DHS COMPARATIVE STUDIES

20

Infant and Child Mortality

DHS

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Infant and Child Mortality

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Preface

One of the most significant contributions of the DHS program is the creation of an internationally comparable body of data on the demographic and health characteristics of populations in developing countries. The *DHS Comparative Studies* series and the *DHS Analytical Reports* series examine these data across countries in a comparative framework, focusing on specific topics.

The objectives of DHS comparative research are: to describe similarities and differences between countries and regions, to highlight subgroups with specific needs, to provide information for policy formulation at the international level, and to examine individual country results in an international context. While the *Comparative Studies* series is primarily descriptive, *Analytical Reports* utilizes a more analytical approach.

The comparative analysis of DHS data is carried out primarily by staff at the DHS headquarters in Calverton, Maryland. The topics covered are selected by staff in conjunction with the DHS Scientific Advisory Committee and USAID.

Reports in the *Comparative Studies* series are based on a variable number of data sets reflecting the number of countries for which data were available at the time the report was prepared. Each report provides detailed tables and graphs for countries in: sub-Saharan Africa, Asia, the Near East and North Africa, and Latin America and the Caribbean. Survey-related issues such as questionnaire comparability, survey procedures, data quality, and methodology are included in the reports. Where appropriate, data from previous DHS surveys are used to evaluate trends over time.

Some *Comparative Studies* reports published under the current phase of the DHS program (DHS-III) are updates and expansions of reports published earlier in the series. Other reports cover new topics that reflect the expanded scope of the DHS program.

It is anticipated that the availability of comparable information for a large number of developing countries will have long-term usefulness for analysts and policymakers in the fields of international population and health.

Martin Vaessen
Project Director

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Executive Summary

Levels, Trends, and Differentials in Childhood Mortality

The aim of this report is to assist in the formulation of child health policy and the evaluation of programs intended to improve the well-being and survival prospects of young children. The report is comparative in nature; levels, trends, and differentials in childhood mortality are presented using DHS data collected in 20 countries over the period 1990-1994. Included are 12 countries in sub-Saharan Africa, five in Asia, the Near East and North Africa, and three in Latin America and the Caribbean.

The results indicate wide disparity in the degree of recent improvement in child survival prospects. In sub-Saharan Africa, most countries have shown declines in under-five mortality. However, in all but three of these countries the declines have been modest—less than 25 percent decline in the 10-year period preceding the survey—and in five countries the declines have been 10 percent or less. In Zambia, under-five mortality has risen by 26 percent over the reference period. In Niger, little change has occurred to improve child survival, and under-five mortality still exceeds 300 deaths per 1,000 live births—i.e., nearly 1 in 3 children dies before reaching the fifth birthday.

For the countries outside sub-Saharan Africa, the picture is more encouraging. With the exception of Pakistan, recent declines in under-five mortality have been greater that 25 percent and, using the most recent estimates, less than 1 in 10 children dies before the fifth birthday (under-five mortality of less than 100 per 1,000 live births). The examples of Colombia, Turkey, and Morocco illustrate particularly dramatic declines of 40 percent or more in the 10-year period before the survey. In Colombia, under-five mortality now stands at 23 deaths per 1,000. This compares with 12 per 1,000 in the United States and 318 per 1,000 in Niger. In Pakistan, the pace of decline is slower (15 percent) and under-five mortality still exceeds 100 per 1,000.

In many countries of sub-Saharan Africa, especially those in the western part of the region, under-five mortality remains high due in large part to high rates of mortality during ages 1-4 years (i.e., after infancy). These findings, which are consistent with previous studies, signal the need for more structured investigation into the underlying causes of poor survival during these ages in this part of the world. The report discusses potentially fruitful areas of research. Also, these results argue for the development of a new set of mortality schedules that will encompass the West African experience.

In countries that have experienced rapid mortality decline (to currently low levels), further improvements in child survival will require improving neonatal and early infant survival through programs to ameliorate problems of adverse pregnancy outcome and poor maternal health and nutrition.

Differentials in Childhood Mortality

This report documents substantial variations in mortality risk across socioeconomic and demographic segments of national populations. While considerable differences exist between countries in the level of excess risk associated with particular characteristics of individuals and households, some generalizations can be made that may be helpful for policy formulation and evaluation. Perhaps the most important of these concerns the relationship between the pace and age pattern of childbearing and child survival. Short birth intervals (less than 24 months) and teenage childbearing (before age 20) are the demographic factors most likely to heighten mortality risk during childhood. The excess risk associated with short interval length (compared with intervals of 24 to 47 months) is substantial, averaging 116 percent (all countries) during the neonatal period, 67 percent during the postneonatal period (1-11 months), and 32 percent during ages 1-4 years. These results underscore the potential for improvement of child health and survival through programs that enhance the choices available to couples to limit or space their children more appropriately.

Mortality differentials are also presented according to residence, migration, parental education and literacy, and father's occupation. As in previous studies, this report documents the "urban advantage" in child survival. Rural children are twice as likely, on average, as their urban counterparts to die in the first five years of life. However, there are differences within the urban setting: poorer urban households and those that recently migrated from rural areas are more likely to report childhood deaths and to exhibit mortality rates approaching those observed in rural areas. Mother's education is shown to be a key factor related to mortality risk during childhood. Death before age five is, on average, more than twice as common among children whose mothers did not complete primary school as among those whose mothers attended secondary school. The strength of the association between any particular socioeconomic indicator and survival chances varies widely by age period. Generally, the "protective" effect of better socioeconomic standing tends to increase in strength with increasing age of the child. However, the strength and age pattern of the socioeconomics-mortality association varies among countries, suggesting that the distribution of health and social services in a particular context may influence how effectively individual assets (i.e., education or employment) can be converted to behaviors that enhance child survival.

1 Introduction

1.1 PURPOSE OF THE STUDY

The principal aim of this report is to provide a reference set of standard childhood mortality statistics for policy-making, program evaluation, and research purposes. The report is as an update of a previous Demographic and Health Surveys (DHS) publication on infant and child mortality (Sullivan, Rutstein, and Bicego, 1994). The earlier paper presented a series of childhood mortality statistics for 28 Phase I DHS countries. The present study presents a similar set of statistics for an additional 20 DHS countries under Phase II and III of the DHS program. The document also highlights variations in mortality risk and, therefore, may be useful in identifying promising directions for both national and international health programs.

Section 1 of the report provides a brief summary of data sources, the methodology for collecting mortality data, issues relating to data quality, and the principles underlying the calculation of mortality rates. Section 2 presents a variety of country-specific childhood mortality indicators for the five-year period preceding the survey, and trends in mortality rates over the 15 years preceding the survey. Biodemographic and socioeconomic differentials in childhood mortality are described in Sections 3 and 4, respectively. Section 5 summarizes the findings of these analyses.

1.2 SOURCES OF DATA

The primary criterion for the inclusion of specific countries in this report was the availability of a standard recode data file at the time of the analysis. The 20 surveys covered in this report are listed below with the dates of fieldwork. Surveys that constitute repeat DHS surveys are marked with an asterisk.

Sub-Saharan Africa

Burkina Faso	1993
Cameroon	1991
Ghana*	1993
Kenya*	1993
Madagascar	1992
Malawi	1992
Namibia	1992
Niger	1992
Nigeria	1990
Rwanda	1992
Senegal*	1992/1993
Zambia	1992

Asia/Near East/North Africa

Indonesia*	1994
Morocco*	1992
Pakistan	1990/1991
Philippines	1993
Turkey	1993

Latin America/Caribbean

Colombia*	1990
Dominican Republic*	1991
Peru*	1991/1992

All of the surveys are national in scope and were conducted during the period 1990-1994. The report presents country-specific summary figures. For reference purposes, countries are grouped into three regions: 12 countries in sub-Saharan Africa, 5 countries in Asia, the Near East, and North Africa, and 3 countries in Latin America and the Caribbean.

1.3 COLLECTION OF MORTALITY DATA

In the DHS surveys, women age 15-49 are eligible for the Individual Questionnaire, which includes nine questions designed to determine the aggregate number of children ever born to a woman. In addition, questions relevant to direct estimation of mortality rates are collected using a complete maternal birth history: the sex and date of birth of every live birth,[1] survival status, current age (surviving children), and age at death (dead children). Interviewers check for and then resolve inconsistencies between the aggregate information on children ever born and the complete birth history data. In addition to providing suitable data for the estimation of levels of childhood mortality, the complete birth history approach allows the analysis of trends and patterns in mortality.

[1] Separate information is obtained for each live birth of a multiple birth.

The data on age at death require additional explanation. These data were collected in *days* for children dying within a month of birth, in *months* for children dying after the first month but before the second birthday, and in *completed years* for deaths occurring at or after the second birthday. With these data it is possible to use direct estimation procedures to calculate mortality rates by days or weeks of life for the neonatal period, by months through the first two years of life, and by single year of age thereafter. The primary advantage of this approach is that, coupled with standard field procedures for probing, the precision in age at death data at exact age 12 months (the cutoff between infant and child mortality) is improved.

1.4 DATA QUALITY

All retrospective survey data are subject to errors arising from faulty respondent recall. Birth history data, in particular, are susceptible to several special problems. In this report, only the most important aspects of data quality are reviewed. For more extensive analyses of the quality of DHS mortality see Sullivan, Bicego, and Rutstein (1990) and Curtis (1995). The surveys covered by Curtis include most of those presented in this report; the findings indicate that:

(1) The quality of data used to directly estimate rates of childhood mortality is generally good.

(2) In certain areas, notably completeness of birth date data and age at death misreporting, recent modifications in DHS procedures have led to improvements in mortality data quality (compared with previous DHS and WFS surveys). The effect on mortality estimates of misreporting of age at death or birth date is largely mitigated when rates are calculated for broad age intervals and time periods. For example, rates for 5- or 10-year periods or for the age interval from birth to age five are little affected by misreporting errors. Rates for neonatal and infant mortality are potentially more susceptible to such error.

(3) The problem of displacement of birth dates (shifting birth dates of children to an earlier calendar period) continues in some recent surveys, despite changes in procedures designed to counter the problem. Yet, simulations show that the impact of such displacement on estimates of childhood mortality is small or negligible.

(4) In a few surveys, mortality estimates for calendar periods more than 10 years prior to the survey appear to be implausibly low (perhaps due to event omission) and should be regarded with caution. Serious problems were not identified for estimates close to the survey date.[2] Whenever possible, trend analysis should involve multiple data sources.

In addition to the potential problems associated with recall error, there are structural reasons for limiting mortality estimation to more recent periods. In DHS surveys, the oldest respondents are women age 49. The birth history data for progressively earlier time periods are restricted to births whose mothers were progressively younger at the time of birth. It is known that a mother's age at birth affects child survival chances, so that the systematic exclusion of births to older women (when they were younger) may bias estimates of mortality for earlier periods.

Also, birth history data collected by sample survey is limited to the experience of children born to surviving (i.e., surveyed) mothers. The children of nonsurviving mothers are likely to be at greater than average mortality risk. The further back in time from the survey date, the greater the proportion of children with relatively high mortality risk who are not represented in the birth history data.

Based on these considerations, mortality rates are not presented for periods more than 15 years prior to a survey and most rates pertain to periods less than 10 years before a survey. No adjustments to the observed data were made in the calculation of the rates presented in this report.

1.5 RATE CALCULATION

A life table approach is used to estimate probabilities of dying between two exact ages. It is based on the number of deaths among a real or synthetic cohort of children in a specified age range who have been exposed to the risk of dying in that age range during a specified calendar period. The rates in this report are based on synthetic cohorts, with children of different birth years (i.e., different birth cohorts) contributing to the exposure and mortality experience used

[2] In a report examining the DHS data from Pakistan, Curtis and Arnold (1994) found evidence of omission of infant deaths throughout the birth history (i.e., even during recent calendar periods).

for estimation of a period-specific, age-specific probability estimate. Seven indices of childhood mortality are used:

Under-five mortality: the probability of dying between birth and exact age five years (${}_5q_0$);

Infant mortality: the probability of dying between birth and exact age one year (${}_1q_0$);

Neonatal mortality: the probability of dying between birth and exact age one month;

Postneonatal mortality[3]**:** the difference between infant and neonatal mortality rates;

Child mortality: the probability of dying between exact ages one and five years (${}_4q_1$);

Early child mortality: the probability of dying between exact ages one and two years (${}_1q_1$);

Late child mortality: the probability of dying between exact ages two and five years (${}_3q_2$).

A technical description of the calculation of the synthetic cohort probabilities presented in this report is provided in Appendix A.

[3] The conventional postneonatal mortality rate is not a mortality probability and is calculated by subtracting the neonatal mortality rate from the infant mortality rate. However, the rate closely approximates a probability measure.

2 Levels, Patterns, and Trends in Childhood Mortality

The mortality level of a society is closely linked to the health and well-being of the population. A society with sufficient and well-distributed resources is more likely to experience lower mortality rates than one with scant or poorly distributed resources. There are, however, countries with limited resources that attain lower than expected mortality levels due to cultural factors and institutions and programs that mitigate against the consequences of poverty.

Of all mortality measures, the infant mortality rate is the most frequently used indicator of broad socioeconomic well-being. It stands as a basic measure of how well a society meets the needs of its people. However, in many developing countries—especially those in sub-Saharan Africa—50 percent or more of early childhood deaths occur *after* infancy. Under such circumstances, other measures of childhood mortality may be more relevant than the infant mortality rate. Such measures include under-five (${}_5q_0$), early child or toddler (${}_1q_1$), late child (${}_3q_2$), and overall child (${}_4q_1$) mortality rates.

Irrespective of overall mortality level, the risk of dying is highest in the period immediately after birth, remains high but at a lower level through infancy, and drops further until about age 10 to 15 years, after which mortality increases with increasing age. This general pattern occurs in all human populations; however, the precise configuration of the mortality schedule depends on both the level of mortality and the relative importance of different age-specific causes of death. The relative contributions of mortality at different ages (the age pattern of mortality) has important implications for policy formulation, for the allocation of resources, and for targeting of interventions.

2.1 RECENT MORTALITY LEVELS

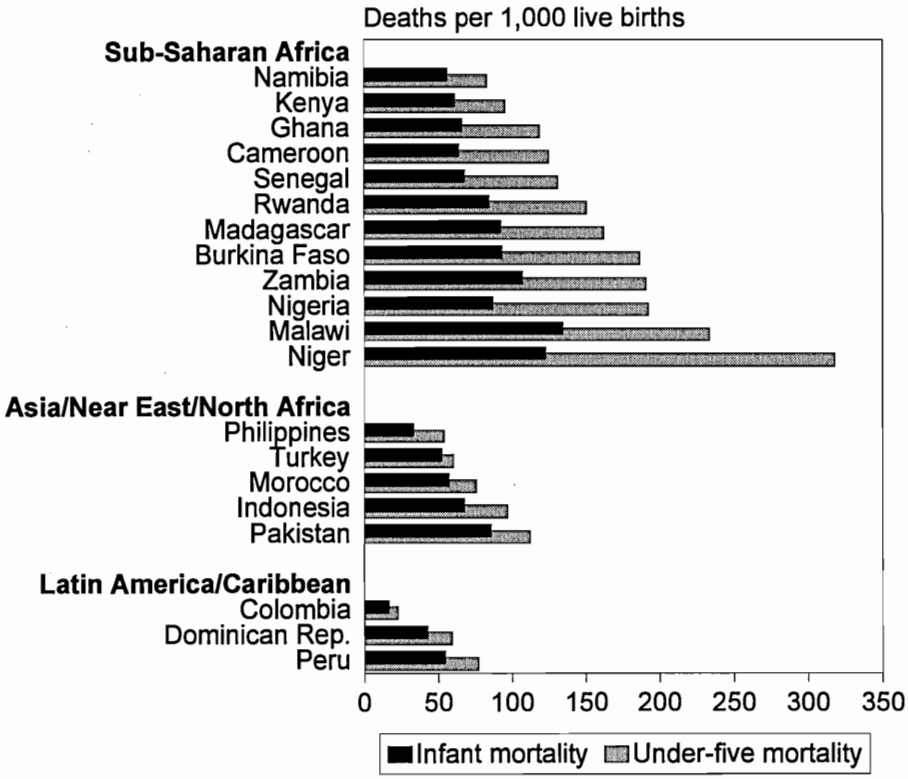
Table 2.1 presents estimated mortality rates for the five-year period preceding 20 DHS surveys. Figure 2.1 shows infant and under-five mortality rates, with countries ordered within region by ascending rate of under-five mortality.

Table 2.1 Childhood mortality rates

Childhood mortality rates for the five-year period preceding the survey, Demographic and Health Surveys, 1990-1994

Country	Year of fieldwork	Under-five mortality (${}_5q_0$)	Infant mortality (${}_1q_0$)	Neonatal mortality	Post-neonatal mortality	Child mortality (${}_4q_1$)	Early child mortality (${}_1q_1$)	Late child mortality (${}_3q_2$)	Ratio (${}_4q_1$)/(${}_5q_0$)
Sub-Saharan Africa									
Namibia	1992	83.7	56.6	31.4	25.1	28.7	12.0	16.9	0.34
Kenya	1993	96.1	61.7	25.7	35.9	36.7	15.4	21.8	0.38
Ghana	1993	119.4	66.4	40.9	25.6	56.8	20.9	36.6	0.48
Cameroon	1991	125.3	64.3	32.8	31.5	65.2	29.8	36.4	0.52
Senegal	1992/1993	131.6	68.2	34.9	33.3	68.0	22.8	46.3	0.52
Rwanda	1992	150.7	85.0	38.6	46.3	71.9	22.6	50.4	0.48
Madagascar	1992	162.4	93.0	39.1	53.8	76.6	33.8	44.4	0.47
Burkina Faso	1993	187.0	93.7	43.2	93.7	103.0	43.4	62.3	0.55
Zambia	1992	191.2	107.4	42.5	64.9	94.0	52.7	43.6	0.49
Nigeria	1990	192.7	87.4	42.1	45.2	115.4	42.6	76.0	0.60
Malawi	1992	233.8	134.6	41.2	93.5	114.5	51.1	66.8	0.49
Niger	1992	318.2	123.0	40.7	82.3	222.5	87.6	148.0	0.70
Asia/Near East North Africa									
Philippines	1993	54.2	33.6	17.7	15.9	21.3	7.8	13.6	0.39
Turkey	1993	60.9	52.6	29.2	23.4	8.8	6.7	2.0	0.14
Morocco	1992	76.1	57.3	31.4	25.9	20.0	12.5	7.5	0.26
Indonesia	1994	81.3	57.0	30.4	26.5	25.8	10.3	5.3	0.32
Pakistan	1990/1991	112.3	86.0	48.9	37.1	28.8	5.8	12.7	0.26
Latin America/ Caribbean									
Colombia	1990	23.1	16.6	10.8	5.8	6.5	3.2	3.4	0.28
Dominican Republic	1991	59.3	42.8	23.5	19.2	17.3	8.6	8.9	0.29
Peru	1991/1992	77.5	54.5	25.3	29.2	24.4	15.2	9.3	0.31
Grand average		126.8	72.1	33.5	40.7	60.3	25.2	35.6	0.41

Figure 2.1 Infant mortality and under-five mortality in 20 developing countries, Demographic and Health Surveys, 1990-1994



Under-Five Mortality ($_5q_0$). Under-five mortality varies from a low of 23 per 1,000 in Colombia to a high of 318 per 1,000 in Niger. This represents greater variability than that observed in previous studies of mortality based on the DHS-I surveys (Sullivan, Rutstein, and Bicego, 1994) and the World Fertility Surveys (Rutstein, 1984). Even in sub-Saharan Africa considerable variation exists, from under 100 per 1,000 in Kenya and Namibia, to well over 200 per 1,000 in Malawi and Niger. The remaining countries of sub-Saharan African have rates between 100 and 200 per 1,000.

Except for Pakistan, with an under-five mortality rate of 112 per 1,000, all the countries outside sub-Saharan Africa have rates below 100 per 1,000. The Philippines, Turkey, the Dominican Republic and Colombia have under-five rates below 70 per 1,000.

Infant Mortality ($_1q_0$). The estimates of infant mortality vary widely from 17 per 1,000 in Colombia to 135 per 1,000 in Malawi (Table 2.1). The ranking of countries by level of infant mortality follows the same pattern as seen for under-five mortality, with the exception of Niger, Nigeria, and Cameroon—countries that have unusually low infant-relative-to-child mortality rates.

All countries representing the sub-Saharan region have infant mortality rates above 55 per 1,000; five countries between 55 and 70, four between 70 and 100, and three over 100 per 1,000. Outside sub-Saharan Africa, only Pakistan (86 per 1,000), Indonesia (57 per 1,000), and Morocco (57 per 1,000) have infant mortality rates above 55 per 1,000.

Neonatal and Postneonatal Mortality. Neonatal and postneonatal mortality are the two components of the infant mortality rate. Much less variation is observed in neonatal rates than in postneonatal rates. Neonatal mortality ranges from 11 (Colombia) to 49 (Pakistan) per 1,000. Postneonatal rates vary from only 6 per 1,000 (Colombia) to 94 per 1,000 (Burkina Faso and Malawi).

As the level of infant mortality declines, the proportion of infant deaths occurring during the neonatal period generally increases. Taking the countries of sub-Saharan Africa together, the average ratio of neonatal to overall infant

mortality is 0.43; for the remaining (i.e., lower mortality) countries, this ratio is 0.54. At the high and low extremes, the neonatal to infant mortality ratio is 0.31 in Malawi and 0.65 in Colombia. These observations have important implications for health and child survival programs because societies that are successful in bringing down infant and child mortality rates generally find that further gains in survival are increasingly dependent on improvements in the conditions that specifically affect neonatal survival (e.g., maternal nutrition, pregnancy outcome, birth weight).

Child Mortality ($_4q_1$). Table 2.1 shows the estimates of mortality between ages 1 and 4 years (child mortality). The values range from just 7 deaths per 1,000 in Colombia to 223 per 1,000 in Niger. The child mortality rate for all the countries outside sub-Saharan Africa is less than 30 per 1,000. Only one country in the sub-Saharan region, Namibia, falls into this category.

Other than Namibia, only Kenya has a child mortality rate below 50 per 1,000. Ghana, Cameroon, Senegal, Rwanda, Zambia and Madagascar fall into an intermediate category with child mortality rates between 50 and 100 per 1,000. Niger, Burkina Faso, Nigeria and Malawi fall into a third category with child mortality rates in excess of 100 per 1,000.

Early ($_1q_1$) and Late ($_3q_2$) Child Mortality. Table 2.1 also presents the estimates for early and late components of child mortality. Early child mortality ranges from 3 per 1,000 in Colombia to 88 per 1,000 in Niger; late child mortality varies from 2 per 1,000 in Turkey to 148 per 1,000 in Niger. With the exception of Zambia, Indonesia, Turkey, Morocco and Peru, late child mortality exceeds early childhood mortality in all the countries studied. In sub-Saharan Africa, especially in the West African countries that have high mortality between ages 1 and 4, this pattern of high late child mortality relative to early child mortality is pronounced.

2.2 AGE PATTERNS OF MORTALITY

This section examines the age patterns of under-five mortality; in particular, the relationship between the levels of infant ($_1q_0$) versus child ($_4q_1$) mortality. At a single *level* of overall under-five mortality, the distribution of deaths between these two age segments can vary substantially. The causes of such variation in the age pattern of mortality are not well understood, although countries in geographic proximity tend to exhibit similar age patterns, suggesting that cultural and environmental factors play major roles. In the first five years, the distribution of deaths by age is greatly influenced by the prevailing causal structure of mortality. For example, where neonatal tetanus is still a significant public health problem, and utilization of antenatal care and delivery services is low, mortality in the first few weeks of life is high. Where immunization coverage is low and poverty and undernutrition are prevalent, mortality related to measles infection is high, especially around age one.

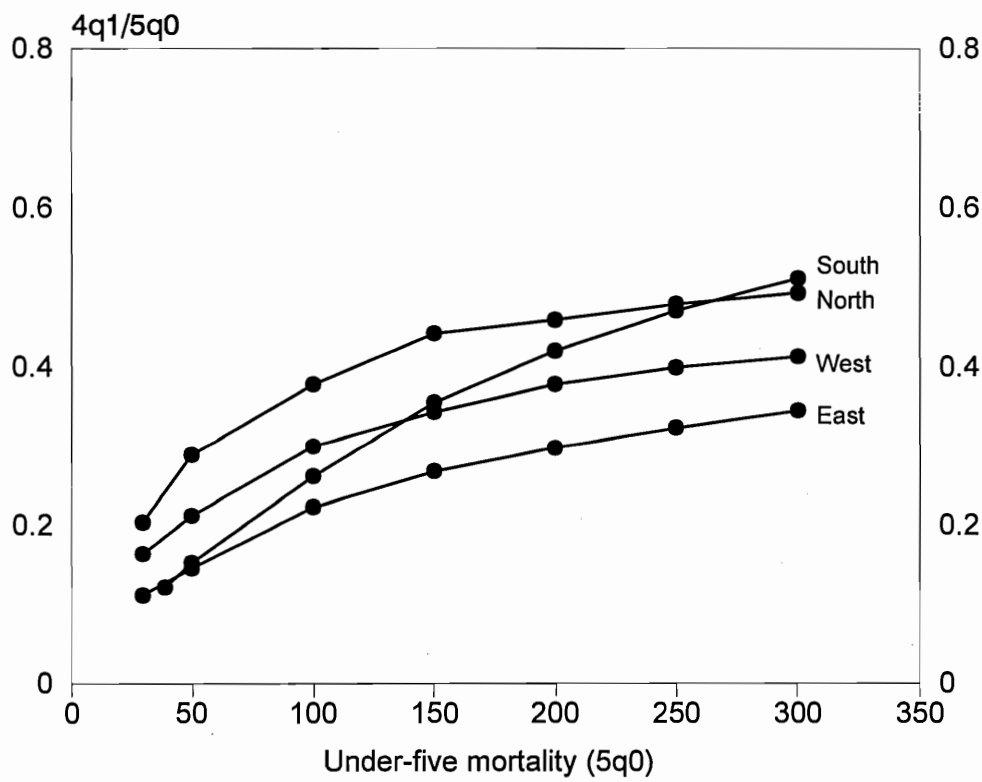
Models of the pace and pattern of mortality by age (i.e., model life tables), derived essentially from empirical observations of historical European populations, serve a useful purpose as references or standards against which international comparisons can be indexed. Embodied in any model life table is the relationship between mortality at different ages, including infancy and the 1-4 year age segment. The Regional Model Life Tables (Coale and Demeny, 1966) are the most commonly used standard against which mortality rates are compared. The Regional Model Life Tables consist of four single-parameter model life table systems: one system with an average or general mortality pattern (the West model) and three systems with distinctive mortality patterns (the North, East and South models).[4]

How well do the Regional Model Life Table systems reflect mortality conditions in actual populations? The issue is important because of the extensive use of model life tables for analytic purposes (e.g., for assessing the quality of mortality data and for producing childhood mortality estimates through indirect techniques). Only to the extent that model life tables represent actual mortality patterns is their use for analytic purposes justified.

[4] In a previous study of the relationship between infant and child mortality rates (United Nations, 1990), two sets of model life tables, those for the Regional Model Tables and those from the Model Life Tables For Developing Countries (United Nations, 1982), were used. In this study of the relationship, only the Regional Model Tables were used. However, the principal conclusion would not have been different had the United Nations Model Tables been used. The reason for this is that the range of variation in the age pattern of mortality under age five is about the same in the Coale and Demeny and the United Nations Tables. The similarity between the two sets of model life tables is described elsewhere (United Nations, 1990 and 1992).

