyses of childhood mortality are likely to be relatively small, especially compared to other types of reporting errors that may occur. The quality of reporting of the date-of-birth data as it relates to the estimation of childhood mortality rates is analyzed in this chapter. The extent of missing information on date of birth by survival status is examined first. The second analysis focuses on displacement of births out of the period covered by the health section of the questionnaire with particular emphasis on the relationship between any such displacement and the survival status of the child.

5.1 Completeness of Reporting by Survival Status

Table 5.1 presents the percentage of births with incomplete information on date of birth by survival status, for each DHS-II survey and selected DHS-I surveys. The denominator of the percentages is births with a date of birth (reported or imputed) during the 15-year period prior to the survey.

For both living and dead children, Sudan (DHS-I) and Yemen present high percentages of births with incomplete information on date of birth. However, this is due to a very high percentage of births with missing information on month of birth, which, in turn, is due to the fact that "season of birth" was treated as an acceptable response in these two surveys. Over 59 percent of children who died do not have a complete month and year of birth, but many of these do have season of birth. For these cases, imputation of month of birth is within a range of only three or six months.

Excluding Sudan and Yemen, the percentage of living children missing any information on date of birth (month or year) ranges from 37 percent and 35 percent in Niger and Senegal, respectively, to zero percent in Paraguay. The highest percentages of surviving births with incomplete information tend to be found in the African surveys. Nevertheless, in all surveys the percentage of living children missing year of birth (and current age) is virtually zero.[1]

As expected, the percentage of births missing information on date of birth is consistently higher for dead children than for surviving children. The percentage of dead children missing any information on date of birth ranges from 69 percent and 65 percent in Senegal and Egypt (DHS-I), respectively, to 1 percent in Paraguay. However, the majority of deceased children with incomplete information are missing information on month of birth only, so imputation is over a range of less than one year. For example, some information is missing on date of birth for 69 percent of dead children in Senegal, but the year of birth is missing for only 2 percent.

The completeness of date-of-birth information for countries that have had two DHS surveys can be compared in Table 5.2. In Morocco, the DHS-I survey allowed a season of birth as an acceptable response whereas the DHS-II survey did not. This change in questionnaire design resulted in a large decrease in the

[1] For cases with year or age given, the imputed date of birth is accurate to within one year if the recorded year of birth (or age) is correct. The fact that a year of birth (or age) was recorded does not necessarily mean that the information is accurate.

Table 5.1 Percentage of births 0-15 years before the survey with incomplete information on date of birth by survival status, DHS-II surveys and selected DHS-I surveys

Country	Living children: Anything missing	Living children: Month only imputed	Living children: Year and age imputed	Dead children: Anything missing	Dead children: Month only imputed	Dead children: Year imputed	All births: Anything missing
Sub-Saharan Africa							
DHS-I							
Kenya	2.4	2.3	0.1	7.5	6.2	1.4	2.8
DHS-II							
Burkina Faso	23.3	23.3	0.0	42.9	42.1	0.8	27.1
Cameroon	26.5	26.5	0.0	55.1	53.8	1.3	30.7
Madagascar	14.5	14.5	0.0	42.0	35.7	6.3	19.3
Malawi	2.1	2.1	0.0	9.6	9.4	0.2	3.8
Namibia	2.6	2.5	0.2	10.9	8.5	2.4	3.4
Niger	37.0	37.0	0.0	49.1	48.9	0.2	40.6
Nigeria	13.9	13.9	0.0	28.7	28.3	0.4	16.6
Rwanda	4.1	4.1	0.0	19.2	18.1	1.1	6.6
Senegal	35.3	35.3	0.0	69.1	67.0	2.1	40.6
Tanzania	14.2	14.2	0.0	31.5	29.2	2.3	16.7
Zambia	1.1	1.0	0.1	5.6	5.3	0.2	1.8
Asia/Near East/ North Africa							
DHS-I							
Egypt	27.1	27.1	0.0	65.3	63.7	1.7	32.5
Sudan[1]	38.5	38.5	0.0	61.1	59.8	1.2	41.5
DHS-II							
Egypt	8.4	8.4	0.0	32.0	31.7	0.3	11.1
Indonesia	10.5	10.5	0.0	38.3	37.9	0.4	13.6
Jordan	0.6	0.6	0.0	7.2	6.7	0.5	0.8
Morocco	2.1	2.1	0.0	3.8	3.7	0.1	2.2
Pakistan	7.2	7.2	0.0	13.8	13.3	0.5	8.0
Yemen[2]	43.1	42.9	0.1	59.2	54.3	4.8	45.4
Latin America/Caribbean							
DHS-I							
Bolivia	0.9	0.8	0.0	18.8	12.6	6.2	3.4
DHS-II							
NE Brazil	1.1	1.0	0.1	11.7	7.9	3.8	2.4
Colombia	0.4	0.4	0.0	12.1	9.9	2.3	0.8
Dominican Republic	1.5	1.5	0.0	11.4	9.1	2.3	2.2
Paraguay	0.0	0.0	0.0	1.0	0.5	0.5	0.1
Peru	0.4	0.4	0.0	6.3	4.5	1.8	1.0

[1]The DHS-I survey in Sudan included "season of birth" as an acceptable response. Responses in which the season is given are coded as "month missing" but imputation is over a 3-, 4-, or 12-month window depending on the season recorded.

[2]The DHS-II survey in Yemen included "season of birth" as an acceptable response. Responses in which the season is given are coded as "month missing" but imputation is over a 6-month window. Islamic months were also included as an acceptable response. Responses in which an Islamic month was given are coded here as "month given" but the conversion to Gregorian months involves imputation over a 2-month window.

Table 5.2 Percentage of births 0-15 years before the survey with incomplete information on date of birth by survival status, DHS-I and DHS-II data for countries participating in both surveys

	Living children			Dead children			
Country	Anything missing	Month only imputed	Year and age imputed	Anything missing	Month only imputed	Year imputed	All births
Asia/Near East/North Africa							
Egypt							
DHS-I	27.1	27.1	0.0	65.3	63.7	1.7	32.5
DHS-II	8.4	8.4	0.0	32.0	31.7	0.3	11.1
Indonesia							
DHS-I	14.4	14.4	0.0	38.9	38.7	0.2	17.2
DHS-II	10.5	10.5	0.0	38.3	37.9	0.4	13.6
DHS-II[1]	11.1	11.0	0.0	39.7	39.4	0.3	14.2
Morocco							
DHS-I	32.1	32.1	0.0	65.9	63.3	2.6	36.3
DHS-II	2.1	2.1	0.0	3.8	3.7	0.1	2.2
DHS-I[2]	2.4	2.4	0.0	7.1	4.6	2.6	3.0
Latin America/Caribbean							
Brazil							
DHS-I	0.7	0.6	0.1	20.5	13.1	7.4	2.7
DHS-II	1.1	1.0	0.1	11.7	7.9	3.8	2.4
DHS-I[3]	1.6	1.4	0.2	27.8	17.9	9.9	5.9
DHS-II[4]	0.9	0.9	0.1	9.2	6.6	2.6	1.9
Colombia							
DHS-I	0.9	0.9	0.0	10.7	10.7	0.0	1.5
DHS-II	0.4	0.4	0.0	12.1	9.9	2.3	0.8
Dominican Republic							
DHS-I	0.9	0.9	0.0	7.5	7.5	0.0	1.5
DHS-II	1.5	1.5	0.0	11.4	9.1	2.3	2.2
Peru							
DHS-I	0.7	0.7	0.0	8.9	8.9	0.0	1.7
DHS-II	0.4	0.4	0.0	6.3	4.5	1.8	1.0

[1] Excluding seven provinces that were not included in DHS-I.
[2] DHS-I in Morocco included a season of birth as an acceptable response. Responses giving season of birth were originally coded as "month missing." In this estimate they are classified as "month given."
[3] Northeast only.
[4] Births to women age 15-44 at the time of the survey only.

Source: DHS-I figures (except Egypt): Sullivan et al., 1990, Table 3.1.

percentage of both surviving and dead children who required some imputation of their date of birth.[2] If births for whom season and year of birth were given in the DHS-I survey are considered as having complete

[2] This improvement in the completeness of date of birth reported when the season of birth is not considered an acceptable response suggests that either respondents in the DHS-II survey who initially provided a season of birth did provide a month of birth when probed or that interviewers used the season of birth to estimate the month of birth in the second survey. The fact that a month of birth is recorded does not mean that the information is accurate.

date-of-birth information, the improvement in completeness of date-of-birth reporting is less dramatic but completeness is still better in the later survey, especially for dead children.

There is substantial improvement in the completeness of reporting of date of birth between the DHS-I and DHS-II surveys in Egypt; 33 percent of all births were missing some date-of-birth information in the DHS-I survey compared to only 11 percent in the DHS-II survey. This is primarily due to increased reporting of month of birth. In Northeast Brazil the completeness of reporting of the date of birth of dead children also showed marked improvement between the DHS-I and DHS-II surveys.

In the remaining countries (Indonesia, Colombia, Dominican Republic, and Peru), the completeness of date-of-birth reporting generally is similar in the two surveys for both surviving and dead children. However, one cause for concern is that in Colombia, the Dominican Republic, and Peru the percentage of dead children missing year of birth increased from zero percent in the DHS-I survey to two percent in the DHS-II survey.

5.2 Displacement of Births by Survival Status

Table 5.3 presents birth ratios for the fifth calendar year before the survey for each DHS-II survey and selected DHS-I surveys by survival status. The birth ratio is defined as:

$$100 \times 2B_5/(B_4+B_6)$$

where B_4, B_5, and B_6 are the number of births in the fourth, fifth, and sixth calendar years preceding the start of the survey, respectively. A value of less than 100 implies fewer births than expected in the fifth calendar year before the survey, indicating displacement of births out of the period covered by the health section of the questionnaire.

Table 5.3 Birth ratios for the fifth calendar year before the start of the survey by survival status, DHS-II surveys and selected DHS-I surveys

Country	Living children	Dead children	Difference in birth ratios[1]	All births
Sub-Saharan Africa				
DHS-I				
Kenya	80.4	65.1	15.2	79.0
DHS-II				
Burkina Faso	73.9	66.4	7.5	72.3
Cameroon	86.9	75.0	24.4	85.3
Madagascar	87.7	78.6	9.1	86.0
Malawi	93.1	70.9	22.2	87.7
Namibia	94.4	112.3	-17.9	95.7
Niger	88.7	73.7	15.1	83.6
Nigeria	80.7	61.9	18.8	76.7
Rwanda	103.7	86.8	16.9	101.0
Senegal	84.3	72.6	11.7	82.5
Tanzania	95.1	62.3	32.8	89.3
Zambia	95.7	93.8	1.9	95.4
Asia/Near East/ North Africa				
DHS-I				
Egypt	92.7	60.9	31.8	88.3
Sudan	90.7	68.5	22.2	87.3
DHS-II				
Egypt	97.1	75.8	21.3	94.9
Indonesia	92.4	66.9	25.5	89.7
Jordan	100.3	66.7	33.6	98.9
Morocco	99.3	105.8	-6.5	99.8
Pakistan	64.8	54.1	10.7	63.4
Yemen	77.2	82.5	-5.3	77.8
Latin America/ Caribbean				
DHS-I				
Bolivia	85.7	83.8	1.9	85.4
DHS-II				
NE Brazil	111.7	87.3	24.4	109.1
Colombia	99.4	94.5	4.9	99.3
Dominican Rep.	89.8	80.6	9.2	89.2
Paraguay	101.9	94.9	7.0	101.5
Peru	92.2	85.9	6.3	91.6

Note: Birth ratios are defined as 100 x 2B5/(B4+B6) where B4, B5, and B6 are the number of births in the fourth, fifth, and sixth calendar years preceding the start of the survey.

[1]Ratio for living children minus ratio for dead children.

The majority of birth ratios reported in Table 5.3 for both surviving and dead children are below 100 and in all surveys except Namibia, Morocco, and Yemen, the birth ratio is lower for dead children than surviving children. This suggests that some degree of displacement of births out of the health section occurred in most DHS-II surveys and that this displacement was more severe for dead children than for surviving ones. The difference in birth ratios for surviving and dead children ranges from 1.9 in Zambia and Bolivia (DHS-I) to over 30 in Tanzania, Egypt (DHS-I), and Jordan. Based on calendar-year periods, at this highest level of differential displacement the mortality rates for the most recent five-year period are likely to be underestimated by about four percent, and the mortality rates for the preceding five-year period to be overestimated by a similar amount (Sullivan et al., 1990). However, the impact will tend to be less on rates from DHS-II surveys, as discussed in Chapter 2. With the exception of Northeast Brazil, the difference in the birth ratios tends to be less in Latin American surveys than in most other surveys. Pakistan stands out with extremely high levels of displacement. However, the level of displacement is very high for both surviving and dead children, so the difference between the two birth ratios is relatively low.

In Table 5.4 the birth ratios for the fifth calendar year before the survey can be compared by survival status for countries with a DHS-I and a DHS-II survey. In Indonesia, the difference in the birth ratios for surviving and dead children is substantially higher in the DHS-II survey than in the DHS-I survey, primarily because of increased displacement of dead children in the later survey. In Northeast Brazil, the difference in the birth ratios between surviving and dead children is also higher in the second survey than in the first one. However, this results from an apparent excess of living children born in the fifth calendar year prior to the survey, and displacement of dead children appears to have decreased slightly.

In contrast, the differential in birth ratios by survival status is lower in the DHS-II survey than in the DHS-I survey in Egypt, Dominican Republic, and Peru. In the Dominican Republic and Peru this is due to some decreases in displacement of dead children combined with some increase in displacement of surviving children. In Egypt, displacement of

Table 5.4 Birth ratios for the fifth calendar year preceding the start of the survey by survival status, DHS-I and DHS-II data for countries participating in both surveys

Country	Living children	Dead children	Difference in birth ratios[1]	All births
Asia/Near East/ North Africa				
Egypt				
DHS-I	92.7	60.9	31.8	88.3
DHS-II	97.1	75.8	21.3	94.9
Indonesia				
DHS-I	110.0	113.8	-3.8	110.4
DHS-II	92.4	66.9	25.5	89.2
DHS-II[2]	93.3	67.3	26.0	90.4
Morocco				
DHS-I	91.0	95.7	-4.7	91.5
DHS-II	99.3	105.8	-6.5	99.8
Latin America/ Caribbean				
Brazil				
DHS-I	99.9	73.2	26.7	97.3
DHS-II	111.7	87.3	24.4	109.1
DHS-I[3]	93.5	73.8	19.7	90.4
DHS-II[4]	110.8	82.8	28.0	107.9
Colombia				
DHS-I	95.7	106.1	-10.4	96.4
DHS-II	99.4	94.5	4.9	99.3
Dominican Rep.				
DHS-I	103.2	72.0	31.2	100.0
DHS-II	89.8	80.6	9.2	89.2
Peru				
DHS-I	101.7	80.5	21.2	99.2
DHS-II	92.2	85.9	6.3	91.6

Notes: Birth ratios are defined as 100 x 2B5/(B4+B6) where B4, B5, and B6 are the number of births in the fourth, fifth, and sixth calendar years preceding the start of the survey.

