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COMMITTEE ON
POPULATION AND DEMOGRAPHY

Report No. 6

Collecting Data for the Estimation of Fertility and Mortality

Panel on Data Collection
Committee on Population and Demography
Assembly of Behavioral and Social Sciences
National Research Council

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FREQUENTLY USED ABBREVIATIONS IN TABLES

CAPMAS Central Agency for Public Mobilisation and Statistics (Egypt)

CDC Cairo Demographic Centre

CELADE Centro Latinoamericano de Demografia

ECWA Economic Commission for Western Asia

ESCAP Economic and Social Commission for Asia and the Pacific

OECD Organisation for Economic Co-operation and Development

PVSR United Nations Population and Vital Statistics Report (published quarterly)

UNDY United Nations Demographic Yearbook (published annually)

UNECA, UNECWA, UNESCAP United Nations Economic Commissions for Africa, Western Asia, and Asia and the Pacific, respectively. (See also ECWA and ESCAP)

UNSO United Nations Statistical Office, New York

USBC U.S. Bureau of the Census, Country Demographic Profiles (various issues)

WP75, WP77, WP 79 U.S. Bureau of the Census, World Population: 1975, World Population: 1977, and World Population: 1979.

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Preface

The Committee on Population and Demography was established in April 1977 by the National Research Council, in response to a request by the Agency for International Development (AID) of the U.S. Department of State. It was widely felt by those concerned that the time was ripe for a detailed review of levels and recent trends of fertility and mortality in the developing world. Although most people in the demographic community agree that mortality has declined in almost all developing countries during the last 30 years, there is uncertainty about more recent changes in mortality in some countries, about current levels of fertility, and about the existence and extent of recent changes in fertility.

In 1963, a Panel on Population Problems of the Committee on Science and Public Policy of the National Academy of Sciences published a report entitled The Growth of World Population. The appointment of that panel and the publication of its report were expressions of the concern then felt by scientists, as well as by other informed persons in many countries, about the implications of population trends. At that time, the most consequential trend was the pronounced and long-continued acceleration in the rate of increase of the population of the world, and especially of the population of the poorer countries. It was estimated in 1963 that the annual rate of increase of the global population had reached 2 percent, a rate that, if continued, would cause the total to double every 35 years. The disproportionate contribution of low-income areas to that acceleration was caused by rapid declines in mortality combined with high fertility that remained almost unchanged: the birth rate was nearly fixed or declined more modestly than the death rate.

Since the earlier report, however, the peak rate of growth in the world's population has apparently been passed. A dramatic decline in the birth rate in almost all the more developed countries has lowered their aggregate annual rate of increase to well below 1 percent, and the peak rate of increase has also apparently been passed in the less-developed parts of the world as a whole. A sharp decline in fertility in many low-income areas has more than offset the generally continued reduction in the death rate, although the rate of population increase remains high in almost all less developed countries.

The causes of the reductions in fertility--whether they are the effect primarily of such general changes as lowered infant mortality, increasing education, urban rather than rural residence, and improving status of women, or of such particular changes as spreading knowledge of and access to efficient methods of contraception or abortion--are strongly debated. There are also divergent views of the appropriate national and international policies on population in the face of these changing trends. The differences in opinion extend to different beliefs and assertions about what the population trends really are in many of the less-developed countries. Because births and deaths are recorded very incompletely in much of Africa, Asia, and Latin America, levels and trends of fertility and mortality must be estimated, and disagreement has arisen in some instances about the most reliable estimates of those levels and trends.

It was to examine these questions that the Committee on Population and Demography was established within the Assembly of Behavioral and Social Sciences of the National Research Council. It was funded initially for a period of three years by AID under Contract No. AID/pha-C-1161. The Committee has undertaken three major tasks:

1. To evaluate available evidence and prepare estimates of levels and trends of fertility and mortality in selected developing nations;

2. To improve the technologies for estimating fertility and mortality when only incomplete or inadequate data exist (including techniques of data collection);

3. To evaluate the factors determining the changes in birth rates in less-developed nations.

Given the magnitude of these tasks, the Committee decided to concentrate its initial efforts on the first two tasks; it initiated work on the third task in 1979.

The Committee approaches the first task through careful assessment, by internal and external comparison, and through analysis, by application of the most reliable methods known, of all the data sources available. Each of the country studies therefore consists of the application of a range of methods to a number of data sets. Estimates of levels and recent trends judged to be the best that are feasible with available resources are then developed on the grounds of their consistency and plausibility and the robustness of the individual methods from which they were derived.

The Committee's second task, refinement of methodology, is seen as a by-product of achieving the first. The application of particular methods to many different data sets from different countries and referring to different time periods will inevitably provide valuable information about the practical functioning of the methods themselves. Particular data sets might also require the development of new methodology or the refinement of existing techniques.

The Committee set three criteria for identifying countries to study in detail: that the country have a population large enough to be important in a world view; that there be some uncertainty about levels and recent trends of fertility and mortality; and that sufficient demographic data be available to warrant a detailed study. After a country has been selected for detailed study, the usual procedure is to set up a panel or working group of experts, both nationals of the country and others knowledgeable about the demography and demographic statistics of the country. The role of these panels and working groups, which generally include at least one Committee member, is to carry out the comparisons and analyses required. A small staff assists the Committee, panels, and working groups in their work.

As of late 1981, 168 population specialists, including 94 from developing countries, have been involved in the work of the Committee as members of panels or working groups. The Committee, the Assembly, and the National Research Council are grateful for the unpaid time and effort these experts have been willing to give.

Each country being studied has a different mix of data sources and different problems with data errors.

Therefore, there is no standard pattern for all the reports. However, each report includes a summary of the main findings regarding estimates of fertility and mortality, a description of the data sources available, and a presentation of the analyses that were carried out, classified by type of data analyzed; detailed methodological descriptions are included where necessary in appendixes.

As part of the second major task and given the importance of data collection in estimating fertility and mortality, the Committee established the Panel on Data Collection, chaired by William Seltzer, a member of the Committee. The specific objective of the Panel on Data Collection is to assist the Committee on Population and Demography in developing recommendations for improving and standardizing techniques for estimating fertility and mortality levels, trends, and patterns in developing nations. To this end, the panel has focused on methods of improving the accuracy, coverage, timeliness, and reliability of such estimates through improvements in the collection of underlying data. As indicated in this report, the methods may range from improved data collection procedures that can be applied immediately to long-term processes that take many years to bring into fruitful operation.

This report is No. 6 in a series produced by the Committee on Population and Demography of the National Research Council. The second product of the Panel on Data Collection, it reviews experience on collecting data using population censuses, civil registration and vital statistics systems, and sample surveys. It is a state-of-the-art report on available procedures that focuses on questions of special relevance to the estimation of fertility and mortality.

The first Panel report was a study of one of the major problems related to the collection of data for fertility and mortality estimation, that of age misreporting and age-selective underenumeration. The study was prepared by Douglas C. Ewbank and published as Report No. 4 of the Committee on Population and Demography.

This second Panel report is intended to provide detailed guidance and information for people who are concerned about the collection of data for demographic measurement in developing nations. These people include administrators and, especially, technicians and survey practitioners in government and international statistical agencies, teachers and researchers in universities and demographic training centers, policy makers who have to decide on the allocation of funds and personnel for data collection activities, and data users who wish to know more about the difficulties, opportunities, and consequences associated with various data collection processes used to collect fertility and mortality data. Thus the report should be of interest to many persons who determine what data should be collected and by what means, those responsible for collecting and processing the data, and users. However, this report is not intended as a detailed compendium covering all details associated with data collection procedures. For example, complete texts have been written on survey sampling. Therefore, although occasionally there is extended discussion in this report, those discussions include generalizations that must be recognized as oversimplifications. Also, the report is concerned primarily with official data collection procedures, although it is recognized that nongovernment institutions--for example, universities--are very much involved in data collection for research activities.

The Panel on Data Collection has prepared one other report, a brief summary statement for administrators on how to improve data collection processes related to the estimation of fertility and mortality levels and trends. It is published as Report No. 7 of the Committee on Population and Demography.

Special acknowledgment is owed to several persons, in addition to the Panel members and Committee staff listed above, who assisted in the preparation of this report. Carl Haub, a research assistant with the Committee during part of 1978, assisted with the compilation of data and preparation of tables for the census chapter in particular. Mary Anne Fitzgerald and Josephine Floyd, research assistants on the Committee staff during 1978 and 1979, also assisted with the preparation of tables. Typing assistance was provided by Solveig Padilla, Brenda Buchbinder, Benita Anderson, and Lois Hemphill.

The Statistical Office of the United Nations deserves specific thanks for making available to the Panel provisional results from a study, Civil Registration/Vital Statistics: National Practices in 1977. That office also kindly allowed the use of its files on censuses and special tabulations prepared by members of the Office staff.

The committee wishes to thank also the Committee, Assembly, and Report Review Committee reviewers of this

1 Overview

1.1 INTRODUCTION

The purpose of this report is to review what is known about collecting the data needed to estimate levels and trends in fertility and mortality. Fertility and mortality data are defined broadly as sets of information that enable users to estimate directly or indirectly measures of fertility such as the crude birth rate, age-specific fertility rates, and the net reproduction rate; and measures of mortality such as the crude death rate, life expectancy at different ages, and infant mortality. Although the report focuses on the task of collecting data in developing countries, relevant experience is drawn from all parts of the world.

There are three major methods used to gather fertility and mortality data: the population census, the civil registration or vital registration system, and the sample survey. Each method is described in detail in the chapters that follow. The present chapter deals with issues that affect all data collection efforts, including the different demands made by data users, the importance of efforts to assess the degree of error in data collected, and the questions of advance planning and cost assessment. Most importantly, it stresses the essential complementarity of the three collection methods, by highlighting the relative strengths and weaknesses of each in relation to different needs and situations.

The chapter is organized around six major points. First, users of fertility and mortality data have quite different needs with respect to the detail, timeliness, and accuracy of such data. Second, it is important to understand the components of error in data, and to relate the degree of required accuracy to the expected uses of the estimates derived from the data. Third, the three major methods of data collection are more or less well-defined processes with distinctive although somewhat overlapping performance characteristics in terms of the detail, timeliness, and accuracy of the data they can generate. Fourth, the three major collection methods must be seen as complementary; no one alone can adequately serve all the needs for fertility and mortality data. Fifth, it is important to consider the length of advance planning required for different data collection activities, and to keep this in mind in developing strategies for improving national data collection capabilities. Sixth, the question of the costs of data collection deserves much more attention.

1.2 USER NEEDS

The collection of fertility and mortality data is not an end in itself but a means to an end. Thus, any review of the methods of data collection must consider the range of uses to which the data, once obtained, are put. These varied uses of data, because they often have quite different statistical requirements, necessarily affect the overall strategy of data collection and the methods to be employed at each stage of the collection and estimation process.

In developing countries, data on fertility and mortality are generally used in three main ways: first, as the basis for policy guidance, planning, and projections; second, in monitoring current demographic trends and action programs; and third, to support the scientific study of interrelationships between demographic phenomena and socioeconomic developments at either the micro or macro level. For convenience, we will refer to these three broad categories of use as (1) policy making, (2) administration, and (3) research.

For certain purposes it may be enough to collect data that allow users to determine simply the approximate level or range of fertility or mortality. For example, in deciding whether or not to establish a family-planning program or an infant health-care program, it may be necessary only to be reasonably certain that fertility and infant mortality are "high," that is, above certain levels--such as a crude birth rate of 40 births per 1,000 population and an infant mortality rate of 125 deaths per 1,000 live births. As long as the margins of error in the estimates produced do not extend below these boundaries, the process is adequate to the task at hand. For example, if the collection and estimation process leads to values of 48 for the crude birth rate and 145 for the infant mortality rate, each with margins of error of plus or minus 10 percent, the user can be reasonably certain that the rates are "high" as defined by the standards above. However, other users who require more precise measures of levels might find these same estimates unsatisfactory.

Uses that require only a rough indication of the level of fertility or mortality place minimal demands on the collection process in terms of the detail and accuracy required. However, most data needed for policy making, administration, or research have to meet more extensive and rigorous requirements. Each broad category and, indeed, each specific use of fertility and mortality data presents a somewhat different mix of technical demands in terms of topical, temporal, and geographic detail as well as timeliness and accuracy. Table 1.1 illustrates the range of such needs.

Although any given user in any specific context would probably be interested in only a few of the cross-classifications listed in Table 1.1, many major users of fertility or mortality data and most large-scale programs aimed at changing fertility or mortality rates sooner or later would require most of the detail specified. For example, analysts examining the impact of any social program often need information on both program-related variables and demographic or socioeconomic control variables. Such studies may involve analyses carried out either at the aggregate or macro-level or at the level of individual women or families. For a user attempting to demonstrate the effectiveness of a new program or program modification, very detailed geographic breakdowns may also be required, again at either the macro or micro level.

User needs in terms of the timeliness of fertility and mortality data may range from minimal, in the case of some research scholars, to the "yesterday" of the earnest program administrator. A number of factors place constraints on the timeliness that is possible with fertility and mortality data in developing countries, but this is particularly so in the case of fertility. First, both fertility and mortality are phenomena that occur over time; one must wait for the year to end before learning the final figure for the year. Second, the

TABLE 1.1 Illustrative Listing of Detail Frequently Required in the Analysis of Fertility and Mortality Data

	Type of Data		
Type of Detail	Fertility	Fertility and Mortality	Mortality
Topical			
Summary	Crude birth rate General fertility rate Children ever born		Crude death rate
Specific[a]	By age (age-specific fertility rates) By age and marital status (marital age-specific fertility rates) By duration of marriage By previous reproductive experience variables By contraceptive and/or abortion practice variables By attitudinal variables By family-planning program variables	By employment variables By education By income By ethnic group By residence variables By nutritional status	Life table (usually by sex) By age (age-sex-specific death rates) By marital status By dependency status By characteristics of spouse or parents By cause of death By whether medically attended By previous health status
Temporal			
Vague	Cumulative	Current Recent Past	Generation[b]

Specific[c]	By age or marriage cohorts	Specified calendar year (or other, e.g., lunar) Specified group of calendar years Specified 12-month period Specified period greater than 12 months Specified period less than 12 months
Geographic		Entire country Urban/rural All major cities Each major city Each major civil division Each minor civil division Specified small areas Individual villages

[a]In most cases, an age control is almost always necessary also to allow for meaningful analysis.
[b]As in "this generation" or "changes from one generation to the next." The "generation life table" is a specific term that refers to the mortality experience over time of a group of people born in the same year or group of years.
[c]Each of these specific items refers to data that provide an estimate of the level of fertility or mortality during that time period and, in the case of infant deaths, during a specified number of months or weeks following birth. To obtain the temporal detail required to estimate change, it is necessary to have estimates for at least two time periods.

seasonal swings of fertility and mortality are very much more pronounced and more irregular in developing countries than in the United States and most other developed countries, which means that extrapolations based on part-year data are hazardous and sometimes quite misleading. Third, data collection activities, particularly if organized on an ad hoc basis, usually have long lead times. Fourth, programs designed to reduce fertility or mortality are usually slow to gather momentum; hence, after a program has been operating for several years, policy makers and administrators may want demographic estimates for the most recent period, e.g., for the third and fourth years of a five-year plan period when they are developing the next five-year plan during year four or five of the current plan period. (Even in cases where changes in vital rates are achieved quickly, estimates for the most recent period are usually desired.) Finally, if the impact of a contraception program is to be measured in terms of the change in the number of births occurring in a population, it is not possible to assess it definitively until 9 months after the fertility-regulation behavior began.

While timeliness usually is thought of in terms of speed of data production, frequency and regularity are also factors in timeliness. In properly functioning collection activities there will usually be a reciprocal relationship between speed and detail as well as speed and accuracy. However, in the case of poorly functioning activities it is often possible to increase both speed and accuracy simultaneously.

1.3 THE CONTEXT OF DATA COLLECTION

In addition to the needs of users, the conditions and characteristics of the population being studied have important effects on the data collection process. Particularly in measuring mortality, it is important to emphasize the sharp differences that exist between the developed and developing nations, both in the aggregate phenomenon being measured and in the conditions of observation. Because of past and current levels of fertility and mortality, mortality in the developed nations occurs primarily among the elderly and rarely among children and infants. In contrast, in developing nations nearly half the deaths occur to those under age 15, and frequently more deaths occur in the first year of life than among those 65 years and over. Table 1.2, which shows the percentage distribution of deaths by age and the median age at death in selected developed and developing countries, illustrates vividly the magnitude of this difference.

In addition, the developed regions are characterized by the greater prevalence of the nuclear family as a living arrangement, greater urbanization, and greater availability and use of inpatient health facilities. Collectively, these factors interact with the different age patterns of mortality to accentuate the differences between the measurement situations in the two groups of countries. For example, while all surveys tend to omit the mortality of persons living alone or with nonrelatives, this is probably a much larger source--perhaps even the primary source--of omissions in surveys of developed countries, where deaths are concentrated among the elderly and where many of those over age 65 live alone or with nonrelatives. On the other hand, omission rates for the deaths of old people tend to be relatively low in developing countries, because the greater proportion of dwelling units with more than one nuclear family (which means that fewer people live alone) increases the probability that the deaths of older persons will be reported.