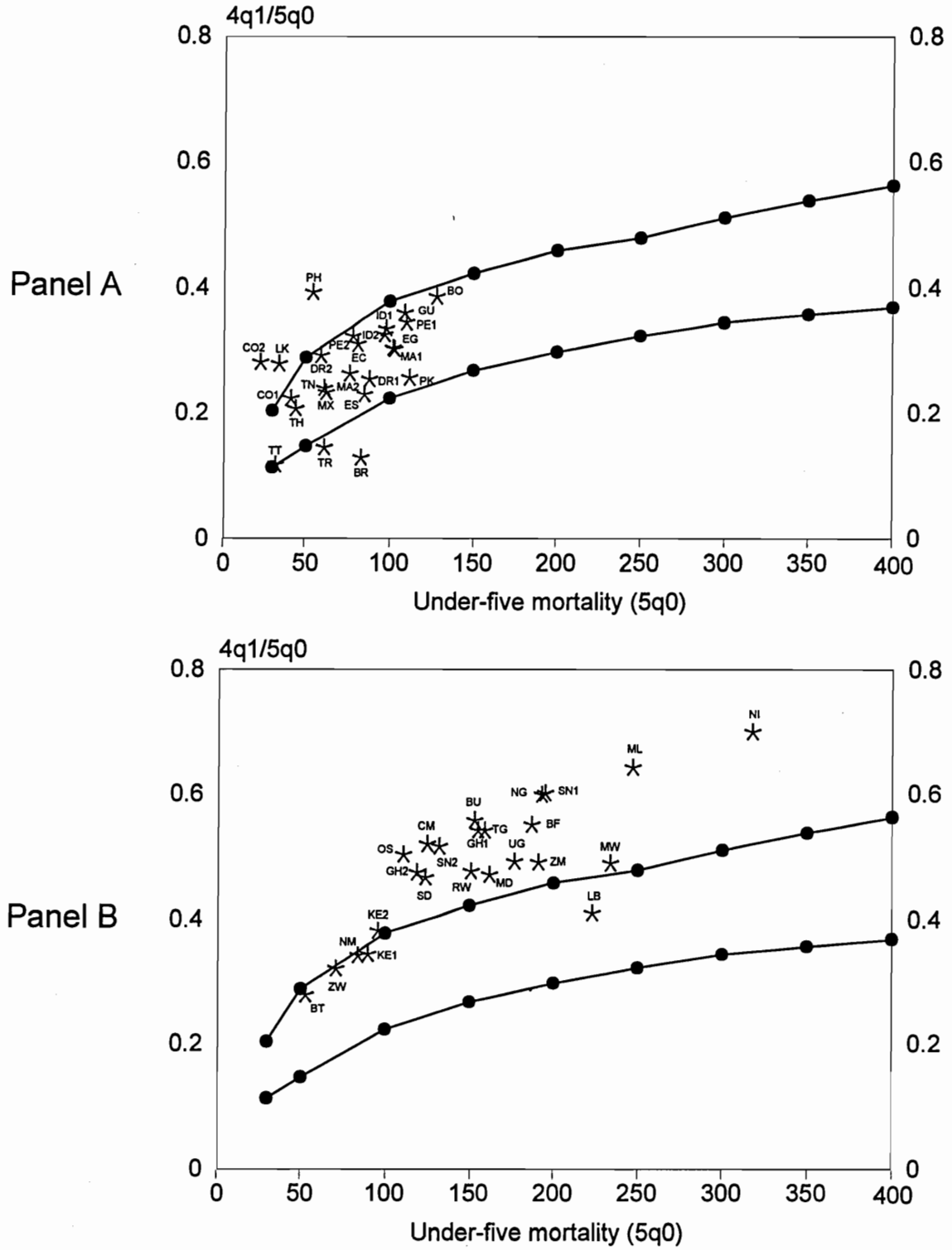
The relationship between infant and child mortality can be described in a number ways. We have chosen the ratio ${}_4q_1$ to ${}_5q_0$, which has the property of approximating the proportion of under-five deaths that occur between the first and fifth birthdays. Use of this particular ratio is appropriate because much of the variation in under-five mortality between countries is explained by variation in ${}_4q_1$. Figure 2.2 shows values of this ratio derived from the Regional Model Life Tables. At any given level of under-five mortality, the East model produces the lowest values of ${}_4q_1/{}_5q_0$. Conversely, the North model produces the highest child relative to under-five mortality, except at very high under-five mortality rates. The South model is peculiar in that it produces the lowest ratios in conditions of low mortality and the highest ratios in conditions of high mortality. The model ratios exceed 0.50 only at mortality levels over 300 per 1,000.

Figure 2.2 Ratio of ${}_4q_1/{}_5q_0$ for the Regional Model Life Tables



Panel A of Figure 2.3 shows the values of ${}_4q_1/{}_5q_0$ observed for countries in the Asia, Near East, North Africa region and Latin America and the Caribbean—16 surveys drawn from DHS-I plus the eight DHS-II and DHS-III surveys covered in this report. The country-specific values for all but five of the surveys fall within the boundary values of the Regional Model Tables. In two countries, Brazil and Turkey, the value of ${}_4q_1/{}_5q_0$ is below that expected based on model age patterns. In three countries (the Philippines, Sri Lanka, and Colombia 1990), the value of ${}_4q_1/{}_5q_0$ falls above the boundary values of the Regional Model Tables. For the remaining 19 countries, a model system can be selected that adequately fits the observed age pattern.

Figure 2.3 Ratio of ${}_4q_1/{}_5q_0$ for the Regional Model Life Tables (solid lines), and for selected countries in the Asia/Near East/North Africa and Latin America/Caribbean regions (Panel A), and for selected countries in sub-Saharan Africa (Panel B), Demographic and Health Surveys, 1985-1994



SYMBOLS: **Panel A** - Bolivia (BO), Brazil (BR), Colombia (CO1 and CO2), Dominican Republic (DR1 and DR2), Ecuador (EC), Egypt (EG), El Salvador (ES), Guatemala (GU), Indonesia (ID1 and ID2), Sri Lanka (LK), Morocco (MA1 and MA2), Mexico (MX), Peru (PE1 and PE2), Philippines (PH), Pakistan (PK), Thailand (TH), Tunisia (TN), Turkey (TR), Trinidad and Tobago (TT); **Panel B** - Burkina Faso (BF), Botswana (BT), Burundi (BU), Cameroon (CM), Ghana (GH1 and GH2), Kenya (KE1 and KE2), Liberia (LB), Madagascar (MD), Mali (ML), Malawi (MW), Nigeria (NG), Niger (NI), Namibia (NM), Ondo State, Nigeria (OS), Rwanda (RW), Sudan (SD), Senegal (SN1 and SN2), Togo (TG), Uganda (UG), Zambia (ZM), Zimbabwe (ZW).

For the countries in sub-Saharan Africa—12 DHS-I surveys and the 12 surveys covered in this report—the situation is quite different. Panel B of Figure 2.3 shows that the ratio ${}_4q_1/{}_5q_0$ is above—often well above—the upper boundary value of the Regional Model Tables in 18 of 24 countries. With the exception of Liberia, all of the countries that fall within the model boundaries are countries with under-five mortality below 100 per 1,000. Of the 16 surveys with ratios exceeding model patterns, all have under-five mortality greater than 100 per 1,000. Put simply, at ${}_5q_0$ levels in excess of 100 per 1,000, the age patterns of childhood mortality described in the Regional Model Life Tables do not reflect the actual mortality conditions occurring in most of sub-Saharan Africa. Specifically, mortality between ages one and four years is unusually high relative to mortality before age one.

The finding of relatively high concentrations of deaths in the age interval 1-4 years in sub-Saharan Africa is one that has been documented previously for Senegal (Cantrelle et al., 1986) and discussed in some detail by Sullivan, Rutstein, and Bicego (1994).[5] However, the pervasiveness of the phenomenon in high-mortality African countries has not been well documented, largely because of the paucity of birth history data that would allow age patterns of under-five mortality to be reliably ascertained. Before the advent of the WFS and DHS programs, most childhood mortality estimation for sub-Saharan Africa was accomplished using indirect Brass-type analytical methods, which generally limit careful analysis to under-five mortality (Hill, 1991).

The implications of these findings lead to at least two salient lines of inquiry: one methodological, the other substantive. First, if the currently available model life table systems do not encompass the mortality schedules commonly observed in sub-Saharan Africa (at under-five mortality levels above 100 per 1,000), analytical methods based on those models can be expected to perform poorly. What are the options in African settings where DHS-type birth history data are not available? Clearly there is a need for additional model life tables that describe the prevailing age patterns of mortality during early childhood in sub-Saharan Africa. These new models should encompass under-five mortality levels ranging from 100 to 350 per 1,000,[6] a range which essentially covers all contemporary moderate to high mortality countries in the region. That such models do not currently exist is unfortunate because it is in precisely these settings where high-quality demographic data are often lacking and where analytic tools such as model life tables are most needed.

Second, what are the factors that explain the high levels of child mortality (${}_4q_1$)—relative to infant mortality—in virtually all high-mortality countries that have been studied? The first and most obvious factor explaining the West African pattern is the very low level of socioeconomic development. It is well established, and shown again in the next section, that mortality especially during ages 1-4 years is sensitive to low economic status and low levels of parental education. Blacker (1991), in discussing variation in African mortality, cites the much lower levels of female education in West Africa compared with those in East and southern Africa. Studies using WFS and DHS data (Cleland and van Ginneken, 1988; Bicego and Boerma, 1993) have shown that about half of the education-mortality association is accounted for by the economic condition of the household. Theories on the mechanism(s) by which socioeconomic conditions—whether education- or economics-related—modify a child's chances of survival have not yet been subjected to adequate empirical investigation. The proximate determinants most likely to influence mortality risk during ages 1-4 years can be grouped as follows:

- Exposure variables (those related to the probability of exposure to disease agents—e.g., natural history of disease vectors, environmental characteristics, sanitation, etc.),

- Susceptibility factors (those modifying a child's biological response to exposure—e.g., nutritional, vaccination status, etc.), and

[5] Sullivan, Rutstein, and Bicego (1994) also pursued the question of whether the unusually high ${}_4q_1/{}_5q_0$ ratios in sub-Saharan Africa are the result of data defects—specifically, underreporting of neonatal deaths or misreporting of late infant deaths as deaths at age one—which would erroneously inflate the ratio. Their analysis indicates that only a small part of the excess ${}_4q_1$ could be explained by data errors.

[6] The United Nations (1982) published a *West African* model, which is essentially a 3-component adjustment to the General system of life tables and considers mortality at all ages. The system, at ages under 10 years, replicates the mortality schedule obtained from one area in rural Senegal. Unfortunately, the model while showing higher ${}_4q_1$ relative to infant mortality than is represented in the Coale-Demeny models, is still lower than is shown with nearly all estimates from the West African countries covered in this and previous reports. Further, the model covers under-five mortality only at levels above 200 per 1,000 and does not provide a model for both sexes combined. These considerations, taken together, limit the practicability of the U.N. *West African* model for analytical purposes.

- Behaviors regarding recognition and treatment of sick children.

A complete survey of the direct and indirect evidence regarding each of the proposed relationships is beyond the scope of this report; however, some general observations can be made to assist in identifying potential areas of future investigation.

Wasting (very low weight-for-age), an index of acute undernutrition, is higher in most West African settings than in the rest of Africa and most of the rest of the World.[7] It is also closely associated with mortality risk, especially during ages 1-4 years. The susceptibility of children to disease and death is greatly heightened among undernourished children. The relationship, however, is complex: poor nutritional status is both an underlying/contributing cause and the frequent consequence of serious morbid conditions during early childhood, and interacts with many common childhood diseases in its effect on mortality (Kirkwood, 1991). Further, micro-nutritional deficit such as Vitamin A, iodine, and iron deficiencies (Pelletier, Frongillo, and Habicht, 1995) are thought to contribute to higher mortality risk through their effects on specific biological processes, but these links are not well established or understood. Currently, there is very little data on the distribution of micro-nutrient deficiency in Africa that might explain variations in child mortality.

Differences in the physical environment and their influence on exposure to disease have been suggested as factors that explain the geographic variation in the level of ${}_4q_1$ in sub-Saharan Africa. An example of this is malaria, the distribution and character of which varies with temperature, humidity, and rainfall (standing water). While malaria is a serious problem in many parts of East and southern Africa—especially the chloroquine-resistant forms—it rarely reaches the holoendemic levels found in most of West Africa. The proportion of child morbidity and mortality related directly or indirectly to malaria is again not known for most of sub-Saharan Africa, but may be expected to be substantial under conditions of intense *Plasmodia* transmission characteristic of much of West Africa (Bradley, 1991). Lower levels of access to prophylactic and curative antimalarials would amplify the effect of increased exposure on mortality.

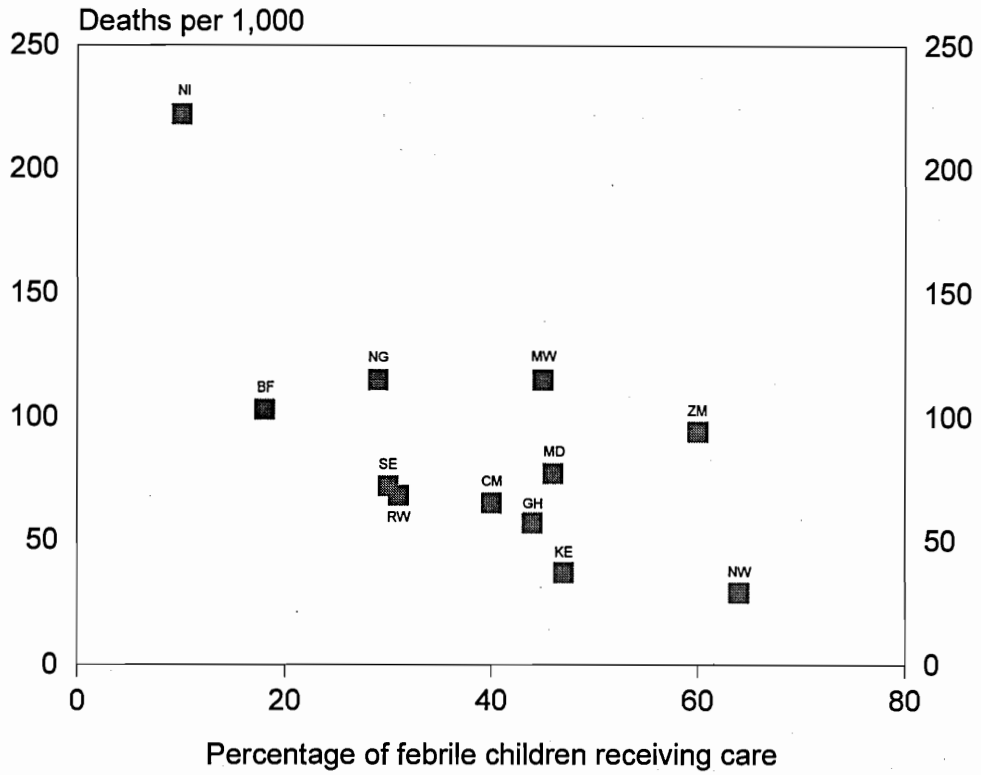
Measles is an important cause of child death in Africa, largely due to the complications arising during and after its acute phase—pneumonia, diarrhea, and undernutrition. Susceptibility to severe life-threatening measles is influenced by many geographically-related factors. Rates of vaccination against measles are lower in the high mortality countries of West Africa than in East and southern Africa (Boerma et al., 1990). The intensity of exposure to measles, which affects the severity and, thus, case-fatality of the disease, may relate to rural settlement patterns which in West Africa tend to involve close grouping of households (Aaby, 1987). In East Africa and much of southern Africa, on the other hand, households tend to be widely scattered. This hypothesis, as well as others involving variations in the "dose" of exposure to measles, requires further analysis. Also, as mentioned above, undernutrition—even in a mild or moderate form—is likely to exacerbate the deleterious effects of measles infection.

Lastly, patterns of treatment of common childhood diseases are likely to figure prominently in any explanation of geographic variation in mortality between ages one and four. Figure 2.4 shows the aggregate relationship between ${}_4q_1$ and the percentage of children with a fever in the last two weeks who received medical attention. While such ecological analyses are severely limited in their usefulness to extract causal inference, the results indicate that young children in countries with higher levels of basic health service utilization (i.e., generally, countries of East and southern Africa) tend to experience better survival prospects. However, the relationship is not a strong one; Malawi and Zambia, for example, have unusually high mortality relative to their level of basic health service utilization.

In sum, much of the variation among countries in the level of under-five mortality can be explained by variation in the rate of mortality during ages 1-4 years. At under-five mortality levels exceeding 100 per 1,000, the ratio ${}_4q_1/{}_5q_0$ exceeds that described in standard reference mortality schedules by a significant margin. The very high levels of child mortality (${}_4q_1$) in many countries of sub-Saharan Africa, especially those of West Africa, are of particular concern. Explanations involving geographic variations in African populations regarding socioeconomic, epidemiologic, and behavioral factors will provide information for policymakers and assist in the design of programs intended to bring down rates of child mortality.

[7] Only in South Asia do levels of wasting compare to those prevailing in West Africa (Sommerfelt, personal communication, 1996).

Figure 2.4 Mortality among children age 1-4 years by percentage of febrile children receiving medical care, selected Demographic and Health Surveys, 1990-1993



2.3 TRENDS IN MORTALITY

There are some limitations to the use of DHS birth history data for documenting trends in mortality. One potential problem is the quality of the data for the various periods preceding individual surveys. In general, birth history data for earlier periods are thought to be of lesser quality because of the greater length of time over which respondents must recall events. Specifically, event omission and misreporting of date of birth and age at death for deceased children are expected to occur more frequently at longer durations of recall. It is suggested that as data quality diminishes with increasing time preceding the survey, mortality rates become progressively *underestimated* (i.e., nonsurviving births are thought to be more frequently omitted than surviving births). This would cause mortality decline to be masked or underestimated.

Despite these considerations, analyses of the quality of DHS mortality data by Sullivan, Bicego, and Rutstein (1990) and Curtis (1995), found little evidence of a decay in the quality of estimates with time preceding the survey date—at least over the 15-year period before the survey. The authors point out that internal data quality assessments are not particularly sensitive to event omission, and that the minor mislocation of events in calendar time will not significantly affect trend estimation using broad time periods. Their conclusions, however, support the use of multiple data sources, where possible, in the analysis of trends.

Trends Assessed Using Data from Single Surveys

In this section, mortality rates are presented for three five-year periods preceding the 20 DHS surveys. Since all fieldwork for the surveys was conducted from 1990 to 1994, the five-year rates pertain roughly to the late 1970s (10-14 years preceding the surveys), early 1980s (5-9 years preceding the surveys), and late 1980s (0-4 years preceding the surveys). Table 2.2 shows infant, child, and under-five mortality rates, along with the percent change in the rates between 10-14 and 0-4 years before the survey, for the 20 surveys. With the exception of Kenya, Nigeria, Niger, and Zambia, all the countries experienced substantial reductions in under-five mortality. The declines were in the range of 20-39 percent in 10 countries: Burkina Faso, Cameroon, Ghana, Namibia, Rwanda, Senegal, Indonesia, the Philippines, the Dominican Republic, and Peru. In three countries (Morocco, Turkey and Colombia), under-five mortality fell by 40 percent or more.

Table 2.2 Trends in childhood mortality rates

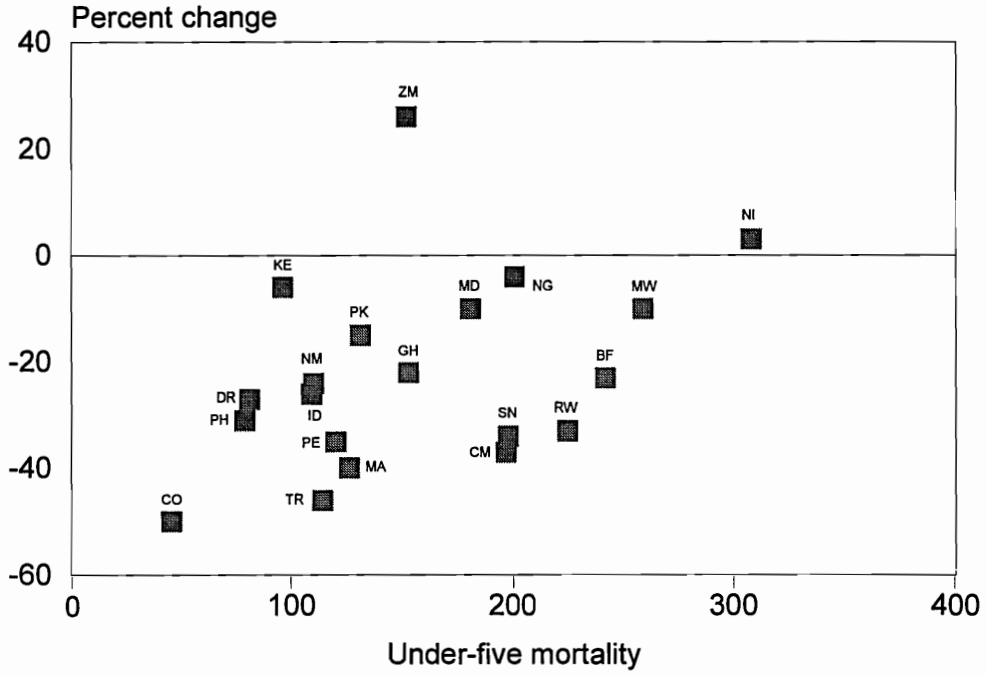
Childhood mortality rates for the three five-year periods preceding the survey and the percent change in rates between the periods 10-14 and 0-4 years before the survey, Demographic and Health Surveys, 1990-1994

	Under-five mortality				Infant mortality				Child mortality			
	(Years before the survey)			Percent	(Years before the survey)			Percent	(Years before the survey)			Percent
Country	10-14	5-9	0-4	change	10-14	5-9	0-4	change	10-14	5-9	0-4	change
Sub-Saharan Africa												
Namibia	110.2	101.5	83.7	-24	72.2	67.2	56.6	-22	40.9	36.7	28.7	-30
Kenya	101.8	89.7	96.1	-6	68.9	63.4	61.7	-10	35.3	28.1	36.7	4
Ghana	153.2	147.8	119.4	-22	76.1	83.8	66.4	-13	83.4	69.9	56.8	-32
Cameroon	198.3	164.7	125.3	-37	108.6	97.6	64.3	-41	100.6	74.3	65.2	-35
Senegal	198.4	184.5	131.6	-34	90.2	84.3	68.2	-24	118.9	109.4	68.0	-43
Rwanda	224.7	175.6	150.7	-33	109.9	95.4	85.0	-23	129.0	88.6	71.9	-44
Madagascar	181.2	194.9	162.4	-10	103.7	113.3	93.0	-10	86.4	92.0	76.6	-11
Burkina Faso	241.5	223.5	187.0	-23	122.7	122.2	93.7	-24	135.4	115.5	103.0	-24
Zambia	151.9	162.2	191.2	26	79.5	87.6	107.4	35	78.8	81.7	94.0	19
Nigeria	201.4	189.2	192.7	-4	99.1	95.8	87.4	-12	113.5	103.2	115.4	2
Malawi	259.0	246.6	233.8	-10	137.9	137.9	134.6	-2	140.5	126.1	114.5	-19
Niger	308.3	334.3	318.2	3	128.9	146.3	123.0	-5	205.9	220.2	222.5	8
Asia/Near East North Africa												
Philippines	78.6	73.6	54.2	-31	51.3	43.5	33.6	-35	28.8	31.5	21.3	-26
Turkey	113.5	96.9	60.9	-46	92.0	81.5	52.6	-43	23.7	16.8	8.8	-63
Morocco	126.3	91.6	76.1	-40	88.7	68.9	57.3	-35	41.3	24.4	20.0	-52
Indonesia	109.9	103.1	81.3	-26	75.3	74.9	57.0	-24	37.5	30.4	25.8	-31
Pakistan	131.9	127.0	112.3	-15	100.1	100.2	86.0	-14	35.3	29.8	28.8	-18
Latin America/ Caribbean												
Colombia	46.4	46.6	23.1	-50	38.8	37.0	16.6	-57	7.8	10.0	6.5	-17
Dominican Republic	81.1	66.0	59.3	-27	65.3	46.2	42.8	-34	16.9	20.7	17.3	2
Peru	119.7	105.9	77.5	-35	78.0	73.2	66.4	-15	45.2	35.4	24.4	-46
Grand average	156.9	146.3	126.8	-19	89.4	86.0	72.7	-19	75.3	67.2	60.3	-20

All the countries showing a recent stagnation or reversal in childhood mortality decline are located in sub-Saharan Africa. Zambia experienced a 26 percent rise and Niger a 3 percent rise in under-five mortality. Nigeria and Kenya had unremarkable declines in under-five rates over the 15-year period, a situation which in both cases was the result of a reversal in the direction of mortality change from a decline between 10-14 and 5-9 years before the survey to an increase in mortality between 5-9 and 0-4 years preceding the survey.

Figure 2.5 shows the relationship between the initial level of under-five mortality (i.e., 10-14 years ago) and the percent decline in under-five rates between 10-14 and 0-4 years before the survey (i.e., over a 10-year period). Countries with low mortality levels tend to exhibit steeper mortality decline, while the higher mortality countries are more likely to have experienced more modest declines, or rises in mortality—thereby widening the gap in child survival between the most and least "risky" settings. In the period 10-14 years before the surveys, children under five in Niger were dying at seven times the rate in Colombia; in the period 0-4 years before the surveys, this had increased to fourteen times the rate in Colombia. Exceptions to this pattern include Kenya, which (by regional standards) had low mortality and showed little improvement in child survival, and Cameroon and Senegal, which had high under-five mortality and experienced a decline of around 35 percent during the reference period. (Results presented in the next subsection indicate that the decline in Senegal was even greater than indicated here.)

Figure 2.5 Percent change in under-five mortality between the periods 0-4 and 10-14 years before the survey, by level of under-five mortality 10-14 years before the survey, Demographic and Health Surveys, 1990-1994



Child mortality is falling more rapidly than infant mortality in 10 of the 20 countries for which data are presented.[8] In three countries (Cameroon, the Philippines, and Colombia), the decline in infant mortality is steeper than the decline in child mortality. In two countries (Burkina Faso and Madagascar), infant and child mortality are decreasing at an equal pace. In four countries, (Kenya, Niger, Nigeria, and the Dominican Republic) infant mortality is falling while child mortality is rising slightly. In Zambia, infant mortality has risen more rapidly than child mortality.

Trends Assessed Using Data from Two Surveys

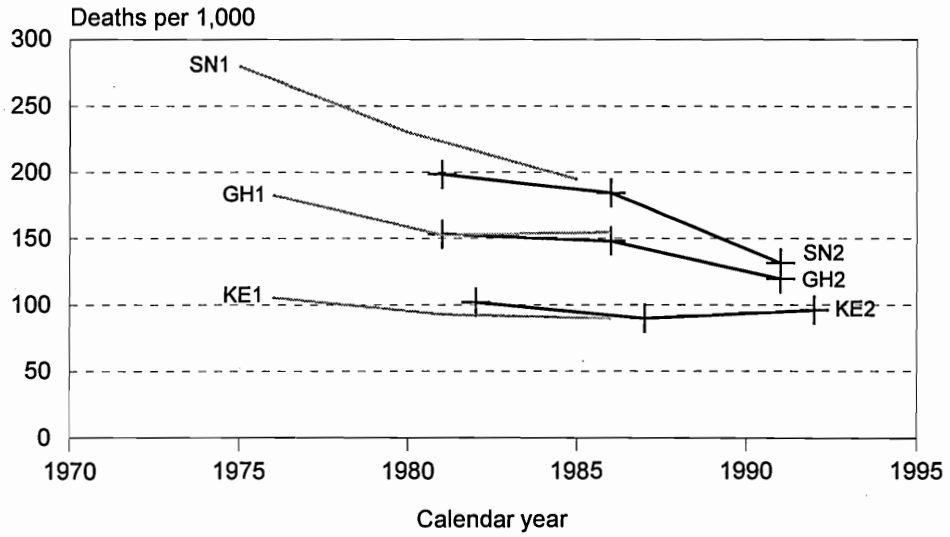
Two or more DHS surveys were conducted in eight of the countries examined here: Ghana, Kenya, Senegal, Indonesia, Morocco, Colombia, the Dominican Republic, and Peru. Combining estimates from two surveys allows assessment of mortality trends covering the period since the mid-1970s. Figure 2.6 shows the trends in under-five mortality. The approach of using two surveys is superior to the single survey approach because it allows data quality defects to be more easily detected through comparison of overlapping estimates. The trends obtained from the Senegal, Ghana, and Colombia surveys illustrate this point. If only the most recent DHS surveys were examined, the trend curves might be interpreted as indicating a slow mortality decline or stagnation during the early to mid-1980s, followed by a steep decline in the late 1980s. When the earlier surveys are added, this interpretation remains true for Ghana but not for Senegal and Colombia. In the latter countries, the most plausible explanation for the results is that the estimates obtained for the period 10-14 years before the most recent surveys were underestimates, and that a fairly uninterrupted, rapid decline in mortality took place over the broad reference period 1975 to 1990.