[1]Ratio for living children minus ratio for dead children.
[2]Excluding seven provinces that were not included in DHS-I.
[3]Northeast only.
[4]Births to women age 15-44 at the time of the survey only.

Source: DHS-I figures (except Egypt): Sullivan et al., 1990, Table 3.2.

both surviving and dead children decreased in the second survey but this decrease was more pronounced for dead children. In Colombia and Morocco,[3] there is no evidence of substantial displacement of either living or dead children in either survey.

To conclude, the problem of birth displacement in general, and differential displacement by survival status in particular, persists in many DHS-II surveys. The number of questions in the health section was increased to 88 in the DHS-II core questionnaires from 52 in the DHS-I A-core questionnaire and 60 in the DHS-I B-core questionnaire. Most of these questions are repeated for each child born after January 1st of the fifth calendar year prior to the survey so the incentive for interviewers to displace births out of the health section is stronger in DHS-II surveys than in DHS-I surveys. However, awareness of the problem in DHS-I surveys enabled it to be addressed in training sessions for DHS-II surveys and the use of field-check tables should have allowed the problem to be identified and discussed with field teams at an early stage. Clearly, these efforts were not successful in solving the problem. Indeed, the pattern of differential displacement by survival status is more consistent across DHS-II surveys than across DHS-I surveys, and the DHS-II survey in Indonesia demonstrates higher levels of displacement of dead children than the DHS-I survey. In fact, the DHS-I survey in Indonesia included only a very brief health section containing just 15 questions so the increase in the incentive to displace births was particularly pronounced there.

Although the increased length of the health section probably explains the persistence of the birth displacement problem in DHS-II surveys, it does not fully explain why dead children are displaced more frequently. Several of the questions in the health section are skipped for dead children so the burden of the health section is actually less for dead children than for surviving children. In DHS-I, 43 of the health questions related to dead children in the B-core questionnaire and 35 in the A-core questionnaire. In DHS-II, this number was increased to 58 for both the A- and B-core questionnaires, 30 fewer than were asked about surviving children. One explanation for the higher level of displacement of dead children could be that respondents are less able to provide a year of birth for a dead child, at least in part because they do not have a current age to work from. Hence, interviewers are more likely to have to estimate the year of birth for dead children, making it easier for them to displace a dead child to before the period covered by the health section. The combination of an increased health section and poorer reporting of the date of birth of dead children appears to have resulted in consistently higher displacement of dead children than surviving children in DHS-II surveys despite the additional emphasis placed on this issue in training and field procedures.

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[3]The DHS-II survey in Morocco used a six-year period for the health section. Consequently the birth ratios refer to the sixth calendar year preceding the survey and any displacement to avoid the health section would have little effect on mortality rates.

Chapter 6

Age-at-death data

In DHS-I and DHS-II surveys, age-at-death information was collected in either days (for children dying within a month of birth), months (for children dying after one month but before their second birthday), or years (for children dying after their second birthday). This information was recorded by first circling the appropriate units code and then recording the number of days, months, or years.

In the DHS-II raw data files, the original information is stored as two variables; the first indicates the units, and the second indicates the number of units recorded on the questionnaire. Dead children with missing information on age at death are given a special code. A third variable (computed from the other two) contains the age at death in completed months. The imputed age at death for children with missing or inconsistent information on age at death is contained in this third variable.

Interviewers did not always follow the correct procedures for recording age at death. A response of "one year" was sometimes recorded rather than the age at death in months. In some surveys, values of one year were changed to 12 months during data entry and this value appears in both the raw and imputed variables. In other surveys, the one-year values were not systematically changed; they appear as one year in the raw variables and 12 months in the imputed variable.

6.1 Completeness of the Data

In DHS-II surveys, the age-at-death data are considered to be complete if both the units indicator and the number of units were recorded on the original questionnaire. In DHS-I surveys, the age-at-death data are considered to be complete if both the units indicator and the number of units were recorded on the original questionnaire and the reported age at death was less than the interval between the date of birth and the date of interview. This difference in definition means that ages at death that are inconsistent with the date of interview are *not* considered as incomplete in DHS-II surveys and is due to the way inconsistent responses were treated in DHS-I and DHS-II surveys, as explained in Section 3.3 of this report. In fact, this difference is very minor because in all DHS-I surveys except the Dominican Republic, the vast majority of incomplete age-at-death data were due to missing information not inconsistent responses (Sullivan et al., 1990). Table 6.1 shows the percentage of deaths among children under five with incomplete information on age at death by the time-period prior to the survey in which the death occurred.

Yemen stands out as having the highest percentage of deaths missing information on age at death. For the period 0-24 years before the survey, seven percent of all deaths in Yemen have an incomplete age at death. This figure is one percent or less in all other surveys except for Kenya (DHS-I, 1.6 percent) and Madagascar (1.2 percent). A similarly high level of completeness was found in DHS-I surveys (Sullivan et al., 1990) and suggests that either respondents are able to provide this information or that interviewers are willing to estimate an age at death after probing. However, it must be stressed that complete information is not necessarily accurate information.

It is often suggested that respondents are less able to provide information about events in the more distant past than about recent events. This hypothesis implies that reporting would be more complete for recent events than for events further back in time. No evidence to support this hypothesis is found in Table 6.1. Indeed, in Cameroon, Madagascar, Namibia, Bolivia (DHS-I), and Colombia, there are more incomplete ages at death in the period 0-4 years before the survey than in the periods 5-9 and 10-14 years before the survey. The reason for this is unclear but it is possible that interviewers were reluctant to probe deeply for

Table 6.1 Percentage of deaths under five with incomplete information on age at death by period in which the death occurred, DHS-II surveys and selected DHS-I surveys

Country	Years preceding survey 0-4	5-9	10-14	15-19	20-24	0-24	Deaths
Sub-Saharan Africa							
DHS-I							
Kenya	1.9	2.1	1.1	0.7	1.7	1.6	2382
DHS-II							
Burkina Faso	0.2	0.3	0.4	0.1	0.0	0.2	4535
Cameroon	0.6	0.0	0.4	0.2	0.6	0.3	1847
Madagascar	1.3	0.7	0.6	1.4	3.4	1.2	3145
Malawi	0.0	0.1	0.4	0.2	0.0	0.2	3871
Namibia	1.8	0.7	0.0	1.1	0.0	0.8	1172
Niger	0.2	0.2	0.1	0.3	0.3	0.2	7069
Nigeria	0.4	0.7	1.0	0.6	0.0	0.6	5308
Rwanda	0.0	0.0	0.1	0.0	0.0	0.0	3383
Senegal	0.3	0.2	0.4	0.0	0.0	0.2	3453
Tanzania	0.2	0.1	0.2	0.4	0.0	0.2	4177
Zambia	0.1	0.0	0.6	0.0	0.0	0.1	3245
Asia/Near East/ North Africa							
DHS-I							
Egypt	0.0	0.2	0.5	0.2	0.0	0.2	5639
Sudan	0.1	0.7	0.4	0.4	0.3	0.4	3203
DHS-II							
Egypt	0.1	0.1	0.1	0.0	0.2	0.1	5039
Indonesia	0.0	0.1	0.2	0.0	0.0	0.1	7785
Jordan	0.0	0.3	0.2	0.0	0.5	0.2	1598
Morocco	0.0	0.4	0.2	0.3	0.0	0.2	2381
Pakistan	0.4	0.4	0.7	1.2	0.3	0.6	3219
Yemen	6.9	8.3	5.8	5.9	6.6	6.8	4355
Latin America/Caribbean							
DHS-I							
Bolivia	2.8	0.5	0.2	0.5	1.2	1.0	3222
DHS-II							
NE Brazil	0.0	0.0	0.1	0.0	0.0	0.0	2179
Colombia	2.7	0.0	1.4	0.0	0.0	0.6	767703[a]
Dominican Republic	0.3	0.0	0.5	0.2	0.3	0.2	1116
Paraguay	0.0	0.2	0.0	0.0	0.6	0.1	730
Peru	0.0	0.6	0.3	0.3	0.6	0.4	3545

Notes: The period in which the death occurred is derived from the date of birth and the imputed age at death in months. Deaths that appear to occur after the date of the survey are tabulated in the most recent period (i.e., 0-4 years before the survey).

[a]The sample weights in Colombia include an inflation factor to inflate the sample population up to the total population size.

an age at death for recent deaths which the respondent may have found more distressing. Sullivan et al. (1990) also failed to find any support in DHS-I surveys for the hypothesis that completeness of age-at-death reporting deteriorates further back in time. Of course, there is no information on the amount of probing required to obtain an age at death and it is possible that more probing and estimation were required from interviewers to obtain information for deaths that occurred in the distant past than for more recent events.

Completeness of age-at-death information in countries that have both a DHS-I and a DHS-II survey can be compared in Table 6.2. There is very little difference in the completeness of the age-at-death information in the two surveys in most countries, mainly because completeness is extremely high in both surveys. The only exception is Northeast Brazil where completeness of age-at-death reporting improved in the second survey.

Table 6.2 Percentage of deaths under five with incomplete information on age at death by period in which the death occurred, DHS-I and DHS-II data for countries participating in both surveys

	Years preceding survey					
Country	0-4	5-9	10-14	15-19	20-24	0-24
Asia/Near East/North Africa						
Egypt						
DHS-I	0.0	0.2	0.5	0.2	0.0	0.2
DHS-II	0.1	0.1	0.1	0.0	0.2	0.1
Indonesia						
DHS-I	0.3	0.1	0.0	0.1	0.0	0.1
DHS-II	0.0	0.1	0.2	0.3	0.0	0.2
DHS-II[1]	0.1	0.1	0.2	0.0	0.0	0.1
Morocco						
DHS-I	0.4	0.5	0.2	0.0	0.2	0.3
DHS-II	0.0	0.4	0.2	0.3	0.0	0.2
Latin America/Caribbean						
Brazil						
DHS-I	1.6	3.8	1.8	3.1	1.3	2.5
DHS-II	0.0	0.0	0.1	0.0	0.0	0.0
DHS-I[2]	2.6	6.5	2.5	5.4	2.0	4.1
DHS-II[3]	0.0	0.0	0.1	0.0	0.0	0.0
Colombia						
DHS-I	0.6	0.5	1.0	0.6	0.9	0.7
DHS-II	2.7	0.0	1.4	0.0	0.0	0.6
Dominican Republic						
DHS-I	1.9	0.8	0.2	0.0	0.4	0.7
DHS-II	0.3	0.0	0.5	0.2	0.3	0.2
Peru						
DHS-I	0.0	0.0	0.0	0.0	0.0	0.0
DHS-II	0.0	0.6	0.3	0.3	0.6	0.4

Notes: The DHS-I figures from Sullivan et al. (1990) are based on calendar-year periods before the survey. For all other figures the periods are based on the difference between the month of survey and the imputed month of death. Deaths that appear to occur after the date of the survey are tabulated in the most recent period (i.e., 0-4 years before the survey).

[1]Excluding the seven provinces not included in DHS-I.
[2]Northeast only.
[3]Deaths to women age 15-44 at the time of the survey only.

Source: DHS-I figures (except Egypt): Sullivan et al., 1990, Table 4.1.

Table 6.3 shows the distribution of deaths of children under five with incomplete or inconsistent information on age at death, by type of defect in the information. For DHS-II surveys, the information on inconsistency is obtained from a flag variable associated with the age at death. With the exception of Rwanda, the majority of deaths with incomplete age-at-death data are due to cases where both the units and the number of units are missing. In all surveys, well under one percent of deaths have an age at death that

Table 6.3 Total reported deaths among children under five 0-24 years before the survey, and the number of deaths with incomplete or inconsistent information on age at death by type of defect in the information, DHS-II surveys and selected DHS-I surveys

Country	Total reported deaths	Deaths with in-complete inform-mation	All infor-mation missing	Units-only given	Incon-sistent response
Sub-Saharan Africa					
DHS-I					
Kenya	2382	37	31	6	0
DHS-II					
Burkina Faso	4535	10	10	0	6
Cameroon	1847	6	5	1	8
Madagascar	3145	36	19	17	0
Malawi	3871	7	6	1	20
Namibia	1172	10	9	1	7
Niger	7069	13	13	0	41
Nigeria	5308	30	24	6	10
Rwanda	3383	1	0	1	8
Senegal	3453	7	6	1	5
Tanzania	4177	8	6	2	27
Zambia	3245	4	4	0	16
Asia/Near East/ North Africa					
DHS-I					
Egypt	5639	13	12	1	0
Sudan	3203	14	8	6	0
DHS-II					
Egypt	5039	5	4	1	0
Indonesia	7785	6	3	4	0
Jordan	1598	3	3	0	2
Morocco	2381	5	5	0	0
Pakistan	3219	19	12	7	11
Yemen	4355	296	296	0	3
Latin America/ Caribbean					
DHS-I					
Bolivia	3222	33	29	4	0
DHS-II					
NE Brazil	2179	1	1	0	3
Colombia	767703[a]	4361	3452	909	0
Dominican Republic	1116	3	2	1	0
Paraguay	730	1	1	0	1
Peru	3545	13	11	2	0

[a]The sample weights in Colombia include an inflation factor to inflate the sample population up to the total population size.

is flagged as inconsistent with other information in the survey. The number of inconsistent cases tends to be higher in some of the sub-Saharan African surveys, particularly Niger, Tanzania, and Malawi. In these surveys the number of inconsistent cases is higher than was found in any of the DHS-I surveys (Sullivan et al., 1990) but it is important to remember that more types of inconsistency are identified in DHS-II data files than was the case in DHS-I data files (see Section 3.3).

6.2 Accuracy of the Age-at-death Data

As discussed in Chapter 2, one of the most significant forms of inaccurate reporting of ages at death is heaping at 12 months, which results in under-estimation of the infant mortality rate and over-estimation of the child mortality rate. The level of heaping at 12 months is also indicative of the general accuracy of age-at-death information; populations that exhibit very high levels of heaping at 12 months are unlikely to report accurately at other ages of death either.

In this section, the amount of heaping at 12 months in DHS-II and selected DHS-I surveys is investigated using the index of heaping used by Rutstein (1985) and by Sullivan et al. (1990). Using this particular index here allows comparison with these reports. The index is calculated as the number of deaths at 12 months of age divided by the average number of deaths at months 10, 11, 13, and 14.[1] Under the assumption that the actual number of deaths changes linearly between 10 and 14 months, a value of greater than one indicates heaping at 12 months. Table 6.4 presents this index of heaping for each survey by time period prior to the survey in which the death occurred.

In the DHS-II surveys, the index of heaping for the period 0-24 years before the survey ranges from below 2 in Paraguay and Zambia to 15 in Yemen. In the same region, the index of heaping tends to be higher in the DHS-I surveys than in the DHS-II surveys. The median index of heaping for the DHS-II surveys is 5, which is well below the value of 11 found for DHS-I surveys (Sullivan et al., 1990) and in the assessment of WFS data (Rutstein, 1985).