Another example of how the measurement problems differ between developed and developing countries can be seen in relation to infant mortality. While deaths of the very young tend to be underreported universally, the fact that few such deaths occur in the developed countries means that even very high omission rates have a minor impact on estimates of total mortality in those countries. The situation is almost reversed in the developing countries. There, high omission rates of the deaths of infants and children have a large impact on mortality estimates, because such a large proportion of the total deaths are those of infants and young children. Furthermore, the prevalence of multiple-family households increases the likelihood that a census or survey respondent will be someone other than the infant's mother and that the infant's death will be subject to the very high omission rates associated with such proxy respondents (Sirken and Royston, 1971).

TABLE 1.2 Percentage Distribution of Deaths by Age in Selected Developed and Developing Countries

Age at Death (years)	Percentage of Total Deaths	
	Developed Countries[a]	Developing Countries[b]
Less than 1	2.4	29.6
Less than 5	2.9	44.8
Less than 15	3.5	49.3
15-24	1.8	3.9
25-64	25.8	23.2
65+	68.9	23.7
Median age at death	71.8	16.3

Note: An examination of the age distribution of deaths for appropriate model stable populations suggests that these results would be altered only slightly if a larger number of countries were included in the analysis and the effects of age misreporting could be eliminated.

[a]Median values using data for year specified in 1977 U.N. Demographic Yearbook for Australia (1975), Canada (1975), England and Wales (1976), Federal Republic of Germany (1976), France (1974), Hungary (1976), Japan (1976), Netherlands (1976), Poland (1976), Spain (1974), Sweden (1976), and United States (1975).
[b]Median values using data for year specified in 1977 U.N. Demographic Yearbook for Algeria (1965), Cuba (1971), Guatemala (1972), Malawi (1971-72), Mexico (1974), Sri Lanka (1968), Tunisia (1973), and Turkey (1967-68).

1.4 ACCOUNTING FOR ERRORS IN DATA

Another major concern of users is, or should be, the accuracy of the fertility and mortality data they employ. While everyone agrees that accuracy is good and error is bad, people (statisticians, demographers, and non-technical users) often seem to have quite different things in mind when they use these terms. The resulting confusions and misunderstandings have sidetracked many discussions about demographic estimates and the methods used to obtain them.

All operations in the data collection process are subject to errors. For example, in census and survey work, there is evidence of large interviewer variances, coder variances, respondent errors in factual data, and large differences in average results between parallel surveys by different organizations. It would be impossible to measure and present each source of error for each census, vital registration system, or survey (much less to eliminate them) the way sampling errors in surveys can be computed and presented. (Even sampling errors need more attention, and the World Fertility Survey is establishing new precedents by including them systematically in their publication of each first country report.)

The multiplicity and complexity of sources of errors forces us to adopt a simplified yet useful conception: a model for survey errors. The concept of "individual true values" of each variable for each population element is a point of departure (Hansen et al., 1953). Thus we have a multiplicity of sources of errors superimposed on a group of variables for a population of elements.

For convenience, the statistical model divides the total error (the difference between the value obtained and the individual true value) into a pair of components for each source of error: a bias component and a variable component. The biases refer to the average errors for each source defined for a set of essential data collection conditions. For example, in a survey a particular set of interviewers would get some average understatement of abortion. That average bias could be different for a team of midwives vs. a team of interviewers, and they could be well or poorly trained, female or male, etc. Furthermore, within each team a good design might detect individual differences between interviewers; these differences can best be conceptualized, and hopefully measured, as variable errors arising from a set of interviewers "randomly" selected from a population of interviewers defined under the essential survey conditions. Another example is a vital registration system in which more closely supervised registration clerks in urban areas obtain more accurate information on age at death than clerks in rural areas. In addition, individual clerks carry out their registration tasks with more or less diligence. Here also these differences can be conceptualized as variable errors arising from a set of registration clerks "randomly" selected from a population of clerks defined under the essential conditions of the vital registration system.

Other sources of measurement error, such as coding, can also be divided into an average, systematic bias and a variable component of error. Nevertheless, for many purposes the chief attention with respect to errors of measurement should be paid to bias rather than to variable errors. However, for errors of sample selection the variable errors of selection will predominate and should be measured, because in well-designed samples systematic biases of selection can be reduced to negligible proportions compared to other sources of error.

It is frequently stated that measurement biases are more important in surveys and in other demographic data collection processes than are sampling errors. There is some truth in that, but only the partial truth of first approximations. It is probably true for most large demographic surveys and censuses that the overall means and rates are affected most by measurement bias. However, most data are also used to investigate subclasses; as these become small and as they are compared (within a cross-section, between censuses and repeated surveys, and across time periods in vital registration systems), the limiting factor almost always becomes the "size of the sample," that is, the sampling errors.

It is often, though not always, a false dichotomy to counterpose biases to variable errors. Both components give rise to the overall error. This is expressed as the total error, or the mean square error (MSE), which equals the square of the error plus the square of the bias. Its square root, the root mean square error, has wide acceptance as a good statistical criterion for the accuracy of results (Cochran, 1963:1.8, 1.9; Kish, 1965:13.1, 13.2, 13.8). Gauss had the first and best word on the mean square error in 1809:

> If one objects that this convention [the MSE] is arbitrary and does not appear necessary, we readily agree. The question which concerns us here has something vague about it from its very nature, and cannot be made really precise except by some principle which is arbitrary to a certain degree. . . . Among the infinite number of functions satisfying this condition, it seems natural to choose the simplest, which is, without doubt, the square of the error,

and in this way we are led to the principle proposed above (Gauss, 1809).

The total error of an estimate or the MSE can be considered as the sum of at least four error components:

(a) Sampling variance is a measure of variability of results from one sample to another sample of the same design and size from the same population. It arises because a probability sample rather than the whole population is covered. It can be measured (estimated) in well-designed samples.

(b) Simple response variance is defined as the variance of the observed values of independent measurements for an individual unit taken under the same conditions and averaged over the individual units (individual people, deaths, births, etc.). For a more technical definition see Appendix A.

(c) Correlated response variance is a measure of the variability due to intra-interviewer or recorder correlation and biases that persist from unit to unit and trial to trial (e.g., the tendency of the individual census taker, interviewer, registration official, or their supervisors to make the same errors repeatedly or more or less consistently).

(d) Biases refer to the average effects of systematic errors that affect any data collection process taken under specified design conditions. The biases may different in different subgroups.

A further discussion of mean square error, including an explanation of the formula, is found in Appendix A.

The MSE approach is an attempt to model total error as the sum of two components: bias and variable error. Another useful approach is to attempt to partition error according to its source, that is, to estimate the contribution to the error of the different survey processes (interviewing, coding, punching, imputation, etc.). Although it is seldom possible to cover all sources of error in this way, the approach may nevertheless yield valuable information for identifying weak procedures and optimizing the impact of corrective measures.

The MSE approach--which partitions total error into fixed and variable components or fixed, variable, and interactive components--was originally developed by sampling statisticians as part of their efforts to improve the design of surveys and the related sampling procedures used (Deming, 1950), but the same approach has been widely used by statisticians in other fields of science (e.g., Eisenhart, 1969).

The principal advantage of the MSE approach is that at least conceptually it provides a body of theory and a strategy that can be used to estimate the components of error and the total MSE. The validity of the MSE approach rests on how closely the assumed error model fits the particular measurement effort and on the extent and quality of the empirical data on errors that are developed and estimated through the survey design or otherwise available for use in applying the model. Considerable attention has been given to the latter problem by Seltzer (1973) and Marks et al. (1974).

1.5 COMPARATIVE ADVANTAGES OF DATA COLLECTION METHODS

Births and deaths are discrete events that occur in time and space. They are widely distributed in the population although at a comparatively low density; in most developing nations one would expect an average of about 10 to 25 births and considerably fewer deaths a year per 100 households.

Several broadly different techniques have been used to detect the occurrence of these isolated events and to assemble this and related information to provide reliable statistics about fertility and mortality behavior in the population generally. The techniques include:

(a) contemporaneous recording of each event as soon as possible after it occurs;

(b) retrospective questions about individual events occurring over some specified period in the past (for example, births in the last 12 months; sometimes for fertility data the question asked is date of last live birth, or a full birth history may be requested);

(c) retrospective questions about the cumulative number of events that have occurred (for example, number of children ever born);

(d) comparing the number of persons by age and sex (or by certain other characteristics) at one or more points in time to derive information about fertility or mortality as an aggregate phenomenon; and

(e) compiling a list of living individuals at one time, repeating the exercise in the same population after an interval of time, and deriving information about individual births and deaths from changes in the two lists.

These techniques are not necessarily mutually exclusive and are often used together. For example, the last method, sometimes referred to as either the "follow-up survey method" or the "household change technique," must be combined with some other method in order to obtain information about the occurrence of live births and related infant deaths occurring between the times when the two lists are compiled. That is, other questions must be asked to ascertain the occurrence of events that are not evident from changes in the two lists. Regardless of the specific technique or techniques used to identify the occurrence of births or deaths, it is essential that data collectors use procedures that are well defined and well controlled.

Three major methods of data collection are based on these five techniques for detecting births and deaths: the population census, the civil registration system, and the sample survey. Accepted definitions of a population census and a system of civil registration are included in Chapters 2 and 3 respectively. Definitions of the wide variety of sample surveys used to collect fertility and mortality data are described in Chapter 4. In addition to these three methods, a few developed countries also use population registers as a basic source of population statistics. Such a register, essentially a ledger or file of data maintained on each individual in the population, has no value as a source of continuing statistical data unless there is a mechanism for keeping it up to date. Since a comprehensive civil registration system is the basic component of any such mechanism, population registers are discussed in Chapter 3 along with civil registration systems.

Table 1.3 lists the five techniques for identifying vital events and indicates the degree to which they can be used in the context of each of the three major data collection methods. As the table shows, a civil registration system is by definition an application of the continuous recording technique. Three of the five techniques can be used in connection with a population census. Sample surveys offer the greatest opportunities for using different types and combinations of the techniques.

TABLE 1.3 Suitability of Various Techniques for Detecting Births and Deaths, Classified by Data Collection Method

	Data Collection Method		
Technique	Population Census	Civil Registration	Sample Survey
(a) Contemporaneous recording of each event	No	Yes	No[a]
(b) Retrospective questions about each event	Yes, but very limited[b]	Generally not applicable[c]	Yes
(c) Questions about cumulative number of events	Yes, but limited[d]	Yes in the case of fertility (parity)	Yes
(d) Aggregate population data classified by age and sex	Yes	Generally not applicable[e]	Yes
(e) Household change technique	No	Not applicable	Yes

[a]Some variations of a sample survey may include a continuous recording operation in sample areas or monthly or more frequent interviewing that approaches notions of contemporaneous recording. However, most sample surveys do not use this technique.
[b]Suitable only for a question relating to events in the last 12 months or the date of the most recent event. Totally unsuited for a full birth history. (Sometimes indirect estimation techniques can be applied to census data to construct better estimates.)
[c]Although by definition CR/VS systems involve the contemporaneous recording of each event, limited information on past fertility can be ascertained, for example, from a question on birth order.
[d]Often not feasible to use the recommended full battery of six questions (i.e., living in household, living elsewhere, born alive but now dead, each separately for males and females).
[e]Although CR/VS systems do not collect aggregate population data, it is possible to use CR/VS data to tabulate births by age of mother, deaths by age and sex, etc.

In fact, the sample survey method generally offers a very wide range of options, not only in terms of techniques used but also in terms of other factors related to the type, design, and execution of the survey. These factors include the number of questions asked, whether the survey involves one visit to each sampled household (single-round survey) or more than one visit (multi-round survey), whether information collected in the current visit is compared with or reconciled with previously collected information, whether the survey is carried out on an ad hoc basis or with the assistance of a permanent household survey organization, whether the survey is carried out by a governmental statistical agency or some other organization, the type and size of sample, the persons used as interviewers and supervisors and the workloads of each, the extent and nature of the training provided the field staff, the type and layout of the questionnaire used, the type and extent of manual and computer editing, and so on.

Although the variations possible in designing and carrying out a population census are considerably fewer than with a survey, variations can and do occur. Some of the major design issues and options that census planners face are presented in Chapter 2. Some of these options are not real options in all situations, because many features of census organization and design are dictated by external factors. For example, in a country in which most of the population is illiterate, the self-enumeration method of enumeration is not a real option. On the other hand, conditions change, so what can be considered a real option changes over time. Since the specific design options chosen may have a substantial impact on the measurement process and therefore on the quality of the data collected, users of census data should want to be sure that apparent intercensal changes in data are not the result of changes in census procedures. This point is particularly important for certain types of demographic estimation.

The basic design options in continuous recording of births and deaths can be expressed in terms of a 2-by-2 classification (Wells and Horvitz, 1978):

	Legal Status of System	
Effort of Field Staff	Civil Registration	Special Registration
Passive		
Active		

"Passive" in this table means that a member of the household or a person closely associated with a household (or with the specific event, e.g., the physician, hospital staff member, or undertaker) brings the information concerning a birth or death to a staff member of the civil registration system. "Active" means that the staff member actually visits households to gather information concerning births and deaths. Special registration, as opposed to civil registration, means one operated under the auspices of some authority other than the central government, such as the church. Despite the considerable scope afforded by these four alternatives and the large number of countries that have undertaken the task, nearly all efforts at continuous recording of births and deaths involve an official civil registration system that depends on passive staff effort (that is, the upper left cell of the table).

The organization of registration systems varies greatly among countries--for example, which ministry has responsibility for the registration work and which carries out the statistical compilation work; whether notification responsibility falls on the family or on health, religious, or local administrative personnel; the hours and location of registration offices; whether the statistical data are compiled locally, regionally, or centrally; and so on--but within the same country there is much institutional continuity. Despite this institutional continuity, countries whose civil registration systems suffer from substantial incompleteness may be subject to sudden variation in the level of completeness. Although these variations sometimes are attributable to obvious organizational changes, more commonly they are due to subtle changes in detailed procedures or to registration drives. For example, the latter often produce a substantial number of delayed registrations with respect to current events.

A national civil registration system that functions as a reliable instrument of demographic measurement is more difficult to establish than a population census or sample survey since it must be more extensive both in time and space than either of the other two methods. In other words, a successful civil registration system must provide a means for detecting and recording substantially all births and deaths regardless of what time of year or where in the nation each event takes place.

A population census, while equally broad in geographic scope, is a single effort carried out once, or at most twice, each decade. As a result, extensive administrative and technical resources can be specially mobilized in an effort to keep the data-gathering and data-processing operations under as much control as possible. Indeed, such a special mobilization of resources is essential if major errors in coverage and content are to be avoided.

The sample survey, restricted as it is to a small proportion of the population, is in a much better position than either the census or the civil registration system to produce observations made under conditions that approach the ideal of statistical control. This is particularly true when, as is the case with most survey sample designs, the sample is confined to a relatively small number of geographic areas. In that situation, it is possible to train and supervise the field staff more effectively than in either a census or civil registration system and to insist, where appropriate, on direct rather than proxy interviews. Furthermore, as Table 1.3 indicates, the sample survey is the most versatile of the three collection processes in terms of the techniques it can use to detect births and deaths.

Against these advantages must be placed the disadvantages that arise because sampling is being used. One disadvantage is that for a census there is better publicity and better public understanding, which may lead to improved respondent cooperation. This may be a factor in the higher coverage that has been observed in censuses as compared with many sample surveys. In addition survey estimates are subject to measurable sampling errors if a probability sample is employed; even greater uncertainties arise if some other sampling procedure is used. Thus, non-probability or "new sampling designs" that depend on the validity of assumed models should not be used to collect fertility and mortality data; standard probability sampling should be employed. One example of the extent of uncertainties that can arise when a non-standard technique is used is described by Trussell and Brown (1979) in their analysis of Afghanistan data.

User confidence in the estimates is an important issue when data are collected by a sample survey. The impact of sampling errors on fertility and mortality estimates can be substantial, particularly with respect to crude rates and age-specific rates based on sample data for a single year. Table 1.4 illustrates how large such errors can be even under perfectly controlled conditions. If one probes further into questions of error (as outlined in the preceding section), there is even greater variability than indicated by the ranges in Table 1.4.

TABLE 1.4 Examples of Approximate Sampling Errors Associated with Estimates of the Crude Birth Rate and the Age-Specific Fertility Rate, by Size of Sample

Size of Sample[a]	CBR ± 2σ	ASFR ± 2σ
1,000	28-52	133-467
3,000	33-47	203-397
5,000	35-45	225-375
10,000	36-44	247-353
50,000	38-42	276-324
100,000	39-41	283-317

Note: Sampling errors shown are the two-sigma (2@) confidence intervals around an assumed crude birth rate (CBR) of 40 per 1,000 population and an assumed age-specific fertility rate (ASFR) of 300 per 1,000 women aged 30-34. Calculations assume that women aged 30-34 comprise 3 percent of the total population, e.g., for a sample size of 1,000 there are 30 women aged 30-34, for a sample size of 5,000 there are 150, etc.

