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

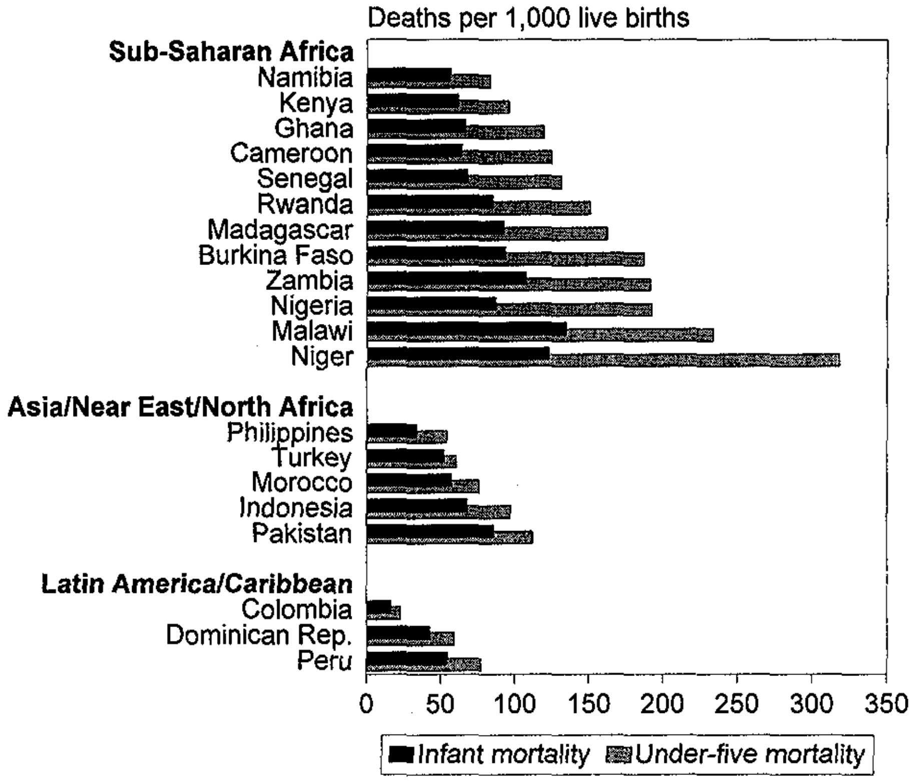
Table 2.1 presents estimated mortality rates for the five-year period preceding 20 DHS surveys. Figure 2.1 shows infant and under-five mortality rates, with countries ordered within region by ascending rate of under-five mortality.

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.

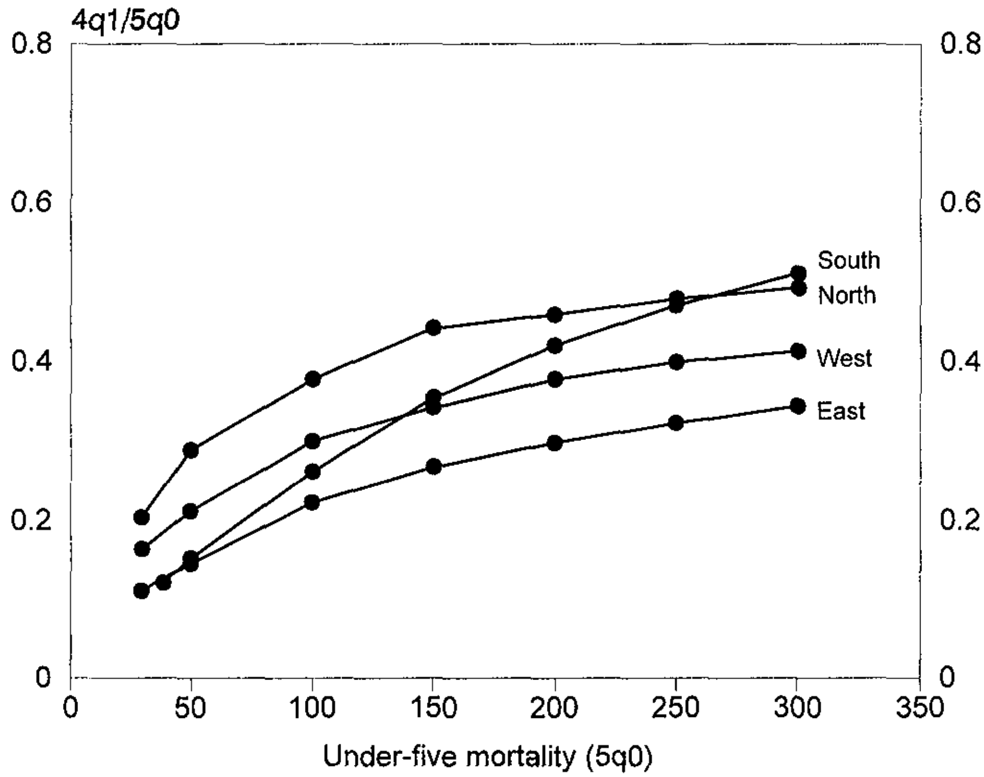
Models of the pace and pattern of mortality by age (i.e., model life tables), derived essentially from empirical observations of historical European populations, serve a useful purpose as references or standards against which international comparisons can be indexed. Embodied in any model life table 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).