The hypothesis that respondents are less able to recall information for events that occurred in the more distant past is again not well supported by these data. Under this hypothesis, the index of heaping would be expected to be higher for more distant time periods. This pattern is seen to some degree in the four DHS-I surveys in Table 6.4, as well as in the DHS-II surveys in Senegal, Tanzania, and Zambia, and, except for the most distant period, in Cameroon and Nigeria. However, the pattern is much less clear and consistent in the remaining surveys and is very erratic in Colombia due to the small number of deaths around 12 months there.

The suggestion from Table 6.4 that heaping of age at death at 12 months generally is less common in DHS-II surveys than in DHS-I surveys is further supported by Table 6.5. In this table the index of heaping in DHS-I and DHS-II surveys for countries with two DHS surveys can be compared. The index of heaping is lower in almost every time period in the DHS-II survey than in the DHS-I survey. The difference is particularly pronounced for Morocco where, for example, the index of heaping for the period 0-24 years before the survey decreases from 12.4 in the first survey to 2.7 in the second survey.

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[1] Other indices of heaping can be developed that may be more useful in specific applications. In particular, the index used here assumes that all the deaths heaped at 12 month actually occurred at ages 10-14 months. In some surveys, the heaped deaths may come from a wider age interval. Analyses of data quality for an individual survey permit more detailed examination of the distribution of deaths throughout the first two years and the index of heaping can be adapted to describe the situation in the particular survey of interest.

Table 6.4 Index of heaping at twelve months of age by period in which the death occurred, DHS-II surveys and selected DHS-I surveys

Country	Years preceding survey					
	0-4	5-9	10-14	15-19	20-24	0-24
Sub-Saharan Africa						
DHS-I						
Kenya	7.3	8.9	7.7	16.7	51.9	9.8
DHS-II						
Burkina Faso	8.0	7.9	7.6	5.8	6.6	7.3
Cameroon	1.8	2.7	5.0	5.7	4.3	3.4
Madagascar	3.6	4.2	2.6	2.3	3.1	3.3
Malawi	2.7	3.7	3.7	4.2	1.6	3.3
Namibia	4.7	4.0	6.2	3.5	2.2	4.4
Niger	3.4	4.3	3.4	5.1	3.7	3.8
Nigeria	4.7	7.0	8.1	9.2	6.4	6.6
Rwanda	4.1	10.6	11.1	6.6	8.0	7.7
Senegal	3.2	6.3	5.5	8.3	12.3	6.2
Tanzania	3.3	4.0	5.2	7.6	8.0	5.0
Zambia	1.4	1.8	2.0	2.6	3.2	1.9
Asia/Near East/ North Africa						
DHS-I						
Egypt	18.2	20.6	29.3	35.6	30.0	27.2
Sudan	13.3	12.6	13.9	32.5	45.3	16.0
DHS-II						
Egypt	10.7	8.3	9.9	17.0	13.0	11.6
Indonesia	3.8	4.9	7.8	5.9	10.5	5.9
Jordan	14.0	10.4	8.5	13.7	9.2	10.3
Morocco	3.6	1.9	3.3	3.5	1.5	2.7
Pakistan	12.4	8.4	15.2	9.7	5.6	9.9
Yemen	11.9	23.2	10.5	19.1	15.6	14.8
Latin America/ Caribbean						
DHS-I						
Bolivia	11.7	11.7	11.9	13.3	25.7	12.9
DHS-II						
NE Brazil	4.1	2.7	4.3	3.4	2.4	3.2
Colombia	5.1	7.6	0.6	10.7	8.9	5.0
Dominican Rep.	2.4	4.4	1.0	1.6	3.3	2.4
Paraguay	1.2	0.2	4.9	1.3	1.0	1.3
Peru	2.7	5.8	5.0	5.7	5.4	4.9

Notes: The index of heaping was calculated as 4D12/(D10+D11+D13+D14) where D12 includes all deaths reported at 12 months and 1 year.

The period in which the death occurred is derived from the date of birth and the imputed age at death in months. Deaths that appear to occur after the date of the survey are tabulated in the most recent period (i.e., 0-4 years before the survey).

Table 6.5 Index of heaping on twelve months of age by period in which the death occurred, DHS-I and DHS-II data for countries participating in both surveys

	Years preceding survey					
Country	0-4	5-9	10-14	15-19	20-24	0-24
Asia/Near East/ North Africa						
Egypt						
DHS-I	12.4	14.0	19.2	23.8	18.1	17.9
DHS-II	10.7	8.3	9.9	17.0	13.0	11.6
Indonesia						
DHS-I	3.4	8.2	9.6	10.9	7.3	7.5
DHS-II	3.8	4.9	7.8	5.9	10.5	5.9
DHS-II[1]	3.5	4.6	7.7	6.1	9.7	5.7
Morocco						
DHS-I	11.6	10.3	10.8	11.7	33.7	12.4
DHS-II	3.6	1.9	3.3	3.5	1.5	2.7
Latin America/ Caribbean						
Brazil						
DHS-I	3.4	1.6	5.2	5.0	6.1	3.4
DHS-II	4.1	2.7	4.3	3.4	2.4	3.2
DHS-I[2]	2.7	2.2	6.2	4.0	6.0	3.7
DHS-II[3]	3.7	2.5	3.3	2.6	1.3	2.6
Colombia						
DHS-I	11.4	7.8	6.9	3.7	2.7	6.0
DHS-II	5.1	7.6	0.6	10.7	8.9	5.0
Dominican Republic						
DHS-I	6.6	5.0	5.8	4.6	5.0	5.3
DHS-II	2.4	4.4	1.0	1.6	3.3	2.4
Peru						
DHS-I	9.1	6.7	7.3	16.4	30.7	9.9
DHS-II	2.7	5.8	5.0	5.7	5.4	4.9

Notes: The DHS-I figures from Sullivan et al. (1990) are based on calendar-year periods before the survey. For all other figures the periods are based on the difference between the month of survey and the imputed month of death. Deaths that appear to occur after the date of the survey are tabulated in the most recent period (i.e., 0-4 years before the survey).

[1]Excluding the seven provinces not included in DHS-I.
[2]Northeast only.
[3]Deaths to women age 15-44 at the time of the survey only.

Source: DHS-I figures (except Egypt): Sullivan et al., 1990, Table 4.3.

This improvement may be due to the efforts to reduce the incidence of heaping of age at death at 12 months in DHS surveys, through increased training and the addition of a specific check question at the end of the birth history. However, increased awareness of the issue among supervisors may also have been an important factor. Interviewers in DHS-II surveys generally appear to have been adept at probing to determine the exact age at death of children, or at least they avoided estimating the age at death as 12 months. Of course, there is no guarantee that the age at death recorded is accurate, but if interviewers were at least able to determine whether the child had or had not reached his/her first birthday at the time of death, the impact of age at death misreporting on infant and child mortality rates should be reduced significantly.

6.3 Impact of Heaping at 12 Months on Mortality Rates

There is no certain way of determining how many of the deaths heaped at 12 months actually occurred before the child's first birthday and how many occurred after. A number of approaches to adjusting the infant and child mortality rates for heaping at 12 months have been adopted in the literature. At one extreme, some analysts argue that heaping of deaths at 12 months primarily represents rounding down of the age at death and consequently do not adjust for the heaping (Rutstein, 1985). At the other extreme, some analysts argue that as much as half of the deaths reported at 12 months are late infant deaths and adjust the infant mortality rate accordingly (Goldman et al., 1979; Thapa and Retherford, 1982). The DHS reports (with the exception of Bolivia) present unadjusted mortality rates but it is clear from this analysis that heaping of age at death at 12 months occurs to varying degrees in almost all DHS-II surveys and it is unlikely that this heaping is exclusively due to rounding down of the age of death. In this section, infant and child mortality rates are adjusted for heaping of deaths at 12 months by assigning 25 percent of the "excess"[2] deaths at 12 months to the period 6-11 months. The decision to redistribute 25 percent of excess deaths is arbitrary, but it represents a compromise between the two extremes described above and is consistent with the approach applied to DHS-I surveys by Sullivan et al. (1990).

Table 6.6 presents the unadjusted and adjusted infant and child mortality rates for each survey for the period 0-9 years before the survey, together with the percent increase or decrease in the rate. Figures 6.1 and 6.2 present the percent change in the mortality rates graphically for DHS-II surveys only. The percent increase in the IMR ranges from 11 percent in Egypt (DHS-I) and 9 percent in Bolivia (DHS-I) to less than 1 percent in Paraguay. In the DHS-II surveys, the percent increase in the IMR exceeds five percent in only four surveys (Burkina Faso, Nigeria, Senegal, and Egypt) and the mean percent increase across all DHS-II surveys is 3.4 percent.

The corresponding decrease in the CMR tends to be somewhat larger in most surveys, averaging 7.1 percent in the DHS-II surveys. This is because child mortality tends to be much lower than infant mortality, so shifting even a small number of deaths has a relatively large impact on the rate. However, in the surveys in sub-Saharan Africa, the difference between the percent increase in the IMR and the percent decrease in the CMR tends to be less than in other regions. This is due to the higher level of child mortality in sub-Saharan Africa than in other regions. Indeed, in Niger, Nigeria, and Senegal, the percent increase in the IMR actually exceeds the percent decrease in the CMR because the CMR is higher than the IMR. The percent decrease in the CMR ranges from 27 percent in Egypt (DHS-I) to less than 1 percent in Paraguay, and exceeds 10 percent in six DHS-II surveys; Egypt, Jordan, Yemen, Pakistan, Northeast Brazil, and Colombia.

[2] Excess deaths are calculated as the difference between the number of deaths at 12 months and the average number of deaths at months 10, 11, 12, 13, and 14.

Table 6.6 Infant and child mortality rates for the period 0-9 years before the survey, adjusted for heaping of deaths at twelve months of age, DHS-II surveys and selected DHS-I surveys

Country	Infant mortality rate ($_1q_0$)			Child mortality rate ($_4q_1$)		
	Unad-justed rate	Ad-justed rate	Percent increase	Unad-justed rate	Ad-justed rate	Percent decrease
Sub-Saharan Africa						
DHS-I						
Kenya	58.9	61.5	4.4	34.4	31.5	8.4
DHS-II						
Burkina Faso	107.6	114.6	6.5	108.7	101.4	6.7
Cameroon	80.5	82.7	2.7	69.2	66.9	3.3
Madagascar	102.5	104.9	2.3	83.7	81.2	3.0
Malawi	135.7	139.8	3.0	120.1	115.9	3.5
Namibia	61.5	63.1	2.6	32.0	30.3	5.3
Niger	134.5	140.6	4.5	221.4	215.7	2.6
Nigeria	91.6	96.9	5.8	109.6	104.3	4.8
Rwanda	90.1	93.5	3.8	79.4	75.9	4.4
Senegal	76.0	80.2	5.5	87.4	83.2	4.8
Tanzania	99.4	102.4	3.0	60.2	57.0	5.3
Zambia	98.2	99.3	1.1	88.1	86.9	1.4
Asia/Near East/ North Africa						
DHS-I						
Egypt	93.1	103.6	11.3	42.4	31.0	26.9
Sudan	77.1	82.1	6.5	62.5	57.3	8.3
DHS-II						
Egypt	79.9	84.2	5.4	30.3	25.8	14.9
Indonesia	74.2	76.7	3.4	35.4	32.8	7.3
Jordan	36.8	37.9	3.0	5.8	4.7	19.0
Morocco	63.1	64.5	2.2	22.1	20.7	6.3
Pakistan	94.0	96.9	3.1	29.2	26.0	11.0
Yemen	100.3	104.7	4.4	40.9	36.1	11.7
Latin America/ Caribbean						
DHS-I						
Bolivia	90.6	98.7	8.9	55.2	46.6	15.6
DHS-II						
NE Brazil	93.6	95.4	1.9	18.5	16.5	10.8
Colombia	26.9	28.2	4.8	8.2	6.9	15.9
Dominican Rep.	44.5	45.2	1.6	18.9	18.2	3.7
Paraguay	36.0	36.1	0.3	11.0	10.9	0.9
Peru	63.7	66.5	4.4	29.7	26.8	9.8

Note: Mortality rates are adjusted by reassigning 25 percent of the "excess" deaths at 12 months and 1 year back to the 6-11 month age segment. See text for definition of "excess" deaths.

Figure 6.1
Percent increase in IMR after adjusting for heaping of deaths at 12 months, DHS-II surveys

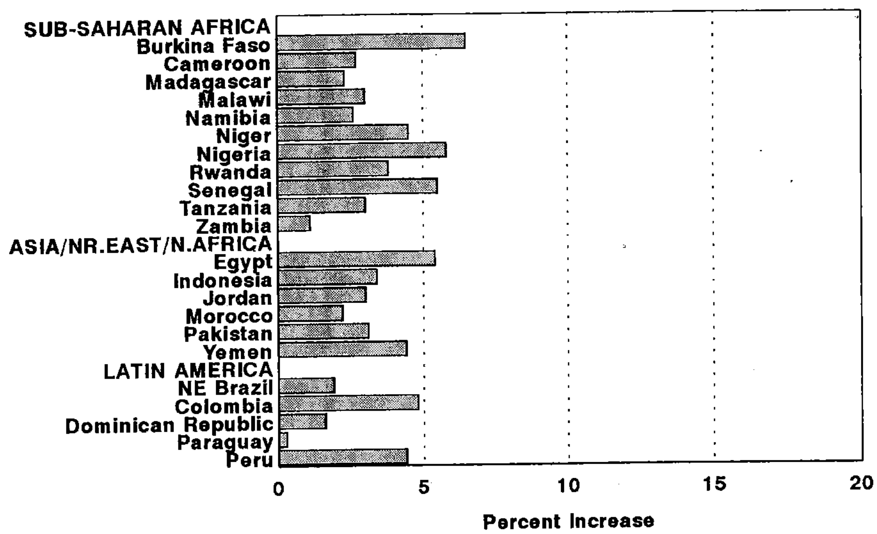
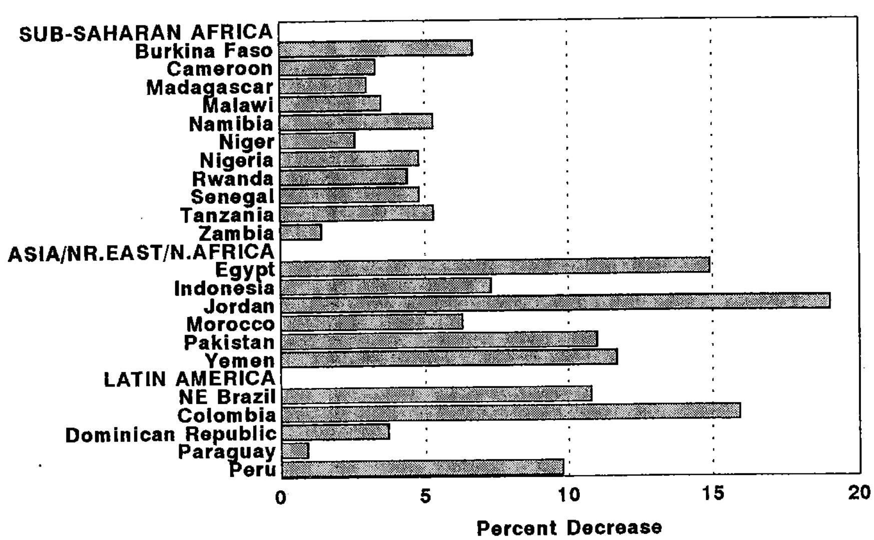


Figure 6.2
Percent decrease in CMR after adjusting for heaping of deaths at 12 months, DHS-II surveys



The under-five mortality rates for the period 0-9 years before each survey were also adjusted for heaping at 12 months (not shown). As expected, this adjustment had virtually no effect on this rate. In 12 of the 26 surveys, the adjusted under-five mortality rate was the same as the unadjusted rate. In another 12 of the 26 surveys, the adjusted rate was 0.1 deaths per 1000 live births lower than the unadjusted rate, and in the remaining 2 surveys, the adjusted rate was 0.2 deaths per 1000 live births lower than the unadjusted rate. This illustrates the robustness of this rate to misreporting of the age at death, which is one of its advantages as an overall index of child mortality.

