

## Chapter I

# INTRODUCTION AND OVERVIEW

### INTRODUCTION

Information on a country's mortality has come to play an important and diversified role in national planning. Mortality data help to identify a country's current demographic situation and to make clear its immediate demographic future. But beyond their role in demographic accounting, mortality data are serving as important indicators of socio-economic and health progress. They chart progress in one of the areas of most universal human concern, the lengthening of life and avoidance of premature death. They are also sensitive indicators of differences, within a national population, in the degree of progress towards modern conditions, thereby helping to identify target groups for special health and development programmes. They can also be very useful in evaluating the success of programmes already instituted. Finally, mortality levels are related to other variables of social concern, such as labour productivity and fertility, and receive attention because of those relationships.

These uses of mortality information are specific to particular planning units. But in evaluating how successful a certain area has been in modernizing its mortality conditions, it is necessary to compare the situation in that area to achievements that have been recorded elsewhere. This publication facilitates these comparisons by presenting data on the current situation and recent trends in mortality for most countries of the world. In so doing, it helps to identify common problems and special areas of concern, as well as the most successful national experience from which lessons can be drawn.

Most of the volume is focused on mortality conditions in developing countries, where the largest percentage of the world's population is found and an even larger percentage of deaths occurs. The concentration on developing countries is made possible by substantial recent improvements in data quality and availability in these countries. Nevertheless, there are very few developing countries where the most reliable information on mortality, deriving from a complete death registration combined with population censuses, is available. In its place is information from a wide variety of sources: multiround surveys covering small sample areas; incomplete vital registration corrected for estimated under-registration; single-round retrospective inquiries in censuses or surveys about household deaths in some fixed time period; comparisons of age distributions in two successive censuses; and, most prominently, retrospective questions on censuses or surveys regarding the survival of

children and, occasionally, of other kin. These sources do not provide as reliable information on mortality levels as that based upon complete vital registration. Consequently, it is more hazardous to rely upon them for indications of mortality trends, since spurious trends can be produced by changes in data quality. It is even riskier to use them to make inferences about a change in trend, such as an acceleration or deceleration of mortality decline. However, in most of the world they must serve as a surrogate for completely accurate mortality information, and without these supplementary sources of data the estimation of mortality levels and trends in many places would be little more than guesswork. One advantage of survey data on mortality as compared to civil registration is that they sometimes provide richer detail on differences in mortality by socio-economic and other characteristics. Each of the following chapters attempts to use mortality data to identify these differences.

### MEASURES

There are a variety of mortality measures in common usage and most of them appear in this volume. Some of these measures refer to all ages combined. One such measure is the crude death rate (CDR) which is defined for purposes of this volume as deaths in a particular year for all ages combined divided by total mid year population. Occasionally, the crude death rate will be expressed as an average of crude death rates recorded during several years. This measure is a crude indicator of mortality levels because it is highly influenced by the age composition of a population. For example, a country with a large fraction of its population over age 65 will tend to have a high crude death rate regardless of the level of mortality at specific ages. A more refined measure of mortality, which is not influenced by a population's age distribution, is life expectancy at a particular age ( $e_x^0$ , sometimes also called the expectation of life at age  $x$ ).<sup>1</sup> This index measures the expected years of future life of an individual at age  $x$  if he or she were subject for the remainder of his or her life to the age-specific death rates beyond that age recorded in some specified period. For example, the male life expectancy at birth in Australia, 1970-1972, is the expected number of

<sup>1</sup> Strictly speaking the symbol ( $e_x^0$ ) refers to the average number of years lived by members of the cohort after age  $x$ , including fractions of a year, while the symbol  $e_x$  refers to the number of years completed after age  $x$ . However, hereafter we shall use the symbol  $e_x$  refer to the full expectation of life.

years a new-born male would live if he were subject at each age to the male age-specific death rates recorded at that age in Australia during 1970-1972.