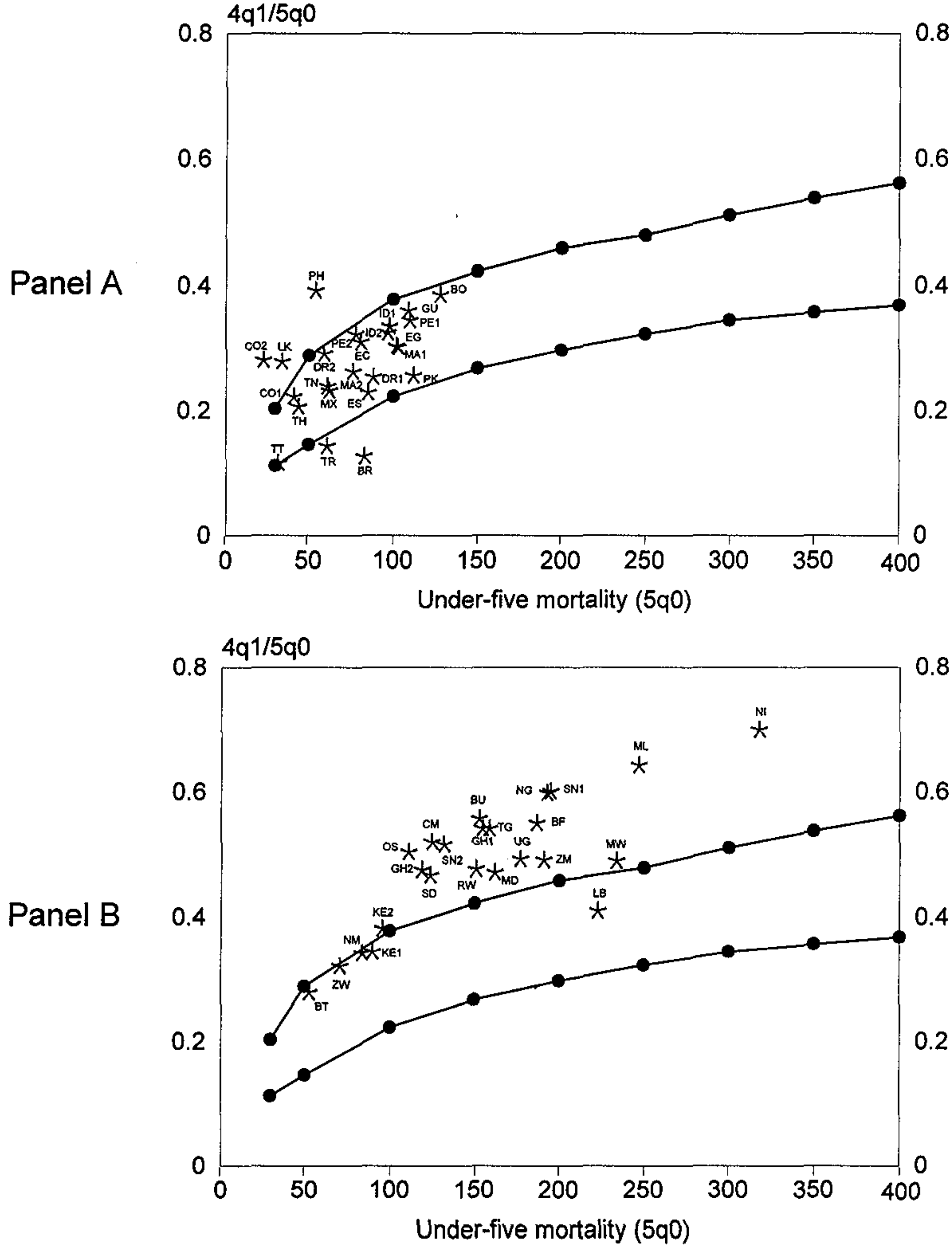
The relationship between infant and child mortality can be described in a number ways. We have chosen the ratio $_4q_1$ to $_5q_0$, which has the property of approximating the proportion of under-five deaths that occur between the first and fifth birthdays. Use of this particular ratio is appropriate 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.