To conclude, it appears that the implications of heaping of deaths at 12 months of age are more serious for estimates of child mortality than for estimates of infant mortality, especially in settings in which child mortality is low. However, in these settings a large relative bias may be less important substantively because the absolute bias is still small. For example, in Jordan the adjusted CMR is 19 percent less than the unadjusted CMR yet this represents a difference of only 1.1 deaths per 1000 live births. As expected, heaping at 12 months has a negligible effect on the under-five mortality rate.

Chapter 7

Completeness of Event Reporting

Omission from the birth history of children who have died is one of the most serious forms of reporting error affecting direct estimates of infant and child mortality rates; it is also one of the most difficult to detect. In this chapter, event omission is investigated by checking the internal consistency of the reported data and by comparing direct mortality estimates from DHS-II surveys with direct estimates obtained from earlier surveys of the same population.

7.1 Internal Consistency

The rationale for internal consistency checks is that mortality rates typically follow well-established patterns when examined by certain characteristics, and that deviations from these expected patterns may be indicative of defective data. However, internal consistency checks have a number of limitations that must be recognized; they cannot detect underreporting that is moderate in degree or that is non-selective across the characteristics being investigated. Therefore, while substantial departures from expected patterns may be indicative of data errors, the absence of such findings does not confirm that reporting is complete. In addition, departures from expected patterns are not necessarily due to data problems but may be due to genuine features of the mortality pattern in the population.

7.1.1 Age Pattern of Mortality

Mortality rates typically decline sharply in the first few days and weeks of life and, with a few exceptions, continue to decline, although less sharply, through late infancy and early childhood. Further, at lower mortality levels deaths typically are more concentrated at younger ages than in higher mortality populations.

It is often hypothesized that children who die at very young ages are those most likely to be underreported in retrospective surveys. If such selective underreporting is severe, an abnormally low ratio of neonatal to infant mortality would be observed. The ratio for each survey, together with the infant mortality rate, for three time periods prior to the survey are shown in Table 7.1 and Figure 7.1. For the most recent period prior to the survey, the ratio of neonatal to infant mortality ranges from 32 percent in Malawi to 66 percent in Colombia. The negative relationship between the infant mortality rate and the ratio of neonatal to infant deaths is clearly seen in Figure 7.1 and is most pronounced for the most recent period. For periods further back in time the relationship becomes weaker. The most likely explanation for this weakening of the relationship is poorer quality reporting in more distant time periods in some surveys.

In all three time periods, Northeast Brazil stands out as experiencing a relatively low ratio of neonatal to infant deaths given the level of infant mortality. This may suggest underreporting of neonatal deaths in the DHS-II survey but it could also indicate an unusual age pattern of mortality in the region. A 1984 prospective study in a rural community in Northeast Brazil found an IMR of 65 per 1000, with about one third of the infant deaths reported in the neonatal period (Bailey et al., 1990). This mortality pattern is consistent with the pattern observed in the DHS-II survey. Kenya (DHS-I) also seems to experience an unusually low ratio of neonatal to infant mortality, particularly in the periods 5-9 and 10-14 years before the survey. In addition, the infant mortality rate in Kenya increased in the most recent period prior to the survey, yet the percentage of infant deaths that occurred in the neonatal period also increased, contrary to expectation. These features of the data suggest that there may have been some omission of neonatal deaths in the earlier periods in Kenya.

Table 7.1 **Infant mortality rate and ratio of neonatal to infant mortality by period preceding the survey, DHS-II surveys and selected DHS-I surveys**

Country	Infant mortality rate			Ratio of neonatal to infant mortality		
	Years preceding survey			Years preceding survey		
	0-4	5-9	10-14	0-4	5-9	10-14
Sub-Saharan Africa						
DHS-I						
Kenya	60.7	56.9	64.1	45.6	40.2	38.2
DHS-II						
Burkina Faso	93.7	122.2	122.7	47.8	50.2	52.9
Cameroon	65.0	97.3	108.1	51.5	54.7	52.0
Madagascar	93.0	113.3	103.8	42.4	42.1	40.7
Malawi	134.3	137.5	137.1	32.0	41.5	47.7
Namibia	56.6	67.3	72.2	57.1	59.4	41.2
Niger	123.1	146.3	129.0	34.1	42.8	43.1
Nigeria	87.4	95.9	99.2	49.6	51.0	56.2
Rwanda	84.8	95.4	109.9	46.3	58.0	56.2
Senegal	68.0	84.3	90.4	52.7	55.5	50.1
Tanzania	91.6	108.6	93.7	43.4	42.4	45.5
Zambia	107.2	87.6	79.5	40.4	43.2	41.6
Asia/Near East/ North Africa						
DHS-I						
Egypt	73.2	114.7	125.5	53.1	48.6	43.9
Sudan	70.0	84.0	80.1	63.6	50.1	50.5
DHS-II						
Egypt	61.5	97.4	108.1	53.6	53.1	46.1
Indonesia	67.8	79.7	82.0	46.9	44.9	51.9
Jordan	33.8	39.9	41.7	63.9	55.7	49.1
Morocco	57.3	68.9	88.7	54.4	52.6	46.8
Pakistan	86.0	100.2	100.1	57.6	57.5	62.4
Yemen	84.4	114.5	132.4	43.1	45.7	37.2
Latin America/ Caribbean						
DHS-I						
Bolivia	81.9	99.1	95.3	46.5	45.3	45.7
DHS-II						
NE Brazil	74.7	110.3	134.3	34.4	33.1	33.2
Colombia	16.7	37.0	38.9	65.5	53.1	50.4
Dominican Republic	43.0	46.1	65.7	55.6	55.8	54.8
Paraguay	33.5	38.6	44.7	57.7	52.7	53.8
Peru	54.5	73.2	78.0	47.2	47.7	44.3

Figure 7.1a
Percent infant deaths in the first 30 days by IMR:
0-4 years before DHS-II and selected DHS-I surveys

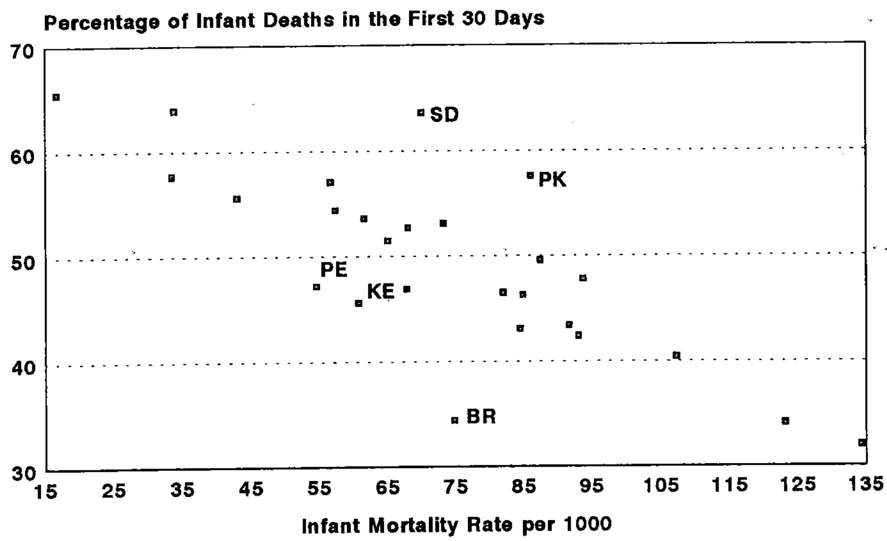
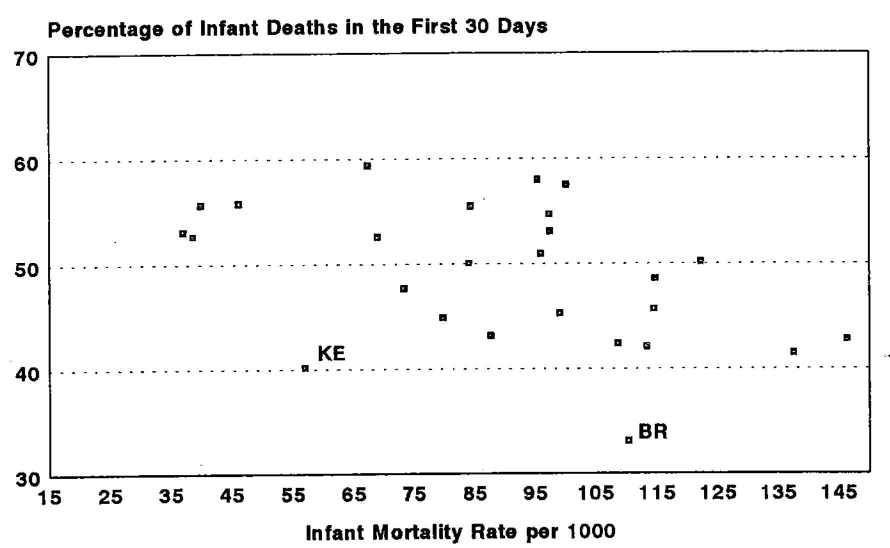
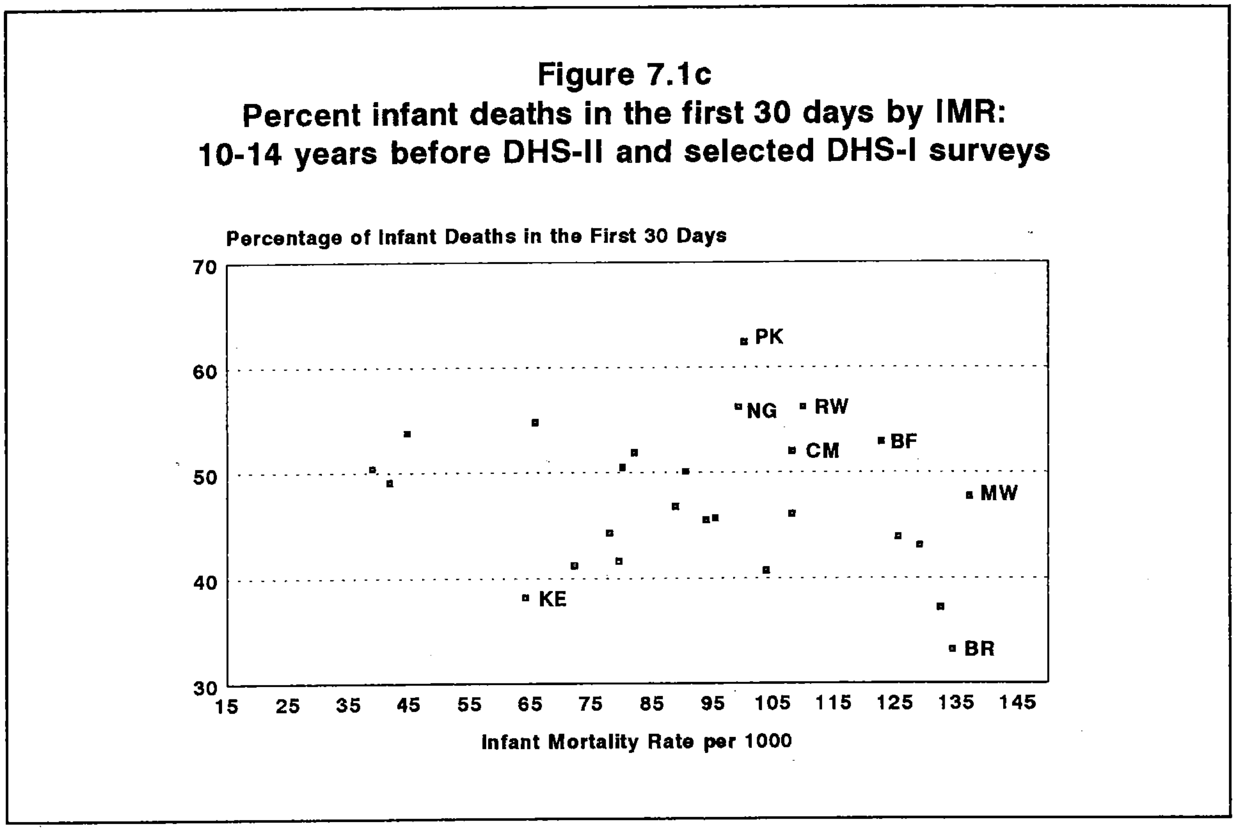


Figure 7.1b
Percent infant deaths in the first 30 days by IMR:
5-9 years before DHS-II and selected DHS-I surveys





One other point to note from Table 7.1 is that in 11 surveys (Burkina Faso, Cameroon, Dominican Republic, Malawi, Namibia, Niger, Nigeria, Peru, Rwanda, Senegal, and Yemen) both the infant mortality rate and the ratio of neonatal to infant deaths declined in the most recent period prior to the survey. This would suggest that the decline in infant mortality has been more rapid in the neonatal period than in the postneonatal period, contrary to expectation. Indeed, in Malawi and Rwanda, neonatal mortality appears to have declined in the most recent period while postneonatal mortality actually increased. This pattern could indicate omission of recent neonatal deaths in at least those surveys in which the pattern is more pronounced. However, it is not possible to draw firm conclusions on this without further investigation because a number of other explanations are possible. For example, the pattern could be genuine because improvements in prenatal care and maternal reproductive health reduce the risk of neonatal death. Another possible explanation is that the reporting of age at death may vary over time. In particular, women may tend to overestimate the age at death of recent late neonatal deaths or underestimate the age at death of early postneonatal deaths in the more distant past.