With the possible exception of the Dominican Republic, under-five estimates produced using two DHS surveys are remarkably consistent and, with the exception of Kenya, show significant declines from the 1970s to the 1990s. Perhaps most encouraging is the case of Senegal where there was a precipitous decline in under-five mortality of nearly 150 per 1,000 (53 percent decline) between the late 1970s and early 1990s. Similar percent declines in under-five mortality were observed in Morocco (55 percent) and the Dominican Republic (48 percent), although at lower mortality levels. Childhood mortality in Colombia fell by nearly three-quarters from 85 to 23 per 1,000. Significant but smaller declines were experienced in Peru (42 percent) and Indonesia (37 percent). The pace of improvement in child survival in Kenya has been slow—9 percent, or less than 1 percent per year over the reference period.

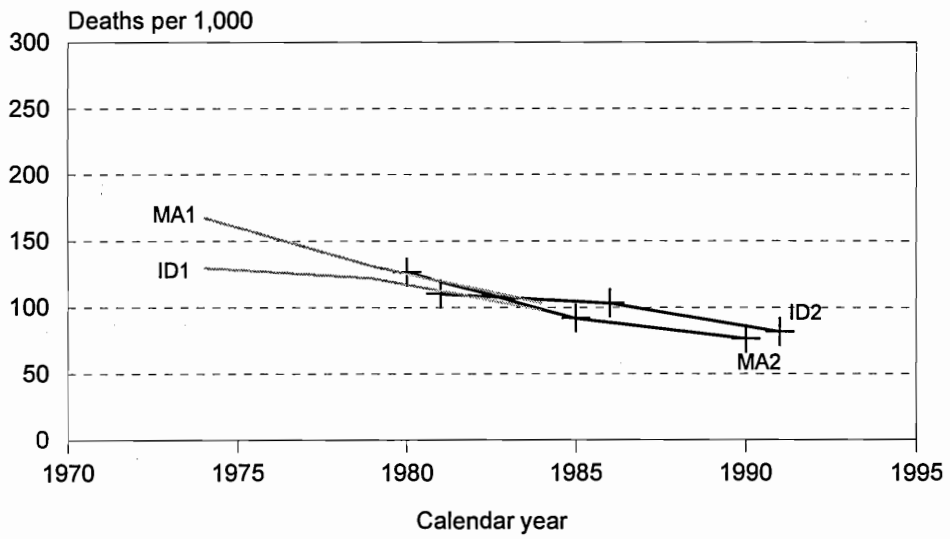
[8] In Sullivan, Rutstein, and Bicego (1994), 20 of 28 countries studied showed more pronounced declines in child mortality than in infant mortality. Readers interested in investigating the apparent change in the age pattern of mortality decline should be aware that a direct comparison of aggregate findings from the two reports is problematic since the regional mix of countries is very different.

Figure 2.6 Trends in under-five mortality for eight countries in which two DHS surveys were conducted: Senegal (SN), Ghana (GH), Kenya (KE), Morocco (MA), Indonesia (ID), Peru (PE), Dominican Republic (DR), Colombia (CO)

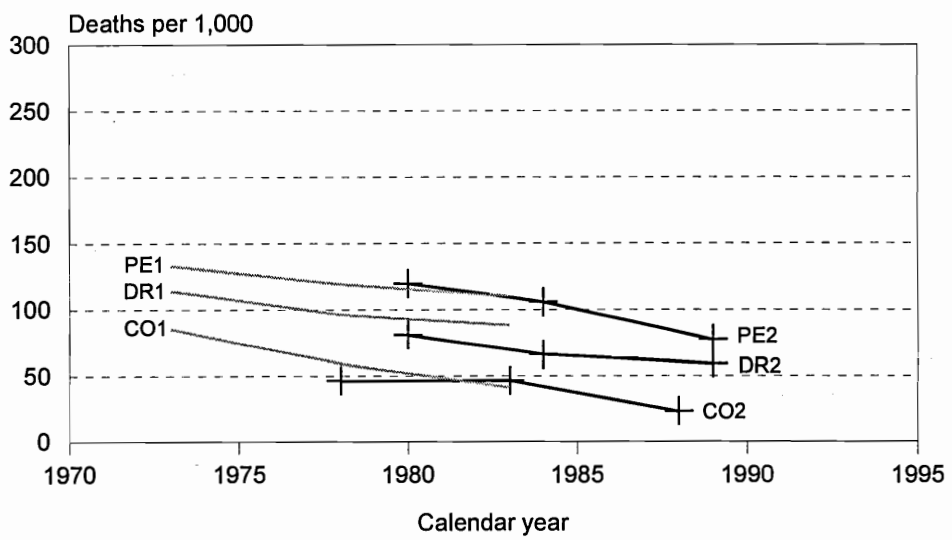
Sub-Saharan Africa



Asia, Near East and North Africa



Latin America and Caribbean



3 Bio-demographic Differentials in Childhood Mortality

This section examines the strength and consistency of associations between common bio-demographic variables and childhood mortality. The variables include: sex of the child, multiplicity of birth (singleton, twin, triplet, etc.), order of birth, age of the mother at birth, and length of the inter-birth interval. The impact of these five factors on the risk of early childhood death is thought to be manifest through both biological and behavioral mechanisms. It is also widely believed that with increasing age of the child behavioral factors take on greater importance while biological factors (e.g., constitution at birth) become less important.

The interpretation of these associations is facilitated by examination of the relative strength of the associations across age groups. In addition to under-five mortality and infant mortality, this analysis examines differences in covariate effects across three key under-five age segments: the *neonatal period,* when the effects of the bio-demographic variable on pregnancy outcome per se (low birth weight, birth trauma, intra-partum complications, and heritable defects) are thought to figure prominently; the *postneonatal period,* when children are increasingly exposed to changes in the nutritional regime and to disease agents in the environment; and the *12-59 month period* (i.e., child mortality), when environmental conditions and preventive and curative health interventions assume greater importance.

To minimize problems of truncation bias while at the same time including as many births as possible, the coverage period in this analysis is limited to the 10-year period preceding the survey. Even following this procedure, for certain covariate categories the number of observations for individual surveys is still quite small; therefore, rates based on less than 500 cases are flagged. Risk ratios are presented in addition to rates. *Risk ratio* (or relative risk) is defined as the ratio of the mortality rate in one risk category to the rate in a specified reference category.

3.1 SEX OF THE CHILD

Male children generally experience higher mortality than female children; exceptions to this pattern have been observed where behavioral factors directly or indirectly favor the health and survival of male children (Hill and Upchurch, 1995). For instance, in settings where the bride's family is responsible for payment of the *bride wealth,* a female child may be viewed as a financial liability. Under such circumstances, patterns of child care and health interventions may be biased against girls.

Table 3.1 presents childhood mortality rates by sex of the child, with corresponding risk ratios. Taking all countries together, under-five mortality is 8 percent higher among males than females (i.e., an unweighted average of 8 percent excess mortality risk). Excess male mortality is most pronounced in the first month of life (24 percent), diminishes considerably during the postneonatal period (6 percent), and essentially disappears in the 12-59 month period.

During the neonatal period, excess male mortality exceeds 30 percent in six countries (Cameroon, Senegal, Zambia, Morocco, Indonesia, and the Dominican Republic), but is less than 10 percent in three countries (Malawi, Niger, and Colombia). In the postneonatal period, only two countries show excess male risk greater than 30 percent (Rwanda and the Philippines), while 13 countries have excess male risk less than 10 percent—four of these have slightly higher female risk.

During ages 12-59 months, only one country (Colombia) has notably high excess male risk (96 percent); most countries have very small or negligible sex differentials, and in five countries female risk exceeds male risk by more than 10 percent. In Pakistan, female child mortality is about one-third higher than male child mortality.

In sum, excess male mortality during the neonatal period is widespread and substantial in some countries. Sex differentials after the neonatal period are generally very small or negligible, with a few exceptions during the postneonatal period (where excess male mortality persists) and during the 12-59 month period (where there is excess female risk).

Table 3.1 Childhood mortality rates and the relative risk of dying by sex

Childhood mortality rates and the relative risk of dying by sex of child, for the ten-year period preceding the survey, Demographic and Health Surveys, 1990-1994

		Mortality rates (deaths per 1,000)					Relative risk of dying (reference: female)				
Country	Sex of child	Neonatal mortality	Post-neonatal mortality	Infant mortality	Child mortality	Under-five mortality	Neonatal mortality	Post-neonatal mortality	Infant mortality	Child mortality	Under-five mortality
Sub-Saharan Africa											
Namibia	M	39.2	27.4	66.6	30.3	94.9	1.24	1.10	1.18	0.88	1.07
	F	31.6	25.0	56.5	34.3	88.9	1.00	1.00	1.00	1.00	1.00
Kenya	M	28.7	37.8	66.6	32.8	97.1	1.14	1.14	1.14	1.01	1.09
	F	25.2	33.3	58.6	32.6	89.3	1.00	1.00	1.00	1.00	1.00
Ghana	M	51.8	27.4	79.2	63.4	137.5	1.29	0.92	1.13	1.02	1.08
	F	40.2	29.9	70.1	62.2	127.9	1.00	1.00	1.00	1.00	1.00
Cameroon	M	48.1	38.3	86.4	63.6	144.5	1.33	1.01	1.16	0.85	1.01
	F	36.3	37.9	74.3	74.8	143.5	1.00	1.00	1.00	1.00	1.00
Senegal	M	47.5	36.1	83.6	95.5	171.0	1.41	1.03	1.22	1.20	1.20
	F	33.6	35.1	68.7	79.5	142.7	1.00	1.00	1.00	1.00	1.00
Rwanda	M	49.1	49.3	98.4	86.9	176.7	1.10	1.33	1.20	1.20	1.19
	F	44.8	37.2	82.1	72.5	148.6	1.00	1.00	1.00	1.00	1.00
Madagascar	M	46.5	56.8	103.2	85.4	179.8	1.18	0.91	1.01	1.04	1.03
	F	39.5	62.3	101.8	81.9	175.3	1.00	1.00	1.00	1.00	1.00
Burkina Faso	M	56.9	57.6	114.5	107.1	209.3	1.25	1.05	1.14	0.97	1.05
	F	45.5	54.8	100.3	110.3	199.5	1.00	1.00	1.00	1.00	1.00
Zambia	M	46.3	59.9	106.2	91.7	188.1	1.37	1.06	1.17	1.08	1.12
	F	33.9	56.7	90.5	85.1	168.0	1.00	1.00	1.00	1.00	1.00
Nigeria	M	49.2	44.7	93.9	117.8	200.6	1.18	0.94	1.05	1.16	1.10
	F	41.8	47.5	89.3	101.6	181.8	1.00	1.00	1.00	1.00	1.00
Malawi	M	50.5	91.1	141.7	125.5	249.4	1.05	1.10	1.09	1.10	1.09
	F	47.9	82.5	130.4	114.4	229.8	1.00	1.00	1.00	1.00	1.00
Niger	M	52.2	83.6	135.8	211.5	318.6	1.02	1.02	1.02	0.91	0.95
	F	51.0	82.0	133.0	231.7	333.9	1.00	1.00	1.00	1.00	1.00
Asia/Near East North Africa											
Philippines	M	19.8	23.7	43.5	27.6	69.9	1.21	1.44	1.32	1.12	1.23
	F	16.4	16.5	32.9	24.7	56.8	1.00	1.00	1.00	1.00	1.00
Turkey	M	40.7	29.7	70.5	12.4	82.0	1.20	0.93	1.07	0.91	1.04
	F	34.0	32.0	66.0	13.6	78.7	1.00	1.00	1.00	1.00	1.00
Morocco	M	38.7	30.0	68.6	20.7	88.0	1.33	1.06	1.20	0.88	1.11
	F	29.1	28.3	57.4	23.6	79.6	1.00	1.00	1.00	1.00	1.00
Indonesia	M	38.2	35.4	73.5	29.9	101.2	1.45	1.09	1.25	1.13	1.21
	F	26.3	32.4	58.8	26.5	83.8	1.00	1.00	1.00	1.00	1.00
Pakistan	M	60.1	42.0	102.1	22.0	121.9	1.30	1.07	1.19	0.60	1.03
	F	46.1	39.3	85.5	36.5	118.9	1.00	1.00	1.00	1.00	1.00
Latin America/ Caribbean											
Colombia	M	15.2	12.0	27.2	11.0	37.9	1.01	1.04	1.02	1.96	1.18
	F	15.1	11.5	26.6	5.6	32.0	1.00	1.00	1.00	1.00	1.00
Dominican Republic	M	31.4	21.8	53.3	17.5	69.9	1.86	1.21	1.53	0.86	1.28
	F	16.9	18.0	34.9	20.4	54.6	1.00	1.00	1.00	1.00	1.00
Peru	M	33.0	35.1	68.1	28.8	94.9	1.21	1.10	1.15	0.94	1.08
	F	27.2	32.0	59.2	30.6	88.0	1.00	1.00	1.00	1.00	1.00
Grand average	M	42.2	42.0	84.1	64.1	141.7	1.24	1.06	1.14	1.02	1.08
	F	34.1	39.7	73.8	63.1	131.1	1.00	1.00	1.00	1.00	1.00

3.2 SINGLE AND MULTIPLE BIRTHS

Children from multiple births—twins, triplets, etc.—experience higher levels of mortality early in life than do children who are singleton births (Pison, van de Walle, and Sala-Diakanda, 1989). Mortality is especially high during the neonatal period. Important mediating factors include low birth weight, complications before and at birth, and competition for time, attention, and material resources after birth. Twinning is a relatively rare event—about 2 percent of births in the 10 years preceding the surveys occurred in a multiple-birth context. Consequently, only one survey (Indonesia) yielded as many as 500 "multiple-birth children" born during the specified time frame, making country-specific analysis of mortality differentials problematic. Nonetheless, the strength and consistency of the relationship are sufficiently compelling to warrant cautious interpretation of the survey findings.

Table 3.2 presents childhood mortality rates for single and multiple births. Taking all countries together, children of multiple births are almost five times more likely to die during the neonatal period than children who are single births, 2.5 times more likely to die during the postneonatal period, and 1.5 times more likely to die during the 12-59 month period. These findings are similar to those observed by Sullivan, Rutstein, and Bicego (1994) using earlier DHS survey data, and Rutstein (1984) using WFS data.

During infancy, the excess risk to children of multiple births exceeds 150 percent in every country, and in 12 of 20 countries exceeds 250 percent. After infancy, however, there is much more variability in the strength and even direction of the relationship between mortality and twinning. In three countries (Namibia, Kenya, and Ghana), twin deaths during the 12-59 month period are substantially less common than singleton deaths. However, this may be due, at least in part, to sampling fluctuation related to small numbers of observations.

3.3 BIRTH ORDER OF THE CHILD

Survival chances have been shown to vary with birth order (i.e., rank) of the child. In general, first births and births of very high order carry greater than average mortality risk. The factors that combine to produce this effect in the developing country setting are not well understood, nor does the typical U-shaped curve apply to birth order in all studies and in all settings. Certainly, there is a biological basis for the poor survival experience of first births—namely, that many first births take place before a woman has reached full physical and reproductive maturity, leading to increased perinatal risk and more difficult delivery. Also, a first-time mother may be poorly prepared to handle new roles and responsibilities in her life. Operating as a mitigating factor, first-time young mothers in developing countries tend to be better educated than older, high parity women, and are more likely to use modern health services.

The causal mechanisms explaining heightened risk for high order births are not well understood. While older, high parity women are at increased risk of complications during and after childbirth and for delivery of a genetically impaired child, it appears that in many countries the poor survival experience of high order births is also related to adverse social and economic factors that are both the cause and consequence of high fertility. The degree of risk elevation associated with grand multiparity varies with the level of access to and use of high-quality antenatal and obstetrical services, which are dependent on the level of community development, the economic situation of the household, and the educational level of the mother. That the strength and consistency of the high birth order effect vary from survey to survey and country to country, lends support to this view. To further complicate analysis, however, the birth order-mortality relationship is confounded by the *birth interval effect* (see Section 3.5); and, grand multiparous women, especially those who are young will, by definition, have had a history of rapid childbearing with its associated maternal depletion.

Table 3.3 presents childhood mortality rates for children of birth order 1, 2-3, 4-6, and 7+. The reference category used for calculation of relative risks is birth order 2-3. When looking at the overall (average) influence of birth order on under-five mortality, the impression is one of minimal effects (Figure 3.1). Relative to birth order 2-3, under-five mortality is 5, 2, and 21 percent higher among children of birth orders 1, 4-6, and 7+, respectively. This aggregate statistic, however, "averages-away" notable country-specific patterns and masks underlying and offsetting age-specific effects.

In the majority of countries, first births are at greater risk of dying during the neonatal period. Combining all countries, first births carry 33 percent higher neonatal risk than births of rank 2-3. However, in four surveys—notably those in countries where good maternal health services are

Table 3.2 Childhood mortality rates and the relative risk of dying by status of birth

Childhood mortality rates and the relative risk of dying by status of birth (whether single or multiple birth), for the ten-year period preceding the survey, Demographic and Health Surveys, 1990-1994

		Mortality rates (deaths per 1,000)					Relative risk of dying (reference: single birth)				
Country	Single or multiple birth	Neonatal mortality	Post-neonatal mortality	Infant mortality	Child mortality	Under-five mortality	Neonatal mortality	Post-neonatal mortality	Infant mortality	Child mortality	Under-five mortality
Sub-Saharan Africa											
Namibia	S	32.4	24.1	56.6	32.7	87.4	1.00	1.00	1.00	1.00	1.00
	M	127.1	88.2	215.3	19.4	230.6	3.92	3.66	3.80	0.59	2.64
Kenya	S	23.1	35.2	58.3	32.9	89.3	1.00	1.00	1.00	1.00	1.00
	M	153.1	48.4	201.6	22.7	219.7	6.63	1.38	3.46	0.69	2.46
Ghana	S	39.8	27.6	67.4	63.4	126.6	1.00	1.00	1.00	1.00	1.00
	M	218.5	56.1	274.6	35.4	300.2	5.49	2.03	4.07	0.56	2.37
Cameroon	S	38.0	36.9	74.9	69.1	138.9	1.00	1.00	1.00	1.00	1.00
	M	155.5	70.4	226.0	71.8	281.5	4.09	1.91	3.02	1.04	2.03
Senegal	S	37.8	33.7	71.5	87.2	152.5	1.00	1.00	1.00	1.00	1.00
	M	145.9	108.3	254.2	94.9	325.0	3.86	3.21	3.56	1.09	2.13
Rwanda	S	41.8	42.5	84.3	79.4	157.0	1.00	1.00	1.00	1.00	1.00
	M	300.7	82.4	383.1	93.0	440.5	7.19	1.94	4.54	1.17	2.81
Madagascar	S	40.2	58.2	98.4	83.6	173.8	1.00	1.00	1.00	1.00	1.00
	M	166.6	113.7	280.3	89.0	344.4	4.14	1.95	2.85	1.06	1.98
Burkina Faso	S	47.8	53.4	101.2	106.4	196.8	1.00	1.00	1.00	1.00	1.00
	M	158.2	137.9	296.1	193.0	431.9	3.31	2.58	2.93	1.81	2.19
Zambia	S	33.5	55.7	89.3	86.9	168.4	1.00	1.00	1.00	1.00	1.00
	M	221.4	129.8	351.2	147.6	446.9	6.61	2.33	3.93	1.70	2.65
Nigeria	S	39.3	44.3	83.6	106.0	180.8	1.00	1.00	1.00	1.00	1.00
	M	211.5	96.4	307.9	237.7	472.4	5.38	2.18	3.68	2.24	2.61
Malawi	S	44.0	80.7	124.7	117.7	227.8	1.00	1.00	1.00	1.00	1.00
	M	156.1	211.1	367.2	177.5	479.5	3.55	2.62	2.94	1.51	2.10
Niger	S	45.4	80.9	126.3	218.3	317.0	1.00	1.00	1.00	1.00	1.00
	M	234.5	138.3	372.8	360.2	598.7	5.17	1.71	2.95	1.65	1.89
Asia/Near East/ North Africa											
Philippines	S	16.9	19.3	36.1	26.1	61.3	1.00	1.00	1.00	1.00	1.00
	M	111.6	90.4	202.0	30.5	226.4	6.60	4.68	5.60	1.17	3.69
Turkey	S	34.6	29.5	64.1	12.6	75.9	1.00	1.00	1.00	1.00	1.00
	M	183.3	98.3	281.6	38.6	309.3	5.30	3.33	4.39	3.06	4.08
Morocco	S	31.2	27.9	59.1	22.1	80.0	1.00	1.00	1.00	1.00	1.00
	M	165.1	90.2	255.3	21.7	271.5	5.29	3.23	4.32	0.98	3.39
Indonesia	S	32.4	39.5	71.8	35.2	104.5	1.00	1.00	1.00	1.00	1.00
	M	138.6	117.8	256.4	65.0	304.7	4.28	2.98	3.57	1.85	2.92
Pakistan	S	50.3	40.0	90.2	28.7	116.3	1.00	1.00	1.00	1.00	1.00
	M	220.0	85.1	305.1	73.0	355.8	4.37	2.13	3.38	2.54	3.06
Latin America/ Caribbean											
Colombia	S	12.7	11.2	23.9	8.4	32.1	1.00	1.00	1.00	1.00	1.00
	M	116.1	35.2	151.3	U	151.3	9.14	3.14	6.33	U	4.71
Dominican Republic	S	22.4	19.4	41.8	18.9	60.0	1.00	1.00	1.00	1.00	1.00
	M	131.2	54.4	185.6	19.3	201.2	5.86	2.80	4.44	1.02	3.35
Peru	S	29.1	32.4	61.5	29.1	88.8	1.00	1.00	1.00	1.00	1.00
	M	97.7	106.8	204.5	81.1	269.1	3.36	3.30	3.33	2.79	3.03
Grand average	S	34.6	39.6	74.3	63.2	131.8	1.00	1.00	1.00	1.00	1.00
	M	170.6	98.0	268.6	93.6	333.0	4.93	2.47	3.62	1.48	2.53

U = Unknown (no deaths reported in this age period)

Table 3.3 Childhood mortality rates and the relative risk of dying by birth order

Childhood mortality rates and the relative risk of dying by birth order of the child, for the ten-year period preceding the survey, Demographic and Health Surveys, 1990-1994

Country	Birth order of child	Mortality rates (deaths per 1,000)					Relative risk of dying (reference: birth order 2-3)				
		Neonatal mortality	Post-neonatal mortality	Infant mortality	Child mortality	Under-five mortality	Neonatal mortality	Post-neonatal mortality	Infant mortality	Child mortality	Under-five mortality
Sub-Saharan Africa											
Namibia	1	30.9	25.0	55.9	30.9	85.2	0.93	0.80	0.87	1.04	0.92
	2-3	33.1	31.4	64.5	29.7	92.3	1.00	1.00	1.00	1.00	1.00
	4-6	38.1	23.4	61.5	31.1	90.7	1.15	0.75	0.95	1.05	0.98
	7+	42.9	21.0	63.8	44.8	105.8	1.30	0.67	0.99	1.51	1.15
Kenya	1	33.6	36.2	69.8	26.3	94.2	1.58	1.03	1.24	0.81	1.09
	2-3	21.3	35.0	56.4	32.3	86.8	1.00	1.00	1.00	1.00	1.00
	4-6	22.9	34.5	57.3	37.6	92.7	1.08	0.99	1.02	1.16	1.07
	7+	36.1	37.5	73.6	32.1	103.3	1.69	1.07	1.30	0.99	1.19
Ghana	1	52.5	24.5	77.0	64.9	136.9	1.40	0.77	1.11	1.22	1.15
	2-3	37.4	31.7	69.1	53.2	118.6	1.00	1.00	1.00	1.00	1.00
	4-6	41.5	22.3	63.8	72.9	132.0	1.11	0.70	0.92	1.37	1.11
	7+	72.1	43.2	115.3	63.1	171.1	1.93	1.36	1.67	1.19	1.44
Cameroon	1	44.8	44.9	89.7	59.1	143.5	1.16	1.27	1.22	0.90	1.06
	2-3	38.5	35.3	73.8	66.0	135.0	1.00	1.00	1.00	1.00	1.00
	4-6	33.8	34.9	68.7	78.4	141.8	0.88	0.99	0.93	1.19	1.05
	7+	61.6	41.4	103.0	69.9	165.7	1.60	1.17	1.40	1.06	1.23
Senegal	1	53.7	32.6	86.4	83.0	162.2	1.35	0.90	1.13	0.96	1.04
	2-3	39.8	36.4	76.2	86.4	156.2	1.00	1.00	1.00	1.00	1.00
	4-6	32.0	32.9	64.9	85.4	144.7	0.80	0.90	0.85	0.99	0.93
	7+	44.4	41.3	85.8	96.8	174.2	1.12	1.13	1.13	1.12	1.12
Rwanda	1	55.6	44.0	99.6	77.7	169.6	1.39	0.94	1.15	0.96	1.05
	2-3	40.0	46.9	86.9	81.3	161.2	1.00	1.00	1.00	1.00	1.00
	4-6	41.4	41.6	83.0	76.6	153.2	1.04	0.89	0.96	0.94	0.95
	7+	58.5	40.0	98.6	83.6	173.9	1.46	0.85	1.13	1.03	1.08
Madagascar	1	53.4	62.4	115.8	72.3	179.7	1.37	1.02	1.16	0.85	1.02
	2-3	38.9	61.3	100.1	84.9	176.5	1.00	1.00	1.00	1.00	1.00
	4-6	37.1	50.0	87.0	82.2	162.1	0.95	0.82	0.87	0.97	0.92
	7+	47.7	67.1	114.8	94.8	198.7	1.23	1.09	1.15	1.12	1.13
Burkina Faso	1	71.5	65.3	136.8	114.9	236.0	1.55	1.09	1.29	0.99	1.13
	2-3	46.1	59.9	106.0	115.6	209.4	1.00	1.00	1.00	1.00	1.00
	4-6	41.3	50.1	91.4	106.1	187.8	0.90	0.84	0.86	0.92	0.90
	7+	58.5	51.9	110.4	92.7	192.9	1.27	0.87	1.04	0.80	0.92
Zambia	1	50.8	70.8	121.5	105.1	213.9	1.44	1.16	1.26	1.13	1.19
	2-3	35.2	60.9	96.2	92.6	179.8	1.00	1.00	1.00	1.00	1.00
	4-6	35.3	50.7	86.0	74.8	154.4	1.00	0.83	0.89	0.81	0.86
	7+	42.6	51.8	94.4	85.4	171.7	1.21	0.85	0.98	0.92	0.95
Nigeria	1	50.9	41.9	92.9	90.6	175.1	1.38	0.93	1.13	0.84	0.97
	2-3	37.0	44.9	81.9	108.0	181.1	1.00	1.00	1.00	1.00	1.00
	4-6	42.7	49.4	92.1	110.8	192.7	1.15	1.10	1.12	1.03	1.06
	7+	61.4	46.8	108.3	137.5	230.9	1.66	1.04	1.32	1.27	1.27
Malawi	1	76.8	98.3	175.1	126.8	279.7	1.60	1.13	1.30	0.96	1.12
	2-3	48.1	87.0	135.2	132.0	249.3	1.00	1.00	1.00	1.00	1.00
	4-6	39.6	78.9	118.4	110.8	216.1	0.82	0.91	0.88	0.84	0.87
	7+	40.9	88.8	129.6	109.7	225.1	0.85	1.02	0.96	0.83	0.90
Niger	1	77.9	87.0	164.9	207.1	337.9	1.75	1.14	1.37	0.92	1.06
	2-3	44.6	76.1	120.6	224.8	318.3	1.00	1.00	1.00	1.00	1.00
	4-6	41.6	85.8	127.4	217.5	317.3	0.93	1.13	1.06	0.97	1.00
	7+	57.7	84.8	142.5	236.5	345.3	1.29	1.11	1.18	1.05	1.08