The other mortality measures that will be encountered in this volume refer to experience during a particular age span, rather than to the whole of life. An age-specific death rate ( ${}_nM_x$ ) is defined in an identical fashion to the crude death rate, except that the deaths in the numerator and mid year population in the denominator pertain only to a certain defined age span.<sup>2</sup> The age-specific death rate is converted by a simple arithmetic operation into a probability of death prior to the end of the interval for someone who survives to its beginning,  $nqx$ . Basically, this operation amounts to applying the age-specific death rate to a hypothetical group of people, starting the interval over and over again, as many times as there are years in the age interval. The complement of the probability of death in some age interval is of course the probability of surviving that interval  ${}_np_x$ , the sum of the death and survival probabilities is always 1.0.

By long-standing convention, the "infant mortality rate" (IMR), as used in this volume, is in fact closer to a probability of dying between birth and age 1 than to a true mortality rate, which would use the mid year population of infants as a denominator. Instead, the denominator of the infant mortality rate is the annual number of births, while the numerator is the number of infant deaths in that year.

A mortality measure that will be encountered frequently in this volume is the probability of death between birth and age 2 [ $q(2)$  or  ${}_2q_0$ ]. The reason for its currency is not so much its intrinsic value but rather its widespread availability. Thanks largely to technical developments attributable primarily to William Brass, estimates of the probability of death prior to age 2 are available for a large number of developing countries.<sup>3</sup> The popularity of this measure derives principally from Brass's demonstration that it can be estimated indirectly, from reports by women on the total number of their live births and on the number of those births who have survived to the time of survey or census. In particular, the fraction of children dead among reporting women aged 20-24 is often close to the probability that a child will die before age 2, and the correspondence can be made closer by using adjustment factors based upon the age profile of childbearing in the population. This technique, like others using surrogate information on deaths, is subject to error from several sources, the most important of which is the failure of women to report on children, living or dead.

The two types of mortality measures, those for specific ages and those for all ages combined, are related to one another since the age-specific data are a component of mortality data for all ages combined. More important, it has been shown that high mortality levels at one age tend to be associated with high levels at other ages. That is, if one population has a higher level of mortality at ages 1-4

than another population, it is also very likely to have higher levels at ages 5-9, 50-54 and even 80-84. The most extensive documentation of these relations is contained in a study by Coale and Demeny.<sup>4</sup> They demonstrated that age-specific death rates were typically correlated with one another at levels of +0.8 to +0.9 in a collection of more than 100 sets of age-specific death rates drawn from various nations and periods. Thus, there is a firm empirical basis for using mortality information pertaining to one age in order to make inferences about mortality levels at other ages.

However, the relation across populations between death rates at any pair of ages is by no means deterministic. In fact, Coale and Demeny have identified four different patterns of relations, which they designated regionally as "North", "East", "South" and "West". A particular death rate at ages 1-4, for example, is associated with a different death rate at ages 20-24 or 40-44 in the "North" than in the "East" pattern. Still other typical patterns of mortality have been suggested,<sup>5</sup> and the Population Division of the United Nations Secretariat is producing a new set of patterns that will reflect more accurately the situation in developing countries.<sup>6</sup> At the present time it is not altogether clear which set of patterns should supply the basic reference group for particular developing countries. As a result, the translation of an age-specific death rate into a composite measure of mortality such as life expectancy at birth is subject to considerable pattern uncertainty. This uncertainty is such that the estimate of life expectancy at birth associated with a particular value of the probability of death before age 2 can vary by as much as 5-6 years, but it is unlikely to introduce much more error than this. The value for interpopulation comparisons of having a common measure of mortality, such as life expectancy at birth, would seem to outweigh disadvantages resulting from uncertainty regarding the choice of reference mortality pattern.

It should be noted that all mortality measures can be defined in such a way that they pertain to a particular cause of death or to a set of causes. In this volume the measures that relate to specific causes are principally age-specific death rates. These are defined in a fashion identical to that for age-specific death rates for all causes combined, except that the numerator contains only deaths ascribed to a particular underlying cause.<sup>7</sup> Since the causes of death are coded in such a way as to be mutually exclusive and exhaustive, the sum of cause-specific death rates at a particular age is simply the age-specific death rate from all causes combined.

<sup>4</sup> Ansley J. Coale and Paul Demeny, *Regional Model Life Tables and Stable Populations* (Princeton, N.J., Princeton University Press, 1966).