[a]Assuming a simple random sample of persons and a sampling fraction of about 10 percent or less.

Source: Seltzer (1973).

Moreover, the mere fact that a sample survey is used does not guarantee that the data will be collected in a carefully controlled manner.

1.6 THE ESSENTIAL COMPLEMENTARITY OF DATA SOURCES

No single data collection method can supply the full range of fertility and mortality data needed by different countries and by different users within those countries. Each of the three major methods--census, civil registration, and sample survey--has advantages and limitations. To be most effective, they must be used in concert to gather the various types of data needed for policy making, administration, and research; to provide mutual cross-checks on accuracy and completeness of coverage; and to collect the combinations of data that are needed to apply some of the more powerful estimation techniques. If planned and carried out in coordination with each other, their advantages can be maximized and their limitations reduced.

The essential complementarity of the methods is reflected in Table 1.5, which indicates their relative strengths in providing different types and quality of data. Table 1.6 displays some of the other advantages and limitations of each method.

In both tables the relative advantages of the three methods are shown to be complementary: where one is strong, another is weak. For example, sample surveys can be designed to obtain wide varieties of data with rich content, and they can be designed to collect the data relatively accurately. Because they are small they can be done fairly inexpensively and can provide timely data, but for the same reason they fail to yield precision and geographic detail. These last two criteria, on the contrary, are the chief virtues of complete censuses (although censuses are by no means immune to coverage problems themselves). Censuses (and well-developed civil registration systems) tend to produce better coverage of the population than sample surveys, which often suffer from higher non-response (although non-response levels vary greatly between surveys and among individual items in surveys). Because censuses are large and expensive, however, they are not conducted frequently and often produce data that are partially obsolete because of the time required for collecting and processing the data and disseminating the results. To obtain either rich or accurate data from a census is often not feasible.

Civil registration systems have a different mix of advantages than either surveys or censuses. Once established, civil registration systems can be inexpensive to maintain if some of the costs are considered necessary for administrative purposes, although to date this is the case in only a few of the developing nations. Moreover, civil registration systems can yield precise, timely, and detailed information about levels and trends in fertility and mortality provided they are tied to good census data.

Sample surveys are an important tool for obtaining fertility and mortality data and for carrying out demographic research at all stages of statistical development, however it is a mistake to think of them primarily as an interim means of supplying data in the

TABLE 1.5 Intrinsic Characteristics of Data Collection Methods in Providing Data Needed to Estimate Fertility and Mortality: A Comparison Using Seven Criteria

Criteria	Data Collection Method: Census	Civil Registration	Sample Survey
Topical detail (richness and diversity of subject matter)	Moderate	Weak	Strong
Accuracy	Moderate	Strong	Moderate
Precision (absence of sampling errors)	Strong[a]	Strong[a]	Weak
Timeliness of data	Weak	Strong	Strong
Geographic detail (subgroups, etc.)	Strong	Strong	Weak
Obtaining information on population at risk[b]	Strong	[c]	Strong
Ease of organization in a developing nation	Moderate	Weak	Strong

[a]An important qualification must be noted. With respect to arriving at inferences, censuses and CR/VS systems are subject to sampling errors. For example, if one has a death rate for a city or county (based on complete registrations and a complete census) or for a specific cause, based on a small sample, and it differs from the death rate in another area (or for another cause), the difference may well be due to the number of observations involved and may not represent any real underlying difference in the cause systems. Thus, when the inference is to a cause system, as is common, census and complete registration results are subject to sampling errors.

[b]The "population at risk" refers to the group of persons who are subject to the events that are counted, measured, or analyzed. For example, the population at risk for the crude death rate is the entire population in the area under measurement or study. The population at risk for each age-specific fertility rate consists of all women in that age group. The population at risk of infant mortality includes all live-born children during their first year of life. (The infant mortality rate is frequently approximated by dividing the deaths to children under one year of age during a year by the number of births occurring in that year.)

[c]In general, CR/VS systems do not provide information on the population at risk. However, for some measures, such as infant mortality, CR/VS systems do provide data on the population at risk. Also, historical analysis is possible when CR/VS data from earlier periods are available.

absence of a reliable civil registration system. Undoubtedly, surveys can be used for this purpose but they can never adequately meet the range of needs served by a national civil registration system. By the same token, even with the most complete and comprehensive civil registration system it is essential to continue an active program of sample surveys.

Another very fruitful way of drawing on more than one data collection method is to combine the use of sampling techniques with a census; this subject is treated in detail in Chapter 2. In countries where the census data are of good quality and where the age data are reliable (e.g., in a few developing countries in East Asia), special analytic techniques can be used to construct fertility and mortality estimates normally obtained from civil registration data. In the application of one such technique, own-children analysis, an estimate of child mortality is required; frequently this estimate is derived from data obtained from a survey or sometimes a civil registration system.

In addition to their use in collecting fertility and mortality data censuses, surveys, and registration systems serve a variety of other specialized needs. For example, censuses are required for purposes related to civil administration and apportionment (e.g., determining the distribution of seats in a legislative body, the allotment of taxes, or the distribution of funds on the basis of population counts). Surveys are a valuable means of testing questions for possible use in censuses, and registration systems serve the socially important function of providing a legal record of vital events. Censuses and surveys can be used to estimate the completeness of national vital registration systems, and in many developing countries the need to see how well or poorly the civil registration system is functioning helps spur the development of complementary data collection systems.

A coordinated approach to data collection is essential because it allows the inherent or temporary deficiencies of any one method to be counterbalanced by the comparative strengths of another. This is as true for countries that have reached a comparatively advanced state of statistical development as it is for countries in which one or more of the data collection systems is limited in geographic scope, seriously deficient in coverage, or otherwise functioning inadequately. For best results, the concepts, definitions, and classifications used in the census, the

TABLE 1.6. Some Advantages and Limitations of Population Censuses, Civil Registration Systems, and Sample Surveys

Data Collection Method	Advantages	Limitations
Population Census	1. Data can be tabulated for many local geographic areas. 2. Detailed cross-tabulations are not subject to sampling errors for complete-count items (except when arriving at inferences--see footnote a in Table 1.5) and are subject to relatively low sampling errors for sample items. 3. Simultaneously obtains information related to enumerated events and population at risk. 4. Useful for time series covering long periods of time.	1. Infrequent. 2. Limited range and depth possible in the collection data on fertility and mortality as well as on classifying variables. 3. Information on "flow" variables (for example, income, births, deaths) and data from proxy respondents are subject to increased levels of response error. 4. Persons not at their usual place of residence are subject to high non-response rates (a lesser problem in de facto censuses). 5. Comparatively difficult to control conditions of observation (because it is extensive in space). 6. Costly and massive in scale, so relatively inflexible.
Civil Registration System	1. Data can be tabulated for many local geographic areas. 2. Detailed cross-classifications often not subject to sampling error. (See footnote a in Table 1.5)	1. Need for separate estimates of population at risk. 2. Limited range and depth possible in the collection of data on classifying variables.

	3. If properly functioning, provides contemporaneous reporting for substantially all events regardless of household status. 4. Institutional continuity. 5. Well-suited for providing both long-term and short-term time series.	3. Relatively inflexible to changes in content and procedures. 4. Very difficult to administer and supervise (because extensive in both time and space). 5. Difficult to establish occurrence of events when births and deaths (or knowledge of them) are not associated with individuals who can serve as informants (for example, health workers or religious personnel).
Sample Surveys	1. Simultaneously obtains information related to enumerated events and population at risk (with the exception of surveys conducted as parts of dual-record systems). 2. Topical flexibility (that is, the depth and range of topics investigated can be altered relatively easily). 3. Conditions of observation are subject to control in a well-designed and administered survey because of the limited geographic scope of collection operations (that is, because a sample is employed). 4. Relatively easy to initiate given availability of a survey-taking infrastructure. 5. Can be useful for time-series analysis, given comparability in data collected.	1. Inability to produce estimates for local areas. 2. Detailed cross-classifications are subject to large sampling errors. 3. Information on "flow" variables (for example, income, births, deaths) and data from proxy respondents are subject to increased levels of response error. 4. Coverage for the nonhousehold population is very poor and it varies markedly for those who are not members of a primary family (for example, members of secondary families, secondary individuals, and distant relatives of the household head). 5. Comparisons over time of estimates based on different ad hoc surveys are subject to many uncertainties. 6. Requires close supervision of field work.

civil registration system, and any surveys used to provide demographic data should correspond with each other as closely as possible. In the context of fertility and mortality estimation, common, or at least compatible, approaches to age-group classifications, household and residence definitions, and urban/rural and other area classifications are particularly critical. Also important are the concepts and classifications used in connection with questions on family relationships, marital status, and children ever born and children surviving.

1.7 LONG VS. SHORT PLANNING HORIZONS

Although there is wide agreement with the view that population censuses, civil registration systems, and sample surveys are essentially complementary in nature, there is less agreement about appropriate strategies for improving national data collection efforts. In part, this disagreement springs from the varying priorities placed on the different possible uses of the fertility and mortality data. A user who wants annual assessments of fertility in specific sub-national areas is likely to place greater emphasis on improving the civil registration system than a user who wants general information on the level of fertility in the country as a whole, who may feel that improving survey capabilities are more important. Complicating this issue is the question of how much of the future (how many years) to take into account when considering proposals for improving data collection activities. We refer to this number of years as the planning horizon.

In deciding how to allocate the often scarce resources available for improving data collection activities, one inevitable trade-off to be made is whether to emphasize actions that will bring short-term benefits (such as a crash program of interviewer training that will improve the quality of sample surveys) or those that will result in benefits farther down the line (for example, investing in computer equipment for the census or earmarking a larger portion of the annual budget for expanding or strengthening the civil registration system). For all such decisions, the choice of planning horizon is crucial.

The planning-horizon issue arises most often in connection with decisions about devoting "substantial" resources to the improvement of civil registration systems. The issue is also relevant when deciding if resources should be spent on preserving some minimum level of census capability during the intercensal years (Stouffer, 1938) and on establishing a permanent organization to perform national surveys (United Nations, 1978b).

If the planning horizon being used is comparatively brief, resources for data collection are allocated almost solely on the basis of immediate needs for specific data. The benefits resulting from longer-term improvements in data collection operations are ignored or given low priority. Under such a view, heavy reliance is placed on ad hoc sample surveys to serve immediate data needs, and few resources are allocated to establishing a national survey organization or to improving the civil registration system. At times, this short-term view has also led to questions about the value of the population census.

Data users and planning officials who adopt longer planning horizons generally have more interest in allocating resources to long-term development of civil registration systems, periodic censuses, and a continuing national survey organization. They also may be more interested in funding methodological research, for example, research to determine which design options for enumeration and processing may be most appropriate in their country.

The length of planning horizons chosen depends on several factors: the importance attached to obtaining reliable data on time trends; concern with a range of data uses rather than a single use; realism, or lack thereof, about the time needed to plan and carry out statistical operations; awareness of the uses of fertility and mortality data and of the operations required to produce them; and views on the degree to which better statistics can contribute to better policy making, administration, or research. Clearly, users who place considerable emphasis on the need for time-series data on fertility and mortality (for example, Bean, 1978) or those who emphasize the contribution that better information can make to better decision-making and science (for example, Juster, 1974; Leontief, 1971; Rivlin, 1974) have little difficulty looking relatively far into the future in terms of data needs or the benefits that may accrue from current investments in improving the statistical capacity of a country.

As is the case with most demographic, social, and economic statistics, a brief planning horizon is unrealistic and counter-productive when making decisions about fertility and mortality statistics. A planning horizon of less than 3 to 5 years is unrealistic for any type of fertility and mortality measurement, including the measurement of levels, and longer planning horizons are needed to measure trends. This is so because almost all good ad hoc surveys that are national in scope take at least two years to plan and carry out and at least another year to analyze the results; many take considerably longer. For a multi-round program of surveys, the time frame is necessarily longer. The length of time required to plan, carry out, and analyze a population census is comparable (at least three years), and with respect to planning and preparatory activities it should be considerably longer. For a program of decennial censuses the planning horizon is at least ten years and a permanent organization is necessary. For all data collection methods it is essential to plan the whole process from beginning to end, including tabulation, processing, and analysis.

The relatively long lead time required to carry out even the "quick" ad hoc survey, if it is not to be too "dirty," is imposed by the need to carry out observations under controlled circumstances. The sample design, the segment maps or house listings provided the interviewers, the survey questionnaire, and the training and supervision of the interviewers and their immediate supervisors are all part of the effort of achieving controlled observations. Such procedures inevitably take time to develop and test, particularly if they are to be robust enough to function adequately in a measurement effort that is national in scope.

The long delay between a decision to collect data and the production of useful estimates is highly frustrating to users. But such delays are in part an inevitable consequence of allocating resources for statistical operations on the basis of a very brief planning horizon and the consequent emphasis on current consumption of statistics at the expense of capital improvements in the infrastructure required to produce them quickly and efficiently. The existence of a continuing organization equipped to conduct national sample surveys generally can shorten this three-year lead time and also provide the flexibility of being able to respond to data needs as they evolve. A well-functioning civil registration system can often provide basic fertility and mortality data with only a three- to six-month time lag. Of course, both these systems require a decision to make capital investments in statistical-production capabilities. In most countries, allocations for both activities can be justified in terms of a planning horizon of ten years, the interval between successive censuses in most countries (although some countries conduct or are planning to conduct quinquennial censuses, e.g., Korea, Turkey, and the Philippines). This means that current allocations of data collection resources should include investments that may not produce usable results until ten years later.

The existence of a permanent data collection organization does not guarantee that all data collection will proceed without problems and in a timely manner. One problem is that of bureaucratic degeneration: older institutions are inclined to slow down. In addition, queuing problems can develop: in a continuing program, processing of one survey may have to await completion of the one ahead in line, and traffic jams easily result. Sometimes CR/VS systems are several years behind in the publication of results because of such queuing problems, and there are instances of data from one census being published after the subsequent census has been taken.

1.8 COSTS OF DATA COLLECTION

1.8.1 Comparative Costs of Different Collection Methods

Relatively little has been written about the costs of data collection, although there are a few exceptions to this bleak generalization: for example, Eckler (1970), Louwes (1967), U.S. Bureau of the Census (1963), and National Academy of Sciences (1976). In the context of the collection of fertility and mortality data, most references to costs have been statements on the order of "Method A is cheaper than Method B for obtaining data, so Method A is preferable." As a rule, such statements have two main faults: first, the methods referred to in these comparisons, and hence the comparisons themselves, are not precisely defined; second, the statements are based on an impression of how much something costs and not on quantitative information on costs.

Such vagueness and lack of rigor concerning costs hamper the recording and analysis of information on costs of data collection and, ultimately, the proper use of this information in making policy choices concerning data collection programs. We can illustrate the problem of vagueness with a concrete example. Two common arguments in planning circles are these: "Population censuses are very expensive, so countries, particularly developing countries, should take sample surveys instead" and "Reasonably reliable estimates of fertility or mortality can be obtained at much lower cost by including a few Brass-type questions in a census or one-time sample survey than by carrying out a multi-round survey, using a dual-record system, or trying to improve the civil registration system." These statements contain elements of truth. However, they contribute as much to an intelligent understanding of the comparative costs and trade-offs involved in data collection as the statement "Automobiles are cheaper than trucks or buses, so one should buy an automobile" contributes to a better understanding of buying decisions in the transportation field.

Discussions of the comparative cost of several products have to be based on an appropriately precise description of the products involved, particularly those aspects of each product that relate to its intended use, and on a clear sense of how much precision one is willing to pay for. These basic points are sometimes disregarded. As discussed earlier, estimates of fertility and mortality levels and trends serve a wide variety of uses. Thus in any discussion of comparative costs there must be some effort to place the discussion in the context of a specific use or, more realistically, a range of uses. Because different uses require different levels of precision and place quite different technical demands on the data collection processes involved, taking uses into account will inevitably lead to a less simplistic view of any attempted costs comparisons.

1.8.2 Accounting for Costs of Different Elements of the Process

Another complicating factor in considering costs is the need to take into account the entire data collection process and not merely one or two elements of the process. The census, the civil registration system, and the sample survey should each be understood as a process or system; changes in one stage of the process often have far-reaching effects on other stages. In general, the greatest attention to costs has been given to those directly related to census or survey field work. However, sound decisions on data collection policies are best made after considering the cost of the entire collection process. This, in turn, means that the entire collection process--including planning, training, coding, tabulating, etc.--must be specified, not merely those activities related to the field work. (For examples of the specification required, see Louwes, 1967; Seltzer, 1972; and United Nations, 1978a: paras. 46 and 48.)

Furthermore, although the terms "census," "civil registration," and "sample survey" each refer to a reasonably well-defined process, there is considerable scope for variation within each category. (Automobiles and trucks differ from each other, but among automobiles a Bentley is quite different from a Datsun 210.) The importance of specifying aspects of the field work that have significant cost or quality implications is widely recognized, though not always acted upon, by survey statisticians. The significance of differences in the other aspects of censuses or surveys is less widely recognized.