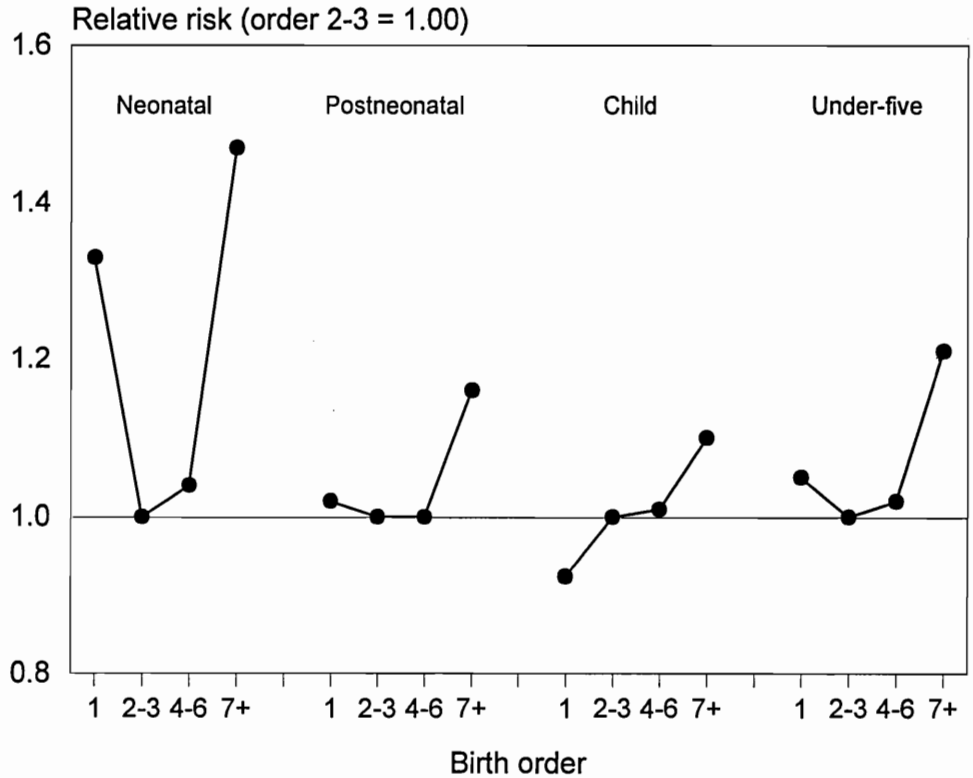
Table 3.3—*Cont.*

Country	Birth order of child	Mortality rates (deaths per 1,000)					Relative risk of dying (reference: birth order 2-3)				
		Neonatal mortality	Post-neonatal mortality	Infant mortality	Child mortality	Under-five mortality	Neonatal mortality	Post-neonatal mortality	Infant mortality	Child mortality	Under-five mortality
Asia/Near East/ North Africa											
Philippines	1	18.1	10.0	28.1	17.9	45.5	1.30	0.58	0.90	0.74	0.83
	2-3	13.9	17.3	31.2	24.3	54.8	1.00	1.00	1.00	1.00	1.00
	4-6	21.5	26.3	47.8	29.6	75.9	1.55	1.52	1.53	1.22	1.39
	7+	23.0	33.0	55.9	39.8	93.5	1.65	1.91	1.79	1.64	1.71
Turkey	1	37.4	26.6	64.0	8.8	72.2	1.43	1.09	1.26	0.80	1.18
	2-3	26.2	24.4	50.6	11.0	61.0	1.00	1.00	1.00	1.00	1.00
	4-6	41.1	39.3	80.3	20.0	98.7	1.57	1.61	1.59	1.82	1.62
	7+	75.4	49.7	125.1	16.5	139.5	2.88	2.04	2.47	1.50	2.29
Morocco	1	41.9	28.5	70.3	17.3	86.4	1.35	1.01	1.19	0.69	1.05
	2-3	31.0	28.1	59.0	25.1	82.6	1.00	1.00	1.00	1.00	1.00
	4-6	27.7	24.7	52.5	23.5	74.7	0.89	0.88	0.89	0.94	0.90
	7+	41.2	38.5	79.8	19.3	97.6	1.33	1.37	1.35	0.77	1.18
Indonesia	1	29.9	29.8	59.7	21.8	80.2	1.00	1.00	1.00	0.92	0.98
	2-3	29.9	29.8	59.7	23.7	81.9	1.00	1.00	1.00	1.00	1.00
	4-6	34.1	38.6	72.7	33.4	103.7	1.14	1.30	1.22	1.41	1.27
	7+	46.9	52.1	98.9	54.1	147.6	1.57	1.75	1.66	2.28	1.80
Pakistan	1	60.9	37.7	98.5	12.9	110.2	1.35	0.98	1.18	0.40	0.98
	2-3	45.0	38.6	83.6	32.1	113.0	1.00	1.00	1.00	1.00	1.00
	4-6	51.8	43.0	94.8	33.6	125.2	1.15	1.11	1.13	1.05	1.11
	7+	63.4	43.5	106.9	32.3	135.7	1.41	1.13	1.28	1.01	1.20
Latin America/ Caribbean											
Colombia	1	8.8	7.6	16.4	7.5	23.8	0.58	0.67	0.62	0.81	0.67
	2-3	15.2	11.3	26.5	9.3	35.5	1.00	1.00	1.00	1.00	1.00
	4-6	20.9	12.4	33.3	7.3	40.4	1.38	1.10	1.26	0.78	1.14
	7+	27.9	28.7	56.6	8.2	64.4	1.84	2.54	2.14	0.88	1.81
Dominican Republic	1	22.5	21.0	43.6	11.9	54.9	0.95	1.27	1.08	0.71	0.97
	2-3	23.6	16.6	40.3	16.8	56.4	1.00	1.00	1.00	1.00	1.00
	4-6	23.0	27.2	50.2	25.6	74.5	0.97	1.64	1.25	1.52	1.32
	7+	40.9	15.5	56.4	37.0	91.3	1.73	0.93	1.40	2.20	1.62
Peru	1	22.2	23.9	46.2	20.2	65.4	0.80	0.81	0.80	0.81	0.81
	2-3	27.9	29.6	57.5	25.0	81.1	1.00	1.00	1.00	1.00	1.00
	4-6	34.3	37.4	71.8	33.1	102.5	1.23	1.26	1.25	1.32	1.26
	7+	42.6	53.8	96.4	53.5	144.7	1.53	1.82	1.68	2.14	1.78
Grand average	1	44.7	40.9	85.6	58.9	137.6	1.33	1.02	1.16	0.92	1.05
	2-3	33.6	40.1	73.8	63.7	131.5	1.00	1.00	1.00	1.00	1.00
	4-6	35.1	40.2	75.2	64.5	134.1	1.04	1.00	1.02	1.01	1.02
	7+	49.3	46.5	95.8	70.4	158.6	1.47	1.16	1.30	1.10	1.21

relatively widespread (Namibia and the three Latin American countries)—first births are at lower risk. After the neonatal period, the risk of death associated with first births diminishes considerably so that by age 1-4 years, in 10 of 20 countries, first births experience mortality risk more than 10 percent lower than other children. Seven of these 10 countries are outside sub-Saharan Africa.

Regarding the association between very high birth order (7+) and mortality, an age-specific effect is observed. In every country except Malawi, the neonatal period poses increased risks for children of high birth order. Excess neonatal risk (i.e., relative to birth order 2-3) averages 47 percent across all countries, and ranges from 12 percent in Senegal to 188 percent in Turkey. The high mortality/high fertility countries of sub-Saharan Africa tend to exhibit the least amount of high birth order effect.

Figure 3.1 Relative risk of dying in childhood by birth order (averages for all countries combined), selected Demographic and Health Surveys, 1990-1994



After the neonatal period, the high birth order effect is generally much weaker and more variable. Excess postneonatal mortality risk averages 16 percent and child mortality risk is 10 percent. However, in 5 countries (all outside sub-Saharan Africa) excess postneonatal risk is greater than 75 percent; during the 1-4 year age period, 4 countries (again, all outside sub-Saharan Africa) show excess risk greater than 60 percent. In most countries of sub-Saharan Africa, mortality after the neonatal period shows only limited effects of high birth order. As discussed by Sullivan, Rutstein, and Bicego (1994), settings with persistently high fertility have maintained social systems that support and foster large families.

3.4 MOTHER'S AGE AT BIRTH

A mother's age at birth has important health and social ramifications. Many of these are the same as those discussed regarding birth order since birth order and mother's age at birth are highly correlated. The relationship between age at birth and birth order varies across sociocultural settings depending on levels and age patterns of fertility. Where age at marriage is rising, first births are often delayed to a later (generally less risky) age, especially among those segments of the population that are in transition. Further, under patterns of lower, later fertility, older age at birth is less likely to be associated with grand multiparity, although this varies across social strata. While very young age at birth and older age at birth continue to be associated with heightened risk of dying in the first five years, there is substantial variation among countries. Part of the negative association between very young mother's age at birth and child survival may be attributed to the tendency for very young mothers to be socially and economically disadvantaged (Geronimus and Korenman, 1993). The age groups used in this analysis are: mother's age less than 20 years, 20-29 years, 30-39 years (reference group), and 40 or more years at the time of the birth.

Table 3.4 presents childhood mortality rates by mother's age at birth. For all countries combined, the average excess under-five risk associated with young age at birth (<20 years) is 26 percent (Figure 3.2). Births to women age 20-29 have essentially the same level of under-five risk as those in the reference 30-39 age category. Births to older women (age 40-49) carry 13 percent excess risk.

Table 3.4 Childhood mortality rates and the relative risk of dying by mother's age at birth

Childhood mortality rates and the relative risk of dying by age of mother at birth, for the ten-year period preceding the survey, Demographic and Health Surveys, 1990-1994

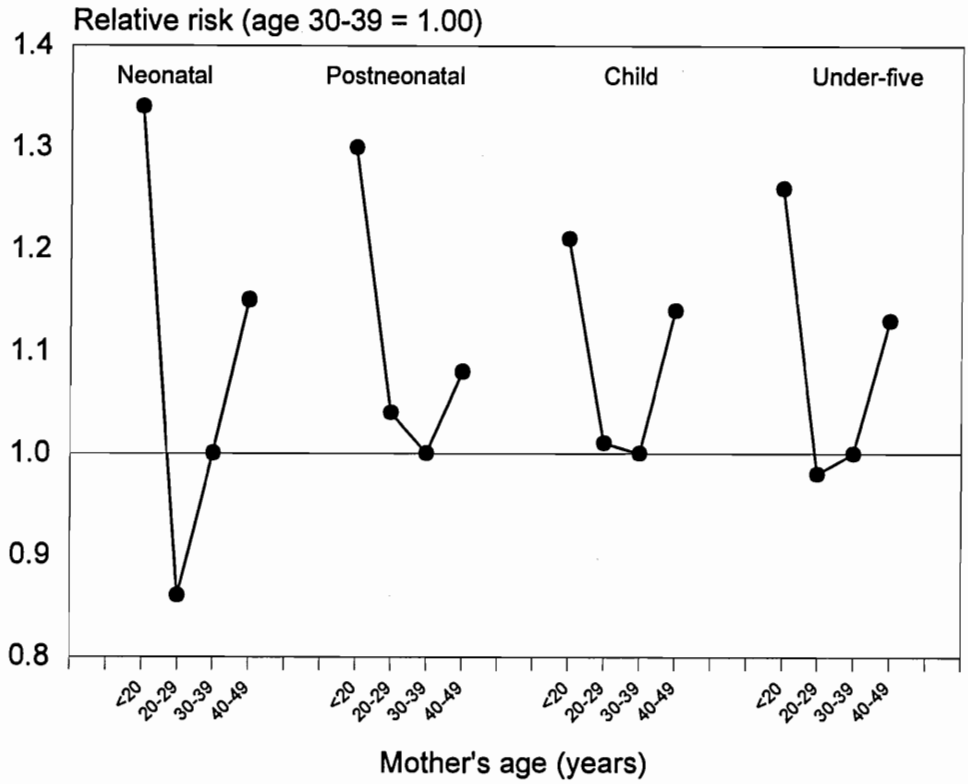
		Mortality rates (deaths per 1,000)					Relative risk of dying (reference: age group 30-39 years)				
Country	Age of mother at birth	Neonatal mortality	Post-neonatal mortality	Infant mortality	Child mortality	Under-five mortality	Neonatal mortality	Post-neonatal mortality	Infant mortality	Child mortality	Under-five mortality
Sub-Saharan Africa											
Namibia	< 20	38.9	27.7	66.6	36.2	100.4	1.17	1.31	1.23	1.05	1.16
	20-29	34.3	29.3	63.6	29.1	90.8	1.03	1.39	1.17	0.85	1.04
	30-39	33.2	21.1	54.3	34.4	86.9	1.00	1.00	1.00	1.00	1.00
	40-49	46.5	20.2	66.7	46.0	109.7	1.40	0.96	1.23	1.34	1.26
Kenya	< 20	31.3	43.9	75.1	35.7	108.1	1.13	1.33	1.24	1.34	1.26
	20-29	23.5	34.6	58.1	34.4	90.5	0.85	1.05	0.96	1.29	1.05
	30-39	27.8	32.9	60.7	26.7	85.8	1.00	1.00	1.00	1.00	1.00
	40-49	55.0	26.8	81.8	34.4	113.4	1.98	0.81	1.35	1.29	1.32
Ghana	< 20	59.3	32.0	91.3	76.6	160.9	1.32	1.25	1.30	1.32	1.30
	20-29	41.9	27.3	69.2	61.6	126.6	0.94	1.07	0.98	1.06	1.02
	30-39	44.8	25.5	70.3	57.9	124.1	1.00	1.00	1.00	1.00	1.00
	40-49	63.3	58.8	122.1	59.7	174.5	1.41	2.31	1.74	1.03	1.41
Cameroon	< 20	59.4	45.7	105.1	82.4	178.8	1.22	1.35	1.27	1.33	1.28
	20-29	30.9	37.0	67.8	64.2	127.7	0.63	1.09	0.82	1.04	0.92
	30-39	48.7	33.9	82.6	62.0	139.5	1.00	1.00	1.00	1.00	1.00
	40-49	42.5	23.3	65.8	123.0	181.2	0.87	0.69	0.80	1.98	1.30
Senegal	< 20	52.2	39.8	92.0	92.9	176.4	1.28	1.17	1.23	1.00	1.10
	20-29	37.0	34.5	71.5	82.9	148.5	0.91	1.02	0.96	0.89	0.93
	30-39	40.8	33.9	74.7	92.7	160.5	1.00	1.00	1.00	1.00	1.00
	40-49	29.2	44.1	73.3	80.8	148.2	0.72	1.30	0.98	0.87	0.92
Rwanda	< 20	64.5	56.6	121.2	131.5	236.8	1.35	1.43	1.39	1.94	1.59
	20-29	45.3	45.0	90.4	80.2	163.3	0.95	1.14	1.04	1.18	1.10
	30-39	47.7	39.5	87.2	67.7	148.9	1.00	1.00	1.00	1.00	1.00
	40-49	33.3	30.6	63.9	79.9	138.7	0.70	0.77	0.73	1.18	0.93
Madagascar	< 20	53.1	74.3	127.5	90.8	206.7	1.30	1.42	1.36	1.10	1.23
	20-29	40.8	58.7	99.5	81.9	173.2	1.00	1.12	1.06	0.99	1.03
	30-39	41.0	52.5	93.5	82.7	168.5	1.00	1.00	1.00	1.00	1.00
	40-49	37.8	34.1	71.9	71.1	137.8	0.92	0.65	0.77	0.86	0.82
Burkina Faso	< 20	80.5	65.4	145.9	128.0	255.2	1.59	1.31	1.45	1.22	1.31
	20-29	41.4	56.4	97.8	104.3	191.9	0.82	1.13	0.97	0.99	0.98
	30-39	50.6	50.0	100.6	104.9	195.0	1.00	1.00	1.00	1.00	1.00
	40-49	54.9	56.5	111.4	99.9	200.2	1.08	1.13	1.11	0.95	1.03
Zambia	< 20	53.3	69.8	123.2	110.1	219.7	1.55	1.32	1.41	1.44	1.40
	20-29	36.0	56.4	92.4	85.2	169.7	1.05	1.07	1.06	1.11	1.08
	30-39	34.4	52.7	87.1	76.6	157.0	1.00	1.00	1.00	1.00	1.00
	40-49	53.8	50.6	104.4	79.8	175.9	1.56	0.96	1.20	1.04	1.12
Nigeria	< 20	62.1	58.9	121.0	122.9	229.0	1.28	1.37	1.32	1.21	1.24
	20-29	36.7	42.3	79.0	107.0	177.5	0.76	0.98	0.86	1.05	0.96
	30-39	48.5	43.0	91.5	101.9	184.1	1.00	1.00	1.00	1.00	1.00
	40-49	70.6	57.5	128.1	144.4	254.0	1.46	1.34	1.40	1.42	1.38
Malawi	< 20	79.2	100.2	179.4	144.1	297.7	2.01	1.19	1.45	1.30	1.35
	20-29	43.6	82.3	125.8	116.8	228.0	1.10	0.98	1.02	1.05	1.03
	30-39	39.5	84.3	123.8	111.1	221.2	1.00	1.00	1.00	1.00	1.00
	40-49	38.2	91.4	129.6	92.1	209.7	0.97	1.08	1.05	0.83	0.95
Niger	< 20	71.4	84.8	156.2	222.4	343.9	1.33	1.06	1.17	1.02	1.06
	20-29	41.5	83.7	125.3	220.7	318.3	0.77	1.04	0.94	1.01	0.98
	30-39	53.8	80.1	134.0	218.7	323.4	1.00	1.00	1.00	1.00	1.00
	40-49	49.9	67.2	117.0	267.5	353.2	0.93	0.84	0.87	1.22	1.09

Table 3.4—*Cont.*

Country	Age of mother at birth	Mortality rates (deaths per 1,000)					Relative risk of dying (reference: age group 30-39 years)				
		Neonatal mortality	Post-neonatal mortality	Infant mortality	Child mortality	Under-five mortality	Neonatal mortality	Post-neonatal mortality	Infant mortality	Child mortality	Under-five mortality
Asia/Near East/ North Africa											
Philippines	< 20	18.9	22.7	41.6	40.5	80.4	0.93	0.96	0.95	1.74	1.21
	20-29	16.1	18.0	34.1	24.9	58.1	0.79	0.76	0.78	1.07	0.88
	30-39	20.4	23.6	44.0	23.3	66.3	1.00	1.00	1.00	1.00	1.00
	40-49	30.2	18.8	49.0	32.0	79.5	1.48	0.80	1.11	1.37	1.20
Turkey	< 20	52.0	40.8	92.8	11.9	103.5	0.93	1.27	1.06	0.94	1.04
	20-29	27.7	27.3	55.0	13.5	67.8	0.50	0.85	0.63	1.06	0.68
	30-39	55.8	32.1	87.9	12.7	99.5	1.00	1.00	1.00	1.00	1.00
	40-49	41.8	60.2	101.9	0.0	101.9	0.75	1.88	1.16	0.00	1.02
Morocco	< 20	65.2	42.1	107.3	19.8	125.0	2.23	1.44	1.83	0.86	1.56
	20-29	32.5	26.6	59.1	22.0	79.8	1.11	0.91	1.01	0.96	1.00
	30-39	29.2	29.3	58.5	22.9	80.0	1.00	1.00	1.00	1.00	1.00
	40-49	29.1	32.8	61.9	24.7	85.1	1.00	1.12	1.06	1.08	1.06
Indonesia	< 20	44.4	42.3	86.8	29.8	114.0	1.33	1.25	1.29	1.00	1.20
	20-29	28.4	31.8	60.2	27.3	85.8	0.85	0.94	0.90	0.91	0.90
	30-39	33.4	33.9	67.2	29.9	95.1	1.00	1.00	1.00	1.00	1.00
	40-49	42.1	30.3	72.4	25.9	96.4	1.26	0.89	1.08	0.87	1.01
Pakistan	< 20	70.1	51.2	121.3	26.7	144.8	1.45	1.45	1.45	0.84	1.28
	20-29	50.8	40.0	90.8	28.5	116.7	1.05	1.13	1.08	0.90	1.03
	30-39	48.5	35.4	83.8	31.8	113.0	1.00	1.00	1.00	1.00	1.00
	40-49	56.1	50.4	106.5	27.1	130.7	1.16	1.42	1.27	0.85	1.16
Latin America/ Caribbean											
Colombia	< 20	15.4	16.7	32.1	10.7	42.5	0.90	1.64	1.18	1.75	1.28
	20-29	13.6	11.3	24.9	7.3	32.0	0.80	1.11	0.91	1.20	0.96
	30-39	17.1	10.2	27.3	6.1	33.2	1.00	1.00	1.00	1.00	1.00
	40-49	32.5	2.0	34.5	31.8	65.2	1.90	0.20	1.26	5.21	1.96
Dominican Republic	< 20	36.0	30.5	66.5	21.5	86.6	1.37	1.88	1.56	0.87	1.31
	20-29	19.8	17.7	37.5	16.2	53.0	0.75	1.09	0.88	0.66	0.80
	30-39	26.3	16.2	42.6	24.7	66.2	1.00	1.00	1.00	1.00	1.00
	40-49	35.2	15.7	50.9	29.6	79.0	1.34	0.97	1.19	1.20	1.19
Peru	< 20	32.5	46.0	78.5	40.8	116.1	1.00	1.49	1.24	1.36	1.27
	20-29	27.2	30.7	58.0	26.3	82.7	0.84	0.99	0.91	0.88	0.90
	30-39	32.5	30.9	63.4	29.9	91.4	1.00	1.00	1.00	1.00	1.00
	40-49	47.9	52.6	100.5	43.3	139.5	1.47	1.70	1.59	1.45	1.53
Grand average	< 20	52.0	49.6	101.6	73.8	166.3	1.34	1.30	1.32	1.21	1.26
	20-29	33.5	39.5	73.0	61.7	129.1	0.86	1.04	0.95	1.01	0.98
	30-39	38.7	38.1	76.8	60.9	132.0	1.00	1.00	1.00	1.00	1.00
	40-49	44.5	41.2	85.7	69.7	148.7	1.15	1.08	1.12	1.14	1.13

The most pronounced effects of young mother's age at birth on child survival occur during the first month of life, although the excess risk persists throughout the five-year period. Average excess risk associated with young age of the mother falls from 34 percent in the neonatal period, to 30 percent in the postneonatal period, to 21 percent during ages 1-4 years. Excess neonatal risk related to young mother's age ranges from -10 percent (i.e., *lower* risk is associated with young mother's age) in Colombia to 123 percent excess risk in Morocco. In the postneonatal period, excess risk ranges from -4 percent in the Philippines to 88 percent excess risk in the Dominican Republic. Excess child mortality risk ranges from -16 percent in Pakistan to 94 percent in Rwanda.

Figure 3.2 Relative risk of dying in childhood by mother's age at birth (averages for all countries combined), selected Demographic and Health Surveys, 1990-1994



The influence of older mother's age at birth (40-49 years) on mortality risk varies widely among countries. Excess under-five risk ranges from -18 percent in Madagascar to 96 percent in Colombia. Taking all countries together, excess mortality risk changes little with age of the child from an average of 15 percent excess neonatal risk to 8 percent average excess postneonatal risk, to 14 percent average excess child mortality risk. However, underlying these averages, widely different patterns define the relationship between older mother's age and childhood mortality. For example, comparing Ghana and Cameroon, overall excess under-five risk is roughly the same among mothers age 40-49 (41 vs 30 percent). Closer examination reveals that, in Ghana, excess risk is substantial during infancy (74 percent) but almost nonexistent during ages 1-4 years; while in Cameroon, risk to children of older women is actually lower than the reference group, but is two times higher during the age period 1-4 years.

3.5 LENGTH OF PRECEDING BIRTH INTERVAL

In a 1984 study of data from the World Fertility Survey (WFS), Shea Rutstein was the first to show decisively that the pace of childbearing is closely linked to survival chances of children. Subsequent research has refined our understanding of the relationship between short birth intervals and heightened mortality risk. Part of the observed bivariate association appears to be due to common cause household factors mediated by replacement of the dead child (Hobcraft, McDonald, and Rutstein, 1985), while part is due to the bias introduced by using interbirth (rather than interpregnancy) intervals (Miller, 1989). Still, even after accounting for these factors, the short birth interval defines mortality risk better than any other demographic variable, especially mortality during infancy (0-11 months). Using DHS data from 17 countries, Boerma and Bicego (1992) point to antenatal factors, particularly those involving maternal nutrition/depletion, to explain the relationship between short birth intervals and high early childhood mortality.

The following presentation focuses on the simple bivariate relationship between birth interval lengths of <24 months, 24-47 months, and 48+ months and childhood mortality. The <24 month category includes all intervals of this length—i.e., it is not restricted to those intervals in which the preceding sibling survived for at least two years before the birth of the index child, as is presented in Sullivan, Rutstein, and Bicego (1994). It should be emphasized that previous studies using both DHS and WFS data indicate that such a restriction has the effect of attenuating the birth interval-mortality relationship in most countries, especially during the neonatal and postneonatal periods.

Table 3.5 indicates that, without exception, children born after a short interval (<24 months) are at increased risk of dying during the first five years and, with the exception of the Dominican Republic, children born after a long interval (48+ months) are at lower risk relative to the 24-47 month interval. Figure 3.3 shows that, for all countries together, short preceding birth intervals are associated with 58 percent higher risk of dying before the age of five while long birth intervals are associated with 28 percent lower risk of dying, compared with intervals 24-47 months in length.