<sup>5</sup> *Age and Sex Patterns of Mortality; Model Life-tables for Underdeveloped Countries* (United Nations publication, Sales No. 55.XIII.9). Norman Carrier and John Hobcraft, *Demographic Estimation for Developing Societies* (London, Population Investigation Committee, 1971).

<sup>6</sup> United Nations model life table project (publication forthcoming).

<sup>7</sup> For a discussion of the concept of underlying cause of deaths, see Iwao Moriyama, "Development of the present concept of cause of death", *American Journal of Public Health*, vol. 46 (1956), pp. 436-441.

<sup>2</sup> The notation for the age-specific death rates in a life table population is  ${}_nM_x$ .

<sup>3</sup> William Brass and others, eds. *The Demography of Tropical Africa* (Princeton, N.J., Princeton University Press, 1968.)

## ISSUES CONSIDERED

This review is organized primarily on a geographic basis. However, more developed countries are considered as a group regardless of the region in which they are located. For purposes of this volume, "the more developed countries" include Europe, the Union of Soviet Socialist Republics, Northern America, Japan, Australia and New Zealand. One chapter is devoted to this group of countries and other chapters are devoted to Africa, Asia (except Japan) and Latin America.

Each chapter deals with a common set of issues. An attempt is made to assess levels of mortality among countries of the region in the most recent period for which information is available. Other information available on mortality in a country since 1950 is also introduced so that mortality trends in the region can be identified. The function of the volume is not, however, to estimate levels and trends in mortality for every country of the world; this important function is served by other publications prepared by the Population Division of the United Nations Secretariat.<sup>8</sup> Instead, attention is confined to countries which appeared able to supply reasonably reliable mortality information. What is reasonably reliable is necessarily a subjective matter, since the variety of types of data available does not permit application of uniform tests. Doubtless some readers will disagree with the choices that have been made, and in some instances new studies have appeared since this volume went to press that would alter certain of the estimates appearing herein. Standards of reliability had to be relaxed for the sub-Saharan African region simply because so few estimates would have survived rigorous tests of reliability. Although mortality data in Latin America and Asia seem to have improved somewhat in quantity and quality throughout the post-war period, the same cannot be said for tropical Africa.

In addition to estimates of levels and trends in mortality within a region, each chapter also attempts to identify major demographic differentials in mortality. Age and sex patterns of mortality are examined where information permits, and these will be seen to show very important regional differences. Furthermore, mortality differences among groups defined by basic socio-economic criteria are described. Among these criteria, the most abundant mortality information exists for urban versus rural residence and, with respect to child mortality, for educational group of the mother. Father's literacy and occupation are also available on occasion to supplement the child mortality tabulations. For the more developed countries, a far richer set of variables is often available for examining socio-economic mortality differences. However, the data available for developing regions are often completely adequate to establish the existence of socio-economic mortality differences. One of the most important functions that this volume will serve is the systematic documentation of enormous differences in mortality conditions within many developing countries. These differences are sometimes as

<sup>8</sup> Among them, see, in particular, *World Population Trends and Prospects by Country, 1950-2000: Summary Report of the 1978 Assessment* (United Nations publication, ST/ESA/SER.R/33, 1979).

large as those which distinguish more developed from less developed countries. They suggest that, in the drive to improve mortality conditions in the developing world, attention must be paid to the distribution of health-related resources within countries as well as among countries.

## RECENT PACE OF MORTALITY DECLINE IN DEVELOPING COUNTRIES

The chapters in this volume are specific to particular regions and groups of countries. This regional focus is appropriate because problems of health and development often show unique regional features. Nevertheless, it is useful to attempt to draw together results from certain common issues considered in the chapters. Perhaps the most central of these issues is the recent pace of mortality decline in developing countries. In particular, various alarms have been sounded about a supposed deceleration in rates of mortality improvement. The present volume, which has attempted to identify the most reliable information available on mortality levels in developing countries, provides a fresh opportunity to examine these trends. As noted above, measurement error is inescapably present when dealing with developing country mortality data. Such error often produces trends when none are present and obscures those which actually occurred. These problems are often critical in making judgements about a particular country, but they are less consequential in dealing with large groups of countries simply because they can be expected largely to offset one another.