Two examples may help illustrate these points. The first concerns user services for population census data. One country may decide to spend substantial funds to reorganize the census files in the form of a computerized data base. The existence of such a census data base may facilitate extensive and highly creative use of the results of the population census for policy and basic research purposes by enabling the census office to respond cheaply and quickly to a wide range of requests for ad hoc tabulations in the post-census period. Another country may not make this investment. As a result, it is substantially more expensive, more difficult, and more time-consuming for the second country's census office to respond to equivalent ad hoc requests. The cost of the field work for the two censuses in per capita terms may be roughly the same, but the additional costs and the additional benefits of the highly accessible computerized data base properly complicate efforts at facile cost comparisons.

The second example concerns large-scale surveys. It is probable that the cost of the World Fertility Survey (WFS) program, exclusive of second stage analysis, will total approximately U.S. $40 million by 1982. This amount includes funds spent on central office activities from the inception of the program in 1972 as well as funds spent in developing countries. The latter covers the money paid by external technical-cooperation agencies and an estimate of the survey costs paid by the participating developing countries. Assuming that approximately 40 developing countries will ultimately participate in the program, the average costs are likely to be about $1 million per country survey and between $200 and $250 per eligible woman sampled. A per-interview cost of this magnitude is high by traditional standards, particularly in the context of survey work in developing countries. (For several countries, some of the information can be obtained from a variety of surveys, such as the National Demographic Survey and other surveys in the Philippines.) However, this WFS per-interview cost is at least to some extent misleading since about half of total data files in about half of the countries contain household interviews that produce data useful for many other purposes besides fertility estimation. Furthermore, the WFS program has given high priority to quality control and to obtaining data of high quality in all countries in the program. Hence the following activities are all reflected in the total cost:

(a) High level of technical assistance.
(b) Insistence on pushing every survey through to completion, at any cost (with three exceptions in which there was a political decision by the country to stop the survey).
(c) Insistence on full data cleaning and production of standardized tapes.
(d) A variety of supporting activities, including regional conferences, national meetings, bringing national staff to London for training, and production of standard computer packages such as COCGEN and CLUSTERS.
(e) Investment in the countries' on-going survey capabilities through such activities as constructing the master sample in Egypt, creating the sampling frame in South Sudan, and providing in-country instruction in the use of COCENTS and CONCOR (see footnote on Figure 2.3; these are computer programs developed by the Centro Latinoamericano de Demografia [CELADE] and the U.S. Bureau of the Census).

In addition, there were expenses for the preparatory phase of the program, including the cost of developing the standard WFS core questionnaire and related subject-specific questionnaire modules. Hence, if the cost comparison of WFS with other surveys were limited to field work costs, it is likely that WFS field work would be on average only slightly costlier than other ad hoc fertility surveys.

It is worth noting that despite elaborate planning by the WFS, it has been difficult for the program to obtain information on actual, as opposed to budgeted, expenditures. Most countries simply take the budgeted money and place it into their government account. They then make the necessary expenditures--e.g., field workers' salaries--but no itemized accounts are kept. The government knows only that it paid all its employees each month, and the size of the total wage bill, perhaps by ministry.

1.8.3 Cost Allocation and Budgetary Practices

The census and WFS examples just cited also illustrate three other difficulties in assessing the cost of a particular census, survey, or civil registration program, or the cost-effectiveness of any specific data collection technique. First, it is often difficult to know how to allocate certain expenses among closely related census or survey programs. For example, certain continuing cartographic activities contribute significantly to both the quality of a decennial population census and to the quality and cost-effectiveness of intercensal household-survey programs used to generate fertility and mortality data. Similarly, it is often difficult to make a clear-cut allocation of expenses for a wide variety of user services among closely related census, survey, and vital statistics programs, particularly when they are carried out by the same agency of the government.

Second, there is wide variation in the comprehensiveness of census and survey budgets. In some cases this arises out of normal accounting practices. For example, census enumerators and supervisors may be hired and paid by local governmental authorities, so the cost of the field staff never appears in the national government's census budget. In other cases, the field staff may be school teachers or other government employees who are made available "at no cost" to the census authorities by another government ministry. A major cost item in a census is transportation. Frequently, army vehicles are utilized, and these costs are absorbed by the military rather than the census budget. Variations in comprehensiveness with respect to time also cause differences in census cost comparisons. Some countries may include in their census budget the cost of all preparatory activities for the census regardless how far in advance they occur; others begin the budget accounting an arbitrary four, three, or two years before the census.

In the United States, virtually the full cost of the census is born by the central government, though in some instances local governments supply free space or other services. In Germany, the system is much more complex. Local administrative areas and the cities are required to make significant contributions of personnel. In return, they receive contributions from the central government, which covers a large share of the total cost. In some countries, employees at various levels of the government are required to perform service in connection with the census and may or may not receive some bonus for that work. For example, in Puerto Rico in 1970, elementary school teachers were required to perform a month's public service in addition to their teaching responsibilities, and they could satisfy this requirement by working on the census.

However, it is unrealistic to assume that such contributions of personal services are cost-free. Experience in the United States indicates that enumerators and other workers who are contributed by a local government may require much more intensive training and supervision than is the case with persons recruited in the usual way. Furthermore, teachers, students, and other occasional personnel may all stop enumerating at a preassigned date whether their assignments have been completed or not. However, in a country in which the teachers are the only adults in a local village who can be presumed to be able to read and write, there may be little choice about local enumerators.

Similar kinds of problems arise in the case of survey programs and civil registration systems. Surveys make use of a range of infrastructure services; if these services are charged to a single survey or amortized over a relatively short period, the cost of the survey will seem high. If these infrastructure costs are ignored or are properly amortizable over a long period, the cost of the survey will, other things equal, seem low. Because civil registration systems have both a legal and statistical function and because they are often carried out as a minor part of other administrative activities on a highly decentralized basis, almost no information exists concerning the costs of obtaining vital statistics from national civil registration systems.

Third, cost comparisons are often greatly affected by whether or not the cost of large one-time capital expenditures are charged to the statistical budget in question. The issue arises most frequently in the case of a population census for which new data-processing equipment or a new software system is being acquired. Such acquisitions are often justified on the basis of their use in processing the population census data and are charged to the census budget. In countries that have upgraded their data-processing capability for other reasons--for example, in connection with the census of agriculture--the capital expenditures charged to the population census are nominal.

1.8.4 The Prospects for Improved Cost Analysis

Many of the issues of product specification and costing discussed here in the context of demographic data collection are only particular instances of more general issues that are widely encountered by economists and managers: the proper allocation of costs to current and capital improvement accounts, the proper allocation of common expenses to specific product lines, the treatment of costs incurred over a period of rapid inflation, the drawbacks of using exchange rates in international comparisons of costs for products that do not enter into international trade, and the special problems of cost accounting that arise in most public-sector activities.

There is no right way to resolve these issues. As with demographic statistics, fiscal data may be best handled in one way for one purpose and in another way for another purpose. Nevertheless, the development of costing conventions that would help in resolving these issues would be as helpful to those who administer statistical programs as the existence of similar accounting conventions is to managers of automobile manufacturers or oil companies.

Some of the obstacles to the collection and analysis of meaningful cost data can be overcome by concentrating first on comparing the resources used in censuses, surveys, and civil registration systems rather than the budgets or expenditures for these programs. For example, such resources can be measured in terms of how many person-hours of enumerators were needed for the census or survey, how many computer hours were required to process the data, how many square meters of office space were required for the staff, how many person-months of supervising and professional staff were required, etc. Such an approach does not, however, overcome problems related to vague specifications nor does it resolve the question of how to allocate common resources among specific programs.

As yet, there are no generally recognized conventions for assessing the costs of data collection and other statistical activities. Although the Statistical Office of the United Nations, with financial support from the U.N. Fund for Population Activities, is now undertaking a study of the cost and staffing requirements of population censuses, it is likely that a considerable period of experimentation will be needed before useful conventions can be developed and agreed upon, even in the relatively simple case of the population census. In the meantime, it is all the more important that persons and groups recording, reporting on, and discussing comparative cost data state clearly how they are resolving these issues, specify as completely as possible the entities they are comparing, and place any discussion of costs in the context of the benefits received relative to an appropriate range of uses.

Table 1.7 is an attempt to list some of the factors affecting the costs of the three major data collection systems. For clarity, the factors are grouped under three broad headings: (A) factors related to the population of the country and the circumstances in which the population lives; (B) factors related to the collection method itself; and (C) factors related to the accounting or budgetary practices employed.

Type A factors arise out of the geographic, demographic, political, cultural, economic, or social circumstances of each country; they represent the constraints under which any national statistical operation must operate. Although they are givens for any one-time collection effort, Type A factors may change over time. Type B factors are, at least in theory, under the control of those directing the data collection program. In fact, however, planners seldom have full discretion on decisions relating to these factors. Type C factors, as noted above, are often critical determinants of how expensive a method appears to be relative to other options, because they define the measuring sticks that are used in calculating costs. As with any classification system, difficulties arise in drawing the boundaries between categories. For example, should a high rate of inflation be considered a Type A factor or Type C? It is clear, nevertheless, that each of the three types of factors can have a significant upward or downward effect on the apparent cost of a census or survey.

It should be stressed that Table 1.7 speculates only on the likely impact of each factor taken one at a time; that is, the direction of the relationship indicated between each factor and overall costs assumes that all other aspects of the collection process (for example, quality and timeliness) are held constant. Furthermore, the table says nothing about the relative importance of any given factor compared to other factors. In practice, the importance of individual factors is determined partly by the impact of other factors and partly by how those administering the program decide to handle the trade-offs between cost on the one hand and quality, timeliness, and detail on the other. Another limitation of the table is that it omits the question of governmental structure, which has a major effect on how a data collection effort operates and how resources are allocated. In countries with highly centralized governments, the data collection operations are the responsibility of one or two units in the central government, while in other countries decentralized government units have major data collection responsibilities. For example, in the United States, the states are responsible for collecting information on vital events and for determining what data to collect.

1.8.5 Cost Efficiency of Long-Range Planning and Funding Support

Finally, bilateral and international aid agencies frequently have taken a short-term view regarding the financing of data collection activities. These agencies, partly for budgetary reasons of their own, are more willing to fund specific, short-term projects than longer-term development of statistical and data collection organizations. The development of CR/VS

TABLE 1.7 Likely Relationship Between the Costs of the Data Collection Systems and Specific Determining Factors

	Direction of Gross Relationship to System Costs[a]		
Determining Factor	Census	Survey	Civil Registration
A. Factors Related to the Population and Its General Circumstances			
1. Size of country	Direct	Direct	Direct
2. Population size	Direct[b]	N.A.[c]	Direct
3. Average household size	Inverse[d]	Inverse[d]	N.A.
4. Proportion of population living in primary families	Inverse	Inverse	N.A.
5. Heterogeneity of population with respect to languages spoken, cultural patterns, etc.	Direct	Direct	Direct
6. Extent to which "natural population clusters are homogeneous with respect to fertility and mortality	N.A.	Direct	N.A.
7. Level of literacy	Inverse	Inverse	Inverse
8. Proportion of population living in large cities	Direct	Direct	Inverse
9. Proportion of population living in small towns or compact and well-bounded villages	Inverse	Inverse	Direct
10. Proportion of population living in scattered and isolated housing units	Direct	Direct	Direct
11. Proportion of households with a telephone	Inverse	Inverse	N.A.
12. Proportion of population who present special problems during enumeration/interviewing/registration	Direct	Direct	Direct

13. Proportion of population away from their usual place of residence at the time of the data collection effort	Direct	Direct	N.A.
14. General level of administration development[e]	Inverse	Inverse	Inverse
15. General level of wage rates for those with at least a primary education (the potential pool for staffing the system)[f]	Direct	Direct	Direct
B. Factors Related to the Data Collection System Itself			
1. Existence of continuing census or sample survey	Inverse[g]	Inverse[h]	N.A.
2. Extent to which cartographic preparations have to begin de novo	Direct	Direct	N.A.
3. Extent of cartographic preparations required	Direct[i]	Direct	N.A.
4. Extent to which special house-listing operations are required	Direct	Direct	N.A.
5. Number of separate schedules, questionnaires, or forms used by the interviewer or registrar	Direct[j]	Direct[j]	Direct
6. Total number of questionnaire items	Direct[k]	Direct[k]	Direct
7. Extent to which sample frame has be be constructed de novo	N.A.	Direct	N.A.
8. Existence of permanent field organization	Direct[l]	Direct[m]	N.A.
9. Extent to which infrastructure has to be established specifically for the data collection system	Direct	Direct	Direct
10. Number of primary sampling units (PSUs)	N.A.	Direct[n]	N.A.
11. Average size of PSUs	N.A.	Direct[o]	N.A.
12. Total size of sample	N.A.	Direct	N.A.
13. Proportion of questionnaire items precoded	Inverse	Inverse	Inverse

TABLE 1.7 (continued)

Determining Factor	Direction of Gross Relationship to System Costs[a]		
	Census	Survey	Civil Registration
14. Extent to which self-enumeration method is employed	Inverse	Inverse	N.A.
15. Extent to which proxy interviews are accepted	Inverse	Inverse	Inverse
16. Extent to which interviews/follow-ups are done by telephone	Inverse	Inverse	N.A.
17. Number of call-backs specified	Direct	Direct	N.A.
18. Extent of training and supervision provided	Direct[p]	Direct[p]	Direct
19. Extent of traveling required	Direct	Direct	N.A.
20. Ratio of interviews to interviewers (daily average)	Inverse	Inverse	N.A.
21. Extent to which special procedures to improve coverage or quality are employed	Direct	Direct	Direct
22. Extent to which the public, or important population subgroups, are fearful or apprehensive about the data collection method or the information to be collected	Direct	Direct	Direct
23. Level of detail sought in responses	Direct	Direct	Direct
24. Use of fertility-history approach	Direct[q]	Direct[q]	N.A.
25. Number and detail of tabulations run	Direct[r]	Direct[r]	Direct
26. Number and volume of reports published	Direct	Direct	Direct

27. Extent of user services provided	Direct	Direct	Direct
28. Extent to which sampling is employed at the collection stage	Inverse	N.A.	N.A.
29. Extent to which automatic data-capture methods are used (e.g., FOSDIC, OCR, OMR; see Figure 2.3)	Unknown[s]	Unknown[s]	Unknown[s]
C. Factors Related to Accounting and Budget Practices (how costs are calculated and reported)			
1. Comprehensiveness of cost accounting procedures	Direct[t]	Direct[t]	Direct
2. Extent to which common infrastructure expenses are charged to the system's budget	Direct	Direct	Direct
3. Extent to which the system makes use of uncosted ("free") resources[u]	Inverse	Inverse	Inverse
4. Extent to which large, one-time capital expenditures are charged to the system's budget[v]	Direct	Direct	Direct
5. Rate of inflation during census or survey period	Varies[w]	Varies[w]	N.A.

Note: N.A. means not applicable.

[a]The total cost of any data collection system is a result of the joint impact of all the specified factors plus any unspecified factors that may also affect costs. The direction of the gross relationship indicated assumes that other factors (for example, quality and timeliness) are held constant.

[b]Aggregate costs tend to vary directly with population size. However, costs expressed on a per-capita or per-household basis tend to be relatively high for countries with very small populations.

[c]Although at the gross level costs are determined by the size and nature of the sample rather than the absolute size of the population, it is also true that in a larger population there may be greater interest in separate estimates for regions and other factors that relate population size to costs, e.g. distances to be traveled.

TABLE 1.7 (continued)

[d]Lower average household size implies more one- and two-person households; persons in such households generally are more difficult to locate, e.g. they are away from home more frequently, they may be more relutant to provide information, and they report on behalf of fewer people, which means that more questionnaires or forms must be filled out and processed per capita.

[e]Includes the comprehensiveness and efficiency of the transportation and communications systems as well as quality of address information.

[f]Includes the price and wage and salary system of the country.

[g]The absence of a continuing census organization (core staff and operations) during the intercensal period may tend to increase costs for many items at the time of the next census, especially the cost of trained senior staff, who may not be available (which can lead to quality problems). Also, the complete processing and tabulation of data from one census usually takes a number of years, and planning for the next census must start some years in advance of the census. Thus there is usually plenty of work for a core census staff during the intercensal period.

[h]Any saving from the existence of a sample survey organization depends on how intensively the organization is used.

[i]For example, if each enumerator is provided with a map of his or her individual enumeration area.

[j]In a general sense, the relationship is direct. However, if the total number of questions is not increased but simply divided among several shorter questionnaire forms, the cost may not increase, and it could actually decrease if there are subsequent savings at processing stages. Also, the direction of the relationship is affected by whether the separate questionnaires are used with different respondents in the household: if an interviewer must seek and interview an additional respondent for one of the questionnaires, the cost will increase.

[k]Although the marginal cost of adding any one precoded item is usually low, the cumulative impact of adding several items can be substantial. Moreover, the low marginal cost is often achieved by not altering the census or survey plan to take into account the added items. This, in turn, may result in trade-offs in terms of census coverage, the quality of responses obtained for other items, and respondent burden.