Underreporting of early infant deaths can also be investigated by examining the age distribution of neonatal deaths. Table 7.2 and Figure 7.2 present the ratio of deaths that occur under seven days (early neonatal deaths) to all neonatal deaths, together with the neonatal mortality rate for each survey for three time periods prior to the survey. The value of the ratio ranges from 46 percent in Egypt (DHS-II) for the period 10-14 years before the survey, to 82 percent in Colombia for the period 0-4 years before the survey. In Zambia, there has been a steady increase in neonatal mortality over the three periods presented. However, contrary to expectation, this increase in neonatal mortality has been accompanied by an increase in the ratio of early neonatal to neonatal deaths. This may reflect improved reporting of early neonatal deaths in the more recent period, which would suggest that there may have been some omission of early neonatal deaths in the more distant periods. This is supported to some extent by Figure 7.2. Zambia appears to have a relatively

Table 7.2 Neonatal mortality rate and percentage of neonatal deaths occurring in the first seven days by period before the survey, DHS-II surveys and selected DHS-I surveys

	Neonatal mortality rate			Ratio of neonatal deaths occurring under seven days		
	Years preceding survey			Years preceding survey		
Country	0-4	5-9	10-14	0-4	5-9	10-14
Sub-Saharan Africa						
DHS-I						
Kenya	27.8	22.5	24.3	67.5	79.6	70.2
DHS-II						
Burkina Faso	43.2	60.0	64.1	58.3	53.2	57.9
Cameroon	33.1	52.4	55.4	72.7	73.1	67.9
Madagascar	38.9	47.8	41.5	56.1	58.1	54.0
Malawi	40.8	57.5	63.4	70.6	65.2	66.7
Namibia	31.5	39.9	29.2	76.1	77.3	77.5
Niger	40.7	63.1	52.3	54.2	54.4	54.1
Nigeria	42.2	48.9	52.4	71.5	60.6	59.0
Rwanda	38.6	55.4	59.8	64.2	68.7	69.9
Senegal	34.9	46.5	43.8	63.0	57.0	60.4
Tanzania	37.9	42.4	41.2	65.5	60.4	62.5
Zambia	42.5	37.1	31.6	67.4	57.5	48.4
Asia/Near East/ North Africa						
DHS-I						
Egypt	38.3	55.5	55.0	60.4	51.2	47.3
Sudan	43.8	41.8	39.5	69.1	73.8	68.4
DHS-II						
Egypt	32.8	51.4	48.3	60.6	47.9	45.8
Indonesia	31.7	35.5	41.3	58.5	54.0	52.8
Jordan	21.4	22.6	19.7	71.0	69.8	54.4
Morocco	31.4	36.5	39.9	58.4	54.0	52.8
Pakistan	48.9	56.7	60.9	63.3	64.7	63.8
Yemen	40.9	57.7	55.2	69.7	59.0	63.9
Latin America/ Caribbean						
DHS-I						
Bolivia	36.3	46.0	43.8	63.5	60.6	65.0
DHS-II						
NE Brazil	26.1	35.8	43.5	63.2	75.4	58.1
Colombia	10.8	19.5	19.3	82.3	70.4	63.8
Dominican Rep.	23.7	25.4	35.5	74.0	69.8	65.6
Paraguay	19.4	20.1	23.3	75.0	65.3	54.8
Peru	25.3	35.2	33.4	66.9	61.9	55.7

Figure 7.2a
Percent neonatal deaths occurring under seven days by NNMR: 0-4 years before DHS-II and selected DHS-I surveys

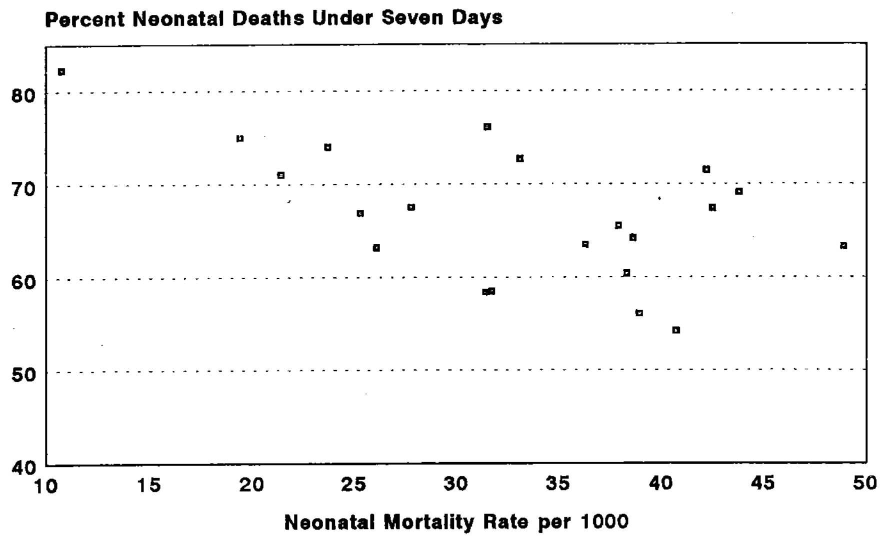


Figure 7.2b
Percent neonatal deaths occurring under seven days by NNMR: 5-9 years before DHS-II and selected DHS-I surveys

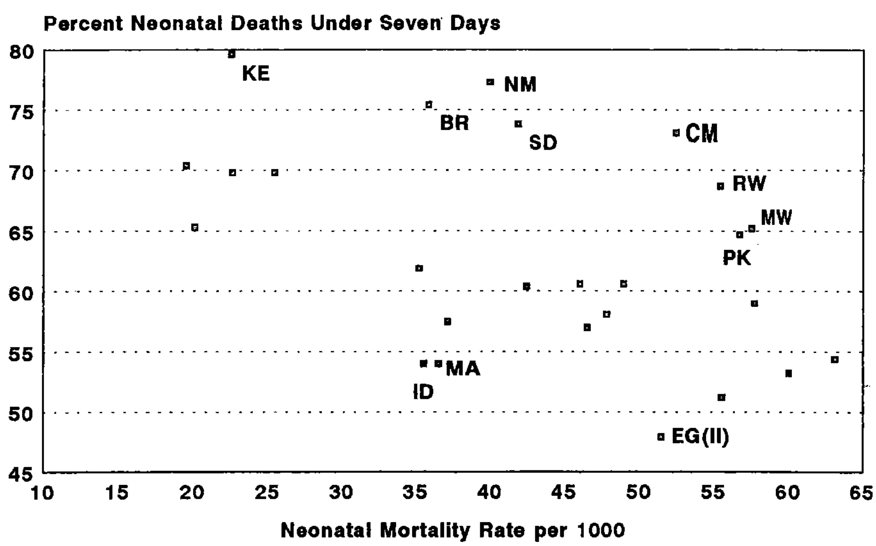
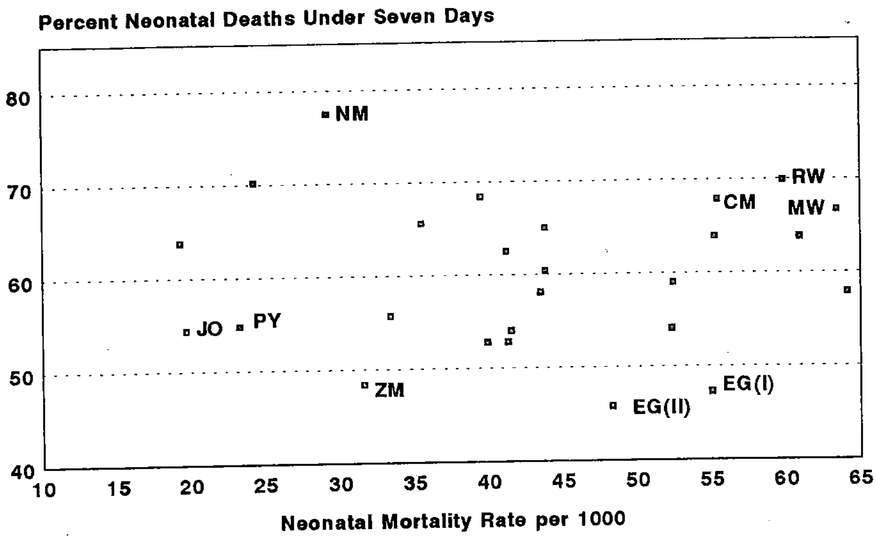


Figure 7.2c
Percent neonatal deaths occurring under seven days by NNMR: 10-14 years before DHS-II and selected DHS-I surveys



low ratio of early neonatal deaths to neonatal deaths in the period 10-14 years before the survey, but in more recent periods, this ratio conforms more with that observed in other populations with similar levels of neonatal mortality.

The expected negative relationship between the ratio of early neonatal to neonatal mortality and the neonatal mortality rate is seen in Figure 7.2 and the relationship becomes weaker for more distant time periods. Indeed, for the period 10-14 years before the survey, no clear negative relationship emerges from the graph. Again, this probably indicates poorer quality reporting of early neonatal deaths in the more distant past in some surveys. The lack of a negative relationship for the period 10-14 years before the survey is partly due to the low values of the ratio in Jordan, Paraguay, and Zambia, given the level of neonatal mortality. In his review, Boerma (1988) suggested that at a level of neonatal mortality of 20 per 1000 or higher, approximately 70 percent of neonatal deaths occur within the first six days of life. This value is much higher than observed in Jordan and Paraguay for the period 10-14 years before the survey, which could suggest poorer reporting of early deaths in the distant past in these surveys. However, no surveys consistently experience an unusually low ratio of early neonatal to neonatal deaths and there is no evidence of substantial underreporting of early neonatal deaths in recent time periods from these data.

7.1.2 Sex Differentials

Variations in mortality risk between male and female children are expected for a number of reasons. In particular, biological factors predispose boys to higher risk of death, especially during infancy. However, behavioral factors may operate in the opposite direction in societies with strong preferences for male children and where child care practices differ by sex.

The IMR sex ratio (male IMR/female IMR) of the regional model life tables varies from 1.36 to 1.16 for infant mortality rates ranging from 25 to 200 per 1000 (Coale and Demeny, 1966). These values were used to define a plausible range for the IMR sex ratio in earlier assessments of mortality data for WFS and DHS-I surveys (Rutstein, 1985; Sullivan et al., 1990). If female children who have died are omitted more frequently than male children who have died, the sex ratio will be biased upwards. If male deaths are omitted more frequently, the sex ratio will be biased downwards.

Table 7.3 presents neonatal, postneonatal, and infant mortality rates by sex, together with the sex risk ratio for each age interval, for the period 0-9 years before each survey. The value of the IMR sex ratio is within the expected range in over half of the surveys, but exceeds this range in 2 surveys, and falls below it in 10 others. In 6 of the 10 surveys with unusually low IMR sex ratios (Burkina Faso, Egypt (DHS-I and DHS-II), Madagascar, Nigeria, and Tanzania) the low IMR sex ratio is primarily due to unusually low risk ratios in the postneonatal period, whereas the sex ratio in the neonatal period is within or close to the expected range. This suggests that the apparent excess of female infant deaths is primarily concentrated in the postneonatal period and may be attributable to preferential care of sons resulting in a narrowing of the female survival advantage. This general pattern is seen in Jordan but there is some possible omission of early deaths of sons because the sex risk ratio is also low in the neonatal period.

Colombia, Malawi, and Niger also have relatively low IMR sex ratios but in these surveys the sex risk ratio is low in both the neonatal and postneonatal periods. In the case of Malawi, it is particularly low in the neonatal period. These findings are not readily explained and may indicate underreporting of male deaths in both periods, and particularly in the neonatal period in Malawi. The IMR sex ratio was also relatively low in the DHS-I survey in Colombia (Sullivan et al., 1990) but it was within the expected range in the WFS survey (Rutstein, 1985).

The surveys in Northeast Brazil and in the Dominican Republic are the only ones in which the IMR sex ratio is unexpectedly high, indicating possible omission of female deaths. In the case of Northeast Brazil, the sex risk ratio is high in both the neonatal and postneonatal period, so if omission of female deaths did occur, it was probably in both periods. The IMR sex ratio of 1.34 in the DHS-I survey, which covered the whole of the country, was also relatively high (Sullivan et al., 1990) so it is possible that excess male mortality is particularly pronounced in this population. In the Dominican Republic, the high IMR sex ratio is primarily due to the high sex risk ratio in the neonatal period, suggesting that if this is due to omission of female deaths, such omission was concentrated in the neonatal period. In the DHS-I survey in the Dominican Republic the IMR sex ratio was 1.27, which is at the upper end of the expected range (Sullivan et al., 1990).

7.2 External Consistency

External consistency checks are an extremely useful tool for assessing the quality of the estimates of childhood mortality obtained from DHS surveys. According to the United Nations data base, all the countries included in this study except Namibia, Niger, and Yemen[1] have estimates of childhood mortality obtained from sources other than the DHS-II (or DHS-I) survey (United Nations, 1992). However, the focus of this report is on direct estimates of childhood mortality rates and the majority of the alternative mortality estimates available are indirect estimates based on censuses or household surveys that included Brass questions on the number of children ever born and the number of children who died. Comparisons of direct and indirect estimates are complicated by the differences in the methodology so, for the purposes of this study, it was decided to restrict the external consistency checks to comparisons with alternative direct esti-

[1] There was a WFS survey in North Yemen in 1979 that provided estimates of childhood mortality. However, no alternative estimates are available for the country since the unification of North and South Yemen.

Table 7.3 Neonatal, postneonatal, and infant mortality rates by sex of child, and sex risk ratios for neonatal (NN), postneonatal (PNN), and infant mortality (IM), for the period 0-9 years before the survey, DHS-II surveys and selected DHS-I surveys

Country	Neonatal mortality rate		Postneonatal mortality rate		Infant mortality rate		Sex risk ratio (M/F)		
	Male	Female	Male	Female	Male	Female	NN	PNN	IM
Sub-Saharan Africa									
DHS-I									
Kenya	28.9	21.5	34.5	32.8	63.4	54.3	1.34	1.05	1.17
DHS-II									
Burkina Faso	56.9	45.5	57.6	54.8	114.5	100.3	1.25	1.05	1.14
Cameroon	48.1	36.7	38.3	37.9	86.4	74.6	1.31	1.01	1.16
Madagascar	46.5	39.5	56.8	62.3	103.2	101.8	1.18	0.91	1.01
Malawi	49.8	47.9	91.2	82.5	141.0	130.4	1.04	1.11	1.08
Namibia	39.2	31.6	27.4	25.0	66.6	56.5	1.24	1.10	1.18
Niger	52.2	51.0	83.6	82.0	135.8	133.0	1.02	1.02	1.02
Nigeria	49.2	41.8	44.7	47.5	93.9	89.3	1.18	0.94	1.05
Rwanda	49.1	44.8	49.1	37.2	98.2	82.1	1.10	1.32	1.20
Senegal	47.5	33.6	35.9	35.1	83.4	68.7	1.41	1.02	1.21
Tanzania	42.6	37.4	61.2	57.7	103.7	95.1	1.14	1.06	1.09
Zambia	46.3	33.9	59.9	56.5	106.2	90.3	1.37	1.06	1.18
Asia/Near East/ North Africa									
DHS-I									
Egypt	51.4	41.4	42.4	51.0	93.7	92.5	1.24	0.83	1.01
Sudan	50.1	35.3	33.5	35.0	83.6	70.3	1.42	0.96	1.19
DHS-II									
Egypt	48.4	36.1	36.0	39.2	84.4	75.3	1.34	0.92	1.12
Indonesia	35.9	31.4	44.1	36.5	79.9	67.9	1.14	1.21	1.18
Jordan	22.6	21.3	13.7	15.9	36.4	37.3	1.06	0.86	0.98
Morocco	38.7	29.1	30.0	28.3	68.6	57.4	1.33	1.06	1.20
Pakistan	60.1	46.1	42.0	39.3	102.1	85.5	1.30	1.07	1.19
Yemen	56.8	42.6	51.3	49.5	108.1	92.1	1.33	1.04	1.17
Latin America/ Caribbean									
DHS-I									
Bolivia	45.9	36.2	53.0	45.7	98.9	82.0	1.27	1.16	1.21
DHS-II									
NE Brazil	37.5	24.4	73.2	50.5	110.7	74.9	1.54	1.45	1.48
Colombia	15.2	15.1	12.0	11.5	27.2	26.6	1.01	1.04	1.02
Dominican Rep.	31.5	17.0	21.7	18.0	53.3	35.1	1.85	1.21	1.52
Paraguay	21.4	18.0	17.7	14.8	39.0	32.8	1.19	1.19	1.19
Peru	33.0	27.2	35.1	32.0	68.1	59.2	1.21	1.10	1.15

mates of childhood mortality. However, in-depth evaluations of individual surveys should include comprehensive comparisons with mortality rates from as many sources as possible, including indirect estimates.