Table 3.5 Childhood mortality rates and the relative risk of dying by length of preceding birth interval

Childhood mortality rates and the relative risk of dying by length of preceding birth interval, for the ten-year period preceding the survey, Demographic and Health Surveys, 1990-1994

Country	Length of preceding birth interval (years)	Mortality rates (deaths per 1,000)					Relative risk of dying (reference: birth interval 2-3 years)				
		Neonatal mortality	Post-neonatal mortality	Infant mortality	Child mortality	Under-five mortality	Neonatal mortality	Post-neonatal mortality	Infant mortality	Child mortality	Under-five mortality
Sub-Saharan Africa											
Namibia	< 2	63.9	33.5	97.5	42.5	135.8	2.32	1.32	1.84	1.36	1.65
	2 - 3	27.5	25.4	52.9	31.3	82.5	1.00	1.00	1.00	1.00	1.00
	4+	26.2	21.9	48.1	25.2	72.1	0.95	0.86	0.91	0.81	0.87
Kenya	< 2	32.2	49.2	81.4	38.1	116.4	1.53	1.60	1.57	1.09	1.37
	2 - 3	21.1	30.8	51.9	34.8	84.8	1.00	1.00	1.00	1.00	1.00
	4+	21.1	23.4	44.5	20.8	64.4	1.00	0.76	0.86	0.60	0.76
Ghana	< 2	80.7	36.6	117.3	90.8	197.4	2.18	1.18	1.73	1.53	1.60
	2 - 3	37.1	30.9	67.9	59.4	123.3	1.00	1.00	1.00	1.00	1.00
	4+	30.5	20.2	50.7	39.3	88.0	0.82	0.65	0.75	0.66	0.71
Cameroon	< 2	76.8	61.2	138.0	110.2	233.1	2.87	2.34	2.60	1.82	2.11
	2 - 3	26.8	26.2	53.1	60.7	110.5	1.00	1.00	1.00	1.00	1.00
	4+	32.3	28.1	60.5	34.7	93.0	1.21	1.07	1.14	0.57	0.84
Senegal	< 2	65.1	46.5	111.6	89.2	190.9	2.19	1.36	1.74	0.96	1.26
	2 - 3	29.7	34.3	64.0	93.2	151.3	1.00	1.00	1.00	1.00	1.00
	4+	18.3	23.9	42.2	63.2	102.7	0.62	0.70	0.66	0.68	0.68
Rwanda	< 2	87.9	70.9	158.8	100.4	243.2	3.30	2.14	2.66	1.33	1.86
	2 - 3	26.6	33.2	59.8	75.7	131.0	1.00	1.00	1.00	1.00	1.00
	4+	33.2	23.9	57.0	45.0	99.5	1.25	0.72	0.95	0.59	0.76
Madagascar	< 2	63.2	81.8	145.0	111.6	240.4	2.16	1.61	1.81	1.52	1.63
	2 - 3	29.2	50.8	80.0	73.2	147.3	1.00	1.00	1.00	1.00	1.00
	4+	24.9	26.6	51.5	68.8	116.8	0.85	0.52	0.64	0.94	0.79
Burkina Faso	< 2	93.0	85.2	178.2	165.3	314.0	2.56	1.75	2.10	1.77	1.84
	2 - 3	36.3	48.6	84.9	93.2	170.2	1.00	1.00	1.00	1.00	1.00
	4+	20.3	26.3	46.7	65.7	109.3	0.56	0.54	0.55	0.70	0.64
Zambia	< 2	70.0	86.4	156.3	104.5	244.5	2.47	1.79	2.04	1.30	1.62
	2 - 3	28.3	48.2	76.5	80.1	150.5	1.00	1.00	1.00	1.00	1.00
	4+	20.1	36.0	56.1	70.3	122.5	0.71	0.75	0.73	0.88	0.81
Nigeria	< 2	69.9	64.3	134.2	123.9	241.5	2.04	1.57	1.78	1.05	1.31
	2 - 3	34.2	41.0	75.2	118.0	184.3	1.00	1.00	1.00	1.00	1.00
	4+	21.2	25.1	46.3	69.8	112.8	0.62	0.61	0.62	0.59	0.61
Malawi	< 2	66.7	116.0	182.6	161.5	314.6	1.88	1.54	1.65	1.50	1.52
	2 - 3	35.5	75.4	110.9	108.0	206.9	1.00	1.00	1.00	1.00	1.00
	4+	31.2	65.1	96.2	76.7	165.6	0.88	0.86	0.87	0.71	0.80
Niger	< 2	61.5	97.1	158.6	222.7	346.0	1.50	1.25	1.34	0.94	1.06
	2 - 3	41.1	77.4	118.5	236.3	326.8	1.00	1.00	1.00	1.00	1.00
	4+	21.6	52.1	73.8	157.2	219.4	0.53	0.67	0.62	0.67	0.67

Table 3.5—*Cont.*

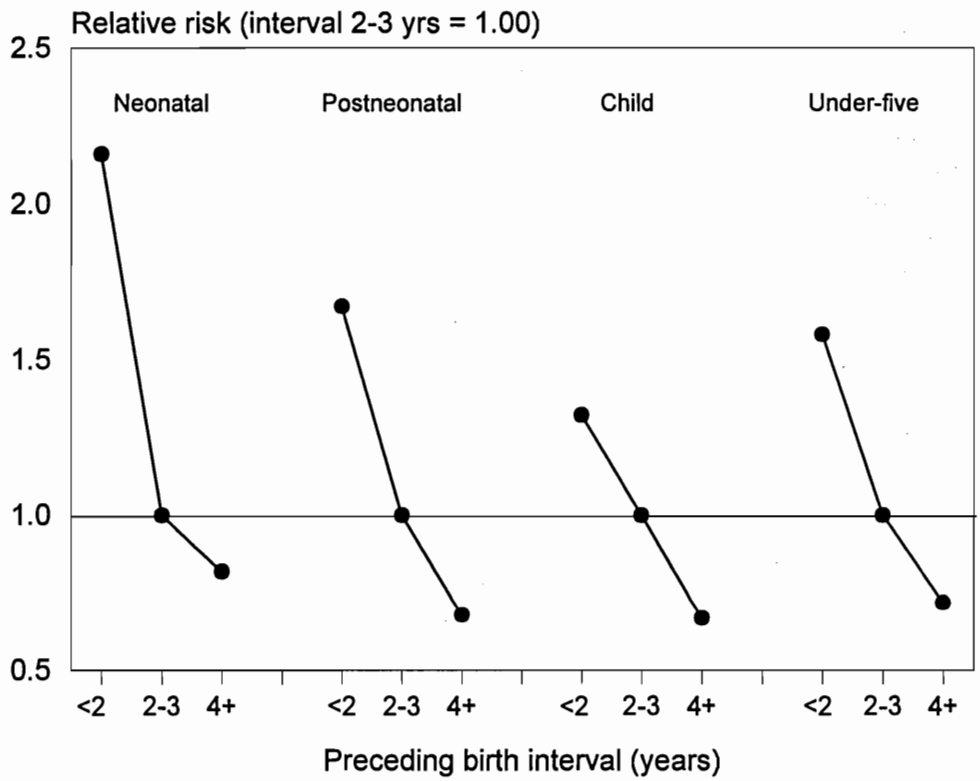
Country	Length of preceding birth interval (years)	Mortality rates (deaths per 1,000)					Relative risk of dying (reference: birth interval 2-3 years)				
		Neonatal mortality	Post-neonatal mortality	Infant mortality	Child mortality	Under-five mortality	Neonatal mortality	Post-neonatal mortality	Infant mortality	Child mortality	Under-five mortality
Asia/Near East/ North Africa											
Philippines	< 2	20.6	33.5	54.0	38.3	90.3	1.37	1.86	1.64	1.53	1.58
	2 - 3	15.0	18.0	33.0	25.0	57.2	1.00	1.00	1.00	1.00	1.00
	4+	19.3	13.9	33.2	15.1	47.8	1.29	0.77	1.01	0.60	0.84
Turkey	< 2	63.3	50.1	113.4	24.5	135.1	2.73	1.84	2.25	2.13	2.20
	2 - 3	23.2	27.3	50.4	11.5	61.3	1.00	1.00	1.00	1.00	1.00
	4+	20.4	15.0	35.4	3.9	39.1	0.88	0.55	0.70	0.34	0.64
Morocco	< 2	56.6	47.2	103.8	31.0	131.6	2.53	1.96	2.23	1.46	1.97
	2 - 3	22.4	24.1	46.5	21.3	66.8	1.00	1.00	1.00	1.00	1.00
	4+	19.3	12.3	31.6	14.0	45.1	0.86	0.51	0.68	0.66	0.68
Indonesia	< 2	57.2	60.4	117.7	46.2	158.4	2.06	1.71	1.87	1.45	1.70
	2 - 3	27.8	35.3	63.1	31.9	93.0	1.00	1.00	1.00	1.00	1.00
	4+	24.2	18.4	42.6	15.6	57.5	0.87	0.52	0.68	0.49	0.62
Pakistan	< 2	75.0	59.6	134.6	43.5	172.2	2.06	2.18	2.11	1.71	1.97
	2 - 3	36.4	27.4	63.8	25.4	87.6	1.00	1.00	1.00	1.00	1.00
	4+	13.7	18.3	32.0	13.6	45.2	0.38	0.67	0.50	0.54	0.52
Latin America/ Caribbean											
Colombia	< 2	16.9	22.4	39.3	15.4	54.1	0.92	1.95	1.32	2.26	1.49
	2 - 3	18.3	11.5	29.8	6.8	36.3	1.00	1.00	1.00	1.00	1.00
	4+	18.5	6.7	25.3	2.5	27.7	1.01	0.58	0.85	0.37	0.76
Dominican Republic	< 2	35.8	27.1	62.9	25.9	87.2	2.27	1.73	2.00	1.27	1.70
	2 - 3	15.8	15.7	31.5	20.4	51.2	1.00	1.00	1.00	1.00	1.00
	4+	22.4	13.9	36.3	17.0	52.6	1.42	0.89	1.15	0.83	1.03
Peru	< 2	49.4	61.8	111.2	46.2	152.2	1.86	2.09	1.99	1.41	1.75
	2 - 3	26.6	29.5	56.0	32.7	86.8	1.00	1.00	1.00	1.00	1.00
	4+	19.7	12.8	32.5	12.2	44.3	0.74	0.43	0.58	0.37	0.51
Grand average	< 2	60.3	59.5	119.8	81.6	189.9	2.16	1.67	1.89	1.32	1.58
	2 - 3	27.9	35.6	63.5	61.9	120.5	1.00	1.00	1.00	1.00	1.00
	4+	22.9	24.2	47.1	41.5	86.3	0.82	0.68	0.74	0.67	0.72

Generally, the most pronounced effect of short birth intervals on childhood mortality occurs during the neonatal period, and the weakest effect during the period 1-4 years. This is consistent with the hypothesis that antenatal and maternal health factors mediate the relationship. Taking all countries together, excess mortality risk is 116 percent during the neonatal period, 67 percent during the postneonatal period, and 32 percent during the period 1-4 years. There are exceptions to this pattern. For example, in the Philippines, postneonatal risk is more sensitive to the *interval effect* than neonatal risk; however, this may be due to misreporting of age at death (i.e., neonatal deaths reported at "1 month"). More strikingly, in Colombia excess risk associated with short birth intervals is much greater during ages 1-4 years (126 percent) than during infancy (32 percent). In this case, the minimal birth interval effect during infancy is probably due to a combination of age at death misreporting (e.g., heaping of deaths at age 12 months) and selective underreporting of neonatal deaths. (Note that essentially no interval-related differentials are observed in the neonatal period.)

Children born after long intervals (48+ months) generally have better survival chances in every age category than children in the reference group 24-47 months, especially after the neonatal period. In four countries, however—Cameroon, Rwanda, Philippines, and the Dominican Republic—long intervals are associated with relatively high neonatal risk. This suggests that some long intervals may be "long" due to poor maternal health, pregnancy loss (unre-

ported in DHS surveys), or omitted births leading to neonatal deaths during the reference interval. In the latter case, the "long" reference interval may in fact be composed of two or more short intervals. Overall, however, intervals of 48+ months are associated with lower (often substantially lower) rates of childhood mortality. Taking all countries together, long birth intervals are associated with averages of 18 percent (neonatal), 32 percent (postneonatal), and 33 percent (age 1-4 years) lower risk of dying during the first five years (Figure 3.3).

Figure 3.3 Relative risk of dying in childhood by length of preceding birth interval (averages for all countries combined), selected Demographic and Health Surveys, 1990-1994



4 Socioeconomic Differentials in Childhood Mortality

The evidence for large socioeconomic differentials in infant and child mortality is substantial, as demonstrated in several large cross-national studies (Rutstein, 1984; Hobcraft, McDonald, and Rutstein, 1985; Bicego and Boerma 1993; Sullivan, Rutstein, and Bicego, 1994). In this section, four types of characteristics are examined: residence, migration, parental education/literacy, and husband/father's occupation. Socioeconomic characteristics are highly correlated with one another and with bio-demographic characteristics which, in their own right, are important determinants of mortality. This warns against a causal interpretation of the bivariate associations discussed here. Using an appropriate analytical model, simultaneous consideration should be given to the various characteristics to differentiate properly among their effects.

4.1 RESIDENCE

Urban-Rural Residence

Residence in this analysis refers to the de facto location (urban or rural) of the place where the mother's interview was conducted, and is based on the official classification system of the country (usually the most recent census designation). For respondents who have recently relocated, some births and deaths may have occurred at locations different from the de facto location. Such misclassification can operate to lessen observed differentials. Lack of migration history data precludes the classification of births and deaths according to actual place of occurrence.

Table 4.1 shows the percent distribution of births in the 10-year period preceding the survey by urban-rural residence. The proportion of births occurring in urban areas varies from 5 percent in Rwanda to 66 percent in Colombia (Figure 4.1).[9] In five countries (Rwanda, Kenya, Niger, Madagascar and Burkina Faso) less than 20 percent of births were to mothers living in urban areas. In Nigeria, Ghana, Indonesia, Pakistan, Namibia, Senegal, Morocco and Cameroon, between 20 and 40 percent of the births were urban. In Zambia, the Philippines, Turkey and the Dominican Republic, the proportion of urban births was 40 to 60 percent. In Peru and Colombia, more than 60 percent of births took place in urban areas.

Table 4.1 Distribution of births by urban-rural residence

Percent distribution of births in the 10-year period preceding the survey by urban-rural residence, Demographic and Health Surveys 1990-1994

Country	Residence		Total	Number of births
	Urban	Rural		
Sub-Saharan Africa				
Namibia	33	67	100.0	7,095
Kenya	12	88	100.0	12,474
Ghana	27	73	100.0	7,195
Cameroon	38	62	100.0	6,717
Senegal	33	67	100.0	11,068
Rwanda	5	95	100.0	11,388
Madagascar	13	87	100.0	10,680
Burkina Faso	15	85	100.0	12,311
Zambia	47	53	100.0	11,680
Nigeria	21	79	100.0	16,359
Niger	15	85	100.0	14,081
Asia/Near East/ North Africa				
Philippines	48	52	100.0	17,371
Turkey	58	42	100.0	8,186
Morocco	35	65	100.0	10,534
Indonesia	27	73	100.0	3,570
Pakistan	30	70	100.0	14,754
Latin America/ Caribbean				
Colombia	66	34	100.0	7,591
Dominican Republic	59	41	100.0	7,328
Peru	62	38	100.0	16,972

[9] Malawi is excluded because the urban-rural distribution of births is not available.

Figure 4.1 Percentage of births in the 10-year period preceding the survey that occurred in urban areas, Demographic and Health Surveys, 1990-1994

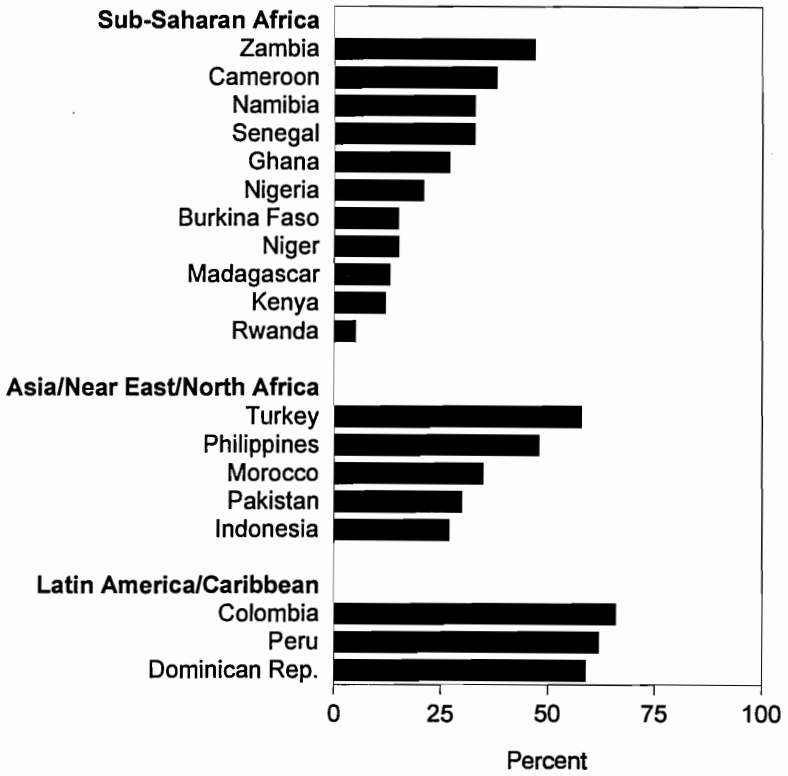


Table 4.2 presents childhood mortality rates by residence, with urban-to-rural risk ratios. Taking all countries together, the average risk of dying during the first five years is 31 percent lower in urban areas than in rural areas. The urban advantage increases with increasing age of the child: urban-to-rural relative risk falls from 0.78 in the neonatal period to 0.62 during ages 1-4 years. Mortality during ages 1-4 years is thus especially sensitive to conditions that vary between urban and rural areas. In five countries, child mortality risk is at least two times higher in rural than urban areas; in Morocco, it is four times higher.

In only one country (Colombia) does urban under-five mortality exceed rural levels, and in this case the urban-rural difference is in a range explainable by sampling fluctuation. Similarly, in two other countries, Namibia and Rwanda, urban mortality is only slightly lower than rural mortality—again within the bounds of sampling error.

Type of urban area

The observation that urban-rural residence has little effect on mortality risk in many countries raises questions since greater access to health technologies and services is expected in urban areas. This apparent paradox is especially striking with regard to neonatal risk because access to services that mitigate the effects of adverse pregnancy outcome are often more available in towns and cities. Recently, more attention has been paid to the heterogeneity of the urban environment in developing countries. With the rapid rise in population levels and concomitant migration of significant numbers of men and women from the countryside to towns and cities, most developing countries are experiencing a sharp rise in urban and periurban populations. Seldom are these populations fully enfranchised with regard to economic life and health and human services.

Table 4.2 Childhood mortality rates by urban-rural residence and urban-rural risk ratios of dying

Childhood mortality rates by urban-rural residence, and the urban-rural risk ratios of dying, for the ten-year period preceding the survey, Demographic and Health Surveys 1990-1994

	Neonatal mortality			Postneonatal mortality			Infant mortality			Child mortality			Under-five mortality		
Country	Urban	Rural	Risk ratio	Urban	Rural	Risk ratio	Urban	Rural	Risk ratio	Urban	Rural	Risk ratio	Urban	Rural	Risk ratio
Sub-Saharan Africa															
Namibia	34	36	0.93	29	25	1.20	63	61	1.04	25	36	0.69	86	95	0.91
Kenya	23	28	0.84	23	37	0.60	46	65	0.70	31	33	0.95	75	96	0.79
Ghana	39	49	0.80	16	33	0.48	55	82	0.67	37	73	0.51	90	149	0.60
Cameroon	42	43	0.98	30	43	0.69	72	86	0.84	52	80	0.66	120	159	0.76
Senegal	31	45	0.68	24	42	0.57	55	87	0.63	50	107	0.47	102	184	0.55
Rwanda	43	47	0.92	44	43	1.02	88	90	0.97	74	80	0.93	155	163	0.95
Madagascar	40	44	0.91	35	63	0.55	75	107	0.70	73	86	0.85	142	183	0.78
Burkina Faso	32	55	0.58	45	58	0.77	76	113	0.68	78	114	0.68	148	214	0.69
Zambia	32	47	0.67	46	69	0.67	78	116	0.67	79	97	0.82	151	201	0.75
Nigeria	41	47	0.87	35	49	0.71	76	96	0.79	59	124	0.48	130	208	0.63
Malawi	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Niger	36	55	0.66	53	88	0.60	89	143	0.62	133	238	0.56	210	347	0.61
Asia/Near East/ North Africa															
Philippines	16	20	0.78	16	24	0.67	32	44	0.72	22	31	0.70	53	73	0.72
Turkey	36	39	0.92	22	43	0.51	58	83	0.70	10	18	0.54	67	99	0.68
Morocco	30	36	0.83	22	33	0.66	52	69	0.75	7	31	0.23	59	98	0.60
Indonesia	23	36	0.64	20	39	0.51	43	75	0.57	16	33	0.49	59	106	0.55
Pakistan	41	59	0.70	34	44	0.77	75	102	0.73	21	33	0.62	94	132	0.71
Latin America/ Caribbean															
Colombia	16	13	1.25	13	10	1.31	29	23	1.28	7	10	0.68	36	33	1.09
Dominican Republic	23	26	0.90	14	29	0.48	37	54	0.68	10	31	0.32	47	84	0.56
Peru	21	45	0.46	45	48	0.95	48	90	0.53	21	45	0.47	67	131	0.51
Grand average	31	40	0.78	30	43	0.69	60	83	0.72	42	68	0.62	100	145	0.69

Note: An asterisk indicates that a figure is based on fewer than 250 births and has been suppressed.

Using the standard DHS variable of household access to piped drinking water, Table 4.3.1 presents mortality rates for urban areas with piped water (more developed urban areas), urban areas without piped water (less developed urban areas), and rural areas. Table 4.3.2 presents the corresponding relative risks using rural areas as the reference category (i.e., equaling 1.0). In every country examined, under-five mortality is higher in the less developed urban areas than in the more developed urban areas, often much higher. During certain ages in some countries, mortality risk in the less developed urban areas even exceeds rural mortality. Taking all countries together, children in less developed urban areas experience an under-five mortality risk 57 percent higher than that of other urban children, although still 17 percent lower than that of rural children.

The *urban development* differential increases with increasing age of the child from 30 percent excess risk (less developed relative to more developed urban areas) during the neonatal period, to 62 percent during the postneonatal period, to 83 percent during ages 1-4 years (Figure 4.2).

4.2 MIGRATION

Information used to determine migration status was obtained from respondents. Mothers were asked to identify their childhood place of residence (first 12 years of life), and their current place of residence if not at the site of interview. From these data, a variable was created that captures the *impact* of migration as well as the *direction* of migration on

Table 4.3.1 Childhood mortality rates by urban-rural residence and access to piped water

Childhood mortality rates by urban-rural residence and access to piped water, for the ten-year period preceding the survey, Demographic and Health Surveys, 1990-1994

	Neonatal mortality			Postneonatal mortality			Infant mortality			Child mortality			Under-five mortality		
	Urban			Urban			Urban			Urban			Urban		
Country	Piped water	No piped water	Rural	Piped water	No piped water	Rural	Piped water	No piped water	Rural	Piped water	No piped water	Rural	Piped water	No piped water	Rural
Sub-Saharan Africa															
Namibia	28	48	36	27	35	25	55	83	61	22	32	36	76	112	95
Kenya	24	22	28	20	26	37	43	48	65	20	45	33	63	90	96
Ghana	38	40	49	10	19	33	48	59	82	35	38	73	82	94	149
Cameroon	27	44	43	14	33	43	41	78	86	39	55	80	79	128	159
Senegal	26	36	45	18	30	41	43	66	87	42	60	107	83	122	184
Rwanda	*	44	47	*	48	43	*	91	90	*	78	80	*	163	163
Madagascar	29	43	44	27	37	63	56	81	107	46	81	86	99	155	183
Burkina Faso	36	30	55	46	44	58	82	75	113	37	90	114	116	158	214
Zambia	27	39	47	39	57	69	66	96	116	67	99	97	128	186	201
Nigeria	33	42	47	32	36	49	65	78	96	56	60	124	117	133	208
Malawi	*	49	*	*	87	*	*	136	*	*	120	*	*	240	*
Niger	22	40	54	42	56	88	64	96	143	74	150	238	134	232	347
Asia/Near East North Africa															
Philippines	15	17	20	14	18	24	28	34	44	13	27	30	41	60	73
Turkey	34	42	39	21	24	43	56	66	83	10	10	18	65	75	99
Morocco	27	38	36	19	31	33	45	69	69	7	9	31	52	77	98
Indonesia	24	23	36	12	22	39	35	45	75	7	18	33	43	62	106
Pakistan	34	46	59	26	40	44	60	86	102	15	25	33	74	110	132
Latin America/ Caribbean															
Colombia	17	10	13	10	(46)	10	26	(56)	23	6	(14)	10	33	(69)	34
Dominican Republic	21	24	26	8	16	29	29	40	54	7	11	31	36	51	84
Peru	20	23	45	22	36	45	41	59	90	15	33	45	55	90	131
Grand average	27	35	40	23	37	43	49	72	83	29	53	68	76	120	145

Note: Figures in parentheses are based on 250-500 births. An asterisk indicates that a figure is based on fewer than 250 births and has been suppressed.