[l]The direction of the gross relationship between the existence of a permanent field organization and census costs is direct. However, the advantages (in terms of quality of personnel, the collection of intercensal data, etc.) should be considered.

[m]The direction of the gross relationship between the existence of an overall field organization to conduct surveys and survey cost is inverse. However, if only field workers are considered, the direction of the relationship will depend on the intensity of their use. In general, the need for salary payments between surveys and fringe benefits required for permanent government staff will outweigh savings on recruitment and training. However, other factors must be considered, including skill levels of available short-term personnel, the extent to which field staff can be used for coding and data processing activities, and the general level of government salaries.

[n]This assumes that the sampling error for the system remains constant; therefore, the relationship is between the number of PSUs and the cost for a given sampling error. In an ideal sample the number of PSUs is (in conjunction with cluster size) at an optimum, so that either an increase or a decrease in the number of PSUs will increase the cost for a given sampling error. See also footnote o.

[o]This assumes that work load considerations remain constant. However, frequently work load considerations are not constant as the number and average size of PSUs change, and these work load considerations can affect costs, e.g., travel time, number of interviews completed in a day, size of team than can be transported in available vehicles.

[p]The additional costs of more training and supervision may be partially offset by reduced costs at the processing stages. However, the principal gains achieved through more extensive training and supervision are likely to be improved coverage (in a census) and improved quality generally.

[q]Fertility histories are almost never used in a census, except in small samples within a census. In surveys the impact on costs is high at both the collection and the processing stages.

[r]As the cost of computing and programming time declines, this factor becomes less important.

[s]Too little evidence exists at this time to assess the impact.

[t]Particularly, the extent to which preparatory activities in the early stages of the census and other activities beyond the direct costs of the field work are covered by the census or survey budget.

[u]For example, the use of government-employed primary school teachers as enumerators, interviewers, or supervisors with either no or only modest supplementary payments for their activities.

[v]For example, the cost of a new computer or data-capture equipment.

[w]If a very high rate of inflation prevails, expenditures related to activities in the latter stages of the census or survey (for example, data processing) will be unduly high compared to those for activities in the earlier stages (for examplé, cartographic preparations) unless expenditures are expressed in real terms.

systems suffers in particular from this short-term approach. While any given project provides experience for the persons carrying it out, the project-to-project approach that exists in many countries is not the best way ultimately to develop a comprehensive data-collection capability.

Officials in LDCs are sometimes criticized for having short-term planning horizons for data collection. However, planners and other officials in LDCs usually are keenly aware of what activities are and are not likely to attract attention and funding from multilateral and bilateral aid agencies. They observe that shorter-term projects get funded more readily than longer-term development activities, and this naturally influences the direction of their efforts.

If this short-term approach is to be overcome, bilateral and multi-lateral aid organizations must encourage and provide funding for the long-range development of data collection personnel and facilities for use in censuses, CR/VS systems, and surveys. In effect, funding agencies should be willing to adopt and apply a long-term planning horizon in their own aid programs for demographic data collection.

1.9 SUMMARY

The major conclusion of this overview of data collection methods can be stated briefly: There is no one best source for obtaining fertility and mortality data and no one best design for applying any given data collection method. For this reason, if all users with important needs for fertility and mortality data are to be effectively served, attention and resources must be directed to a balanced program of upgrading census, registration, and survey capabilities and activities within developing countries. This balanced program will vary among countries because priorities, time constraints on data needs, and planning horizons differ.

Several general themes run through this chapter, and through the entire report. First, rational, effective, and efficient policy-making and program administration are enhanced by timely, reliable, and appropriate data. In those few cases where it has been possible to estimate in monetary terms the benefits associated with improved measurement, comparatively expensive collection activities appeared to be a bargain (Hayami and Peterson, 1972; Savage, 1975). However, in most situations the diversity and volume of primary, secondary, and tertiary uses of census, survey, or registration data, and their use either alone or jointly with other data sets, do not permit any simple valuing of the benefits received. Also, the emphasis given at various times to the development of various data collection systems will depend in part on the existing ability of those systems to produce usable data. An informative discussion and bibliography appear in the NAS report Setting Statistical Priorities (National Academy of Sciences, 1976).

Second, although common sense should never be abandoned, there are a variety of technical issues involved in data collecting that must be taken into account fully when assessing collection plans and results. For many sampling problems the issues are more complex than common sense might suggest, and the resolution of these issues leads to unexpected consequences. For example, the sampling fraction in a population is less significant than the absolute size of the sample, except in cases where the sampling fraction is exceptionally high.

Third, all data collection activities are affected by errors that can and do occur at every stage of the collection process--during the design, field work, coding, editing, tabulation, estimation, and dissemination. Although random errors tend to cancel each other out, errors of bias do not necessarily tend to cancel each other (although undoubtedly there are cases where opposing biases lead to some canceling out).

Fourth, the possibility that errors of various types and magnitudes exist in some body of data does not render such data useless; it does, however, impose a responsibility on the producer of a given set of data to provide as much information as possible about the type and size of errors affecting it. The user of such data has a responsibility also: the limitations provided by the producer must be observed, and the quality of the data must be examined in light of the specific use to which it will be put.

Fifth, it is possible and important to reduce to acceptable levels errors in data used to measure fertility and mortality. The first step is to identify the causes and extent of errors; that is one purpose of this report. It is equally important to take action to reduce error to acceptable levels; frequently, but not always, appropriate actions are obvious from the knowledge about the source and type of error.

Sixth, a theme closely related to all of the above is that data quality is important and it can and should be improved. Data quality depends on both design and execution, probably more on the latter. The problem of execution, essentially the problem of effective management, is crucial to the attainment of high quality in statistical data collection. The lack of careful execution of data collection activities is one reason why money often fails to buy quality in demographic-measurement projects in developing countries.

Seventh, statistics are not a free commodity. The resources needed to maintain and improve data collection activities in developing countries may be substantial and as further demands are placed on the data in terms of detail, timeliness, and accuracy, the resources required also increase. By resources we mean primarily, but not exclusively, money. This includes money for the salaries of the staff (e.g., demographers and statisticians, field workers, clerical personnel), money for the purchase or rental of equipment (e.g., computers, duplicators, automobiles, typewriters), money for space, for supplies, and so on. Although such efforts are rarely cheap in absolute terms, the costs involved can reasonably be expected to be small in comparison to the cost of incorrect decisions made on the basis of unreliable data or in the absence of any data.

Establishing data collection operations that are national in coverage, or even making major efforts to upgrade such operations, also takes time. In addition, such operations require experienced and skilled personnel in a variety of disciplines, including, for example, biostatistics, cartography, data processing, demography, management of field operations, sampling, statistical administration. While to some extent money can "buy" time and needed personnel, the extent to which this is possible is often overestimated. In general, there is a direct relationship between the levels of socioeconomic development in countries and their ability to implement and maintain civil registration systems that register most vital events, although there are examples of poor countries with good CR/VS systems, e.g., Egypt and Tunisia.

Eighth, rational thinking about data collection essentially consists of examining a series of interrelated trade-offs about methods and procedures in light of both the uses to which the data will be put and the resources required to implement the methods and procedures. In the present context, one of the most important functions that statisticians can perform is to help users of fertility and mortality data become more knowledgeable about the trade-offs involved in collecting these statistics and to assist in the process of identifying and quantifying these trade-offs.

Finally, closely linked with trade-offs is the concept of the substitutability of data collection procedures. In some cases and for some purposes it is possible to substitute one data-collection process for another. One example is adding to the census questions on children ever born and children surviving in order to generate data that allow fertility and child mortality to be estimated using indirect estimation techniques, instead of conducting a special survey. This is possible provided, in this example, that there is prior knowledge concerning the adequacy of data generated by these questions, and that the assumptions of the indirect techniques to be applied are met. However, there are cases when user needs preclude substitution. For example, surveys usually cannot provide local area data; only censuses and vital registration systems can do so, and even in those systems special tabulation procedures frequently are required. Hence, substitution is worth considering, particularly in the context of advance planning and resource allocation, but its limitations should be recognized.

The next three chapters of this report describe the current state of the art in collecting data for the estimation of levels and trends of fertility and mortality. The emphasis is on how one identifies problems, successes, errors, lacunae, and so on, and on issues such as complementarity of data collection systems, costs, and trade-offs in design, execution, and long-range planning. This report does not, however, present a systematic set of recommendations on how to improve the collection of data for estimating fertility and mortality. A brief summary statement for administrators and policy makers interested in these matters is contained in a companion report by the Panel, Data Collection: A Statement for Administrators (National Research Council, 1981). A more technical treatment of some of the latest advances in the estimation of fertility and mortality is provided by another Committee publication, Indirect Techniques for Demographic Estimation (Hill et al., 1981).

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2 The Census of Population

2.1 INTRODUCTION

This chapter reviews the state of the art of censuses of population with specific attention to the collection and use of census data for estimating fertility and mortality. It includes ten sections: definitions and the background of census-taking, census procedures and special problems, advantages and limitations of censuses as a data collection method; special relationships between censuses and sampling; the status of censuses in developing nations; measuring error in census data; using censuses to gather data on fertility and mortality, design issues and options; and a summary.

2.2 DEFINITIONS AND BACKGROUND

The United Nations (1980:2) defines a population census as the total process of collecting, compiling, evaluating, analyzing, and publishing or otherwise disseminating demographic, economic, and social data pertaining to all persons in a country or in a well-delimited part of a country at a specified time. A housing census is the comparable process relating to all living quarters and occupants thereof (see United Nations, 1980). Most modern censuses are combined censuses of population and housing.

In some countries the government compiles a list of villages, with counts of housing units and the number of persons in each unit. Such lists usually are designed to meet specific administrative purposes, including the collection of taxes. They should not be confused with population censuses, which seek information concerning each individual in the specified area. Most countries have adopted the principle that information collected in the census should be used only for statistical purposes. These purposes may include the adoption of policies and programs that affect the rights, duties, or obligations of the population (including the respondents). However, the information supplied by the individual is not to be used to take action on that individual.

A census strives for completeness of coverage within defined boundaries. In principle, the data are collected at the same point in time, though the period of enumeration may in fact extend over some weeks or months. Current practice calls for the listing of each individual and for the provision of information about each, although in some cases the amount of information collected on each individual is very small; for example, the 1953 census in the People's Republic of China asked only name, age, sex, and nationality. Data collection efforts that produce only totals for a household, a village, or some other group of individuals are no longer considered adequate for the purposes for which a census is taken.

In principle, a census relates to a specific time unit: a day, a week, or some other period. However, many censuses also call for information relating to some time in the past; questions about births or deaths during the preceding year, or occupation during the preceding week, month, or year are frequently included. A longer time reference underlies questions on numbers of children ever born and surviving and questions about migration, during a fixed or indefinite period.

When governments wish to know how many people there are, how they are distributed over the national territory, how many there are in particular categories (such as men of military age or children of school age) and whether or not the population is growing, they turn to a census for the information. A count of the people has long been one of the early steps in any program of development, and newly established nations have turned to censuses as one of the first steps in their development programs. By 1980, only Ethiopia and a few smaller countries had not taken at least one census, and the great majority of countries and an even larger proportion of the world's population live in countries where more than one census has been carried out. A number of countries have had censuses at fairly regular intervals for a century or more.

Although a census is in effect a snapshot of a population at a given point in time, it also provides a basis for inferences concerning past and future changes. Comparison of censuses taken at different times provides information concerning growth or decline of the total population and of groups of people, as well as changes in sub-areas within the country. Analysis of the data can throw important light on changes that have taken place and also provide a basis for projections of future changes.

The importance of censuses for national and international programs has long been recognized. In the latter half of the nineteenth century, the International Statistical Institute undertook to develop standards and guidelines for census taking and to ensure a measure of comparability from one national census to another. An early activity of the United Nations was the promotion of census taking by member countries. Since the 1940s the Interamerican Statistical Institute has actively promoted the taking of censuses in the western hemisphere, developing standards and providing technical assistance. Regional offices established by the United Nations have made substantial efforts to support censuses in their regions. More recently, there have been significant international efforts to stimulate the conduct of censuses, especially in Africa, where a number of countries had not previously taken any census of population. It is anticipated that by 1985 there will be virtually no countries in the world that have not had at least one census.

2.3 PROCEDURES AND PROBLEMS IN CENSUS TAKING

The major purpose of most censuses is to establish how many people are residing within a defined area as of a stated time. The number of persons in a given sub-area may be established on the basis of actual physical presence (de facto) or on the basis of a legal or customary attachment to the area (de jure). In practice it may be difficult to adhere rigorously to either concept, and many censuses in fact represent a compromise between the two. Military personnel, migratory workers, guest workers, interns, university students, and in some countries secondary school students, nomads, and visitors are some of the individuals for whom special provisions must be made.

A person's eligibility for inclusion in a census may vary from one country to another. Although normally a census is totally inclusive, there are instances in which certain categories of people are omitted. These might be non-citizens who are presumed to be temporary residents, or they might be nomadic peoples or other groups that are especially difficult to enumerate. There is considerable variation in practice regarding domestic or foreign military personnel; sometimes censuses omit them entirely. Analysts of census data need to pay special attention to the criteria for inclusion in the count which were applied to the census in question.

Some of the most difficult problems in demographic measurement, which arise in CR/VS (civil registration or vital statistics) systems and surveys as well as in censuses, are the problems associated with the determination of residence and migration, especially internal migration. Even when counting and classification rules are clear and respondents understand such concepts as "usual resident," "visitor," "temporarily absent," "intent to stay," and "duration of stay," application of the rules can be a complex process, leading to undercounts and overcounts in censuses, failure to register vital events or, in rare cases, double registration, and to improper inclusion or exclusion of respondents in surveys.

Another decision that must be made in planning a census is whether to contact respondents directly (normally by having enumerators visit households) or to ask respondents to fill in forms themselves and return them to the census office. The latter approach is feasible only for countries in which literacy levels are reasonably high and in almost all cases must be supplemented by personal visits for missing and incomplete forms. The first approach involves direct personal reporting by the respondent (or respondents, if more than one person is providing information to the census interviewer) as well as indirect or proxy reporting on other members of the household. In general, direct reporting provides more accurate and complete information than proxy reporting (Hobcraft, 1980; Marckwardt, 1973; Tuygan and Cavdar, 1975; Madigan, 1973; Madigan and Herrin, 1973). With proxy reporting, however, costs are reduced, and there are fewer refusals because respondents tend to be the more cooperative members of households.

Combinations of the two reporting modes are commonly used in developed nations; personal visits to householders who may require assistance in filling out the form and follow-up visits to nonrespondents are essential elements in any census that relies primarily on census returns provided by householders. Most developing nations use the direct-contact method, which has the advantage of allowing the enumerator to verify the existence of the household being enumerated and often also the members of the household. It does not solve all data collection problems, however, since enumerators often need to probe for correct or additional information. Moreover, in many developing nations crucial items, especially those needed to estimate of fertility and mortality, are not known with precision, and errors by both enumerators and respondents occur.

Age is one such item. In some developing societies, such as Korea and Thailand, individuals know their birth dates and ages with considerable accuracy, while in many others, such as many countries of Africa and South Asia, age is known only within rather broad ranges. In the latter situations attempting to produce reasonable estimates of age can be a very frustrating experience for both the census enumerator and the respondent. In a technical sense, there is much room for interviewer and respondent bias and for interviewer and respondent error. In two countries, Morocco and Gambia, some census interviews were tape-recorded to study the sources of error in age reports (Quandt, 1973; Gibril, 1979). Morocco and Gambia are among the very few countries that have undertaken serious efforts to ascertain the reasons for and the ways in which age misreporting occurs, with the goal of improving the enumeration process in subsequent censuses. One finding in these and other studies is that ages for an entire household are frequently reported by a single individual who may not be in a good position to estimate all of the ages. Studies of the use of historical calendars, an interviewing tool designed to improve the accuracy of age reporting, indicate that this technique does not improve reporting significantly, even when interviewers bother to use it properly. A more complete review of the sources of age misreporting and the significance of it for data analysis is found in a study by Ewbank (1981).

Experience indicates that the most reliable way of conducting a census in most circumstances is to seek contact with the population at their places of residence. Requiring that people come to some central point to report the census information places additional burdens on them and is likely to lead to incompleteness. Special circumstances pertain in the case of nomads who have no fixed place of residence; the usual practice is to require them to assemble at some fixed point in their normal path of movement. The central-point method also causes particular problems for demographic surveys that use the census for local area data, or as a sampling frame, because it makes it difficult to identify the particular geographic location of each household, information needed for areal sampling. If a demographic survey sample is drawn by randomly selecting households from a census list obtained through central-point interviewing, the households selected usually will not be located near to one another, resulting in a very scattered sample. Also, such samples frequently are not up-to-date. A third method is to require all persons to remain all day long at home or wherever they happen to be (e.g., their workplace, a school, a bus station) on a day designated as "census day." Jordan and Turkey have used this method.