Few of the countries included in this study have direct estimates of childhood mortality rates available from external sources, and in most cases the only alternative direct estimates are from WFS or DHS-I surveys. The only countries in this study with direct estimates of childhood mortality rates available from sources other than WFS and DHS are Malawi, Pakistan, and Peru (United Nations, 1992). Hence, the external consistency checks in this report are restricted to comparisons with the childhood mortality rates obtained from WFS and

DHS-I surveys. Eight of the countries with a DHS-II survey also had a DHS-I survey conducted 3-7 years earlier, and 14 had a WFS survey conducted 9-16 years earlier. In addition, the DHS-I surveys in Kenya, Egypt, and Sudan included in this report can be compared against WFS surveys conducted 9-11 years earlier.

The external consistency of the DHS-II mortality data is assessed by comparing the direct estimates of infant and child mortality rates obtained from DHS-II surveys with those obtained from DHS-I and WFS surveys for the period 0-4 years before the earlier survey.[2] Hence, the estimates obtained from the DHS-II survey are based on events that require a longer recall period. This is particularly true for comparisons between DHS-II and WFS data where the recall period for the DHS-II respondents is often more than 15 years. Consequently, the events in the DHS-II survey would be expected to be recalled less completely and less accurately than the events in the earlier survey.

External consistency checks are subject to several limitations and it is important to be aware of these. First, large discrepancies in the mortality rates obtained from two surveys are indicative of some sort of data quality problem but it is not possible to be absolutely certain what the problem is. The most frequently proposed explanation of large discrepancies is omission of deaths in the survey with the lower rate. However, systematic misplacement of deaths in time could also contribute to discrepant rates, as could sample bias in one or other of the surveys. Second, comparison of rates obtained from two surveys will not detect data quality problems that are present to the same extent in both. Third, the comparison of mortality rates refers to a period some time prior to the DHS-II survey and consequently provides no information on the quality of more recent reporting, which is often the period of most interest. This is particularly true of comparisons with WFS data. Finally, it is very important to remember that the mortality rates obtained from WFS, DHS-I, and DHS-II surveys are all subject to relatively large sampling errors. Some discrepancy in the estimated rates will result even if there are no significant data quality problems in either survey.

Table 7.4 presents neonatal, postneonatal, infant, and child mortality rates estimated from DHS-II and DHS-I surveys for the period 0-4 years before the DHS-I survey. The percent difference[3] between the DHS-II and the DHS-I rates is presented graphically for each age interval in Figures 7.3a to 7.3d. The estimated neonatal mortality rates are higher in the DHS-II survey in three countries (Egypt, Indonesia, and Peru) and are higher in the DHS-I country in the remaining five. The largest percent difference between the two rates is observed in the Dominican Republic. Here the DHS-II estimate is about 35 percent lower than the corresponding DHS-I estimate, which may suggest omission of neonatal deaths in the DHS-II survey. In contrast, the DHS-II estimates of neonatal mortality are around 20 percent higher than the DHS-I estimates in Egypt and Indonesia, which could indicate omission of early deaths in the DHS-I surveys in these countries.

The situation is very similar for postneonatal mortality. In three countries the estimated postneonatal rate is higher in the DHS-II survey and in the remaining five countries it is higher in the DHS-I survey. Again, the largest percent difference is seen in the Dominican Republic, where the DHS-II estimate is around 25 percent lower than the DHS-I estimate. This suggests that the possible omission of deaths in the DHS-II survey in the Dominican Republic is not restricted to neonatal deaths. Relatively large discrepancies between the estimated postneonatal mortality rates are also seen in Egypt and Colombia but in these two cases the

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[2] The direct estimates from the earlier survey are adjusted to allow for possible truncation bias (see Chapter 2). In the comparison of DHS-I and DHS-II surveys, truncation bias is compensated for by calculating the mortality rates based on births to women age 15-44 at the time of the DHS-I survey only (15-42 in the case of Senegal). In the comparison of DHS-II and WFS surveys, the mortality rates are based on births to women age 15-34 at the time of the WFS survey (15-33 in the case of the Dominican Republic).

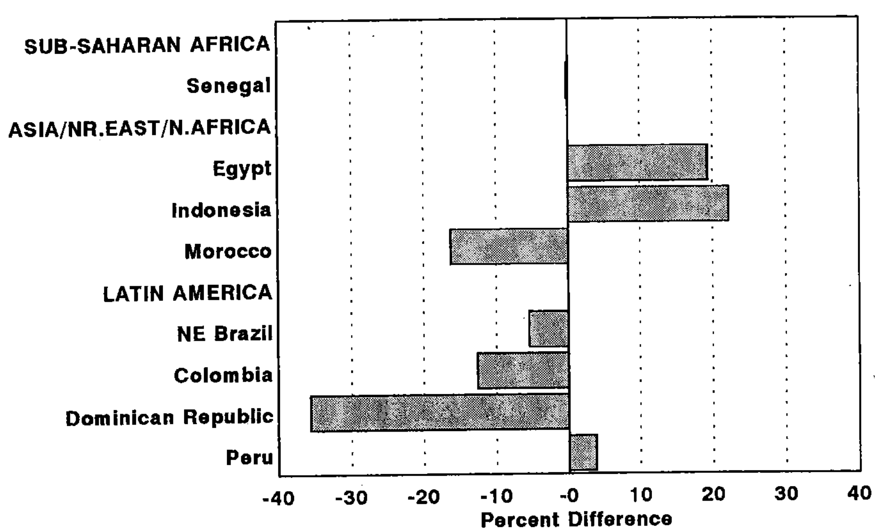
[3] The percent difference is defined as 100×(DHS-II rate - DHS-I rate)/DHS-I rate.

Table 7.4 Neonatal, postneonatal, infant, and child mortality rates estimated from DHS-I and DHS-II surveys for the period 0-4 years before the DHS-I survey

Country	Mid-point of reference period	Neonatal mortality		Postneonatal mortality		Infant mortality		Child mortality	
		DHS-I	DHS-II	DHS-I	DHS-II	DHS-I	DHS-II	DHS-I	DHS-II
Sub-Saharan Africa									
Senegal	Nov. 1983	44.7	44.6	42.8	42.5	87.6	87.1	117.6	112.4
Asia/Near East/ North Africa									
Egypt	May 1986	38.3	45.7	35.1	42.2	78.5	87.9	30.6	34.0
Indonesia[1]	April 1985	27.4	35.7	40.0	43.3	67.3	79.0	32.3	37.5
Morocco	Dec. 1984	42.1	35.3	32.9	31.4	75.0	66.7	30.8	24.0
Latin America/ Caribbean									
NE Brazil	Dec. 1983	38.4	36.3	80.3	75.4	118.7	111.7	22.2	24.0
Colombia	April 1984	19.1	16.7	12.8	15.9	31.9	32.6	9.6	9.0
Dominican Republic	April 1984	39.3	25.3	27.6	20.6	66.9	45.8	21.3	19.8
Peru	April 1984	34.1	35.4	41.2	37.7	75.3	73.1	37.4	36.1

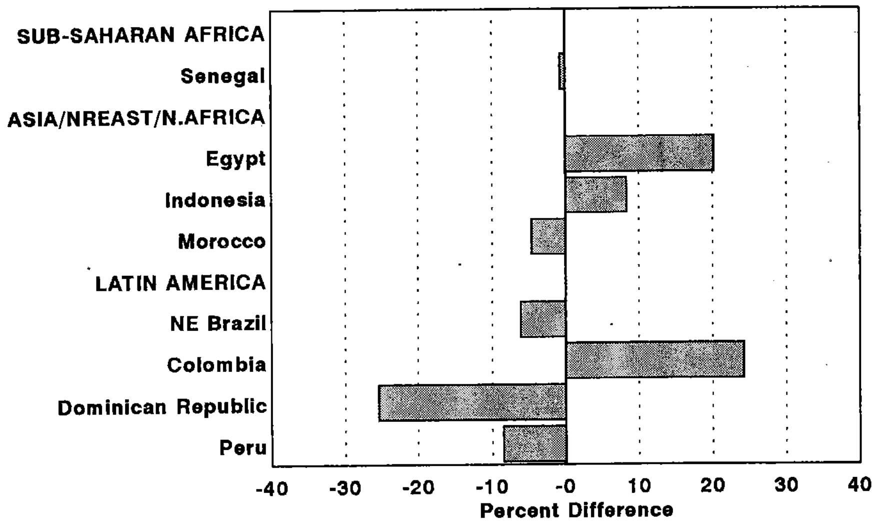
Note: Figures are based on births to women age 15-44 (15-42 in the case of Senegal) at the time of the DHS-I survey.
[1]Excluding the seven provinces not included in DHS-I.

Figure 7.3a
Percent difference in DHS-II and DHS-I NNMR estimates 0-4 years before the DHS-I survey



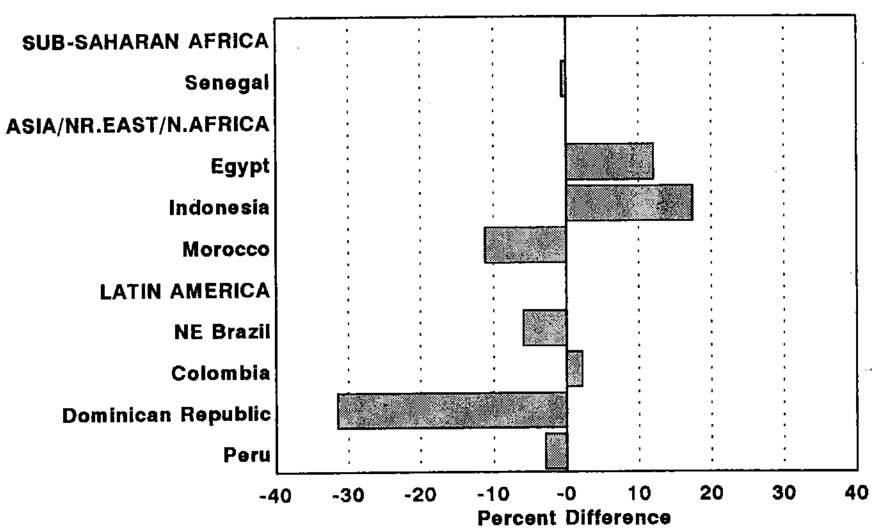
Percent difference = (DHS-II - DHS-I)/DHS-I

Figure 7.3b
Percent difference in DHS-II and DHS-I PNMR estimates 0-4 years before the DHS-I survey



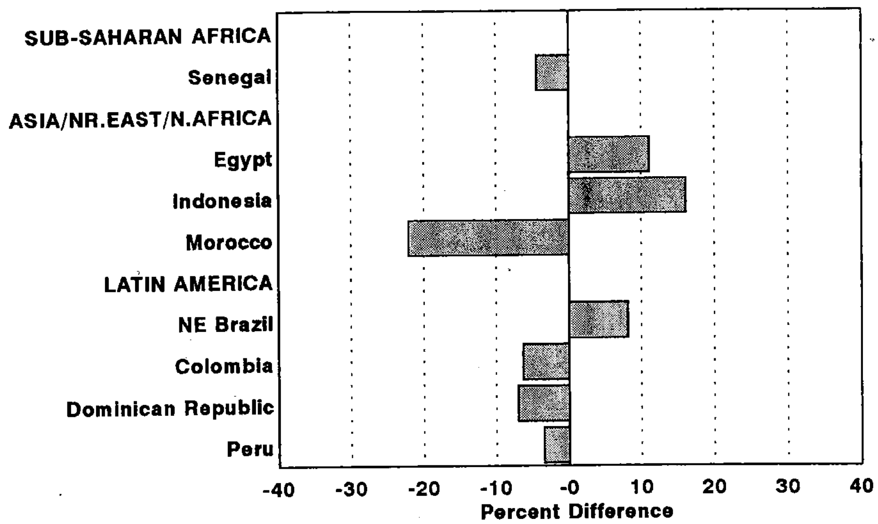
Percent difference = (DHS-II - DHS-I)/DHS-I

Figure 7.3c
Percent difference in DHS-II and DHS-I IMR estimates 0-4 years before the DHS-I survey



Percent difference = (DHS-II - DHS-I)/DHS-I

Figure 7.3d
Percent difference in DHS-II and DHS-I CMR estimates 0-4 years before the DHS-I survey



Percent difference = (DHS-II - DHS-I)/DHS-I

DHS-II estimates are around 20 percent higher than the DHS-I estimates. In the remaining five countries the estimates from the two surveys are very similar.

Overall, estimates of the infant mortality rate for the period 0-4 years before the DHS-I survey are quite similar from the DHS-I and the DHS-II surveys. The major exception is the Dominican Republic, where the infant mortality rate estimated from the DHS-I survey is 67 per 1000 compared to only 46 per 1000 from the DHS-II survey. In Indonesia, the infant mortality rate estimated from the DHS-II survey is 79 per 1000 compared to 67 per 1000 in the DHS-I survey, which is due primarily to the higher neonatal mortality rate obtained from the DHS-II survey.

The estimated child mortality rates obtained from each survey are generally very similar. This would be consistent with the hypothesis that early deaths are the most likely to be omitted. The only country in which there is a notable difference in the child mortality estimates obtained from the DHS-I and the DHS-II surveys is Morocco, where the DHS-II estimate is about 20 percent lower than the DHS-I estimate. However, this reflects an absolute difference of only 7 deaths per 1000 and it must be remembered that the sampling errors associated with child mortality rates are large. In addition, heaping of deaths at 12 months was much less common in the DHS-II survey in Morocco than in the DHS-I survey, which could also contribute to the difference.

Table 7.5 presents infant and child mortality rates estimated from DHS and WFS surveys for the period 0-4 years before the WFS survey (see also Figure 7.4). The recall period for the events used to calculate mortality rates from the DHS surveys in this comparison is much longer than in the previous comparison so the DHS estimates would be expected to compare less favorably with the WFS estimates than with the DHS-I estimates. This is supported to some extent by the fact that the estimated infant mortality rate from the DHS survey is lower than the estimate obtained from the WFS survey in 12 of the 17 comparisons.