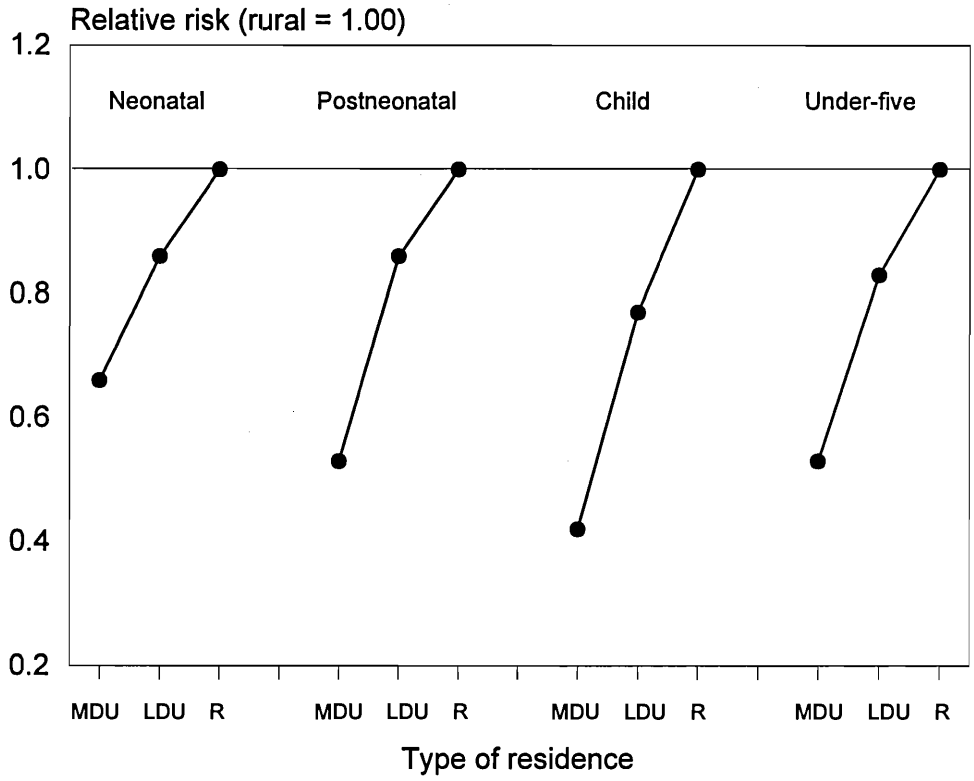
Table 4.3.2 Relative risk of dying in childhood, by urban-rural residence and access to piped water

Relative risk of dying in childhood by urban-rural residence and access to piped water, for the ten-year period preceding the survey, Demographic and Health Surveys, 1990-1994

	Neonatal mortality			Postneonatal mortality			Infant mortality			Child mortality			Under-five mortality		
	Urban			Urban			Urban			Urban			Urban		
Country	Piped water	No piped water	Rural	Piped water	No piped water	Rural	Piped water	No piped water	Rural	Piped water	No piped water	Rural	Piped water	No piped water	Rural
Sub-Saharan Africa															
Namibia	0.78	1.33	1.00	1.08	1.40	1.00	0.90	1.36	1.00	0.61	0.89	1.00	0.80	1.18	1.00
Kenya	0.86	0.79	1.00	0.54	0.70	1.00	0.66	0.74	1.00	0.61	1.36	1.00	0.66	0.94	1.00
Ghana	0.78	0.82	1.00	0.30	0.58	1.00	0.59	0.72	1.00	0.48	0.52	1.00	0.55	0.63	1.00
Cameroon	0.63	1.02	1.00	0.33	0.77	1.00	0.48	0.91	1.00	0.49	0.69	1.00	0.50	0.81	1.00
Senegal	0.58	0.80	1.00	0.44	0.73	1.00	0.49	0.76	1.00	0.39	0.56	1.00	0.45	0.66	1.00
Rwanda	*	0.94	1.00	*	1.12	1.00	*	1.01	1.00	*	0.98	1.00	*	1.00	1.00
Madagascar	0.66	0.98	1.00	0.43	0.59	1.00	0.52	0.76	1.00	0.53	0.94	1.00	0.54	0.85	1.00
Burkina Faso	0.65	0.55	1.00	0.79	0.76	1.00	0.73	0.66	1.00	0.32	0.79	1.00	0.54	0.74	1.00
Zambia	0.57	0.83	1.00	0.57	0.83	1.00	0.57	0.83	1.00	0.69	1.02	1.00	0.64	0.93	1.00
Nigeria	0.70	0.89	1.00	0.65	0.73	1.00	0.68	0.81	1.00	0.45	0.48	1.00	0.56	0.64	1.00
Malawi	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Niger	0.41	0.74	1.00	0.48	0.64	1.00	0.45	0.67	1.00	0.31	0.63	1.00	0.39	0.67	1.00
Asia/Near East/ North Africa															
Philippines	0.75	0.85	1.00	0.58	0.75	1.00	0.64	0.77	1.00	0.43	0.90	1.00	0.56	0.82	1.00
Turkey	0.87	1.08	1.00	0.49	0.56	1.00	0.67	0.80	1.00	0.56	0.56	1.00	0.66	0.76	1.00
Morocco	0.75	1.06	1.00	0.58	0.94	1.00	0.65	1.00	1.00	0.23	0.29	1.00	0.53	0.79	1.00
Indonesia	0.67	0.64	1.00	0.31	0.56	1.00	0.47	0.60	1.00	0.21	0.55	1.00	0.41	0.58	1.00
Pakistan	0.58	0.78	1.00	0.59	0.91	1.00	0.59	0.84	1.00	0.45	0.76	1.00	0.56	0.83	1.00
Latin America/ Caribbean															
Colombia	1.31	0.77	1.00	1.00	(4.60)	1.00	4.60	(2.43)	1.00	0.60	(1.40)	1.00	0.97	(2.03)	1.00
Dominican Republic	0.81	0.92	1.00	0.28	0.55	1.00	4.60	0.74	1.00	0.23	0.35	1.00	0.43	0.61	1.00
Peru	0.44	0.51	1.00	0.49	0.80	1.00	4.60	0.66	1.00	0.33	0.73	1.00	0.42	0.69	1.00
Grand average	0.66	0.86	1.00	0.53	0.86	1.00	0.59	0.86	1.00	0.42	0.77	1.00	0.53	0.83	1.00

Note: Figures in parentheses are based on 250-500 births. An asterisk indicates that a figure is based on fewer than 250 births and has been suppressed.

Figure 4.2 Relative risk of dying in childhood by residence and access to piped water (averages for all countries combined), selected Demographic and Health Surveys, 1990-1994



MDU = More developed urban areas (piped water)
LDU = Less developed urban areas (no piped water)
R = Rural areas

childhood mortality. Comparison is made of the childhood mortality experience of:

- urban natives,
- rural-to-urban migrants,
- urban-to-rural migrants, and
- rural natives.

Individuals are considered urban or rural natives if they have lived in a particular setting all their lives. They are classified as rural-to-urban migrants if they are currently living in an urban area but their childhood place of residence was rural, and vice versa for urban-to-rural migrants.

Table 4.4.1 presents childhood mortality rates by migration status of the mother and direction of migration. Corresponding relative risks are presented in Table 4.4.2. In general, urban natives have the lowest under-five mortality rates, followed by rural-to-urban migrants; urban-to-rural migrants have rates that are closer to those of rural natives. The advantage held by urban natives and rural-to-urban migrants exists at all ages but tends to be more pronounced as age of the child increases. For example, rural-to-urban migrants in Cameroon experience essentially the same neonatal mortality risk as rural natives but have 20 percent and 43 percent lower mortality risk during the postneonatal and 1-4 year periods, respectively.

4.3 EDUCATION AND LITERACY

The positive impact of parental education and literacy on child survival is well documented. While the behavioral mechanisms that drive the education-child survival relationship are not completely understood, it is generally recognized that improved and/or increased use of preventive and curative health technologies by more educated mothers is part of the explanation. In a recent study using DHS data from 17 countries, Bicego and Boerma (1993) showed that child health status and use of maternal and child health

Table 4.4.1 Childhood mortality rates by migration status of mother and direction of migration

Childhood mortality rates by migration status of mother and direction of migration, for the ten-year period preceding the survey, Demographic and Health Surveys, 1990-1994

	Neonatal mortality				Postneonatal mortality				Infant mortality				Child mortality				Under-five mortality			
Country	Urban native	Rural-to-urban migrant	Urban-to-rural migrant	Rural native	Urban native	Rural-to-urban migrant	Urban-to-rural migrant	Rural native	Urban native	Rural-to-urban migrant	Urban-to-rural migrant	Rural native	Urban native	Rural-to-urban migrant	Urban-to-rural migrant	Rural native	Urban native	Rural-to-urban migrant	Urban-to-rural native	Rural native
Sub-Saharan Africa																				
Namibia	29	37	*	36	24	33	*	24	53	70	*	61	17	30	*	36	69	99	*	94
Kenya	(23)	23	29	27	(18)	25	69	34	(41)	48	97	61	(41)	27	52	31	(80)	73	144	90
Ghana	40	(36)	53	47	15	(20)	30	35	55	(56)	83	82	33	(50)	53	81	86	(103)	132	156
Cameroon	41	43	(36)	44	26	37	(25)	46	67	80	(61)	90	56	46	(73)	81	119	122	(129)	163
Senegal	31	31	34	47	21	29	49	41	52	60	83	87	42	67	68	111	92	124	145	189
Rwanda	59	35	*	47	(52)	40	*	43	(111)	75	*	91	(101)	60	*	80	(201)	131	*	163
Madagascar	40	38	47	43	30	49	63	63	71	87	109	106	70	81	78	87	136	161	179	184
Burkina Faso	29	36	58	54	42	49	54	59	71	85	111	113	74	84	(116)	114	140	161	(214)	214
Zambia	31	33	42	49	49	42	70	68	80	75	111	117	84	72	94	97	157	142	194	203
Nigeria	39	44	59	45	32	43	38	51	71	88	97	96	62	51	122	124	128	135	207	208
Malawi	49	*	*	*	87	*	*	*	136	*	*	*	120	*	*	*	240	*	*	*
Niger	32	41	(52)	55	54	52	(110)	87	86	93	(162)	142	119	151	*	240	194	230	*	348
Asia/Near East/ North Africa																				
Philippines	15	16	10	22	14	18	18	25	29	34	28	47	18	25	27	31	47	58	54	76
Turkey	31	42	(33)	40	16	29	(49)	43	47	71	(82)	83	10	9	*	18	57	79	*	99
Morocco	22	39	29	37	16	29	15	34	38	67	44	71	4	11	8	32	42	78	(51)	101
Indonesia	25	21	34	36	10	30	24	40	35	51	58	76	12	20	18	34	46	69	75	108
Pakistan	33	56	(21)	61	31	38	(58)	43	64	95	(79)	104	19	25	(47)	32	81	117	(122)	133
Latin America/ Caribbean																				
Colombia	17	13	(16)	12	11	19	(4)	13	28	33	(20)	24	7	6	(12)	10	35	38	(32)	34
Dominican Republic	22	25	14	28	15	12	(29)	29	37	37	(42)	57	9	13	(36)	30	45	50	(76)	86
Peru	20	24	40	48	23	47	42	47	43	71	81	95	18	38	45	45	60	106	123	136
Grand average	31	33	36	41	29	34	44	43	61	67	79	84	46	46	57	69	103	109	125	147

Note: Figures in parentheses are based on 250-500 births. An asterisk indicates that a figure is based on fewer than 250 births and has been suppressed.

Table 4.4.2 Relative risk of dying in childhood by migration status of mother and direction of migration

Relative risk of dying in childhood by migration status of mother and direction of migration, for the ten-year period preceding the survey, Demographic and Health Surveys, 1990-1994

	Neonatal mortality				Postneonatal mortality				Infant mortality				Child mortality				Under-five mortality			
Country	Urban native	Rural-to-urban migrant	Urban-to-rural migrant	Rural native	Urban native	Rural-to-urban migrant	Urban-to-rural migrant	Rural native	Urban native	Rural-to-urban migrant	Urban-to-rural migrant	Rural native	Urban native	Rural-to-urban migrant	Urban-to-rural migrant	Rural native	Urban native	Rural-to-urban migrant	Urban-to-rural native	Rural native
Sub-Saharan Africa																				
Namibia	0.81	1.03	*	1.00	1.00	1.38	*	1.00	0.87	1.15	*	1.00	0.47	0.83	*	1.00	0.73	1.05	*	1.00
Kenya	(0.85)	0.85	1.07	1.00	(0.53)	0.74	2.03	1.00	(0.67)	0.79	1.59	1.00	(1.32)	0.87	1.68	1.00	(0.89)	0.81	1.60	1.00
Ghana	0.85	(0.77)	1.13	1.00	0.43	(0.57)	0.86	1.00	0.67	(0.68)	1.01	1.00	0.41	(0.62)	0.65	1.00	0.55	(0.66)	0.85	1.00
Cameroon	0.93	0.98	(0.82)	1.00	0.57	0.80	(0.54)	1.00	0.74	0.89	(0.68)	1.00	0.69	0.57	(0.90)	1.00	0.73	0.75	(0.79)	1.00
Senegal	0.66	0.66	0.72	1.00	0.51	0.71	1.20	1.00	0.60	0.69	0.95	1.00	0.38	0.60	0.61	1.00	0.49	0.66	0.77	1.00
Rwanda	1.26	0.74	*	1.00	(1.21)	0.93	*	1.00	(1.22)	0.82	*	1.00	(1.26)	0.75	*	1.00	(1.23)	0.80	*	1.00
Madagascar	0.93	0.88	1.09	1.00	0.48	0.78	1.00	1.00	0.67	0.82	1.03	1.00	0.80	0.93	0.90	1.00	0.74	0.88	0.97	1.00
Burkina Faso	0.54	0.67	1.07	1.00	0.71	0.83	0.92	1.00	0.63	0.75	0.98	1.00	0.65	0.74	(1.02)	1.00	0.65	0.75	(1.00)	1.00
Zambia	0.63	0.67	0.86	1.00	0.72	0.62	1.03	1.00	0.68	0.64	0.95	1.00	0.87	0.74	0.97	1.00	0.77	0.70	0.96	1.00
Nigeria	0.87	0.98	1.31	1.00	0.63	0.84	0.75	1.00	0.74	0.92	1.01	1.00	0.50	0.41	0.98	1.00	0.62	0.65	1.00	1.00
Malawi	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Niger	0.58	0.75	(0.95)	1.00	0.62	0.60	(1.26)	1.00	0.61	0.65	(1.14)	1.00	0.50	0.63	*	1.00	0.56	0.66	*	1.00
Asia/Near East/ North Africa																				
Philippines	0.68	0.73	0.45	1.00	0.56	0.72	0.72	1.00	0.62	0.72	0.60	1.00	0.58	0.81	0.87	1.00	0.62	0.76	0.71	1.00
Turkey	0.78	1.05	0.83	1.00	0.37	0.67	1.14	1.00	0.57	0.86	0.99	1.00	0.56	0.50	*	1.00	0.58	0.80	*	1.00
Morocco	0.59	1.05	0.78	1.00	0.47	0.85	0.44	1.00	0.54	0.94	0.62	1.00	0.13	0.34	0.25	1.00	0.42	0.77	0.50	1.00
Indonesia	0.69	0.58	0.94	1.00	0.25	0.75	0.60	1.00	0.46	0.67	0.76	1.00	0.35	0.59	0.53	1.00	0.43	0.64	0.69	1.00
Pakistan	0.54	0.92	0.34	1.00	0.72	0.88	1.35	1.00	0.62	0.91	0.76	1.00	0.59	0.78	1.47	1.00	0.61	0.88	0.92	1.00
Latin America/ Caribbean																				
Colombia	1.42	1.08	1.33	1.00	0.85	1.46	0.31	1.00	1.17	1.38	0.83	1.00	0.70	0.60	1.20	1.00	1.03	1.12	0.94	1.00
Dominican Republic	0.79	0.89	0.50	1.00	0.52	0.41	1.00	1.00	0.65	0.65	0.74	1.00	0.30	0.43	1.20	1.00	0.52	0.58	0.88	1.00
Peru	0.42	0.50	0.83	1.00	0.49	1.00	0.89	1.00	0.45	0.75	0.85	1.00	0.40	0.84	1.00	1.00	0.44	0.78	0.90	1.00
Grand average	0.77	0.81	0.87	1.00	0.67	0.78	1.01	1.00	0.72	0.80	0.94	1.00	0.66	0.66	0.82	1.00	0.70	0.75	0.85	1.00

Note: Figures in parentheses are based on 250-500 births. An asterisk indicates that a figure is based on fewer than 250 births and has been suppressed.

services are closely linked to educational status of the mother, and that the association is only partly explained by the economic standing of the household. In DHS surveys, information on respondent's education was collected using the following questions:

"Have you ever attended school?"
"What was the highest level of school you attended?"
"What was the highest (Grade, Form, Year) you completed at that level?"

For women who had attended primary school, an additional question on literacy was asked, "Can you read a letter or newspaper easily, with difficulty or not at all?" Women who had not attended school were assumed to be illiterate. Women were also asked similar questions about their current or last husband/live-in partner.

In this section, two related variables are examined. The first is the level of maternal education, which has the categories: no schooling, primary incomplete, primary complete and secondary or above. Those who have not been to school at all or who have been to school but have not completed the first year of primary school are grouped into the "no schooling or none" category. This category also includes people who have attended only preschool, kindergarten or Koranic instruction. An advantage of this construction—versus number of years of education—is that it captures the important transition from having completed primary school to starting secondary education, which involves a major investment of household resources. A disadvantage is that it does not precisely quantify exposure to formal schooling; this can make cross-national comparisons difficult (e.g., there are differences among countries in the number of years required to complete "primary" school). All formulations of an education variable using survey data will, however, inevitably fail to capture variations in the quality (i.e., content and character) of the education received.

A second variable measures joint literacy of parents: both parents illiterate, father only literate, mother only literate, and both parents literate. This construction attempts to more directly measure practical skills that, presumably, function to bring health-related information into the household, although it is understood that the variable also proxies other important aspects of household dynamics.

The following section compares the consistency, magnitude and the direction of the gross education-mortality association.

Mother's Level of Education

Table 4.5 shows the percent distribution of births in the 10 years preceding the survey by mother's level of education. The percentage of births to women with no education ranges from 4 percent in the Philippines to over 93 percent in Niger (Figure 4.3). In six countries (the Philippines, Colombia, the Dominican Republic, Peru, Indonesia and Zambia), less than 20 percent of all births are to women with no education. At the other extreme, more than 80 percent of births are to women with no education in Pakistan, Morocco, Senegal, Burkina Faso, and Niger.

The proportion of births to women with secondary or higher education ranges from 1 percent in Niger to over 50 percent in the Philippines. In eight countries (all in Africa), less than 10 percent of the births are to women with secondary or higher education: Niger (1 percent), Burkina Faso (3 percent), Malawi (3 percent), Rwanda (4 percent), Senegal (5 percent), Ghana (6 percent), Morocco (7 percent), and Nigeria (9 percent).

Table 4.6.1 presents childhood mortality rates by mother's level of education. Table 4.6.2 shows the corresponding relative risks using *primary incomplete* as the reference category. Without exception, all countries show a strong positive association between higher level of maternal education and lower mortality risk. Taking all countries together, under-five mortality varies by a factor of more than two between children of mothers with no education (164 per 1,000) and children of mothers with secondary education (71 per 1,000). These aggregate findings are similar to those described in the previous DHS analysis of childhood mortality (Sullivan, Rutstein, and Bicego, 1994).

Table 4.5 Distribution of births by mother's level of education

Percent distribution of births in the ten-year period preceding the survey by mother's level of education, Demographic and Health Surveys, 1990-1994

Country	No education	Primary incomplete	Primary complete	Secondary/ higher	Total	Number of births
Sub-Saharan Africa						
Zambia	19	30	32	19	100	11,680
Namibia	21	41	10	28	100	7,095
Madagascar	23	55	3	19	100	10,680
Kenya	24	37	19	20	100	12,474
Ghana	45	13	36	6	100	7,195
Cameroon	47	27	9	17	100	6,717
Rwanda	50	43	3	4	100	11,388
Malawi	54	37	6	3	100	8,802
Nigeria	67	10	14	9	100	16,359
Senegal	83	6	6	5	100	11,068
Burkina Faso	89	5	3	3	100	12,311
Niger	93	6	0	1	100	14,081
Asia/Near East/ North Africa						
Philippines	4	18	26	52	100	17,371
Indonesia	16	34	27	23	100	3,570
Turkey	34	7	45	14	100	8,186
Pakistan	81	3	6	10	100	14,754
Morocco	83	5	5	7	100	10,534
Latin America/ Caribbean						
Colombia	7	33	19	41	100	7,591
Dominican Republic	10	48	9	33	100	7,328
Peru	12	24	20	44	100	16,972

Figure 4.3 Percent distribution of births that occurred in the 10-year period preceding the survey by mother's level of education, selected Demographic and Health Surveys, 1990-1994

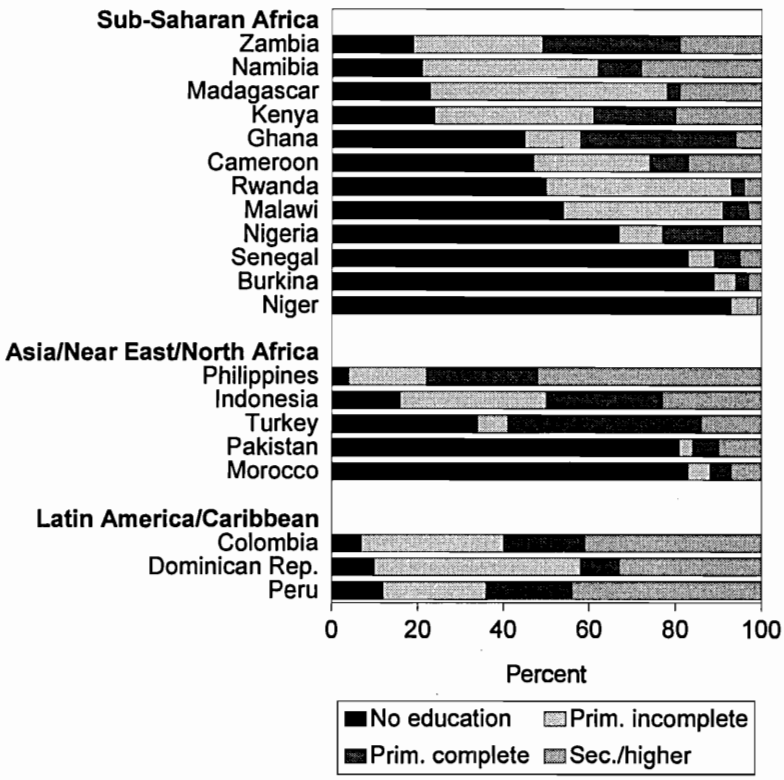


Table 4.6.1 Childhood mortality rates by mother's level of education

Childhood mortality rates by mother's level of education, for the ten-year period preceding the survey, Demographic and Health Surveys, 1990-1994

Country	Neonatal mortality				Postneonatal mortality				Infant mortality				Child mortality				Under-five mortality			
	No education	Primary incomplete	Primary complete	Secondary/ higher	No education	Primary incomplete	Primary complete	Secondary/ higher	No education	Primary incomplete	Primary complete	Secondary/ higher	No education	Primary incomplete	Primary complete	Secondary/ higher	No education	Primary incomplete	Primary complete	Secondary/ higher
Sub-Saharan Africa																				
Namibia	34	37	47	31	24	26	32	26	58	62	79	57	41	37	(25)	20	97	97	(102)	76
Kenya	28	32	26	17	38	48	27	17	66	79	53	35	36	42	22	20	100	118	74	54
Ghana	52	54	38	(35)	36	32	22	(10)	87	85	60	(45)	86	65	38	(26)	166	145	96	69
Cameroon	57	35	18	25	56	20	21	25	113	56	39	51	96	54	(29)	31	198	107	(67)	80
Senegal	43	38	26	19	38	27	26	13	81	65	52	32	98	(47)	(38)	(21)	171	(109)	(89)	52
Rwanda	52	43	(31)	38	45	43	(46)	27	97	85	(77)	65	88	75	*	(31)	177	154	*	94
Madagascar	52	39	(68)	39	86	57	(48)	34	138	97	(115)	73	99	90	*	44	223	178	*	114
Burkina Faso	54	28	42	29	58	51	48	24	111	80	90	53	113	95	(64)	(36)	212	167	(148)	87
Zambia	47	47	33	35	68	70	50	44	115	116	83	79	101	104	81	60	204	208	157	135
Nigeria	49	43	39	36	48	54	41	34	96	97	80	70	127	103	63	46	211	190	138	113
Malawi	52	49	34	(35)	92	88	49	(61)	143	137	84	(96)	131	116	85	(34)	255	237	162	127
Niger	53	48	*	(16)	84	68	*	(32)	137	116	*	(49)	228	134	*	(60)	334	234	*	106
Asia/Near East/ North Africa																				
Philippines	18	23	18	17	59	34	21	12	77	58	39	29	81	40	32	14	152	95	70	42
Turkey	49	50	33	18	44	48	25	7	92	98	58	25	18	24	9	5	109	119	67	30
Morocco	36	31	(33)	14	32	24	(19)	7	68	55	(52)	21	25	10	(5)	(2)	91	64	(56)	22
Indonesia	38	38	29	25	52	42	30	14	91	79	59	40	45	34	22	12	131	111	80	51
Pakistan	56	(47)	51	33	43	(35)	43	26	99	(83)	94	59	33	(14)	20	6	128	(95)	113	65
Latin America/ Caribbean																				
Colombia	(26)	14	15	14	(34)	17	6	7	(60)	31	21	20	(15)	10	8	5	(74)	41	29	25
Dominican Republic	23	30	21	18	25	27	20	8	48	56	41	26	45	22	(15)	6	91	77	(56)	31
Peru	49	46	31	16	51	50	36	18	100	96	67	34	56	48	30	11	150	140	96	45
Grand average	43	39	33	26	51	43	32	22	94	82	65	48	78	58	34	25	164	134	94	71

Note: Figures in parentheses are based on 250-500 births. An asterisk indicates that a figure is based on fewer than 250 births and has been suppressed.

Table 4.6.2 Relative risk of dying in childhood by mother's level of education

Relative risk of dying in childhood by mother's level of education, for the ten-year period preceding the survey, Demographic and Health Surveys, 1990-1994

Country	Neonatal mortality				Postneonatal mortality				Infant mortality				Child mortality				Under-five mortality			
	No education	Primary incomplete	Primary complete	Secondary/ higher	No education	Primary incomplete	Primary complete	Secondary/ higher	No education	Primary incomplete	Primary complete	Secondary/ higher	No education	Primary incomplete	Primary complete	Secondary/ higher	No education	Primary incomplete	Primary complete	Secondary/ higher
Sub-Saharan Africa																				
Namibia	0.92	1.00	1.27	0.84	0.92	1.00	1.23	1.00	0.94	1.00	1.27	0.92	1.11	1.00	(0.68)	0.54	1.00	1.00	(1.05)	0.78
Kenya	0.88	1.00	0.81	0.53	0.79	1.00	0.56	0.35	0.84	1.00	0.67	0.44	0.86	1.00	0.52	0.48	0.85	1.00	0.63	0.46
Ghana	0.96	1.00	0.70	(0.65)	1.13	1.00	0.69	(0.31)	1.02	1.00	0.71	(0.53)	1.32	1.00	0.58	(0.40)	1.14	1.00	0.66	0.48
Cameroon	1.63	1.00	0.51	0.71	2.80	1.00	1.05	1.25	2.02	1.00	0.70	0.91	1.78	1.00	(0.54)	0.57	1.85	1.00	(0.63)	0.75
Senegal	1.13	1.00	0.68	0.50	1.41	1.00	0.96	0.48	1.25	1.00	0.80	0.49	2.09	(1.00)	(0.81)	(0.45)	1.57	(1.00	(0.82)	0.48
Rwanda	1.21	1.00	(0.72)	0.88	1.05	1.00	(1.07)	0.63	1.14	1.00	(0.91)	0.76	1.17	1.00	*	(0.41)	1.15	1.00	*	0.61
Madagascar	1.33	1.00	(1.74)	1.00	1.51	1.00	(0.84)	0.60	1.42	1.00	(1.19)	0.75	1.10	1.00	*	0.49	1.25	1.00	*	0.64
Burkina Faso	1.93	1.00	1.50	1.04	1.14	1.00	0.94	0.47	1.39	1.00	1.13	0.66	1.19	1.00	(0.67)	(0.38)	1.27	1.00	(0.89)	0.52
Zambia	1.00	1.00	0.70	0.74	0.97	1.00	0.71	0.63	0.99	1.00	0.72	0.68	0.97	1.00	0.78	0.58	0.98	1.00	0.75	0.65
Nigeria	1.14	1.00	0.91	0.84	0.89	1.00	0.76	0.63	0.99	1.00	0.82	0.72	1.23	1.00	0.61	0.45	1.11	1.00	0.73	0.59
Malawi	1.06	1.00	0.69	(0.71)	1.05	1.00	0.56	(0.69)	1.04	1.00	0.61	(0.70)	1.13	1.00	0.73	(0.29)	1.08	1.00	0.68	0.54
Niger	1.10	1.00	*	(0.33)	1.24	1.00	*	(0.47)	1.18	1.00	*	(0.42)	1.70	1.00	*	(0.45)	1.43	1.00	*	0.45
Asia/Near East/ North Africa																				
Philippines	0.78	1.00	0.78	0.74	1.74	1.00	0.62	0.35	1.33	1.00	0.67	0.50	2.03	1.00	0.80	0.35	1.60	1.00	0.74	0.44
Turkey	0.98	1.00	0.66	0.36	0.92	1.00	0.52	0.15	0.94	1.00	0.59	0.26	0.75	1.00	0.38	0.21	0.92	1.00	0.56	0.25
Morocco	1.16	1.00	(1.06)	0.45	1.33	1.00	(0.79)	0.29	1.24	1.00	(0.95)	0.38	2.50	1.00	(0.50)	(0.20)	1.42	1.00	(0.88)	0.34
Indonesia	1.00	1.00	0.76	0.66	1.24	1.00	0.71	0.33	1.15	1.00	0.75	0.51	1.32	1.00	0.65	0.35	1.18	1.00	0.72	0.46
Pakistan	1.19	(1.00)	1.09	0.70	1.23	(1.00)	1.23	0.74	1.19	(1.00	1.13	0.71	2.36	(1.00)	1.43	0.43	1.35	(1.00	1.19	0.68
Latin America/ Caribbean																				
Colombia	(1.86)	1.00	1.07	1.00	(2.00)	1.00	0.35	0.41	(1.94)	1.00	0.68	0.65	(1.50)	1.00	0.80	0.50	(1.80)	1.00	0.71	0.61
Dominican Republic	0.77	1.00	0.70	0.60	0.93	1.00	0.74	0.30	0.86	1.00	0.73	0.46	2.05	1.00	(0.68)	0.27	1.18	1.00	(0.73)	0.40
Peru	1.07	1.00	0.67	0.35	1.02	1.00	0.72	0.36	1.04	1.00	0.70	0.35	1.17	1.00	0.63	0.23	1.07	1.00	0.69	0.32
Grand average	1.12	1.00	0.86	0.66	1.18	1.00	0.75	0.52	1.15	1.00	0.80	0.59	1.34	1.00	0.59	0.42	1.22	1.00	0.70	0.53

Note: Figures in parentheses are based on 250-500 births. An asterisk indicates that a figure is based on fewer than 250 births and has been suppressed.