2.4 ADVANTAGES AND LIMITATIONS

Although the complete coverage provided by a census is an advantage in general, its corollary limit on the amount of detailed information that can be collected on each individual or household is a drawback for the purposes of collecting fertility and mortality data. The questions asked in censuses are necessarily limited in scope because of money costs and burden on the respondents, and because each additional question means much more data to process, even if sampling is utilized. Nevertheless, most censuses provide a great deal of information that can be used in estimating fertility and mortality.

As noted earlier, periodic censuses provide a basis for measuring changes in the total number, geographic distribution, and other characteristics of the population. In addition, censuses provide the essential denominator information needed to calculate crude birth and death rates and age-specific rates in countries where the civil registration/vital statistics systems can to provide the numerator information either directly or after adjustments for incomplete registration.

Even when only one census is available, significant information about fertility can be extracted from it. Size of household, the relationship of the number of young children to the number of women of childbearing age, and the relative size of age cohorts provide clues to the past as well as to the future. Information about the relationship of each child to the head of the household can serve as the basis for fertility estimates derived using the "own children" method of indirect estimation (see Cho, 1973; Hill et al., 1981).

Recent changes in fertility can be discerned from the age structure revealed by a census if the age distribution is available for single years, if age misreporting is not a major factor or the age distribution can be reasonably adjusted, and if reasonable assumptions can be made about mortality patterns. Figure 2.1 shows the age structure for the 1973 census in Colombia, by five-year age groups. The single-year distribution is available; five-year groups are used here for simplicity. Note that the number of children aged 0 to 4 is less than the number aged 5 to 9, suggesting declining fertility. This suggestion of declining fertility requires an assumption that the extent of underreporting in the 0-4 age group is not severe.

Additional information on fertility is gained if census data include proportions married and duration of marriage. Another item useful in fertility analysis is the parity of the mothers of children born during the 12 months before the census.

More accurate estimates of both fertility and mortality--including age-specific fertility rates and estimates of the probability of dying by exact ages 2, 3, and 5--can be made from one census if data on children ever born and children surviving have been collected. This is possible even in situations where fertility and mortality are changing. (See Section 2.9 below and Appendix B.)

Successive population censuses can provide a good basis for estimating mortality as long as the population has not been subject to much migration or if such migration can be estimated with reasonable accuracy. By comparing the number of people in each age group present at one census with the number present at a subsequent census, one can calculate the survivorship rate of each age cohort alive at the first census. Before attempting such calculations, however, the data frequently must be adjusted to compensate for the effects of differential age misreporting across age groups.

Some censuses (and surveys) have included questions on the number of deaths in the household during a recent

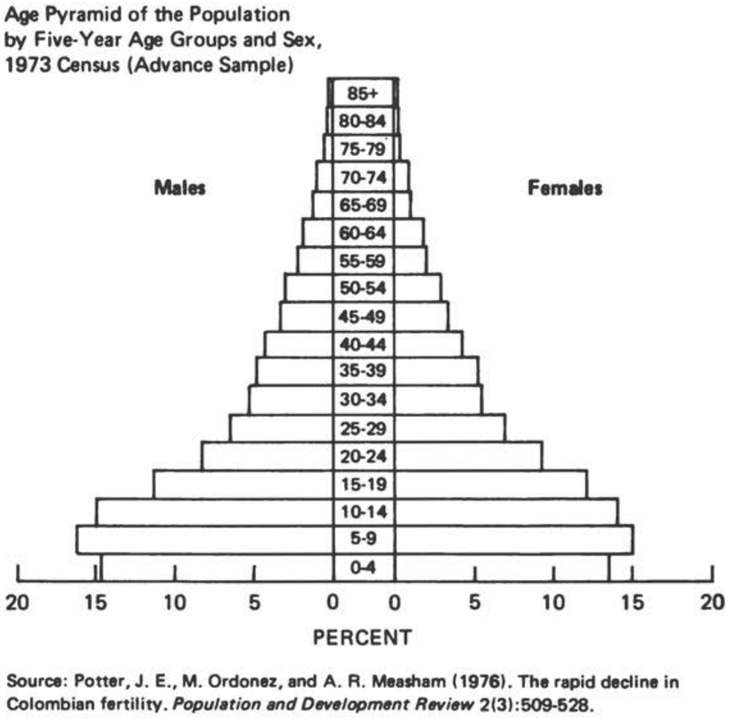

FIGURE 2.1 Age Structure of Colombia, 1973

period or on whether the respondent's mother or father or (in the case of surveys) first spouse, is still living. In conjunction with information on age, responses to such questions on orphanhood and widowhood permit adult mortality levels to be estimated indirectly, using techniques developed in recent years (Brass and Hill, 1973; Hill and Trussell, 1977; Hill et al., 1981).

2.5 RELATIONSHIPS BETWEEN CENSUSES AND SAMPLING

As noted in Chapter 1, each of the major data collection methods has relative advantages over the others. By using censuses and sample surveys in combination, one can capitalize on the strengths of both methods. A census, by definition, strives for complete coverage of the population within the defined territory, which means that it can provide data for each of the subdivisions within the country. If only national figures are desired, a properly selected and well controlled sample survey may be adequate for the purpose in hand; surveys carried out with sufficiently large samples can provide regional estimates (see Chapter 4). Such surveys, however, should not be confused with full-scale censuses, nor with samples that are designed specifically to be used in conjunction with censuses.

Samples connected with censuses differ from other samples because of their double roots. They share methods with other samples, but their connection with censuses gives them special functions and special advantages in terms of funds and resources. For one thing, they are usually larger than samples not connected with censuses and often are large enough to produce statistics for moderately small areas. However, they also share the inflexibilities of censuses in timing and content. The four basic ways that samples and sampling techniques are used with censuses are shown in Figure 2.2, which also lists the primary purposes of each approach.

2.5.1 Samples Built into Censuses

Probably the most closely interrelated use of samples and censuses is the case of samples that are built in to a census: a sample of the census population responds to a set of special questions in addition to those on the standard census schedule. In censuses, each question is expensive because it is asked for every member of the population or for every household. Hence, census questionnaires are generally kept brief and simple (precoded or easily coded items) to save costs of collection, processing, and tabulation and to reduce the burden they place on respondents. However, more diverse and richer data are increasingly being obtained with samples built in to the census. The size of these "built-in" samples usually ranges from 1 percent to 25 percent of the census population. In most cases the absolute size of the sample and how it is selected are more important than the sampling fraction. Often the sample questionnaire contains the regular questions of the census and the special questions, so that a single visit to each unit suffices.

One of the primary advantages of built-in samples is that they generally include more persons than could be

FIGURE 2.2 The Purposes Served by Associating Samples with Censuses

1. Samples Built into Censuses
   a. Obtaining richer data
   b. Reducing costs of collection and tabulation
   c. Reducing social burden (longer interviews required only from a small part of the population)

2. Samples Added to Censuses
   a. Evaluating quality of census data
   b. Checking coverage of census
   c. Obtaining dual coverage
   d. Establishing a base for continuing sample surveys
   e. Providing quality control of individual enumerators
   f. Investigating methods and questions prior to the census (pretesting)

3. Sampling from Census Data
   a. Early tabulation and release of data (preliminary results)
   b. Checking quality of editing and processing
   c. Reducing costs of complex analysis
   d. Generating public-use tapes for deeper analysis

4. Census as Auxiliary Data for Samples
   a. Providing data for sample selection (e.g., measures of size, stratification, mapping, and seldom names or addresses)
   b. Providing data for improved estimation (ratio, regression, analysis, etc.)

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included in independent sample surveys. The larger sample size facilitates analysis of differences within the country, such as those among regions, between rural and urban residents, or among persons in different occupational or other socioeconomic groups.

Another advantage of built-in samples is that they facilitate more detailed analysis. Relating information about fertility collected from a built-in sample to some of the characteristics normally included in the census questionnaire provides a relatively efficient basis for analyzing the effect on fertility of such factors as education, occupational and industrial activity, rural-urban residence, membership in ethnic or linguistic groups, etc., provided that the tabulations are prepared in appropriate combinations.

Procedures for selecting a built-in sample vary. Households may be used as sampling units in order to spread the sample widely, but bias seems unavoidable in such cases to the extent that individual enumerators are given responsibility for selecting households. For that reason, sample selection should not be left to enumerators but controlled centrally. Enumeration areas (EAs), which are sometimes referred to as enumeration districts, may be used also, or even larger units such as administrative districts, especially if the distinction between the special sample (with its longer questionnaire) and the full census (shorter questionnaire) needs special explanations and public relations efforts. The use of EAs or larger units makes it possible to provide special training for enumerators who will administer the longer forms used in sample areas. Such training is especially necessary in collecting high-quality data on fertility and mortality, or on nuptiality.

Including a built-in sample in a census operation does complicate the process, a fact that is not trivial and should be weighed carefully in any decision to use built-in samples. A general rule that holds for censuses conducted in developing nations is that adding complexity to field operations may jeopardize the entire data collection effort. The greater the complexity of the census field operations, the greater is the possibility that the census will collect poor-quality data. This is a general problem, although the level of data quality also depends strongly on the quality of enumerators. Problems in implementing the questionnaire at the enumerator level can also lead to subsequent analysis dilemmas. For example, if in theory there is a 5-percent sample but the result obtained is only 4.5 percent of the total count, should the data be adjusted, and if so, which set: the sample or the total population count? Countries that have experienced such problems with built-in samples of censuses include the Philippines, South Korea, and Ghana. In general, a census is usually better on coverage than a well-conducted sample survey.

Difficulties can arise in using census EAs as sampling units. Enumeration districts have two functions when used in censuses: they partition the area the population lives in with clear and identifiable boundaries, which facilitates its complete and unique coverage; they also help establish equal and feasible workloads for enumerators. Because these two aims are often in conflict, compromises are usually necessary. In addition, enumeration areas are often used for built-in samples in connection with censuses as well as for sample surveys carried out entirely separately. (In separate surveys they are often subsampled to yield clusters of desired sizes.) Enumeration areas are also small enough that they can be aggregated to construct sub-areas of cities or rural districts to be used for analysis, for example, census tracts, voting precincts and neighborhood areas.

The populations of EAs are compact and hence relatively homogeneous. The effects inherent in this homogeneity are increased by the response variance, since each EA usually is enumerated by a single interviewer, who adds the effects of his or her own interviewer bias. These effects may influence items that are crucial for estimating fertility and mortality, such as age or intervals between births.

2.5.2 Samples Added to Censuses

Like built-in samples, samples added to censuses are often planned in close conjunction with the census. Typically, however, they are conducted separately from the census and are usually smaller than built-in samples; the sampling fractions may range from 1/100 down to 1/1,000 or even 1/10,000. The items included may be different from those in the census schedule or may duplicate some or all of the items asked in the complete census or in the built-in sample. In the latter case, the sample added to a census can be used to evaluate the quality of census data, and to check the census coverage.

Among the most common forms of samples added to censuses are post-enumeration surveys (PES), which are generally used to check the quality of the census both in terms of completeness of enumeration and consistency of responses. This can be particularly useful in collecting data on items such as children ever born and children surviving. One approach to conducting a PES is to give PES enumerators the census reports for the sample they are reinterviewing and to have them reconcile the data they collect with the data in the census reports in order to improve the estimates. In another approach, PES enumerators are not given the census reports, in an effort to ensure "independence" between the PES and census observations. The same sample can be designed to include both coverage and content checks, or separate samples can be used for each purpose. Quality control and correcting the work of individual enumerators (i.e., details of the management of data collection) are separate issues that are discussed in Chapter 4.

Another form of samples added to censuses are pre-census sample surveys designed to pretest census items and procedures and provide training for census enumerators and supervisors. A census can be used also as a base for continuing sample surveys.

2.5.3 Sampling from Census Data

Another way to combine the sample and census methods is to apply sampling techniques to the body of data collected by the census. This approach is used in two major ways: (1) a sample set of data can be used to create preliminary tabulations, which can be made available before all the data have been processed; and (2) tabulations based on random sampling of census data can reliably be substituted for complete tabulations for some items in the interests of cutting costs. This kind of sampling is typically applied to data stored in census records, microfilms, and tapes. When early tabulation and release of census results is a priority, it is convenient to process initially the data from a selection of entire EAs or even entire administrative districts, in accord with the timing and flow of returns from the field. Such preliminary processing may also be helpful in checking the quality of editing and processing in the census office.

On the other hand, samples using households as the sampling unit are usually preferred for more complex analyses of census data, and especially for preparing tapes for public use. Spreading the sample often greatly reduces the level of the sampling errors. For most uses, it is preferable to select households rather than individuals because that approach provides samples of both of these populations. The clustering of individuals in households matters little in deeper analyses that do not utilize more than one member of the same household, and for some types of analysis multiple members are essential--for example, in applying the own-children technique of fertility estimation (see Cho, 1973; Hill et al., 1981).

Some countries, including Ecuador and Tunisia in recent years, have sampled complete-enumeration census data by household to produce tabulations on marital status, parity, and surviving children. Turkey used a 1-percent sample of households to produce preliminary tabulations of its 1975 census.

2.5.4 Using Census Data for Samples

Another way in which censuses and sample surveys are linked is by using a census as the frame from which samples are drawn for subsequent inquiries. The frame can provide the basis for selecting samples of areas or households. Good samples often are based on census data, which can provide measures of size for stratification and PPS sampling (sampling with probabilities proportionate to measures of size), information needed for stratification, and the details needed for maps of sampling units, such as EAs. Names of respondents usually are not provided to potential users of census data because of efforts to insure confidentiality and because of obsolescence caused by migration, the creation of new households, and changes in household composition. Census data can also be used to improve statistics by making it possible to calculate ratio and regression estimates.

2.6 THE STATUS OF CENSUSES IN DEVELOPING NATIONS

Table 2.1 summarizes the recent census experience of 95 countries in developing regions of the world, all of which were estimated to have populations of one million or more in mid-1980. In addition to information on past censuses (especially in terms of the availability and quality of age-sex data), the table indicates the prospects for 1980-round censuses (defined by the U.N. as 1975-84). The countries selected contain about 96 percent of the total population of Africa, Asia, and Latin America, which are defined as follows: Africa comprises the entire African continent and Madagascar; Asia includes all of Asia except Japan, Israel, and the Asian areas of the U.S.S.R.; Latin America is comprised of all of Central and South America including the Caribbean. The primary sources of the data in the tables are the U.N. Demographic Yearbook and the Population and Vital Statistics Report of the United Nations Statistical Office, showing data available as of 1 January 1981.

Table 2.2, a summary of census information published by the United Nations in 1974, shows the number of countries in the world that held a national census during the decades centering on 1950, 1960, 1970, and 1980.

The number of countries taking censuses has been increasing slowly over the past two decades. In the 1960 round (defined by the U.N. as 1955-64), 64 of the 95 countries identified in Table 2.1 undertook a census; during the 1970 round this number increased slightly, up to 69 of the 95. If current expectations for the 1980 round are realized, 86 of the 95 countries will hold a census (49 reportedly already have).

Generally Latin America has the best record of these three regions concerning frequency of censuses and availability of data, followed by Asia and Africa in that order. In mid-1980, about 45 percent of the African population resided in 17 countries that either had taken their first census during the period 1975-84 (13 countries), had never taken a census (3 countries) or had not had a census of acceptable quality during the preceding 25 years (1 country).

Column 3 of Table 2.1 indicates whether the census taken was complete ("C") or partial ("UR"). Nearly all the countries listed have conducted complete censuses. The number of first censuses ("C*")is particularly high in Africa, including 15 countries that conducted their first census in the 1970s.

If census data are to be of value for analytical purposes, they not only must be of adequate quality but the information generated must be made available to users. Normally, census data are prepared in the form of printed tabulations, but increasingly they are being made available in the form of computer tapes, especially in countries with advanced computing capabilities. Although these two requirements--adequate quality and data availability--may seem obvious, they often are not met, particularly in Africa. For example, in a recent Nigerian census, competition among different regions for representation in government resulted in accusations of false population counts, after which the government officially rejected the census (the chief of state declared the census null and void, and not to be used for planning purposes). Ironically, this occurred because the population had an all-too-clear understanding of the importance of the census and the benefits of a high count.