Table 7.5 Infant and child mortality rates estimated from WFS and DHS-II and selected DHS-I surveys for the period 0-4 years before the WFS survey

Country	Mid-point of reference period	Infant mortality		Child mortality	
		WFS	DHS	WFS	DHS
Sub-Saharan Africa					
DHS-I					
Kenya	June 1975	86.4	70.0	57.6	51.1
DHS-II					
Cameroon	Oct. 1975	103.0	115.7	97.9	93.1
Nigeria	Sept. 1975	87.4	104.6	79.2	108.1
Rwanda	March 1981	99.0	105.1	107.3	118.4
Senegal	Jan. 1976	115.1	97.1	167.4	168.2
Asia/Near East/ North Africa					
DHS-I					
Egypt	Aug. 1977	134.2	121.5	68.3	79.3
Sudan	July 1976	76.7	81.1	78.3	67.4
DHS-II					
Egypt	Aug. 1977	134.2	121.7	68.3	76.2
Indonesia[1]	Oct. 1973	97.0	100.1	73.1	55.5
Jordan	Jan. 1974	65.8	57.2	14.2	12.9
Morocco	Nov. 1977	92.2	90.8	57.3	51.2
Pakistan	Jan. 1973	146.4	98.8	80.4	53.4
Yemen[2]	March 1977	167.0	158.0	85.0	105.9
Latin America/ Caribbean					
DHS-II					
Colombia	Dec. 1973	63.7	50.4	35.5	30.0
Dominican Republic	Nov. 1972	85.4	73.8	44.8	31.5
Paraguay	Sept. 1976	56.6	48.3	23.2	21.0
Peru	March 1975	92.5	80.0	56.9	49.1

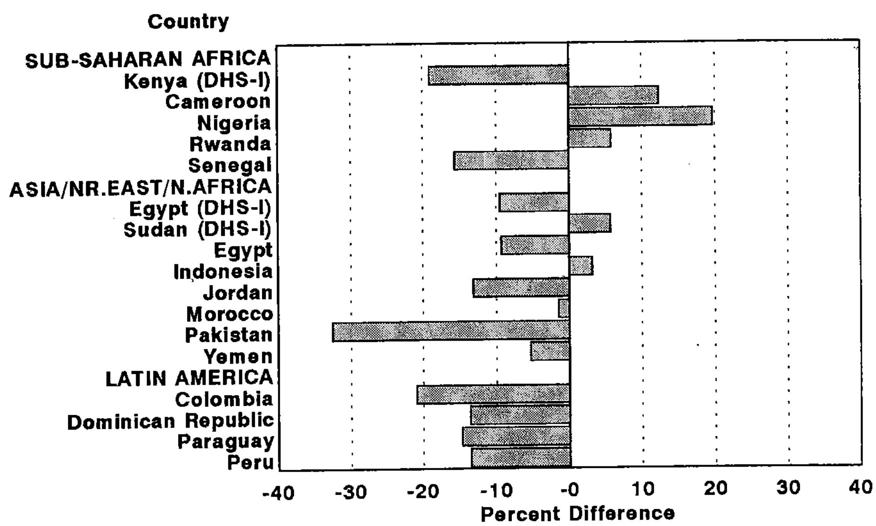
Note: Figures are based on births to women age 15-34 (15-33 in the case of the Dominican Republic) at the time of the WFS survey.

[1]Java-Bali only
[2]Former North Yemen only

The largest percent difference is found in Pakistan, where the DHS estimate is 30 percent below the corresponding WFS estimate, suggesting underreporting of infant deaths in the distant past in the Pakistan DHS. This is consistent with the findings of a reinterview survey conducted in Pakistan following the DHS survey wherein evidence of omission of infant deaths throughout the birth history in the Pakistan DHS was found (Curtis and Arnold, 1994).

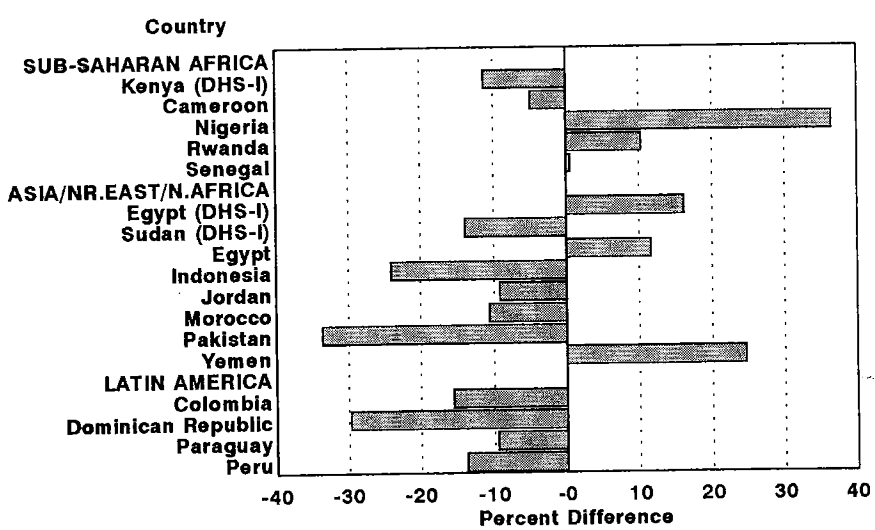
The DHS surveys in Kenya (DHS-I) and Colombia also provide estimates of the infant mortality rate somewhat below the corresponding estimates obtained from the WFS. In the case of Colombia, the period covered by these estimates is on average about 17 years before the DHS-II survey and the previous comparison with the DHS-I survey in Colombia found no evidence of substantial omission of more recent deaths in the DHS-II survey.

Figure 7.4a
Percent difference in DHS-II and WFS IM estimates 0-4 years before the WFS survey



Percent difference = (DHS - WFS)/WFS

Figure 7.4b
Percent difference in DHS-II and WFS CM estimates 0-4 years before the WFS survey



Percent difference = (DHS - WFS)/WFS

In the case of Kenya, Brass and Jolly (1993) also found evidence of underreporting of deaths in the DHS-I survey. However, because their analysis was also based on comparisons with the Kenya Fertility Survey, it again refers only to a period more than 10 years before the DHS survey. Therefore, they are unable to conclude anything about the quality of reporting in more recent periods prior to the DHS. The quality of reporting closer to the DHS-I survey can be investigated by comparing the rates obtained for the periods 0-4 and 5-9 years before the DHS-I survey with those recently published from the 1993 DHS-III survey in Kenya for the periods 5-9 and 10-14 years before the DHS-III survey.

The IMR obtained from the DHS-I survey for the period 5-9 years before the DHS-I survey is 56.9 per 1000 compared to 68.9 per 1000 obtained from the DHS-III survey for the period 10-14 years before the DHS-III survey. The DHS-I estimate of the IMR for the period 0-4 years before the survey is 60.7 per 1000 compared to 63.4 per 1000 obtained from the DHS-III survey for the period 5-9 years before the DHS-III survey (National Council for Population and Development, Central Bureau of Statistics, and Macro International Inc., 1994). These comparisons are very crude because the DHS-III survey actually took place about four years after the DHS-I survey so the time periods do not correspond exactly and there is no control for truncation bias. However, they do suggest that there may be omission of deaths in the DHS-I survey in the period 5-9 years before the DHS-I survey, but there is no evidence of omission in the 0-4 year period prior to the DHS-I survey. This conclusion is consistent with Figure 7.1 discussed in Section 7.1 wherein possible omission of neonatal deaths in the Kenya DHS for the periods 10-14 and 5-9 years before the survey, but not in the 0-4 year period before the survey, was suggested.

In several surveys the relative difference between the child mortality rates estimated from the DHS and the WFS surveys in each country is larger than the relative difference between the infant mortality rates. This contrasts with the pattern seen in the comparison of DHS-II and DHS-I child mortality rates but is consistent with the pattern noted by Sullivan et al. (1990) in their comparison of under-five mortality rates obtained from DHS-I and WFS surveys. Omission of child deaths is expected to be less frequent than omission of infant deaths, which would lead to the expectation that the child mortality rates should be more consistent than the infant mortality rates. However, sampling errors tend to be large for child mortality rates, especially in populations with low child mortality (see Chapter 4) so this may account for the larger relative differences.

The CMR estimated from the DHS in Nigeria is more than 30 percent higher than the corresponding rate obtained from the WFS but in Pakistan it is more than 30 percent lower. Interestingly, the reinterview study in Pakistan found no evidence of omission of child deaths although it is possible that undetected omission did occur (Curtis and Arnold, 1994). Relatively large shortfalls in the CMR estimated from the DHS compared to the WFS are also observed in the Dominican Republic and Indonesia, whereas in Yemen the WFS rate appears to be too low when compared to the DHS rate. In the remaining surveys, the WFS and DHS estimates are quite close, especially when sampling variation and the long recall period for DHS respondents are taken into consideration.

Chapter 8

Discussion and Recommendations

A comprehensive comparative analysis of the quality of the data used for the direct estimation of infant and child mortality rates collected in DHS-II and selected DHS-I surveys has been presented in an attempt to: assess the general quality of DHS-II child mortality data, evaluate progress in the improvement of data quality between DHS-I and DHS-II, and identify particular problems in individual surveys. Overall, the quality of the DHS-II mortality data appears to be comparable to or better than the data of other retrospective household surveys such as WFS and DHS-I. However, a number of problems were identified. The main findings are summarized below.

8.1 Quality of the Data

The reporting of date of birth is consistently less complete for dead children than for surviving children. However, the percentage of dead children missing year of birth is under seven percent in all surveys in this study, which is an improvement over DHS-I. Further, omission of date of birth information does not present a significant problem for the estimation of childhood mortality rates in any of the surveys in this report. It must be stressed, though, that this high level of completeness does not imply that the date-of-birth data are accurate. Indeed, it probably reflects improvements in supervision and the implementation of DHS field and editing procedures rather than improvements in the knowledge of dates among respondents.

Displacement of births to the period prior to that covered by the health section of the questionnaire remains a problem in DHS-II surveys despite the additional emphasis placed on this issue in training. The differential in birth displacement by survival status is more consistent across DHS-II surveys than across DHS-I surveys, with dead children being displaced more often than surviving ones. In addition, of the seven populations that have both a DHS-I and a DHS-II survey, only Egypt, Morocco, and Northeast Brazil show reduced displacement of both living and dead children in the DHS-II survey compared to the DHS-I survey.

The reporting of age at death is very complete but again this is probably as indicative of the standard of field procedures as of the level of knowledge of respondents. Heaping of age at death on 12 months is much less severe in DHS-II surveys than in DHS-I surveys but it still persists in many surveys.

Both internal and external consistency checks suggest evidence of omission of neonatal deaths in the DHS-I survey in Kenya in the periods 10-14 and 5-9 years before the survey but they do not suggest omission of deaths in the 0-4 year period before the survey. Internal consistency checks also show some evidence of omission of early neonatal deaths in Zambia in the periods 5-9 and 10-14 years before the surveys, and in Jordan and Paraguay in the period 10-14 years before the survey. However, in all these surveys reporting appears to be more complete in more recent periods prior to the survey.

The estimates of infant and child mortality obtained from the DHS-II surveys for the period immediately prior to the WFS survey generally are below the corresponding estimates obtained from the WFS. The differences are particularly pronounced in Pakistan for both infant and child mortality, in Kenya (DHS-I) and Colombia for infant mortality, and in Indonesia and the Dominican Republic for child mortality. This suggests possible omission of infant and child deaths in the distant past in these surveys. However, other explanations are also possible and no information is provided about the reporting of more recent events.

In general, the estimates of infant and child mortality rates obtained from the DHS-II surveys compare more favorably with the estimates obtained from the DHS-I surveys for the period immediately prior to the DHS-I surveys than with the estimates obtained from the WFS surveys for the period immediately prior to the WFS survey. This suggests that the reporting of deaths is indeed better for periods closer to the survey. However, there is evidence of possible omission of both neonatal and postneonatal deaths in the period prior to the DHS-I survey in the DHS-II survey in the Dominican Republic.

8.2 Recommendations

The assessment of DHS-I data for direct estimation of infant and child mortality included a recommendation for the inclusion of a specific box at the end of the birth history where interviewers are required to check that the year of birth is recorded for all dead children and a similar box for interviewers to check that any age at death given at 12 months had been probed (Sullivan et al., 1990). Providing increased emphasis on the issue of heaping in training was also recommended. These recommendations were implemented in most DHS-II surveys. Although they seem to have been effective in reducing problems of omission of year of birth of dead children and of heaping of age at death at 12 months these problems still occur. Thus, it is essential that the emphasis placed on these issues is maintained in the surveys conducted under the third phase of the DHS program (DHS-III).

The two main problems for the direct estimation of mortality rates that appear from this report are differential displacement of the date of birth of surviving and dead children to the period prior to that covered by the health section of the questionnaire and omission (or misplacement) of deaths that occurred more than 10 years before the survey. Both of these problems are likely to prove difficult to deal with.

Differential displacement of births by survival status has implications for the estimation of mortality rates, although its impact is relatively modest. Birth displacement is believed to be associated with the presence of the health section of the questionnaire, which was expanded for both surviving and dead children in DHS-II. Field experience suggests that in some surveys interviewers felt uncomfortable discussing infant and child deaths in such detail with respondents and this, combined with the increased burden imposed by the expanded health section, may have increased the incentive to displace births, especially the births of deceased children, to the period immediately before that covered by the health section. Increased emphasis on this issue in training was recommended by Sullivan et al. (1990) as was the use of field-check tables to identify the problem at an early stage. However, these measures do not appear to have been effective in reducing the problem.

In DHS-III surveys, the period covered by the health section has been reduced to the three calendar years prior to the start of the survey in an attempt to reduce the interview burden associated with the health section and hence to reduce the incentive to displace births. Whether this change will be effective in reducing the problem remains to be seen; the situation is being monitored very closely during DHS-III. If the problem persists despite the reduced health section, additional steps must be taken to address the issue. For example, field-check tables must be produced as early as possible in the fieldwork and any problems identified must be reported back to the interview teams. Additional field supervision by Macro staff may also be required to ensure adherence to field procedures. Motivation and morale of field staff are key factors and efforts should be made to ensure that they are maintained at high levels.

Omission (or misplacement) of deaths that occurred in the distant past has been a longstanding problem in retrospective demographic surveys. To some extent this is a product of the cultural environment in which the surveys are conducted although every effort should be made to probe for omitted deaths in the birth history. In an attempt to reduce the omission of events the DHS-III core questionnaire includes an additional question in the birth history for each child (except the first one) which specifically probes for omitted births in intervals where the difference in the year of reported births is more than four years. However, this is an extremely difficult problem to identify with confidence and is likely to persist for some time in populations in which knowledge of ages and dates is poor. Considerable caution should be exercised when using the data on infant and child mortality from the birth history for periods more than 10 years prior to the survey. In particular, it is strongly recommended that data from more than one source be used for trend analyses whenever possible.