In considering mortality trends it is necessary to choose an index of mortality. Very different trends can be registered on different indexes. In particular, a certain percentage change in all age-specific death rates results in less and less percentage improvement in life expectancy as the initial level of mortality improves.<sup>9</sup> For present purposes, the mean annual change in life expectancy at birth is used as the basic index of mortality change. Life expectancy at birth is the most common index of mortality conditions and estimates of it are available in the present work for all three major developing regions in the period from 1950 to the present. However, it should be emphasized that geographic coverage by this index is quite incomplete and that the countries which can supply data may not be representative of all countries.

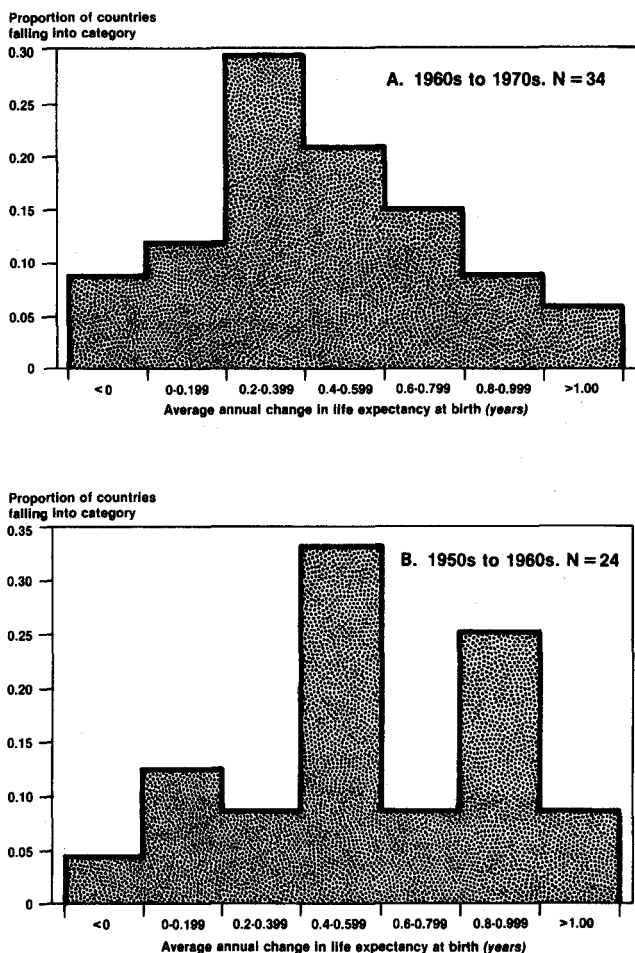
Data for this analysis are drawn from tables III.1 and III.8 in chapter III (Africa), table IV.4 in chapter IV (Asia), and table VA.1 in the annex to chapter V (Latin America). A country is included if it can supply an observation on life expectancy in the 1960s and another in the 1970s, and if central dates of these observations are separated by at least five years.<sup>10</sup> Thirty-four countries are represented: 16 from Latin America, nine from Asia and nine

<sup>9</sup> Nathan Keyfitz and Antonio Golini, "Mortality comparisons: the male-female ratio", *Genus*, vol. 33, Nos. 1-4 (1975), pp. 1-34.

<sup>10</sup> Where several choices were available the latest date was chosen for the 1970s and a date closest to the middle of the 1960s. For the subsequent analysis of change between the 1950s and 1960s, the same data points were chosen for the 1960s and the earliest available data point for the 1950s. Occasionally, when data for the 1950s were unavailable, an observation was substituted from the late 1940s.

from Africa.<sup>11</sup> Analysis is focused on the mean of male and female life expectancies.

Figure I.1. Frequency distribution of rates of mortality change in developing countries



Sources: Based on data in tables II.1, III.8, IV.4 and VA.1.

Figure I.1A shows the distribution of annual rates of change in life expectancy between the 1960s and 1970s for these 34 countries. The distribution is unimodal and skewed to the right. The mode occurs in the range of 0.2 to 0.399 years of gain in life expectancy per calendar year.