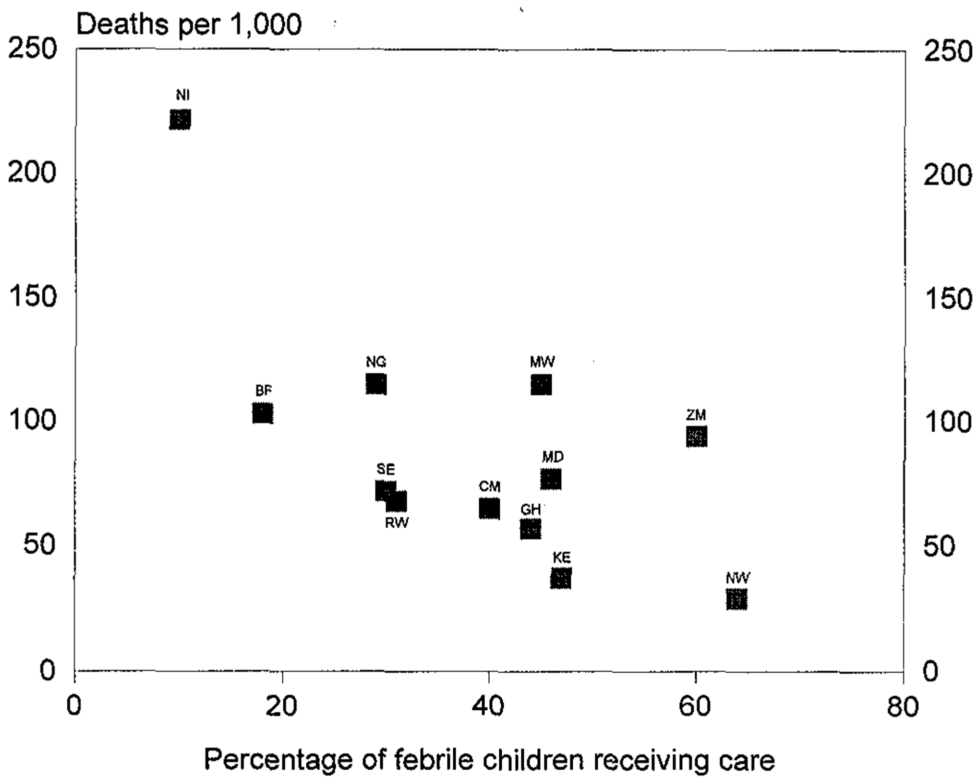
Measles is an important cause of child death in Africa, largely due to the complications arising during and after its acute phase—pneumonia, diarrhea, and undernutrition. Susceptibility to severe life-threatening measles is influenced by many geographically-related factors. Rates of vaccination against 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

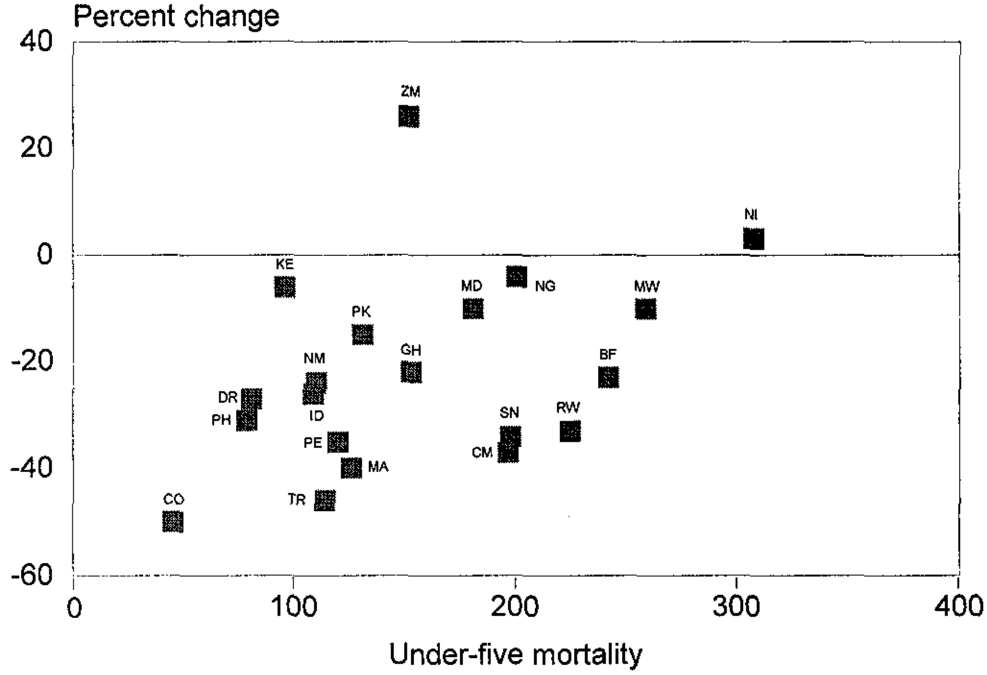
Childhood mortality rates for the three five-year periods preceding the survey and the percent change in rates between the periods 10-14 and 0-4 years before the survey, Demographic and Health Surveys, 1990-1994

	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)