Problems with census-taking in less developed countries (LDCs) are widespread and can be cited in

TABLE 2.1 Type, Quality, and Availability of Data from Recent Censuses and Status of Census for 1980 Round: 95 Developing Nations with Estimated Mid-1980 Population of 1 Million or More, by Region

Region, Country or Area	Estimated Pop. in Mid-1980 (millions)	Year of Census	Type of Census[a]	Extent of Age Misreporting and Underenumeration: U.N. Age-Sex Accuracy Index	Meyers Index of Age Heaping	Estimated % Under-enumeration	Availability of Census Data: Age Dist. By Sex[b]	Age Dist. by Urban/Rural Residence[b]	Avail. of Census Schedule[c]	Status of Census for 1980 Round[d]
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Africa										
Algeria	19.0	1960	C	--		--	--	--	--	X
		1966	C	38	7.6	--	UN 70	UN 70	Q	
		1977	C	--		3.4	--	--	Q	
Angola	6.7	1960	C	47	--	--	UN 70	--	--	2/83
		1970	C	60	--	--	A	--	--	
Benin	3.6	1979	C*	--	--	--	--	--	Q	X
Burundi	4.5	1979	C*	--	--	--	--	--	--	X
Cameroon	8.5	1976	C*	38	--	6.9,7.4	UN 78	UN 78	Q	X
Central African Republic	2.2	1975	C*	--	--	--	--	--	Q	X
Chad	4.5	None	--	--	--	--	--	--	--	NE**
Congo	1.6	1974	C*	45	--	--	A	--	Q	(1984)
Egypt	42.1	1960	C	53	66.4	--	UN 70	UN 70	--	X
		1966	C	--	--	--	--	--	--	
		1976	C	49	--	--	A	A	Q	
Ethiopia	32.6	None	--	--	--	--	--	--	--	(1982/1983)
Ghana	11.7	1960	C	49	15.6	2.5	UN 70	UN 70	--	3/82**
		1970	C	40	15.2	1.6	UN 72	--	Q	
Guinea	5.0	1972	C*	--	--	--	--	--	Q	2/81**
Ivory Coast	8.0	1975	C*	59	--	--	UN 77	UN 77	Q	X
Kenya	15.9	1962	UR	49	19.4	--	UN 70	--	--	X
		1969	C	33	13.4	--	UN 72	UN 73	Q	
		1979	C	--	--	--	--	--	--	
Lesotho	1.3	1956	C	--	--	--	UN 70	--	--	X
		1966	C	57	6.4	--	UN 70	--	Q	
		1976	C	--	--	--	--	--	Q	
Liberia	1.9	1962	C*	57	21.6	--	UN 70	--	--	(1984)
		1974	C	62	--	11.0	UN 78	--	Q	

Libya	3.0	1964	C	44	--	--	UN 70	UN 70	--	(1983)
		1973	C	45	--	--	UN 75	UN 75	Q	
Madagascar	8.7	1974-75	C*	--	--	--	--	--	Q	X
Malawi	6.1	1966	C	47	--	--	UN 70	--	Q	X
		1977	C	--	--	--	--	--	Q	
Mali	6.6	1976	C*	--	--	--	--	--	Q	X
Mauritania	1.6	1976	C*	--	--	--	--	--	--	X
Morocco	21.0	1960	C*	157	42.3	--	UN 70	UN 70	--	1981**
		1971	C	96	22.2	5.9	UN 72	UN 72	Q	
Mozambique	10.3	1960	C	45	--	--	UN 70	--	--	X
		1970	C	52	--	--	UN 77	--	--	
		1980	C	--	--	--	--	--	--	**
Namibia	1.0	1960	C	29	--	--	UN 70	UN 70	--	NE
		1970	C	--	--	--	--	--	--	
Niger	5.5	1977	C*	--	--	--	--	--	Q	X
Nigeria	77.1	1963	C	109	28.0	--	UN 70	UN 70	--	E
		1973	C	--	--	--	--	--	Q	
Rwanda	5.1	1978	C*	--	--	--	--	--	Q	X
Senegal	5.7	1976	C*	19	--	--	UN 77	--	Q	X
Sierra Leone	3.5	1963	C*	71	--	5.0	UN 70	--	--	(1984)
		1974	C	53	--	10.0	UN 77	--	Q	
Somalia	3.6	1975	C*	--	--	--	--	--	--	X
S. Africa	28.4	1960	C	23	--	7.0	UN 70	UN 70	--	X
		1970	C	11	8.6	2.6	UN 76	UN 76	Q	
		1980	C	--	--	--	--	--	--	
Zimbabwe	7.4	1961-62	C*	--	--	--	UN 70	--	--	E
(S. Rhodesia)		1969	C	59	8.1	4.2	UN 70	UN 70	Q	
Sudan	18.7	1955-56	UR*	--	--	--	UN 78-H	--	--	11/82**
		1973	C	67	--	4.8	A	--	--	
Tanzania	18.6	1957	C	--	--	5.4,6.3	UN 70	--	--	X
		1967	C	66	17.4	--	UN 72	UN 72	Q	
		1978	C	--	--	--	--	--	--	
Togo	2.5	1958-60	C*	66	16.4	--	UN 70	UN 70	--	3/81**
		1970	C	70	14.2	--	UN 77	--	Q	
Tunisia	6.5	1956	C	--	--	--	UN 70	--	--	
		1966	C	30	7.2	2.7-4.0	UN 70	UN 70	Q	X
		1975	C	30	--	--	A	A	Q	
Uganda	13.7	1959	C	102	23.6	--	UN 70	--	--	X
		1969	C	49	15.0	--	UN 72	UN 72	Q	
		1980	C	--	--	--	--	--	--	
Upper Volta	6.9	1975	C*	--	--	--	--	--	Q	X
Zaire	29.3	None	--	--	--	--	--	--	--	E**

TABLE 2.1 (continued)

Region, Country or Area	Estimated Pop. in Mid-1980 (millions)	Year of Census	Type of Census[a]	Extent of Age Misreporting and Underenumeration: U.N. Age-Sex Accuracy Index	Extent of Age Misreporting and Underenumeration: Meyers Index of Age Heaping	Extent of Age Misreporting and Underenumeration: Estimated % Under-enumeration	Availability of Census Data: Age Dist. By Sex[b]	Availability of Census Data: Age Dist. by Urban/Rural Residence[b]	Availability of Census Data: Avail. of Census Schedule[c]	Status of Census for 1980 Round[d]
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Zambia	5.8	1963	C*	--	--	--	UN 70	UN 70	--	X
		1969	C	73	7.4	2.1	UN 72	--	Q	
		1980	C	--	--	--	--	--	--	
Total African Population	472.0									
Asia										
Afghanistan	15.9	1979	C*	--	--	--	--	--	Q	X
Bangladesh	90.6	1961	C	69	--	--	A	--	--	2/81
		1974	C	57	34.7	6.4	UN 78-H	UN 78-H	Q	
Bhutan	1.3	1969	C*	--	--	--	--	--	--	NE
Burma	34.4	1973	C	--	--	--	--	--	--	1983
Kampuchea	6.0	1962	C	18	--	--	UN 70	UN 70	--	NE
China (PRC)	975.0	1953	C	--	--	0.1	--	--	--	7/82
Hong Kong	4.8	1961	C	37	1.8	0.6	UN 70	UN 70	--	2/81-3/81
		1966	S	38	1.5	--	A	--	--	
		1971	C	37	2.8	1.1	UN 73	--	Q	
		1976	S	43	--	0.4	UN 78-H	--	--	
India	676.2	1961	C	51	31.1	2.8	UN 70	UN 70	--	3/81
		1971	C	39	32.8	1.7,2.7	UN 72	UN 73	Q	
Indonesia	144.3	1961	C	78	--	--	UN 70	UN 70	--	X
		1971	C	53	24.7	2.0,6.9	UN 75	UN 75	Q	
		1980	C	--	--	--	--	--	--	
Iran	38.5	1956	C*	--	--	7.5	UN 70	UN 70	--	X
		1966	C	68	23.6	5.0	UN 70	UN 70	Q	
		1976	C	51	--	3.0	UN 78	UN 78	Q	

Iraq	13.2	1957	C	51	--	--	UN 70	UN 70	--	X
		1965	C	41	22.3	--	UN 70	UN 70	Q	
		1977	C	--	--	--	--	--	Q	
Jordan	3.2	1961	C*	34	--	4.3	UN 70	UN 70	--	
		1979	C	--	--	--	--	--	--	X
Korea, N.	17.9	None	--	--	--	--	--	--	--	NE
Korea, S.	38.2	1955	C	34	1.1	--	UN 70	--	--	X
		1960	C	27	2.1	2.0	UN 70	UN 70	--	
		1966	C	26	0.8	2.9	UN 70	UN 70	--	
		1970	C	28	1.5	5.2	UN 73	UN 73	Q	
		1975	C	23	2.0	5.7	UN 77	UN 77	Q	
		1980	C	--	--	--	--	--	--	
Kuwait	1.3	1957	C*	123	--	--	UN 70	--	--	X
		1961	C	--	--	--	UN 70	--	--	
		1965	C	117	--	--	UN 70	--	--	
		1970	C	94	--	--	UN 72	--	--	
		1975	C	58	--	--	UN 75	--	--	
		1980	C	--	--	--	--	--	--	
Laos	3.7	None	--	--	--	--	--	--	--	(1984)**
Lebanon	3.2	None	--	--	--	--	--	--	--	NE
Malaysia	14.0	1957	C	33	8.0	--	UN 70	--	--	X
		1960	C	51	19.0	--	UN 70	UN 70	--	
		1970	C	28	--	4.7	UN 73	UN 73	Q	
		1980	C	--	--	--	--	--	--	
Mongolia	1.7	1956	C	39	--	--	UN 70	--	--	X
		1963	C	--	--	--	--	--	--	
		1969	C	--	--	--	--	--	--	
		1979	C	--	--	--	--	--	--	
Nepal	14.0	1961	C	56	--	--	UN 70	UN 70	--	6/81
		1971	C	53	--	4.9	UN 73	UN 73	Q	
Pakistan	86.5	1961	C	53	--	--	UN 70	UN 70	--	3/81
		1972	C	--	--	6.3	--	--	Q	
Philippines	47.7	1960	C	33	10.0	--	UN 70	--	--	X
		1970	C	24	--	0.3,1.9	UN 73	UN 73	Q	
		1975	C	--	--	--	--	--	--	--
		1980	C	--	--	--	--	--	--	--
Saudi Arabia	8.2	1962-63	C	--	--	--	--	--	--	NE
		1974	C	--	--	--	--	--	--	
Singapore	2.4	1957	C	34	2.4	--	UN 70	--	--	X
		1970	C	26	2.1	--	UN 70	--	Q	
		1980	C	--	--	--	--	--	--	
Sri Lanka	14.8	1963	C	29	14.1	1.0	UN 70	UN 70	--	3/81
		1971	C	26	8.7	1.0	UN 78-H	UN 78-H	Q	

TABLE 2.1 (continued)

Region, Country or Area	Estimated Pop. in Mid-1980 (millions)	Year of Census	Type of Census[a]	Extent of Age Misreporting and Underenumeration: U.N. Age-Sex Accuracy Index	Meyers Index of Age Heaping	Estimated % Under-enumeration	Availability of Census Data: Age Dist. By Sex[b]	Age Dist. by Urban/Rural Residence[b]	Avail. of Census Schedule[c]	Status of Census for 1980 Round[d]
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Syria	8.6	1960	C*	66	24.0	6.0	UN 70	UN 70	--	1981**
		1970	C	34	13.9	--	UN 73	UN 73	Q	
Taiwan	17.8	1956	C	45	1.7	0.1	UN 70	--		1980
		1966	C	39	--	1.0	UN 70	--		
		1970	S	37	1.5	0.4	A	--		
		1975	S	38	1.4	0.3	A	--		
Thailand	47.3	1960	C	19	2.4	4.0	UN 70	--	--	X
		1970	C	18	1.4	2.0,6.6	UN 73	UN 73	Q	
		1980	C	--	--	--	--	--	--	
Turkey	45.5	1955	C	67	32.3	--	UN 70	--	--	X
		1960	C	71	30.7	--	UN 70	UN 70	--	
		1965	C	53	17.2	--	UN 70	--	Q	
		1970	C	53	19.9	--	UN 72	--	Q	
		1975	C	35	--	1.2	UN 76	--	Q	
		1980	C	--	--	--	--	--	--	
Vietnam	53.3	1960	C	--	--	--	UN 70	--	--	X
		1974	C	--	--	--	--	--	--	
		1979	C	--	--	--	--	--	--	
Yemen (Aden)	1.9	1973	C	75	--	--	UN 74	UN 78-H	--	NE
Yemen (San'a)	5.6	1975	C	--	--	--	--	--	--	X
Total Asian Population	2,563.0									
Latin America										
Argentina	27.1	1960	C	12	1.1	3.6,4.4	UN 70	--	--	X
		1970	C	10	0.9	--	UN 73	--	Q	
		1980	C	--	--	--	--	--	--	
Bolivia	5.3	1950	C	46	21.0	8.4,10.4	UN 70	--	--	X
		1976	C	31	--	4.2,7.8	UN 77		Q	

Brasil	122.0	1960	C	19	9.1	--	UN 78-H	UN 78-H	--	X
		1970	C	11	5.1	3.1	UN 73	UN 73	Q	
		1980	C	--	--	--	--	--	--	
Chile	11.3	1960	C	16	6.5	3.8,5.4	UN 70	UN 70	--	4/82**
		1970	C	14	5.2	4.8	UN 72	UN 72	Q	
Colombia	26.7	1964	C	31	8.4	3.3	UN 70	UN 70	--	E
		1973	C	32	8.4	9.4	UN 77	--	Q	
Costa Rica	2.2	1963	C	25	5.6	3.3	UN 70	UN 70	--	5/83
		1973	C	21	5.1	0.4	UN 74	UN 74	Q	
Cuba	10.0	1953	C	34	--	--	UN 70	--	--	1981
		1970	C	23	--	--	UN 72	UN 72		
Dominican Rep.	5.4	1960	C	52	13.4	3.8	UN 70	UN 70	--	1981**
		1970	C	41	12.8	6.4	UN 72	UN 74	Q	
Ecuador	8.0	1962	C	35	15.0	--	UN 70	UN 70	--	6/83
		1974	C	26	--	2.5	UN 76	UN 76	Q	
El Salvador	4.8	1961	C	34	13.7	5.0	UN 70	UN 70	--	NE**
		1971	C	26	10.3	3.6	UN 72	UN 72	Q	
Guatemala	7.0	1964	C	28	9.8	3.5	UN 70	UN 70	--	3/81
		1973	C	28	11.1	9.5	UN 74	UN 74	Q	
Haiti	5.8	1950	C*	53	22.2	7.7, 8.3	UN 70	--		8/81
		1971	C	38	12.7	8.4	UN 78-H	UN 78-H	Q	
Honduras	3.8	1961	C	24	8.7	6.0	UN 70	UN 70	--	3/82
		1974	C	27	6.0	12.5	UN 77	UN 77	Q	
Jamaica	2.2	1960	C	25	5.4	0.9	UN 70	UN 70	--	5/81**
		1970	C	21	--	4.6	UN 73	--	Q	
Mexico	68.2	1960	C	26	13.0	4.0	UN 70	UN 70	--	X
		1970	C	19	8.5	2.4	UN 72	--	Q	
		1980	C	--	--	--	--	--	--	
Nicaragua	2.6	1963	C	39	14.8	--	UN 70	UN 70	--	1982
		1971	C	31	14.0	3.8	UN 74	UN 74	Q	
Panama	1.9	1960	C	17	4.0	0.8	UN 70	UN 70	--	X
		1970	C	14	3.3	1.3	UN 73	--	Q	
		1980	C	--	--	--	--	--	--	
Paraguay	3.3	1962	C	27	5.6	--	UN 70	UN 70	--	7/82
		1972	C	27	4.0	9.9	UN 75	UN 75	Q	
Peru	17.6	1961	C	25	9.3	--	UN 70	UN 70	--	6/81**
		1972	C	22	6.5	3.9,4.9	UN 78-H	UN 78-H	Q	
Puerto Rico	3.5	1960	C	30	3.8	--	UN 70	UN 70	--	X
		1970	C	17	--	--	UN 72	UN 72	--	
		1980	C	--	--	--	--	--	--	
Trinidad and Tobago	1.2	1960	C	23	--	--	UN 70	UN 70	--	X
		1970	C	28	--	8.4	UN 78-H	--	--	
		1980	C	--	--	--	--	--	--	

TABLE 2.1 (continued)

Region, Country or Area	Estimated Pop. in Mid-1980 (millions)	Year of Census	Type of Census[a]	Extent of Age Misreporting and Underenumeration: U.N. Age-Sex Accuracy Index	Meyers Index of Age Heaping	Estimated % Under-enumeration	Availability of Census Data: Age Dist. By Sex[b]	Age Dist. by Urban/Rural Residence[b]	Avail. of Census Schedule[c]	Status of Census for 1980 Round[d]
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Uruguay	2.9	1963	C	16	2.3	1.7	UN 70	UN 70	--	X
		1975	C	16	1.8	2.1	UN 78	UN 78	Q	
Venezuela	13.9	1961	C	19	3.8	5.5,5.8	UN 70	UN 70	--	10/81-11/81
		1971	C	20	--	4.6	UN 78-H	--	Q	
Total Latin American Population	360.0									

Notes: Dash in column means not applicable or not available.

Mid-1980 population (column 1) is taken from the Population Reference Bureau's 1980 World Population Data Sheet. Unless otherwise noted, the U.N. Age-Sex Accuracy Index (column 4) for countries in Africa and Asia has been calculated from the age-sex distribution indicated in column 7. For countries in Latin America, the values for U.N. Age-Sex Accuracy Index (column 4) and Myers Index (column 5) are from Kamps (1976), unless otherwise noted. The Myers Index values obtained from OECD and Kamps were divided by 2 to conform with the formula in Shryock and Siegel (1973:207) used to calculate all other Myers values in the table.

Additional information on some countries is provided below. The census questions are referred to by column number.