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APPENDIX A

CALCULATION OF SYNTHETIC COHORT PROBABILITIES OF DEATH

Appendix A

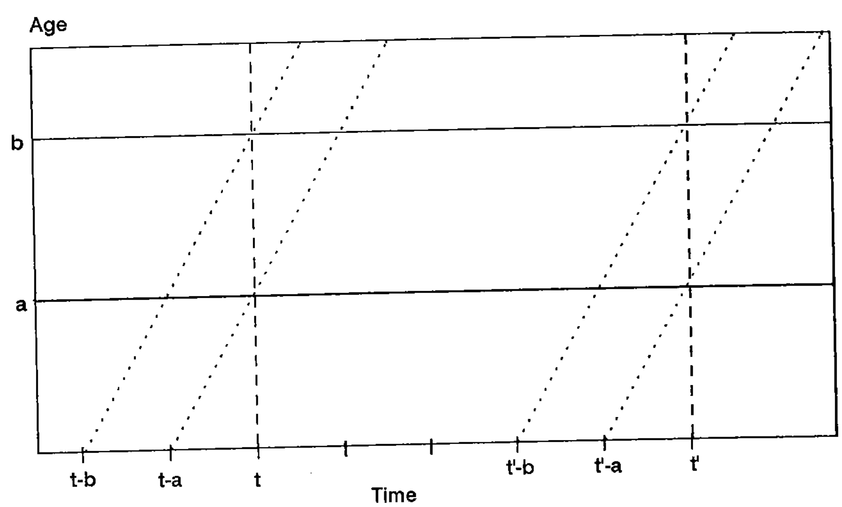
Calculation of Synthetic Cohort Probabilities of Death

The procedure for calculating synthetic cohort probabilities of death is based on the procedure first developed by Somoza (1980) and modified by Rutstein (1984). In this approach, probabilities of death are built up from probabilities calculated for the following age intervals: less than 1 month, 1-2 months, 3-5 months, 6-11 months, 12-23 months, 24-35 months (2 years), 36-47 months (3 years), and 48-59 months (4 years). The probability of death is obtained by dividing the number of deaths occurring between the relevant age limits to children who were exposed to death within the calendar period by the number of children exposed in the same age/calendar period.

Referring to Figure A.1, there are three groups of children who are exposed to death between ages a and b during the time t to t′:

- Children born between t-a (age a at time t) and t′-b (age b at time t′),
- Children born between t-b and t-a, and
- Children born between t′-b and t′-a.

Figure A.1
Cohorts used to calculate synthetic rates
Demographic and Health Surveys, 1985-1990



Children in the first group were exposed during the entire period in question, whereas children in the latter groups have been exposed only during part of that period. Due to the short length of the intervals used to code age at death, it is safe to assume that in the latter cases one-half of both the deaths and the exposure occurred within the relevant period. Thus, the numerator becomes the sum of all deaths at ages a to b occurring to children born between t-a and t′-b plus one-half of the deaths to children born between t-b and t-a, plus one-half of the deaths to children born between t′-b and t′-a. Similarly, the denominator becomes the number of children born between t-a and t′-b who survived to age a, plus one-half the number of children born between t-b and t-a who survived to age a, plus one-half the number of children born between t′-b and t′-a who survived to age a.

An exception to the procedure must be made for the period immediately before the survey since all deaths recorded for children exposed during that period must have occurred before the date of the survey. Therefore, all the deaths (rather than one-half) are counted for children born between t′-b and t′-a, although the children have been exposed, on average, for one-half of the time.

In order to calculate the conventional probabilities of death, which are presented in the tables, the probability of surviving through the sub-interval is calculated first by subtracting the probability of dying (the quotient given above) from one. Then the sub-interval survival probabilities included within the conventional age limits are multiplied together. Finally, this product is subtracted from one to give the probability of death within the conventional limits

$$(n)q(x) = 1 - \prod_{i=x}^{i=x+n} (1 - q[i])$$

where (n)q(x) is the conventional probability of dying between ages x and x+n, and q[i] are the sub-interval probabilities of dying.

The postneonatal mortality rate is defined differently from conventional rates. Although it refers to the age interval between 1 and 11 months (completed), it is not a probability. Rather it is the arithmetic difference between the infant mortality rate (the probability of dying in the first year of life) and the neonatal mortality rate (the probability of dying in the first month of life).

APPENDIX B

REPRODUCTION SECTION OF THE DHS-II CORE QUESTIONNAIRE

SECTION 2. REPRODUCTION

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP TO
201	Now I would like to ask about all the births you have had during your life. Have you ever given birth?	YES.....1 NO.....2	 →206
202	Do you have any sons or daughters to whom you have given birth who are now living with you?	YES.....1 NO.....2	 →204
203	How many sons live with you? And how many daughters live with you? IF NONE RECORD '00'.	SONS AT HOME..... [ ][ ] DAUGHTERS AT HOME..... [ ][ ]	
204	Do you have any sons or daughters to whom you have given birth who are alive but do not live with you?	YES.....1 NO.....2	 →206
205	How many sons are alive but do not live with you? And how many daughters are alive but do not live with you? IF NONE RECORD '00'.	SONS ELSEWHERE..... [ ][ ] DAUGHTERS ELSEWHERE..... [ ][ ]	
206	Have you ever given birth to a boy or a girl who was born alive but later died? IF NO, PROBE: Any baby who cried or showed any sign of life but only survived a few hours or days?	YES.....1 NO.....2	 →208
207	In all, how many boys have died? And how many girls have died? IF NONE RECORD '00'.	BOYS DEAD..... [ ][ ] GIRLS DEAD..... [ ][ ]	
208	SUM ANSWERS TO 203, 205, AND 207, AND ENTER TOTAL. IF NONE RECORD '00'.	TOTAL..... [ ][ ]	
209	CHECK 208: Just to make sure that I have this right: you have had in TOTAL ____ births during your life. Is that correct? YES [ ] ↓ NO [ ] → PROBE AND CORRECT 201-208 AS NECESSARY		
210	CHECK 208: ONE OR MORE BIRTHS [ ] ↓ NO BIRTHS [ ] → 225		→225

9

211 Now I would like to talk to you about all of your births, whether still alive or not, starting with the first one you had.
RECORD NAMES OF ALL THE BIRTHS IN 212. RECORD TWINS AND TRIPLETS ON SEPARATE LINES.

212 What name was given to your (first,next) baby?	213 RECORD SINGLE OR MULTIPLE BIRTH STATUS.	214 Is (NAME) a boy or a girl?	215 In what month and year was (NAME) born? PROBE: What is his/her birthday? OR: In what season was he/she born?	216 Is (NAME) still alive?	217 IF ALIVE: How old was (NAME) at his/her last birthday? RECORD AGE IN COMPLETED YEARS.	218 IF ALIVE: Is (NAME) living with you?	219 IF LESS THAN 15 YRS. OF AGE: With whom does he/she live? IF 15+: GO TO NEXT BIRTH.	220 IF DEAD: How old was he/she when he/she died? IF "1 YR.", PROBE: How many months old was (NAME)? RECORD DAYS IF LESS THAN 1 MONTH, MONTHS IF LESS THAN TWO YEARS, OR YEARS.
01 ________ (NAME)	SING...1 MULT...2	BOY...1 GIRL..2	MONTH.. [ ][ ] YEAR... [ ][ ]	YES...1 NO....2 → 220	AGE IN YEARS [ ][ ]	YES.......1 (GO TO NEXT BIRTH) NO........2	FATHER.........1 OTHER RELATIVE.2 SOMEONE ELSE...3 (GO NEXT BIRTH)	DAYS....1 MONTHS..2 YEARS...3 [ ][ ]
02 ________ (NAME)	SING...1 MULT...2	BOY...1 GIRL..2	MONTH.. [ ][ ] YEAR... [ ][ ]	YES...1 NO....2 → 220	AGE IN YEARS [ ][ ]	YES.......1 (GO TO NEXT BIRTH) NO........2	FATHER.........1 OTHER RELATIVE.2 SOMEONE ELSE...3 (GO NEXT BIRTH)	DAYS....1 MONTHS..2 YEARS...3 [ ][ ]
03 ________ (NAME)	SING...1 MULT...2	BOY...1 GIRL..2	MONTH.. [ ][ ] YEAR... [ ][ ]	YES...1 NO....2 → 220	AGE IN YEARS [ ][ ]	YES.......1 (GO TO NEXT BIRTH) NO........2	FATHER.........1 OTHER RELATIVE.2 SOMEONE ELSE...3 (GO NEXT BIRTH)	DAYS....1 MONTHS..2 YEARS...3 [ ][ ]
04 ________ (NAME)	SING...1 MULT...2	BOY...1 GIRL..2	MONTH.. [ ][ ] YEAR... [ ][ ]	YES...1 NO....2 → 220	AGE IN YEARS [ ][ ]	YES.......1 (GO TO NEXT BIRTH) NO........2	FATHER.........1 OTHER RELATIVE.2 SOMEONE ELSE...3 (GO NEXT BIRTH)	DAYS....1 MONTHS..2 YEARS...3 [ ][ ]
05 ________ (NAME)	SING...1 MULT...2	BOY...1 GIRL..2	MONTH.. [ ][ ] YEAR... [ ][ ]	YES...1 NO....2 → 220	AGE IN YEARS [ ][ ]	YES.......1 (GO TO NEXT BIRTH) NO........2	FATHER.........1 OTHER RELATIVE.2 SOMEONE ELSE...3 (GO NEXT BIRTH)	DAYS....1 MONTHS..2 YEARS...3 [ ][ ]
06 ________ (NAME)	SING...1 MULT...2	BOY...1 GIRL..2	MONTH.. [ ][ ] YEAR... [ ][ ]	YES...1 NO....2 → 220	AGE IN YEARS [ ][ ]	YES.......1 (GO TO NEXT BIRTH) NO........2	FATHER.........1 OTHER RELATIVE.2 SOMEONE ELSE...3 (GO NEXT BIRTH)	DAYS....1 MONTHS..2 YEARS...3 [ ][ ]
07 ________ (NAME)	SING...1 MULT...2	BOY...1 GIRL..2	MONTH.. [ ][ ] YEAR... [ ][ ]	YES...1 NO....2 → 220	AGE IN YEARS [ ][ ]	YES.......1 (GO TO NEXT BIRTH) NO........2	FATHER.........1 OTHER RELATIVE.2 SOMEONE ELSE...3 (GO NEXT BIRTH)	DAYS....1 MONTHS..2 YEARS...3 [ ][ ]
08 ________ (NAME)	SING...1 MULT...2	BOY...1 GIRL..2	MONTH.. [ ][ ] YEAR... [ ][ ]	YES...1 NO....2 → 220	AGE IN YEARS [ ][ ]	YES.......1 (GO TO NEXT BIRTH) NO........2	FATHER.........1 OTHER RELATIVE.2 SOMEONE ELSE...3 (GO NEXT BIRTH)	DAYS....1 MONTHS..2 YEARS...3 [ ][ ]

212	213	214	215	216	217	218	219	220
What name was given to your next baby?	RECORD SINGLE OR MULTIPLE BIRTH STATUS.	Is (NAME) a boy or a girl?	In what month and year was (NAME) born? PROBE: What is his/her birthday? OR: In what season?	Is (NAME) still alive?	IF ALIVE: How old was (NAME) at his/her last birthday? RECORD AGE IN COMPLETED YEARS.	IF ALIVE: Is (NAME) living with you?	IF LESS THAN 15 YRS. OF AGE: With whom does he/she live? IF 15+: GO TO NEXT BIRTH.	IF DEAD: How old was he/she when he/she died? IF "1 YR.", PROBE: How many months old was (NAME)? RECORD DAYS IF LESS THAN 1 MONTH, MONTHS IF LESS THAN TWO YEARS, OR YEARS.
09 ____ (NAME)	SING...1 MULT...2	BOY...1 GIRL..2	MONTH.. YEAR...	YES...1 NO....2 → 220	AGE IN YEARS	YES.......1 (GO TO NEXT BIRTH) NO........2	FATHER.........1 OTHER RELATIVE.2 SOMEONE ELSE...3 (GO NEXT BIRTH)	DAYS....1 MONTHS..2 YEARS...3
10 ____ (NAME)	SING...1 MULT...2	BOY...1 GIRL..2	MONTH.. YEAR...	YES...1 NO....2 → 220	AGE IN YEARS	YES.......1 (GO TO NEXT BIRTH) NO........2	FATHER.........1 OTHER RELATIVE.2 SOMEONE ELSE...3 (GO NEXT BIRTH)	DAYS....1 MONTHS..2 YEARS...3
11 ____ (NAME)	SING...1 MULT...2	BOY...1 GIRL..2	MONTH.. YEAR...	YES...1 NO....2 → 220	AGE IN YEARS	YES.......1 (GO TO NEXT BIRTH) NO........2	FATHER.........1 OTHER RELATIVE.2 SOMEONE ELSE...3 (GO NEXT BIRTH)	DAYS....1 MONTHS..2 YEARS...3
12 ____ (NAME)	SING...1 MULT...2	BOY...1 GIRL..2	MONTH.. YEAR...	YES...1 NO....2 → 220	AGE IN YEARS	YES.......1 (GO TO NEXT BIRTH) NO........2	FATHER.........1 OTHER RELATIVE.2 SOMEONE ELSE...3 (GO NEXT BIRTH)	DAYS....1 MONTHS..2 YEARS...3
13 ____ (NAME)	SING...1 MULT...2	BOY...1 GIRL..2	MONTH.. YEAR...	YES...1 NO....2 → 220	AGE IN YEARS	YES.......1 (GO TO NEXT BIRTH) NO........2	FATHER.........1 OTHER RELATIVE.2 SOMEONE ELSE...3 (GO TO 221)	DAYS....1 MONTHS..2 YEARS...3

221	COMPARE 208 WITH NUMBER OF BIRTHS IN HISTORY ABOVE AND MARK: NUMBERS ARE SAME ☐ → CHECK NUMBERS ARE DIFFERENT ☐ → (PROBE AND RECONCILE) CHECK: FOR EACH BIRTH: YEAR OF BIRTH IS RECORDED. ☐ FOR EACH LIVING CHILD: CURRENT AGE IS RECORDED. ☐ FOR EACH DEAD CHILD: AGE AT DEATH IS RECORDED. ☐ FOR AGE AT DEATH 12 MONTHS: PROBE TO DETERMINE EXACT NUMBER OF MONTHS. ☐
222	CHECK 215 AND ENTER THE NUMBER OF BIRTHS SINCE JANUARY 1985.* IF NONE, ENTER 0 AND GO TO 224. ☐
223	FOR EACH BIRTH SINCE JANUARY 1985* ENTER "B" IN MONTH OF BIRTH IN COLUMN 1 OF CALENDAR AND "P" IN EACH OF THE 8 PRECEDING MONTHS. WRITE NAME TO THE LEFT OF THE "B" CODE.
224	AT THE BOTTOM OF THE CALENDAR, ENTER THE NAME AND BIRTH DATE OF THE LAST CHILD BORN PRIOR TO JAN. 1985*, IF APPLICABLE.

* For fieldwork beginning in 1991, 1992, or 1993, the year should be changed to 1986, 1987, or 1988, respectively.