<sup>11</sup> The Latin American countries are: Barbados, Cuba, Dominican Republic, Jamaica, Puerto Rico, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Panama, Argentina, Chile, Colombia, Uruguay and Venezuela. Asian countries are Burma (towns), Hong Kong, India, Malaysia (peninsular), Nepal, Philippines, Singapore, Sri Lanka and Thailand. African countries are Algeria, Burundi, Cape Verde, Ghana, Lesotho, Liberia, Mauritius, the United Republic of Tanzania (mainland) and Zaire. For India, 1970-1972, a value of 48.9 years, calculated in the Population Division on the basis of data from the Sample Registration System, was used.

As is typical of distributions skewed to the right, the mean rate of increase of 0.45 years of life per calendar year exceeds the mode. The most common rate of gain falls short of the average rate of gain because several outstandingly rapid improvements were included in the average. The distribution presented in figure I.1 is probably best interpreted as a combination of the true distribution for these 34 countries and a pattern of (probably substantial) measurement error having approximately a zero mean and a bell-shaped distribution.

The distribution of changes in life expectancy for the period from the 1960s to the 1970s is substantially different from that recorded for the period from the 1950s to the 1960s. Unfortunately, only 24 developing countries have supplied data for this earlier period and some of the irregularity shown in figure I.1B is doubtless attributable to this small sample size. But the mean of the earlier distribution, 0.57, clearly lies to the right of the mean of 1960s-1970s changes. Furthermore, there is a distinct bimodality to the distribution for the 1950s-1960s. Closer inspection reveals a regional basis for this bimodality. The mode for Latin American countries is in the 0.80-0.99 range, and these countries account for four of the six observations falling into this category. The mode for the combined group of African-Asian countries falls into the 0.40-0.59 range and they account for five of the eight observations located there. With such small numbers it is unwise to attribute too much significance to these observations, but it is certainly noteworthy that 18 out of 24 countries, or three quarters, had a rate of gain in life expectancy during the 1950s-1960s period that exceeded the modal gain for the 1960s-1970s period.

Table I.1, which presents mean rates of change in life expectancy for the two periods, suggests that much of the decline in rates of gain in life expectancy is attributable to Latin American countries, where the average gain between the 1960s and the 1970s was only half as large as that for the earlier period. Column 3 of the table shows that this slowdown is not attributable to a changing composition of countries supplying information in the two periods. A reduction of about one half is also observed when attention is confined to the 11 countries that can supply data for both periods. In Asia and Africa, however, the situation is much less distinct. The Asian countries show some hint of an accelerated mortality decline between the periods. In Africa, the direction of change depends upon whether or not Algerian data are included. Deaths from activities of war increased Algerian mortality in the 1960s and caused a reduction in life expectancy between the 1950s and the 1960s, followed by a sharp increase in the later period. The changes in rates of decline in Asia and Africa are hardly decisive, and the small number of cases available cautions against drawing any generalizations based upon these data.

The tentative picture that emerges is that mortality declines in developing countries have decelerated during the period from the 1960s to the 1970s but that this deceleration is largely confined to Latin American countries. Since these countries have in general achieved the highest life expectancies within the developing regions, the question

TABLE I.1. AVERAGE ANNUAL RATE OF CHANGE IN LIFE EXPECTANCY AT BIRTH IN DEVELOPING COUNTRIES

(Years; number of countries in parentheses)

| Region                     | 1960s to 1970s<br>for countries in<br>column 1 |                       |           |
|----------------------------|--|-----------------------|-----------|
|                            | 1950s to 1960s<br>(1)                          | 1960s to 1970s<br>(2) | (3)       |
| Latin America .....        | 0.70 (11)                                      | 0.35 (16)             | 0.36 (11) |
| Asia .....                 | 0.48 (7)                                       | 0.57 (9)              | 0.60 (7)  |
| Africa .....               | 0.43 (6)                                       | 0.53 (9)              | 0.62 (6)  |
| Excluding Algeria .....    | 0.60 (5)                                       | 0.45 (8)              | 0.51 (5)  |
| Developing countries ..... | 0.57 (24)                                      | 0.45 (34)             | 0.49 (24) |

Sources: Based on data in tables III.1, III.8, IV.4 and VA.1.

arises of whether they are experiencing a more or less natural deceleration of mortality decline as the biological limits of life expectancy are approached.