The magnitude of the education-mortality association varies with age of the child, with the strongest effects occurring after infancy (Figure 4.4), a finding consistent with many previous studies. The relative risk of dying among children of mothers with secondary education (compared with primary incomplete) falls from 0.66 during the neonatal period, to 0.52 in the postneonatal period, to 0.42 during the period 1-4 years.

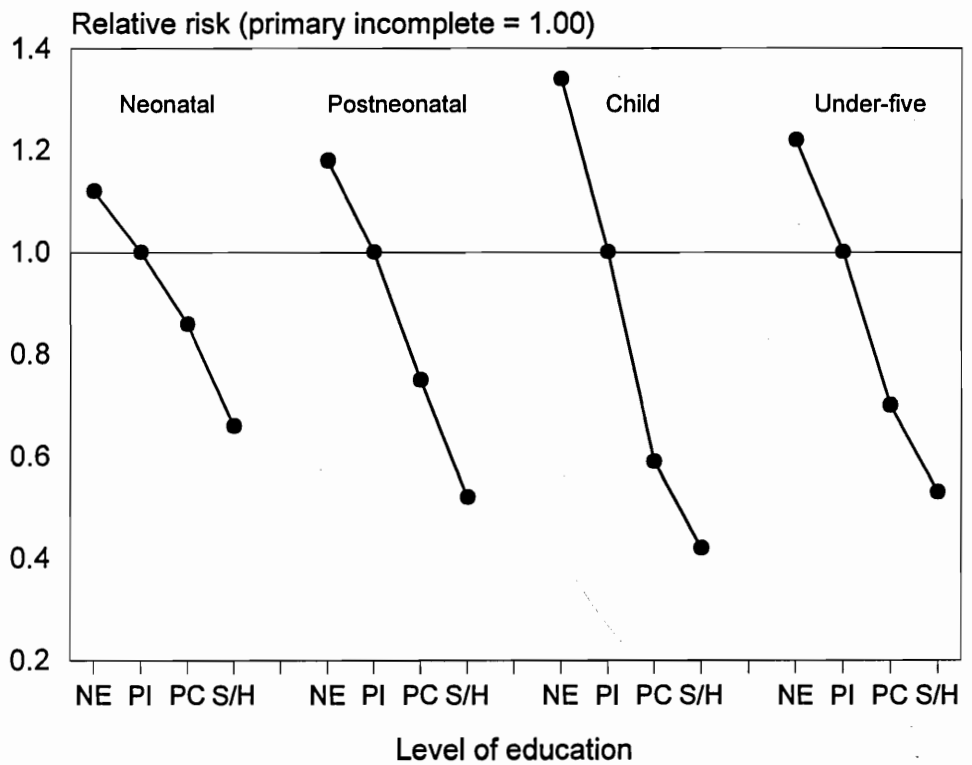
Wide variation in the strength of this relationship was found in the countries examined here. Additionally, there is a tendency for the effect to be less pronounced in sub-Saharan countries and more pronounced in the other regions. A comparison of Namibia and Peru indicates that children of women with secondary education in Namibia experience more than three-quarters (0.78) the under-five mortality risk of children of women with primary incomplete; the comparable figure for Peru is 0.32. Possible explanations for this finding have been reported previously (Bicego and Boerma, 1993, Sullivan, Rutstein, and Bicego, 1994).

Literacy

Table 4.7.1 presents childhood mortality rates by literacy status of the parents. Corresponding relative risks are shown in Table 4.7.2. In all countries, under-five mortality is lowest when both parents are literate, highest when both are illiterate, and intermediate when only one of the parents can read. With a few exceptions, this pattern is observed for all ages.

Figure 4.5 shows the relative risk of dying in childhood by literacy status of the parents. As with mother's education, the effect of parental literacy is most dramatic during ages 1-4 years. When both parents are literate the effect is more than double that when only one parent is literate. When only one parent is literate, mother's literacy appears to have greater impact than father's literacy during the period 1-4 years.

Figure 4.4 Relative risk of dying in childhood by mother's level of education (averages for all countries combined), selected Demographic and Health Surveys, 1990-1994



NE = No education
PI = Primary incomplete
PC = Primary complete
S/H = Secondary/higher

Table 4.7.1 Childhood mortality rates by literacy status of parents

Childhood mortality rates by literacy status of parents, for the ten-year period preceding the survey, Demographic and Health Surveys, 1990-1994

Country	Neonatal mortality				Postneonatal mortality				Infant mortality				Child mortality				Under-five mortality			
	Both illit-erate	Father literate	Mother literate	Both literate	Both illit-erate	Father literate	Mother literate	Both literate	Both illit-erate	Father literate	Mother literate	Both literate	Both illit-erate	Father literate	Mother literate	Both literate	Both illit-erate	Father literate	Mother literate	Both literate
Sub-Saharan Africa																				
Namibia	37	28	37	34	25	32	27	26	62	59	64	60	32	40	30	31	92	97	92	89
Kenya	36	26	33	24	43	38	64	30	78	64	97	54	37	39	49	27	113	100	141	80
Ghana	56	44	*	38	37	28	*	21	93	72	*	59	95	60	*	34	179	128	*	92
Cameroon	56	49	30	25	49	52	25	21	105	100	55	46	96	60	*	35	191	155	*	79
Senegal	44	34	27	22	39	29	15	25	83	64	42	47	103	50	54	20	177	110	93	66
Rwanda	48	51	34	45	43	45	43	42	91	96	77	87	90	77	76	55	173	165	147	137
Madagascar	44	47	50	36	74	63	62	37	118	110	112	73	92	98	81	62	199	197	184	130
Burkina Faso	53	52	29	34	58	51	43	36	111	103	72	69	112	115	90	45	211	206	156	111
Zambia	50	44	39	36	71	69	66	51	121	113	104	87	100	108	83	79	210	209	179	159
Nigeria	52	36	45	35	49	45	38	41	101	81	83	76	132	95	88	63	220	169	164	135
Malawi	54	48	84	40	95	86	108	74	149	134	191	115	132	124	*	93	261	241	*	197
Niger	53	31	61	8	85	62	60	49	138	93	120	56	229	175	143	58	335	252	246	111
Asia/Near East/ North Africa																				
Philippines	24	22	27	17	43	35	36	16	67	57	63	33	52	48	44	21	116	102	104	53
Turkey	59	44	*	31	40	47	*	18	99	91	*	49	23	16	*	8	120	106	*	56
Morocco	37	33	*	16	33	26	*	11	69	60	*	27	26	19	*	2	94	77	*	29
Indonesia	40	39	39	27	55	39	36	24	94	78	75	52	40	37	34	20	131	112	107	70
Pakistan	56	56	69	37	43	42	38	30	99	98	106	67	37	26	35	8	132	121	138	75
Latin America/ Caribbean																				
Colombia	17	12	17	14	17	22	10	7	35	34	27	22	13	4	8	6	47	38	35	28
Dominican Republic	26	21	36	23	34	22	24	14	60	44	60	36	38	30	9	11	96	72	69	47
Peru	52	43	42	20	54	44	39	25	106	86	80	45	51	51	43	17	152	133	120	61
Grand average	45	38	41	28	49	44	43	30	94	82	84	58	77	64	58	35	162	140	132	90

Note: Figures in parentheses are based on 250-500 births. An asterisk indicates that a figure is based on fewer than 250 births and has been suppressed.

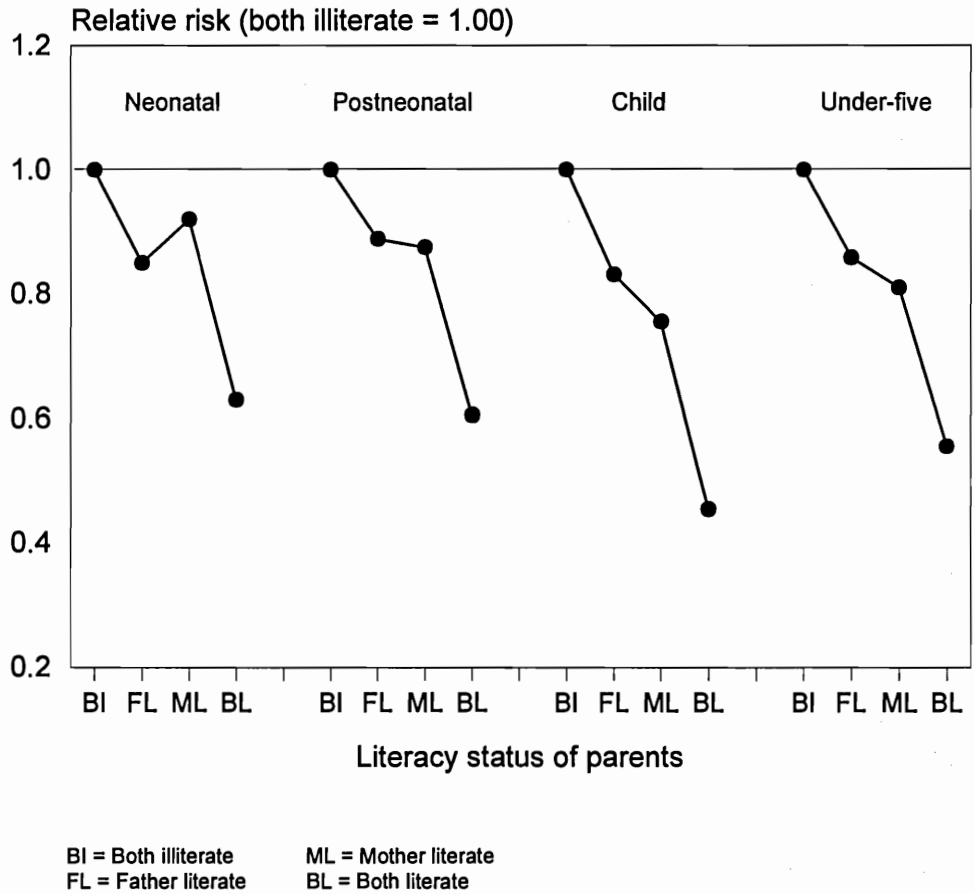
Table 4.7.2 Relative risk of dying in childhood by literacy status of parents

Relative risk of dying in childhood by literacy status of parents, for the ten-year period preceding the survey, Demographic and Health Surveys, 1990-1994

	Neonatal mortality				Postneonatal mortality				Infant mortality				Child mortality				Under-five mortality			
Country	Both illit-erate	Father literate	Mother literate	Both literate	Both illit-erate	Father literate	Mother literate	Both literate	Both illit-erate	Father literate	Mother literate	Both literate	Both illit-erate	Father literate	Mother literate	Both literate	Both illit-erate	Father literate	Mother literate	Both literate
Sub-Saharan Africa																				
Namibia	1.00	0.76	1.00	0.92	1.00	1.28	1.08	1.04	1.00	0.95	1.03	0.97	1.00	1.25	0.94	0.97	1.00	1.05	1.00	0.97
Kenya	1.00	0.72	0.92	0.67	1.00	0.88	1.49	0.70	1.00	0.82	1.24	0.69	1.00	1.05	1.32	0.73	1.00	0.88	1.25	0.71
Ghana	1.00	0.79	*	0.68	1.00	0.76	*	0.57	1.00	0.77	*	0.63	1.00	0.63	*	0.36	1.00	0.72	*	0.51
Cameroon	1.00	0.88	0.54	0.45	1.00	1.06	0.51	0.43	1.00	0.95	0.52	0.44	1.00	0.63	*	0.36	1.00	0.81	*	0.41
Senegal	1.00	0.77	0.61	0.50	1.00	0.74	0.38	0.64	1.00	0.77	0.51	0.57	1.00	0.49	0.52	0.19	1.00	0.62	0.53	0.37
Rwanda	1.00	1.06	0.71	0.94	1.00	1.05	1.00	0.98	1.00	1.05	0.85	0.96	1.00	0.86	0.84	0.61	1.00	0.95	0.85	0.79
Madagascar	1.00	1.07	1.14	0.82	1.00	0.85	0.84	0.50	1.00	0.93	0.95	0.62	1.00	1.07	0.88	0.67	1.00	0.99	0.92	0.65
Burkina Faso	1.00	0.98	0.55	0.64	1.00	0.88	0.74	0.62	1.00	0.93	0.65	0.62	1.00	1.03	0.80	0.40	1.00	0.98	0.74	0.53
Zambia	1.00	0.88	0.78	0.72	1.00	0.97	0.93	0.72	1.00	0.93	0.86	0.72	1.00	1.08	0.83	0.79	1.00	1.00	0.85	0.76
Nigeria	1.00	0.69	0.87	0.67	1.00	0.92	0.78	0.84	1.00	0.80	0.82	0.75	1.00	0.72	0.67	0.48	1.00	0.77	0.75	0.61
Malawi	1.00	0.89	1.56	0.74	1.00	0.91	1.14	0.78	1.00	0.90	1.28	0.77	1.00	0.94	*	0.70	1.00	0.92	0.00	0.75
Niger	1.00	0.58	1.15	0.15	1.00	0.73	0.71	0.58	1.00	0.67	0.87	0.41	1.00	0.76	0.62	0.25	1.00	0.75	0.73	0.33
Asia/Near East/ North Africa																				
Philippines	1.00	0.92	1.13	0.71	1.00	0.81	0.84	0.37	1.00	0.85	0.94	0.49	1.00	0.92	0.85	0.40	1.00	0.88	0.90	0.46
Turkey	1.00	0.75	*	0.53	1.00	1.18	*	0.45	1.00	0.92	*	0.49	1.00	0.70	*	0.35	1.00	0.88	*	0.47
Morocco	1.00	0.89	*	0.43	1.00	0.79	*	0.33	1.00	0.87	*	0.39	1.00	0.73	*	0.08	1.00	0.82	*	0.31
Indonesia	1.00	0.98	0.98	0.68	1.00	0.71	0.65	0.44	1.00	0.83	0.80	0.55	1.00	0.93	0.85	0.50	1.00	0.85	0.82	0.53
Pakistan	1.00	1.00	1.23	0.66	1.00	0.98	0.88	0.70	1.00	0.99	1.07	0.68	1.00	0.70	0.95	0.22	1.00	0.92	1.05	0.57
Latin America/ Caribbean																				
Colombia	1.00	0.71	1.00	0.82	1.00	1.29	0.59	0.41	1.00	0.97	0.77	0.63	1.00	0.31	0.62	0.46	1.00	0.81	0.74	0.60
Dominican Republic	1.00	0.81	1.38	0.88	1.00	0.65	0.71	0.41	1.00	0.73	1.00	0.60	1.00	0.79	0.24	0.29	1.00	0.75	0.72	0.49
Peru	1.00	0.83	0.81	0.38	1.00	0.81	0.72	0.46	1.00	0.81	0.75	0.42	1.00	1.00	0.84	0.33	1.00	0.88	0.79	0.40
Grand average	1.00	0.85	0.92	0.63	1.00	0.89	0.87	0.61	1.00	0.87	0.89	0.62	1.00	0.83	0.76	0.45	1.00	0.86	0.81	0.56

Note: Figures in parentheses are based on 250-500 births. An asterisk indicates that a figure is based on fewer than 250 births and has been suppressed.

Figure 4.5 Relative risk of dying in childhood by literacy status of parents (averages for all countries combined), selected Demographic and Health Surveys, 1990-1994



4.4 FATHER'S OCCUPATION

The nature of a parent's occupation can have both positive and negative effects on a child's well-being and survival chances. For instance, professional employment may bring certain benefits to the mother and child that are not associated with other types of employment. Such benefits include health insurance and maternity leave. In addition, occupation is an important determinant of economic circumstance (i.e., wealth and income), which in turn often influences decisions regarding use of health services. Agricultural occupations may bring nonmonetary income into the household, but are often associated with low levels of disposable income and poor sanitary conditions in the household.

The DHS survey question on mother's occupation is not specific to the period of exposure of each child to mortality risk but rather is limited to current occupation. The present analysis, therefore, focuses on the husband's occupation, which is likely to have been more stable over time. Father's occupation is also more likely to be representative of a household's overall level of disposable income and wealth. Based on the question posed to women about their current or latest partner—"What kind of work does (did) your husband/partner mainly do?"—occupations have been recoded and grouped into four categories:

- agricultural,
- blue collar (skilled and unskilled),
- sales and service, and
- professional, technical, managerial, and clerical (PTMC).

A fifth category includes children of unmarried mothers and mothers whose partners are not employed. It should be noted that this classification system, although based on the international scheme for coding occupations, when applied

uniformly across widely divergent cultures is likely to result in some level of misclassification, which can lead to faulty conclusions. For instance, in the more developed countries of Latin America, a larger part of the agricultural sector will be comprised of large landowners, compared with sub-Saharan Africa where the vast majority of agricultural workers are subsistence farmers or estate/commercial workers. Clearly, these agricultural occupations are operating at different socioeconomic levels.

Table 4.8 presents the distribution of births that occurred in the 10-year period preceding the survey by occupation of the father. The percentage of children whose fathers work in agriculture ranges from 20 percent in Turkey to around 80 percent in Burkina Faso, Niger and Rwanda.[10]

[10] Namibia was excluded from consideration because the fathers of a large proportion of children (47 percent) fall into the category "father unemployed/mother not married."

At the other end of the spectrum, less than 10 percent of children in eight countries (six of these in sub-Saharan Africa) have fathers who have PTMC occupations, compared with 23 percent in Peru.

Table 4.9.1 presents childhood mortality rates by father's occupation; corresponding relative risks are shown in Table 4.9.2. Because of the small numbers of births for most countries, the category "father unemployed/mother not married" is not shown. In nearly all countries and at all ages, children whose fathers work in the PTMC occupations have the lowest mortality, while children whose fathers work in agricultural occupations have the highest. Taking all countries together, under-five mortality in children of fathers in the PTMC occupations averages about half that of children of agricultural workers (82 versus 156 deaths per 1,000).

Table 4.8 Distribution of births by father's occupation

Percent distribution of births in the 10-year period preceding the survey by father's occupation, Demographic and Health Surveys, 1990-1994

Country	Father unemployed or mother not married	Agricultural	Blue collar	Sales/ service	Professional, technical or clerical	Total	Number of births
Sub-Saharan Africa							
Namibia	47	10	22	12	9	100	7,095
Kenya	9	36	26	16	13	100	12,474
Ghana	3	57	18	9	13	100	7,195
Cameroon	7	44	23	12	14	100	6,717
Senegal	8	42	24	17	9	100	11,068
Rwanda	3	80	8	6	3	100	11,388
Madagascar	7	70	13	4	6	100	10,680
Burkina Faso	1	78	8	11	2	100	12,311
Zambia	6	39	32	13	10	100	11,680
Nigeria	2	58	3	25	12	100	16,359
Malawi	1	51	25	13	10	100	8,802
Niger	2	76	12	8	2	100	14,081
Asia/Near East/ North Africa							
Philippines	3	42	35	13	7	100	17,371
Turkey	9	20	39	21	11	100	8,186
Morocco	4	37	33	17	9	100	10,534
Indonesia	2	43	26	18	11	100	3,570
Pakistan	5	32	34	19	10	100	14,754
Latin America/ Caribbean							
Colombia	5	28	32	19	16	100	7,591
Dominican Republic	6	28	33	21	12	100	7,328
Peru	5	36	25	11	23	100	16,972

Table 4.9.1 Childhood mortality rates by father's occupation

Childhood mortality rates by father's occupation, for the ten-year period preceding the survey, Demographic and Health Surveys, 1990-1994

	Neonatal mortality				Postneonatal mortality				Infant mortality				Child mortality				Under-five mortality			
Country	Agricultural	Blue collar	Sales/service	Professional, technical or clerical	Agricultural	Blue collar	Sales/service	Professional, technical or clerical	Agricultural	Blue collar	Sales/service	Professional, technical or clerical	Agricultural	Blue collar	Sales/service	Professional, technical or clerical	Agricultural	Blue collar	Sales/service	Professional, technical or clerical
Sub-Saharan Africa																				
Namibia	36	30	33	20	27	23	19	29	63	53	52	49	30	32	37	22	91	84	87	70
Kenya	29	23	33	18	42	32	35	22	71	55	68	40	37	33	34	21	106	87	100	60
Ghana	51	40	39	37	33	21	29	24	84	60	69	61	79	46	38	33	156	104	104	92
Cameroon	50	34	59	20	51	23	34	28	101	57	93	49	85	65	57	36	178	118	144	83
Senegal	44	37	45	27	42	30	35	20	85	67	80	47	115	68	73	39	191	130	147	84
Rwanda	48	40	54	41	43	42	44	53	91	83	98	94	85	54	47	(43)	168	132	141	(132)
Madagascar	47	26	36	25	65	49	(42)	25	112	75	(77)	50	88	86	(92)	43	190	154	(162)	91
Burkina Faso	54	44	42	(24)	58	57	51	(35)	112	101	92	(59)	114	95	99	(32)	213	186	182	(89)
Zambia	49	32	40	27	72	49	57	36	121	81	96	63	102	81	97	57	211	156	184	116
Nigeria	51	36	39	33	52	62	35	37	102	97	74	70	129	(61)	91	65	218	(153)	159	131
Malawi	48	57	44	46	94	87	70	64	142	144	114	111	134	110	113	78	257	238	214	180
Niger	54	49	50	11	89	57	73	29	143	106	124	40	236	185	166	108	345	271	269	144
Asia/Near East/ North Africa																				
Philippines	20	17	15	20	28	15	14	12	48	32	29	32	32	26	17	5	79	58	45	37
Turkey	42	36	36	29	48	33	19	13	90	68	56	42	26	13	7	2	114	81	62	44
Morocco	35	37	31	19	32	28	29	17	67	64	61	36	27	26	12	13	92	89	72	48
Indonesia	34	33	33	19	42	30	32	16	76	63	66	35	36	24	23	14	110	86	87	49
Pakistan	68	48	46	38	44	42	40	35	111	90	86	74	34	25	33	17	142	113	116	90
Latin America/ Caribbean																				
Colombia	17	15	16	9	9	18	15	4	25	33	31	13	11	7	8	5	36	39	39	17
Dominican	34	24	21	13	32	18	13	8	66	43	34	21	33	12	14	13	97	54	47	33
Peru	43	24	36	15	48	33	25	19	91	57	61	35	45	28	22	15	131	83	82	49
Grand average	43	34	37	25	48	37	36	26	90	71	73	51	74	54	54	33	156	121	122	82

Note: Figures in parentheses are based on 250-500 births.

Table 4.9.2 Relative risk of dying in childhood by father's occupation

Relative risk of dying in childhood by father's occupation, for the ten-year period preceding the survey, Demographic and Health Surveys, 1990-1994

	Neonatal mortality				Postneonatal mortality				Infant mortality				Child mortality				Under-five mortality			
Country	Agricultural	Blue collar	Sales/service	Professional, technical or clerical	Agricultural	Blue collar	Sales/service	Professional, technical or clerical	Agricultural	Blue collar	Sales/service	Professional, technical or clerical	Agricultural	Blue collar	Sales/service	Professional, technical or clerical	Agricultural	Blue collar	Sales/service	Professional, technical or clerical
Sub-Saharan Africa																				
Namibia	1.00	0.83	0.92	0.56	1.00	0.85	0.70	1.07	1.00	0.84	0.83	0.78	1.00	1.07	1.23	0.73	1.00	0.92	0.96	0.77
Kenya	1.00	0.79	1.14	0.62	1.00	0.76	0.83	0.52	1.00	0.77	0.96	0.56	1.00	0.89	0.92	0.57	1.00	0.82	0.94	0.57
Ghana	1.00	0.78	0.76	0.73	1.00	0.64	0.88	0.73	1.00	0.71	0.82	0.73	1.00	0.58	0.48	0.42	1.00	0.67	0.67	0.59
Cameroon	1.00	0.68	1.18	0.40	1.00	0.45	0.67	0.55	1.00	0.56	0.92	0.49	1.00	0.76	0.67	0.42	1.00	0.66	0.81	0.47
Senegal	1.00	0.84	1.02	0.61	1.00	0.71	0.83	0.48	1.00	0.79	0.94	0.55	1.00	0.59	0.63	0.34	1.00	0.68	0.77	0.44
Rwanda	1.00	0.83	1.13	0.85	1.00	0.98	1.02	1.23	1.00	0.91	1.08	1.03	1.00	0.64	0.55	(0.51)	1.00	(0.79)	0.84	(0.79)
Madagascar	1.00	0.55	0.77	0.53	1.00	0.75	(0.65)	0.38	1.00	0.67	(0.69)	0.45	1.00	0.98	(1.05)	0.49	1.00	0.81	(0.85)	0.48
Burkina Faso	1.00	0.81	0.78	(0.44)	1.00	0.98	0.88	(0.60)	1.00	0.90	0.82	(0.53)	1.00	0.83	0.87	(0.28)	1.00	0.87	0.85	(0.42)
Zambia	1.00	0.65	0.82	0.55	1.00	0.68	0.79	0.50	1.00	0.67	0.79	0.52	1.00	0.79	0.95	0.56	1.00	0.74	0.87	0.55
Nigeria	1.00	0.71	0.76	0.65	1.00	1.19	0.67	0.71	1.00	0.95	0.73	0.69	1.00	(0.47	0.71	0.50	1.00	0.70	0.73	0.60
Malawi	1.00	1.19	0.92	0.96	1.00	0.93	0.74	0.68	1.00	1.01	0.80	0.78	1.00	0.82	0.84	0.58	1.00	0.93	0.83	0.70
Niger	1.00	0.91	0.93	0.20	1.00	0.64	0.82	0.33	1.00	0.74	0.87	0.28	1.00	0.78	0.70	0.46	1.00	0.79	0.78	0.42
Asia/Near East/ North Africa																				
Philippines	1.00	0.85	0.75	1.00	1.00	0.54	0.50	0.43	1.00	0.67	0.60	0.67	1.00	0.81	0.53	0.16	1.00	0.73	0.57	0.47
Turkey	1.00	0.86	0.86	0.69	1.00	0.69	0.40	0.27	1.00	0.76	0.62	0.47	1.00	0.50	0.27	0.08	1.00	0.71	0.54	0.39
Morocco	1.00	1.06	0.89	0.54	1.00	0.88	0.91	0.53	1.00	0.96	0.91	0.54	1.00	0.96	0.44	0.48	1.00	0.97	0.78	0.52
Indonesia	1.00	0.97	0.97	0.56	1.00	0.71	0.76	0.38	1.00	0.83	0.87	0.46	1.00	0.67	0.64	0.39	1.00	0.78	0.79	0.45
Pakistan	1.00	0.71	0.68	0.56	1.00	0.95	0.91	0.80	1.00	0.81	0.77	0.67	1.00	0.74	0.97	0.50	1.00	0.80	0.82	0.63
Latin America/ Caribbean																				
Colombia	1.00	0.88	0.94	0.53	1.00	2.00	1.67	0.44	1.00	1.32	1.24	0.52	1.00	0.64	0.73	0.45	1.00	1.08	1.08	0.47
Dominican Republic	1.00	0.71	0.62	0.38	1.00	0.56	0.41	0.25	1.00	0.65	0.52	0.32	1.00	0.36	0.42	0.39	1.00	0.56	0.48	0.34
Peru	1.00	0.56	0.84	0.35	1.00	0.69	0.52	0.40	1.00	0.63	0.67	0.38	1.00	0.62	0.49	0.33	1.00	0.63	0.63	0.37
Grand average	1.00	0.80	0.88	0.57	1.00	0.79	0.75	0.55	1.00	0.79	0.81	0.57	1.00	0.74	0.76	0.47	1.00	0.77	0.78	0.52

Note: Figures in parentheses are based on 250-500 births.