One way to investigate this question is to examine rates of mortality decline for countries classified according to their initial level of life expectancy at birth. Table I.2 presents the average rates of change for the two post-war periods under consideration.<sup>12</sup>

According to table I.2, during the period from the 1950s to the 1960s the average rate of mortality improvement was about 0.6 year per calendar year regardless of the level of mortality at the outset of the period. However, no countries at the outset had achieved a life expectancy exceeding 65 years. By the 1960s, seven countries had achieved a life expectancy of at least 65 years, and these countries showed the slowest average gain in years of life between the 1960s and the 1970s. Their average gain of 0.24 year per calendar year was exactly half of the 0.48 year value recorded by countries that started the period with life expectancies below 65 years. Thus, there is reason to believe that part of the deceleration in average rates of mortality improvement resulted from the fact that, by the 1960s, a substantial number of countries had entered a range of relatively high life expectancies where mortality advances tend to occur much more slowly. However, this slowdown at higher life expectancies was not inevitable, since a healthier rate of gain of 0.5 year of life per calendar year would still have left the seven countries with a level of life expectancy in the 1960s below that typical of the developed countries.

But this changing distribution of countries according to initial life expectancy is not a complete explanation of the

<sup>12</sup> Data for Algeria are not included because of its anomalous mortality conditions and trends that were cited above.

TABLE I.2. AVERAGE ANNUAL RATE OF CHANGE IN LIFE EXPECTANCY AT BIRTH IN DEVELOPING COUNTRIES CLASSIFIED BY LEVEL OF LIFE EXPECTANCY AT START OF PERIOD

(Years; number of observations in parentheses)

| Initial level of life expectancy<br>(Years) | Period         |                |
|---|----------------|----------------|
|   | 1950s to 1960s | 1960s to 1970s |
| 30. - 39.99 .....                           | 0.64 (5)       | 0.47 (4)       |
| 40. - 49.99 .....                           | 0.59 (7)       | 0.70 (7)       |
| 50. - 59.99 .....                           | 0.61 (8)       | 0.35 (8)       |
| 60. - 64.99 .....                           | 0.62 (3)       | 0.43 (7)       |
| 65+ .....                                   | - (0)          | 0.24 (7)       |
| All .....                                   | 0.61 (23)      | 0.43 (33)      |

Sources: Based on data in tables III.1, III.8, IV.4 and VA.1.

deceleration in mortality advance. As shown in table I.2, in three of the four categories where comparisons can be made between rates of advance in the 1950s-1960s and the 1960s-1970s, gains in life expectancy decelerated. For countries beginning with life expectancies below 65 years, the average annual increase was 0.61 year in the 1950s-1960s (N = 23) and 0.48 year in the 1960s-1970s (N = 26). This decline is not large but it is surely disturbing to those concerned with improving living conditions in developing countries. It is clearly the major factor contributing to the slowdown from average gains of 0.61 year to gains of 0.43 year. That is, even if no countries had moved into the range of life expectancies above 65 years where advance seems slowest, a decline of 0.13 in average rates of advance (of the observed 0.18 decline) would have occurred between the two decades. So approximately one third of the slowdown is attributable to the emergence of selected countries into the low mortality-slow advance zone, but the remaining two thirds is attributable to a reduced pace of improvement at higher mortality levels where the large majority of developing countries have been located throughout the post-war period.

A note of caution should again be interjected. It is possible that the majority of developing countries, which are not able to supply reasonably reliable data on recent mortality trends, would have very different experiences than the countries which have supplied data. Furthermore, even in the latter group, measurement errors are fully capable of producing spurious trends and changes in trend. But national and international decisions must often be made on the basis of the results available, however incomplete they may be. These suggest that mortality improvements in developing countries have decelerated in recent years and that the deceleration applied regardless of the level of life expectancy attained.