The averages presented mask substantial variation in the magnitude and direction of the differentials among countries. Examining differences in occupation across age periods of risk, it is apparent that much of the variation in occupation categories and among countries within occupation category is explained by variation during ages 1-4 years. That is, the *paternal occupation effect* is most pronounced after infancy. This finding is similar to that observed regarding education differentials, indicating that both dimensions of socioeconomic condition (and perhaps their interacting influence) relate to important constraints on decisions about use of preventive and curative child health services that affect child survival (i.e., immunizations, visits to clinic, etc.), and feeding patterns that affect children's susceptibility to disease and death, particularly during ages 1-4 years.

There are exceptions to the general pattern. During the neonatal and postneonatal periods in some countries, children of agricultural workers are not at highest mortality risk. For example, in Cameroon, Kenya, Rwanda, and Indonesia, neonatal mortality is highest for children of sales and service workers, while in Malawi and Morocco it is highest for children of blue collar workers.

During the postneonatal period, mortality is highest for children of blue collar workers in Rwanda and Colombia. In Colombia, postneonatal risk in the blue collar category is twice that of the agricultural category, which emphasizes the problems inherent in interpreting occupation data using a single set of definitions.

5 Conclusions

5.1 LEVELS AND TRENDS IN CHILDHOOD MORTALITY

This report describes patterns of childhood mortality in 20 countries where DHS surveys have been carried out. It is acknowledged that this statistical description of the state of young children expressed in the broadest terms—survival probabilities—is inadequate since it does not take into account the social and economic costs of childhood deaths for the household, community, and society. However, the findings presented here emphasize the enormity of the problem of childhood mortality and the challenges that remain for health workers in developing countries. This report follows an earlier report on childhood mortality by Sullivan, Rutstein, and Bicego (1994).

Among the countries analyzed, some successes are evident. In 15 of the 20 countries covered, declines in under-five mortality (over the 10-year period preceding the survey) exceed 15 percent, or about 1.5 percent per annum. However, it is difficult to generalize regarding so small a group of countries—variation is substantial in both levels and trends in mortality. In sub-Saharan countries such as Niger, Malawi, Nigeria, and Zambia, under-five mortality remains extremely high; and in two of these countries (Niger and Zambia) survival chances have worsened. In Malawi and Nigeria, improvements have been modest and 1 in 5 children still dies before the fifth birthday. The sub-Saharan region can claim some relative successes. In Cameroon, Senegal, and Rwanda[11] recent declines of 33 percent or more are reported. In Namibia and Kenya, under-five mortality has fallen below 100 per 1,000, although there is evidence of recent stagnation in Kenya.

Outside sub-Saharan Africa, the picture is more encouraging. In all countries except Pakistan, recent declines in under-five mortality exceed 25 percent and under-five mortality levels are below 85 per 1,000. In Colombia and Turkey, the declines approach or exceed 50 percent—less than 1 in 40 children dies before age five in Colombia. In Pakistan, however, mortality decline reaches only 15 percent over the reference period; consequently, the level of under-five mortality remains relatively high (112 per 1,000).

[11] How far Rwanda has been set back by the 1995 civil war cannot yet be ascertained.

In sum, there is huge disparity in the level of progress toward the goals articulated nearly two decades ago in Alma Ata: "Health for All by the Year 2000" (WHO/UNICEF, 1978). In the 20 countries covered here, the child survival situation ranges from one of rapidly declining mortality (to currently low levels), to stagnation, to actual increases in mortality (at high levels). These disparities reflect, at least in part, the variations in political and institutional commitment (at both national and international levels) that exist regarding mobilization of the necessary resources for implementation of effective health and social development programs.

5.2 AGE PATTERNS OF CHILDHOOD MORTALITY

Age patterns of childhood mortality reflect the importance of age-specific causes of death. As such, knowledge of the distribution of mortality risk across age groups is important for designing programs aimed at mortality reduction. This report highlights two phenomena related to age patterns of mortality. The first has to do with shifts in the age pattern of mortality during mortality decline. In many of the countries examined, there have been rapid drops in the *level* of under-five mortality. Since mortality normally falls more rapidly at older ages (1-4 years) than at younger ages, the result is that under-five deaths have become increasingly comprised of infant deaths, with further declines concentrating infant deaths in the neonatal period. Turkey is an example of the shift in the age pattern of mortality. During a remarkable decline in under-five mortality from 114 to 61 per 1,000, the ratio ${}_4q_1/{}_5q_0$ was reduced from 0.21 to 0.14. Further declines in mortality will thus depend on concerted efforts to reduce risk at early ages. This statistical observation is not new; indeed, a shift in the age pattern of childhood mortality is anticipated by model mortality schedules during a period of declining mortality. However, the programmatic implications of these changes have received little attention. Health interventions that in the past had a significant impact on mortality (e.g., vaccinations, oral rehydration, and other treatment regimes), while of continuing importance, are not likely to be the source of substantial mortality declines in the future. Improving maternal health services, pregnancy outcome, and nutrition during the early weaning period are likely to figure prominently in the most effective child survival programs over the next decade.

The second phenomenon is one limited to sub-Saharan Africa. Many countries in this region, especially those in the western part of the region, exhibit very high under-five mortality rates, which are a result of high child mortality rates (${}_4q_1$). Niger and Nigeria exhibit ${}_4q_1/{}_5q_0$ ratios of 0.70 and 0.60, respectively. Unlike almost all countries outside the region (and all commonly used model mortality schedules), under-five mortality in these sub-Saharan countries occurs mostly *after* the first birthday. These findings support those of Sullivan, Rutstein, and Bicego (1994) and argue for a new "family" of model mortality schedules that can encompass the West African experience. More importantly, the findings point to the need for structured investigation into the cause(s) of very high child mortality. Fruitful areas of research should emphasize: (1) nutritional deficits (macro and micro) that result in unusually high levels of wasting and increased susceptibility to disease, (2) the importance of malaria and measles (in particular) in cause of death among children age 1-4 years, (3) environmental and human settlement factors that promote high exposure and susceptibility to the diseases such as malaria and measles, and (4) the potential impact of social and economic development, including women's education and women's employment.

5.3 BIO-DEMOGRAPHIC DIFFERENTIALS IN CHILDHOOD MORTALITY

Findings in the area of bio-demographic differentials confirm previously observed associations. Mortality differentials associated with sex of the child follow the expected patterns. Excess male mortality is pronounced in nearly all countries covered, but the effect is largely confined to the neonatal period with some residual effects extending to the postneonatal period. After the first birthday, the sex-related effect is minimal or nonexistent in most countries. Excess female child mortality (${}_4q_1$) is notable however, exceeding 10 percent in five countries. In Pakistan, the excess is 40 percent, suggesting that household behaviors favoring the survival of male children may be operating.

Over the past decade, there has been an accumulation of evidence that confirms and clarifies the associations between the pace and pattern of childbearing and child survival chances. Hobcraft (1994) provides a comprehensive examination of the subject. Children of teenage mothers, children who are first births or are very high birth order, and children that are spaced too closely have been shown to be at increased risk of dying in early childhood. The findings presented in this report further substantiate these relationships and expand the list of national settings in which the effects are observed.

The excess risk associated with young mother's maternal age at birth averages 34 percent during the neonatal period and falls to 21 percent by ages 1-4 years. However, these averages hide important country-level variations.[12] In many countries, the effect of young mother's age at birth is limited to the first year of life (e.g., Senegal, Niger, Dominican Republic, Morocco), suggesting the primacy of maternity factors and adverse pregnancy outcome. In other settings (largely outside sub-Saharan Africa), excess risk is greatest after the neonatal and postneonatal periods, suggesting that social factors associated with young mother's age at birth are driving the relationship.

First births carry an average of 33 percent excess neonatal risk, but no excess risk following the neonatal period. A large part of the excess neonatal risk is probably associated with young mother's age at birth. The first birth-mortality association shows wide variation in magnitude and even in direction. In four countries (Namibia, Colombia, the Dominican Republic, and Peru), first births are actually at lower neonatal risk than other births. This may be due to: (1) greater access to and use of high quality antenatal and delivery services, and (2) the later age at first birth among women in these countries. Later age at first birth is also associated with higher socioeconomic status, which enhances survival chances but confounds bivariate analysis as undertaken here. Thus, extended analyses of the first birth association should simultaneously take into account other bio-demographic variables, especially mother's age at birth.

[12] In some studies, 18 years (rather than 20 years) has been used with better success as a cut-off in delineating heightened mortality risk associated with "teenage" childbearing. Of course, the cultural and biological rationale for adoption of any particular "threshold" will vary across countries and should be evaluated on a country-by-country basis.

The effect of high birth order (7+) on child survival chances varies greatly within and between age periods and from country to country. In general, the neonatal period poses the greatest risk for high order births (an average of 47 percent excess risk); this diminishes significantly in the 1-4 year age period (10 percent). In several countries of sub-Saharan African, high birth order is not associated with heightened risk at ages 1-4 years, indicating that other mitigating (cultural) factors are probably operating. It is important to take into consideration these other variables that may impinge on the relationship.

The most important bio-demographic variable affecting child survival chances is the length of the preceding birth interval. This is so because:

(1) A significant percentage of children are born after a short birth interval (less than 24 months), placing them at high risk of illness and death,

(2) The strength and consistency of the birth interval-mortality association is compelling, even after taking into account various extraneous factors (Boerma and Bicego, 1992; Hobcraft, 1994), and

(3) There is considerable scope for programs that can decrease the numbers of births in this high-risk category.

In the bivariate analysis presented here, short birth intervals are associated with 58 percent greater risk of dying before the age of five and 116 percent greater risk during the neonatal period. Hobcraft (1994) estimates that: "...achieving adequate spacing (through family planning) might serve to reduce child(hood) mortality by up to 20 percent or more in the countries of the Americas and Northern Africa....and up to a third in Brazil and Egypt." In other settings, including sub-Saharan Africa, the potential scope for mortality reduction is less because birth intervals are already fairly long due to long breastfeeding durations and various postpartum taboos that delay the resumption of sexual relations. In sub-Saharan Africa, it has been suggested that traditional breastfeeding patterns be maintained to avoid a rise in births occurring after a short birth interval, which could result in the deterioration of child health and survival. Given that women are increasingly taking advantage of educational and employment opportunities (which often preclude the practice of full breastfeeding), it may be helpful to focus program efforts on a combination of nutrition/breastfeeding education and postpartum use of modern contraception.

5.4 SOCIOECONOMIC DIFFERENTIALS IN CHILDHOOD MORTALITY

In this report, mortality differentials were examined for the following background characteristics: urban-rural residence, migration status, mother's level of education/literacy, and father's occupation. Substantial differences in mortality were found in each category. Mother's education, particularly, showed a strong positive association with improvement of child survival chances, and was most pronounced at age 1-4 years. Because of the high correlation among socioeconomic characteristics, direct causal interpretation of the observed bivariate associations should not be made.

While social and economic development are the key to progress in reducing childhood mortality, further analysis is necessary to quantify and clarify the potential gains. Survival-enhancing behaviors and characteristics that have been suggested as important in mediating the socioeconomics-mortality association include:

(1) access to, positive attitudes toward, and use of preventive and curative child health services,

(2) knowledge and adoption of proper nutrition and hygiene practices, and

(3) reduction in exposure to disease-causing agents.

During the process of social and economic development in a country, these behaviors and characteristics typically become institutionalized and mortality reduction is sustained in the process. Unfortunately, economic downturns may lead to society's inability to satisfy the demand for health and human services that comes with increasing education and urbanization. These constraints are most acute, and the consequences most severe, in sub-Saharan Africa.

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Appendix A

Calculation of synthetic cohort probabilities of dying

The procedure for calculating synthetic cohort probabilities of dying is based on the procedure first developed by Somoza (1980) and modified by Rutstein (1984). Probabilities of dying are built up from probabilities calculated for specific 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 dying is the result of dividing the number of deaths occurring in the relevant age interval for children who were exposed to death in a specific the calendar period by the number of children exposed in the calendar period.

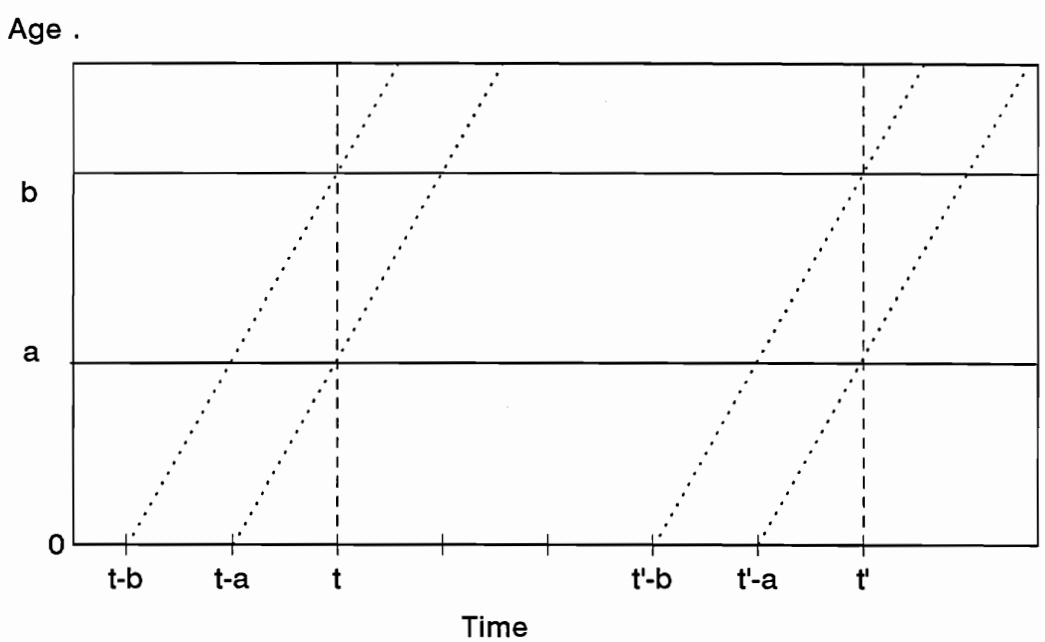
Figure A.1 shows that there are three groups of children who are exposed to death between ages *a* and *b* during the time *t* to *t'*:

(1) children born between *t-a* (age *a* at time *t*) and *t'-b* (age *b* at time *t'*),
(2) children born between *t-b* and *t-a*, and
(3) children born between *t'-b* and *t'-a*.

Children in the first group were exposed during the entire period in question, while 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 can safely be assumed that in the latter case half of the deaths and the exposure occurred in the relevant period. The numerator thus becomes the sum of all deaths at ages *a* to *b* among children born between *t-a* and *t'-b*, plus half of the deaths among children born between *t-b* and *t-a*, plus half of the deaths among 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 half of the children born between *t-b* and *t-a* who survived to age *a*, plus half the children born between *t'-b* and *t'-a* who survived to age *a*.

An exception must be made for the period immediately before the survey since all deaths recorded for children exposed during this period must have occurred before the date of the survey. Therefore, all the deaths (rather than half) are counted for children born between *t'-b* and *t'-a*, although the children have been exposed on average for half of the time.

Figure A.1 Cohorts used to calculate synthetic rates, Demographic and Health Surveys, 1990-1994



To calculate the conventional probabilities of dying, which are presented in the tables in this report, the authors first calculated the probability of surviving through the subinterval by subtracting the probability of dying (the quotient given above) from one. Then they multiplied together the subinterval survival probabilities included in the conventional age limits and, finally, subtracted this product from one to give the probability of dying 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 subinterval probabilities of dying.

The conventional postneonatal mortality rate is defined differently from conventional rates. Although it refers to the age interval between one and eleven months (completed), it is not a probability, but rather 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

Summary of DHS-I, DHS-II, and DHS-III Surveys, 1985-1995

Region and Country	Date of Fieldwork	Implementing Organization	Respondents	Sample Size	Male/Husband Survey	Supplemental Studies, Modules, and Additional Questions
SUB-SAHARAN AFRICA						
DHS-I						
Botswana	Aug-Dec 1988	Central Statistics Office	AW 15-49	4,368		AIDS, PC, adolescent fertility
Burundi	Apr-Jul 1987	Département de la Population, Ministère de l'Intérieur	AW 15-49	3,970	542 Husbands	CA, SAI, adult mortality
Ghana	Feb-May 1988	Ghana Statistical Service	AW 15-49	4,488	943 Husbands	CA, SM, WE
Kenya	Dec-May 1988/89	National Council for Population and Development	AW 15-49	7,150	1,133 Husbands	
Liberia	Feb-Jul 1986	Bureau of Statistics, Ministry of Planning and Economic Affairs	AW 15-49	5,239		TBH, employment status
Mali	Mar-Aug 1987	Institut du Sahel, USED/CERPOD	AW 15-49	3,200	970 Men 20-55	CA, VC, childhood physical handicaps
Ondo State, Nigeria	Sep-Jan 1986/87	Ministry of Health, Ondo State	AW 15-49	4,213		CA, TBH
Senegal	Apr-Jul 1986	Direction de la Statistique, Ministère de l'Economie et des Finances	AW 15-49	4,415		CA, CD
Sudan	Nov-May 1989/90	Department of Statistics, Ministry of Economic and National Planning	EMW 15-49	5,860		FC, M, MM
Togo	Jun-Nov 1988	Unité de Recherche Démographique, Université du Benin	AW 15-49	3,360		CA, SAI, marriage history
Uganda	Sep-Feb 1988/89	Ministry of Health	AW 15-49	4,730		CA, SAI
Zimbabwe	Sep-Jan 1988/89	Central Statistical Office	AW 15-49	4,201		AIDS, CA, PC, SAI, WE
DHS-II						
Burkina Faso	Dec-Mar 1992/93	Institut National de la Statistique et de la Démographie	AW 15-49	6,354	1,845 Men 18+	AIDS, CA, MA, SAI
Cameroon	Apr-Sep 1991	Direction Nationale du Deuxième Recensement Général de la Population et de l'Habitat	AW 15-49	3,871	814 Husbands	CA, CD, SAI
Madagascar	May-Nov 1992	Centre National de Recherches sur l'Environement	AW 15-49	6,260		CA, MM, SAI
Malawi	Sep-Nov 1992	National Statistical Office	AW 15-49	4,850	1,151 Men 20-54	AIDS, CA, MA, MM, SAI
Namibia	Jul-Nov 1992	Ministry of Health and Social Services, Central Statistical Office	AW 15-49	5,421		CA, CD, MA, MM
Niger	Mar-Jun 1992	Direction de la Statistique et des Comtes Nationaux	AW 15-49	6,503	1,570 Husbands	CA, MA, MM, SAI
Nigeria	Apr-Oct 1990	Federal Office of Statistics	AW 15-49	8,781		CA, SAI
Rwanda	Jun-Oct 1992	Office National de la Population	AW 15-49	6,551	598 Husbands	CA

Senegal	Nov-Aug 1992/93	Direction de la Prévision et de la Statistique	AW 15-49	6,310	1,436 Men 20+	AIDS, CA, MA, MM, SAI
Tanzania	Oct-Mar 1991/92	Bureau of Statistics, Planning Commission	AW 15-49	9,238	2,114 Men 15-60	AIDS, CA, MA, SAI
Zambia	Jan-May 1992	University of Zambia	AW 15-49	7,060		AIDS, CA, MA
DHS-III						
Central African Republic	Sep-Mar 1994/95	Direction des Statistiques Démographiques et Sociales	AW 15-49	5,884	1,729 Men 15-59	AIDS, CA, CD, MA, MM, SAI
Côte d'Ivoire	Jun-Nov 1994	Institut National de la Statistique	AW 15-49	8,099	2,552 Men 15-59	CA, MA, SAI
Ghana	Sep-Dec 1993	Ghana Statistical Service	AW 15-49	4,562	1,302 Men 15-59	CA, MA
Kenya	Feb-Aug 1993	National Council for Population and Development	AW 15-49	7,540	2,336 Men 20-54	AIDS, CA, MA, SAI
Tanzania (KAP)[a]	Jun-Oct 1994	Bureau of Statistics, Planning Commission	AW 15-49	4,225	2,097 Men 15-59	AIDS, PC
Tanzania (In-depth)	Jun-Oct 1995	Bureau of Statistics, Planning Commission	AW 15-49	2,130		Adult and childhood mortality estimation
Uganda	Mar-Aug 1995	Statistics Department, Ministry of Finance and Economic Planning	AW 15-49	7,070	1,996 Men 15-54	AIDS, CA, MA, MM, SAI
Uganda (In-depth)	Oct-Jan 1995/96	Institute of Statistics and Applied Economics, Makerere University	AW 20-44	1,750	1,356 Partners	Negotiating reproductive outcomes
Zimbabwe	Jul-Nov 1994	Central Statistical Office	AW 15-49	6,128	2,141 Men 15-54	AIDS, CA, MA, MM, PC, SAI
NEAR EAST/NORTH AFRICA						
DHS-I						
Egypt	Oct-Jan 1988/89	National Population Council	EMW 15-49	8,911		CA, CD, MM, PC, SAI, WE, WS
Morocco	May-Jul 1987	Ministère de la Santé Publique	EMW 15-49	5,982		CA, CD, S
Tunisia	Jun-Oct 1988	Office National de la Famille et de la Population	EMW 15-49	4,184		CA, S, SAI
DHS-II						
Egypt	Nov-Dec 1992	National Population Council	EMW 15-49	9,864	2,466 Husbands	CA, MA, PC, SM
Jordan	Oct-Dec 1990	Department of Statistics, Ministry of Health	EMW 15-49	6,461		CA, SAI
Morocco	Jan-Apr 1992	Ministère de la Santé Publique	AW 15-49	9,256	1,336 Men 20-70	CA, MA, MM, SAI
Yemen	Nov-Jan 1991/92	Central Statistical Organization	EMW 15-49	5,687		CA, CD, SAI
DHS-III						
Egypt	Nov-Jan 1995/96	National Population Council	EMW 15-49	14,779		CA, FC, MA, WS
Morocco (Panel)	Apr-May 1995	Ministère de la Santé Publique	AW 15-49	4,753		SAI
ASIA						
DHS-I						
Indonesia	Sep-Dec 1987	Central Bureau of Statistics, National Family Planning Coordinating Board	EMW 15-49	11,884		PC, SM

Nepal (In-depth)	Feb-Apr 1987	New Era	CMW 15-49	1,623		KAP-gap survey
Sri Lanka	Jan-Mar 1987	Department of Census and Statistics, Ministry of Plan Implementation	EMW 15-49	5,865		CA, NFP
Thailand	Mar-Jun 1987	Institute of Population Studies Chulalongkorn University	EMW 15-49	6,775		CA, S, SAI
DHS-II						
Indonesia	May-Jul 1991	Central Bureau of Statistics, NFPCB/MOH	EMW 15-49	22,909		PC, SM
Pakistan	Dec-May 1990/91	National Institute of Population Studies	EMW 15-49	6,611	1,354 Husbands	CA
DHS-III						
Bangladesh	Nov-Mar 1993/94	Mitra & Associates/NIPORT	EMW 10-49	9,640	3,284 Husbands	PC, SAI, SM
Indonesia	Jul-Nov 1994	Central Bureau of Statistics/ NFPCB/MOH	EMW 15-49	28,168		MM, PC, SAI, SM
Kazakstan	May-Aug 1995	Institute of Nutrition, National Academy of Sciences	AW 15-49	3,771		CA, MA
Philippines	Apr-Jun 1993	National Statistics Office	AW 15-49	15,029		MM, SAI
Turkey	Aug-Oct 1993	General Directorate of MCH/FP Ministry of Health	EMW <50	6,519		CA, MA
LATIN AMERICA/CARIBBEAN						
DHS-I						
Bolivia	Feb-Jul 1989	Instituto Nacional de Estadística	AW 15-49	7,923		CA, CD, MM, PC, S, WE
Bolivia (In-depth)	Feb-Jul 1989	Instituto Nacional de Estadística	AW 15-49	7,923		Health
Brazil	May-Aug 1986	Sociedade Civil Bem-Estar Familiar no Brasil	AW 15-44	5,892		CA, S, SM, abortion, young adult use of contraception
Colombia	Oct-Dec 1986	Corporación Centro Regional de Población, Ministerio de Salud	AW 15-49	5,329		CA, PC, S, SAI, SM
Dominican Republic	Sep-Dec 1986	Consejo Nacional de Población y Familia	AW 15-49	7,649		CA, NFP, S, SAI, family planning communication
Dominican Republic (Experimental)	Sep-Dec 1986	Consejo Nacional de Población y Familia	AW 15-49	3,885		S, SAI
Ecuador	Jan-Mar 1987	Centro de Estudios de Población y Paternidad Responsable	AW 15-49	4,713		CD, SAI, employment
El Salvador	May-Jun 1985	Asociación Demográfica Salvadoreña	AW 15-49	5,207		CA, S, TBH
Guatemala	Oct-Dec 1987	Instituto de Nutrición de Centro América y Panamá	AW 15-44	5,160		CA, S, SAI
Mexico	Feb-May 1987	Dirección General de Planificación Familiar, Secretaría de Salud	AW 15-49	9,310		NFP, S, employment
Peru	Sep-Dec 1986	Instituto Nacional de Estadística	AW 15-49	4,999		NFP, employment, cost of family planning
Peru (Experimental)	Sep-Dec 1986	Instituto Nacional de Estadística	AW 15-49	2,534		
Trinidad and Tobago	May-Aug 1987	Family Planning Association of Trinidad and Tobago	AW 15-49	3,806		CA, NFP, breastfeeding

DHS-II						
Brazil (NE)	Sep-Dec 1991	Sociedade Civil Bem-Estar Familiar no Brasil	AW 15-49	6,222	1,266 Husbands	AIDS, PC
Colombia	May-Aug 1990	PROFAMILIA	AW 15-49	8,644		AIDS
Dominican Republic	Jul-Nov 1991	Instituto de Estudios de Población y Desarrollo (PROFAMILIA), Oficina Nacional de Planificación	AW 15-49	7,320		CA, MA, S, SAI
Paraguay	May-Aug 1990	Centro Paraguayo de Estudios de Población	AW 15-49	5,827		CA, SAI
Peru	Oct-Mar 1991/92	Instituto Nacional de Estadística e Informática	AW 15-49	15,882		CA, MA, MM, SAI
DHS-III						
Bolivia	Nov-May 1993/94	Instituto Nacional de Estadística	AW 15-49	8,603[b]		AIDS, CA, CD, MA, MM, S, SAI
Colombia	Mar-Jun 1995	PROFAMILIA	AW 15-49	11,140		AIDS, CA, MA, PC
Guatemala	Jun-Dec 1995	Instituto Nacional de Estadística	AW 15-49	12,403		AIDS, CA, MA, MM, S
Haiti	Jul-Jan 1994/95	Institut Haitien de l'Enfance	AW 15-49	5,356	1,610 Men 15-59	AIDS, CA, CD, MA, SAI

[a] No health or birth history section in questionnaire.
[b] Household questionnaire was administered in 26,144 households.

AIDS acquired immune deficiency syndrome
AW all women
CA child anthropometry
CD causes of death (verbal reports of symptoms)
CMW currently married women
EMW ever-married women
FC female circumcision
M migration
MA maternal anthropometry
MM maternal mortality
NFP natural family planning
PC pill compliance
S sterilization
SAI service availability information
SM social marketing
TBH truncated birth history
VC value of children
WE women's employment
WS women's status

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