[a]Column 3: C = Complete census.
C* = First census ever taken.
UR = Full enumeration of urban areas with sample of rural areas.
S = Sample census.

[b]Columns 7 and 8: UN (year) = First issue of U.N. Demographic Yearbook (1970 and later) to include specified age distribution. (UN 78-H indicates the Historical Supplement to UNDY 1978.)
A = Available in other source (see notes below).

[c]Column 9: Q = Questionnaire available. (Unless otherwise noted below, questionnaire is on file at the U.N. Statistical Office.)

[d]Column 10: X = 1980 round has been taken.
DATE = Projected date.
(DATE) = Census date anticipated by the U.N. Statistical Office, based on established pattern.
** = Indicates that current plans for a census in the 1980 round reflect a delay from previous plans.
E = A census in the 1980 round is expected, but there is no established pattern with which to estimate a date.
NE = No basis for expecting a census in the 1980 round.

AFRICA

Algeria 1960: (7) Broad age groups from a post-censal survey available in UNDY 1965, Table 6. 1966: (4) Ohadike and Tesfaghiorghis, 1975, p. 23. (5) UNDY 1971. 1977: (6) WP 79.

Angola 1960: (7) Ages 0-1 not shown. 1970: (7) For black population only, OECD.

Cameroon 1976: (3) WP 77 refers to this enumeration as a "survey" as well as a "census." (6) Low figure from WP 79; high figure from PVSR, 1 Jan. 80.

Chad An "administrative" census was conducted in March 1968.

Congo 1974: (7) OECD.

Egypt 1960: (5) Cairo Demographic Centre, 1970, pp. 252-253. Myers Index shown is for females; males = 50.4. 1976: (7) and (8) Available from CAPMAS.

Ghana 1960: (4) USBC. (5) UNDY 1962. (6) USBC. 1970: (4) USBC. (5) UNDY 1973. (6) USBC.

Ivory Coast 1975: (7) Ages 0-1 not shown.

Kenya 1962: (4) USBC. (5) UNDY 1971. (7) Ages 0-1 not shown. 1969: (4) USBC. (5) UNDY 1971. (6) Officially reported total includes an adjustment for underenumeration (USBC). (8) Broad age groups over age 30.

Lesotho 1956: (4) Data by broad age groups in UNDY 1970. (6) Census thought to be highly underenumerated (WP75). 1966: (5) OECD. Myers Index shown is for females; males = 6.8. (7) Ages 0-1 not shown.

Liberia 1962: OECD. Myers Index shown is for females; males = 17.9. 1974: (6) WP79. (7) Ages 0-1 not shown.

Libya 1964: (4) Ohadike and Tesfaghiorghis, 1975, p. 23.

Madagascar 1974-75: (3) Census conducted 12/1/74-6/1/75 (WP77).

Malawi 1966: (7) Ages 0-1 not shown.

Mauritania 1976: (7) and (8) Distribution of population by broad age groups but not by sex available in UNDY 1978-Historical Supplement.

Morocco 1960: (5) UNDY 1963, Myers Index shown is for females; males = 38.4. 1971: (5) UNDY 1973. (6) WP79.

Mozambique 1960: (7) Ages 0-1 not shown. 1970: (4) OECD.

Namibia 1960: (7) Ages 0-1 not shown.

TABLE 2.1 (continued)

Nigeria 1963: (3) The 1962 census was rejected and the 1963 census is thought to have been highly overenumerated (Caldwell, Okonjo, ed., 1968, pp. 5-6). (5) OECD. Myers Index shown is for females; males = 26.7. 1973: (3) Census results rejected because of overenumeration (Lagos Daily Times, May 13, 1978, p. 21).

Senegal 1976: (4) OECD. (7) Ages 0-1 not shown.

Sierra Leone 1963: (6) UNDY 1970, Table 6. (7) Ages 0-1 not shown. 1974: (6) Official total includes adjustment for underenumeration (WP75; PVSR, April 1978). (7) Ages 0-1 not shown.

South Africa 1960: (6) Implied by comparison with official mid-year estimate (WP77). 1970: (5) UNDY 1973. (6) WP77. (7) and (8) Broad age groups over age 55.

Sudan 1955-56: (3) Sample census covering 10 percent of population in rural areas and 100 percent in urban areas (Brass et al., 1968, p. 467). (7) Broad age groups. 1973: (4) Sudan, 1977. (6) WP79. (7) Available at UNSO.

Tanzania 1957: (4) Age distribution smoothed and interpolated for African population. (6) Ominde, 1975, p. 5. 1967: (4) Excluding Zanzibar. (5) UNDY 1971, excluding Zanzibar. (8) Excluding Zanzibar.

Togo 1958-60: (3) Census conducted 11/58-12/60 (UNDY 1970, Table 6). (5) UNDY 1963. 1970: (5) OECD. Myers Index shown is for females; males = 13.8.

Tunisia 1956: (7) Age distribution smoothed and interpolated; ages 0-1 not shown. 1966: (5) UNDY 1971. (6) Low estimate implied by estimate cited in United States Bureau of the Census, 1971; high estimate from UNDY 1970, footnote to Table 6. 1975: (7) and (8) Republique Tunisienne (no date).

Uganda 1959: (4) and (5) OECD. Myers Index shown is for females; males = 20.9. (7) Age distributions smoothed and interpolated; ages 0-1 not shown. 1969: (5) UNDY 1971. (8) Ages 0-1 not shown.

Zaire "Administrative" censuses were reported held in 1970 (WP77) and 1974 (WP79).

Zambia 1963: (7) and (8) Broad age groups. 1969: (5) UNDY 1971. (6) Official estimate cited in WP77.

Zimbabwe (Southern Rhodesia) 1961-62: (3) Census conducted 4/10-5/20/1962 for African population and 11/26/61 for non-Africans (UNDY 1970, Table 6). (4) Age distribution smoothed and interpolated for African population. 1969: (4) UNDY 1972, African population only. (5) UNDY 1971. (6) WP77.

ASIA

Bangladesh 1961: (3) In 1961, Bangladesh was a part of Pakistan. (7) OECD. 1974: (4) and (5) OECD. Myers Index shown is for females; males = 34.6. (6) Based on the results of the Post Enumeration Check (WP77). (9) Cho, 1976.

Burma 1973: (3) 14.9 percent of the territory, with about 2.9 percent of the population, was inaccessible (Cho, 1976). (9) A list of questions is available in Cho, 1976.

China (People's Republic of) 1953: (3) UNSO reports that a census may have been held in June 1964 (UNSO, 1981). (6) UNDY 1976, footnote to Table 6.

Hong Kong 1961: (5) OECD. Myers Index shown is for females; males = 2.0. (6) UNESCAP, 1974. (8) Broad age groups. 1966: (5) OECD. Myers Index shown is for females; males = 1.9. (7) OECD. 1971: (5) UNDY 1973. (6) and (9) Cho, 1976. 1976: (6) WP79.

India 1961: (5) OECD. Myers Index shown is for females; males = 29.2. (6) WP77. 1971: (5) UNDY 1973. (6) Low figure cited in PVSR, 1 April 1980; high figure from WP77. (9) Cho, 1976.

Indonesia 1961: (4) OECD. (7) and (8) Broad age groups. 1971: (5) UNDY 1973. (6) Lower estimate from Cho, 1976; higher from WP75. (9) Cho, 1976.

Iran 1956: (6) Bharier, 1968. (7) Age distributions smoothed. 1966: (5) UNDY 1971. (6) Bharier, 1968. 1976: (6) WP79. (7) and (8) Ages 0-1 not shown.

Iraq 1957: (4) UNDY 1962. 1965: (5) UNDY 1971.

Jordan 1961: (6) Official figure is 4.0; 0.3 added in WP77. 1979: (3) East Bank only (PVSR, 1 Jan. 1981).

Kampuchea (Cambodia) 1962: (4) Age distributions may have been smoothed.

Korea, North Last known census of North Korea was held in May 1944.

Korea, South 1955: (5) OECD. Myers Index shown is for females; males = 2.0. 1960: (5) OECD. Myers Index shown is for females; males = 1.7. (6) WP77. 1966: (5) UNDY 1971. (6) WP77. (8) Broad age groups. 1970: (5) UNDY 1973. (6) WP77. (9) Cho, 1976. 1975: (5) OECD. Myers Index shown is for females; males = 1.8. (6) WP79.

Kuwait 1961: (7) Broad age groups above age 30.

Lebanon (3) The last census of Lebanon was held in 1932 (ECWA, 1977).

Malaysia 1957: (3) Malaysia was formed in 1963; the 1957 census covered West (Peninsular) Malaysia, while the 1960 census covered Sabah and Sarawak. The 1970 census was the first to cover all three (Cho, 1976). (5) UNDY 1962. 1960: (5) OECD. Myers Index shown is for Sabah females; Sabah males = 18.2; Sarawak females = 19.0; Sarawak males = 17.7. 1970: (4) West Malaysia only. (6) WP79. (9) Cho, 1976.

Nepal 1971: (6) WP79. (8) Ages 0-1 not shown.

Pakistan 1972: (6) From a post-enumeration check (Cho, 1976); there is, however, a controversy over the census results, some researchers indicating an overcount (WP77). (9) Cho, 1976.

Philippines 1960: (5) Shryock and Siegel, 1973, p. 207. 1970: (6) Low figure from Cho, 1976; high figure from WP77. (9) Cho, 1976.

TABLE 2.1 (continued)

Saudi Arabia 1962-63: Results officially repudiated (UNDY 1970, WP75). 1974: Only district totals available, and the count appears high (ECWA, 1977; ECWA, 1978).

Singapore 1957: (5) OECD. Myers Index shown is for females; males = 2.9. (8) Singapore is 100 percent urban. 1970: (5) UNDY 1973. (7) Ages 0-1 not shown. (9) Cho, 1976.

Sri Lanka 1963: (4) and (6) USBC. (5) UNDY 1971. 1971: (4) and (6) USBC. (5) OECD. Myers Index shown is for females; males = 6.4. (9) Cho, 1976.

Syria 1960: (5) OECD. Myers Index shown is for females; males = 9.2. (6) Suggested by comparison of census results with civil registration data (Cairo Demographic Centre, 1970). 1970: (5) UNDY 1973.

Taiwan 1956: (5) UNDY 1962. (6) USBC. (10) Taiwan has a decennial census law. 1966: (4) and (6) USBC. 1970: (4) and (6) USBC. (5) OECD. Myers Index shown is for females; males = 1.4. (7) OECD. 1975: (4) and (6) USBC. (5) OECD. Myers Index shown is for females; males = 1.4. (7) USBC.

Thailand 1960: (4) USBC. (5) OECD. Myers Index shown is for females; males = 2.3. (6) WP77. 1970: (4) USBC. (5) UNDY 1973. (6) Low figure based on a post-enumeration survey (Cho, 1976); high figure from WP77. (9) Cho, 1976.

Turkey 1955: (5) OECD. Myers Index shown is for females; males = 13.3. 1960: (4) Shryock and Siegel, 1973, p. 222. (5) OECD. Myers Index shown is for females; males = 14.2. 1965: (5) UNDY 1971. 1970: (5) UNDY 1973. 1975: (6) WP79. (7) Ages 0-1 not shown.

Vietnam 1960: (3) Conducted in northern part of the country only. (7) Broad age groups. 1974: (3) Conducted in northern part of the country only.

Yemen (Aden) 1973: (7) and (8) Ages 0-1 not shown.

LATIN AMERICA

Argentina 1960: (6) Low figure from WP75; high figure from UNDY 1969, footnote to Table 9. 1970: (7) Ages 0-1 not shown.

Bolivia 1950: (6) Low figure from UNDY 1971, footnote to Table 4; high figure implied by adjusted mid-year population in PVSR, April 1975. 1976: (4) UNDY 1977. (6) WP79. (Low estimate is adjustment made by United States Bureau of the Census; high estimate is based on preliminary results of the post-enumeration survey.)

Brazil 1960: (5) OECD. Myers Index shown is for females; males = 8.3. 1970: (6) WP79.

Chile 1960: (6) Low figure from USBC; high figure from UNDY 1965, footnote to Table 2. 1970: (6) USBC. (7) and (8) Ages 0-1 not shown.

Colombia 1964: (6) WP75. 1973: (4) and (5) OECD. Myers Index shown is for females; males = 7.0. (6) WP79.

Costa Rica 1963 and 1973: (6) USBC.

Cuba 1970: (4) UNDY 1972.

Dominican Republic 1960 and 1970: (6) Implied by estimates cited in WP77.

Ecuador 1974: (6) WP79.

El Salvador 1961 and 1971: (6) Implied by comparison with official mid-year estimate in WP77.

Guatemala 1964: (6) Implied by estimate cited in WP77. 1973: (6) USBC.

Haiti 1950: (6) Low fiqure from WP75; high figure from UNDY 1970, footnote to Table 2. 1971: (6) WP79.

Honduras 1961 and 1974: (6) USBC.

Jamaica 1960: (4) and (6) USBC. (5) UNDY 1962. 1970: (4) USBC. (6) WP79. (7) First two age groups are less than 2 and 2-4, according to UNDY 1977.

Mexico 1960: (6) WP77. 1970: (6) WP79.

Nicaragua 1963 and 1971: (7) and (8) Ages 0-1 not shown. 1971: (6) WP79.

Panama 1960 and 1970: (6) USBC.

Paraguay 1962: (8) Ages 0-1 not shown. 1972: (6) WP79.

Peru 1972: (6) Low figure from PVSR, 1 April 1980; high figure from WP79.

Puerto Rico 1960: (5) OECD. Myers Index shown is for females; males = 3.3. 1970: (4) UNDY 1972.

Trinidad and Tobago 1960: (4) UNDY 1970. 1970: (6) WP79.

Uruguay 1963 and 1975: (6) Implied by comparison with mid-year estimate cited in WP77. 1975: (4) and (5) OECD. Myers Index shown is for females; males = 1.3.

Venezuela 1961: (6) Low figure from WP75; high figure from UNDY 1970, footnote to Table 6. 1971: (6) WP79.

TABLE 2.2 Number of Countries Conducting a National Census and Percentage of World and Continental Populations Covered by These Censuses, by Ten-Year Periods from 1945 to 1984.

			At Least One Census Held During Decade			Announced Plan for Census to be Held Before End of Decade			No Census During Decade		
Continent	Number of Countries	Total Population (millions)	Number of Countries	Population (millions)	Percentage of Total Population	Number of Countries	Population (millions)	Percentage of Total Population	Number of Countries	Population (millions)	Percentage of Total Population
1945-54[a]											
World	223	2,486	150	2,009	81	--	--	--	73	476	19
Africa	57	217	24	118	54	--	--	--	33	100	46
America, N.	36	218	32	217	99	--	--	--	4	2	1
America, S.	15	110	12	100	91	--	--	--	3	10	9
Asia	46	1,355	23	1,172	87	--	--	--	23	183	13
Europe	41	392	40	392	100	--	--	--	1	0	0
Oceania	27	13	19	11	85	--	--	--	8	2	15
USSR	1	180	--	--	--	--	--	--	1	180	100
1955-64[a]											
World	223	2,982	174	2,142	72	--	--	--	49	840	28
Africa	57	270	36	172	64	--	--	--	21	97	36
America, N.	36	267	34	256	96	--	--	--	2	11	4
America, S.	15	145	13	141	97	--	--	--	2	4	3
Asia	46	1,645	30	920	56	--	--	--	16	725	44
Europe	41	425	38	425	100	--	--	--	3	0	0
Oceania	27	16	22	14	87	--	--	--	5	2	13
USSR	1	214	1	214	100	--	--	--	--	--	--

1965-74[b]

World	213	3,604	173	2,645	73	--	--	--	40	959	27
Africa	55	354	35	247	70	--	--	--	20	107	30
America, N.	35	318	34	314	99	--	--	--	1	4	1
America, S.	14	187	12	179	96	--	--	--	2	8	4
Asia	43	2,024	33	1,186	59	--	--	--	10	838	41
Europe	37	459	32	459	100	--	--	--	5	0	0
Oceania	28	19	26	17	89	--	--	--	2	2	11
USSR	1	243	1	243	100	--	--	--	--	--	--

1975-84[b]

World	213	4,414	113	1,796	41	74	2,555	58	26	66	1
Africa	55	472	32	241	51	19	225	48	4	6	1
America, N.	35	367	19	323	88	15	40	11	1	5	1
America, S.	14	239	6	159	67	6	70	29	2	11	5
Asia	43	2,563	18	590	23	15	1,914	75	10	58	2
Europe	37	484	16	176	36	16	306	63	5	3	1
Oceania	28	23	21	23	100	3	0	0	4	0	0
USSR	1	266	1	266	100	--	--	--	--	--	--

Note: The data in this table take into account only complete enumerations of the population; enumerations on a sample basis are not considered to be "censuses."

[a]The data in this portion of the table are based on countries and territories existing in May 1973 and are therefore not affected by changes in their numbers from period to period. All population figures used are the relevant mid-decade (i.e., 1950 and 1960) estimates shown in the working paper "Total population estimates for world, regions, and countries each year, 1950-1985" (ESA/P/WP.34) prepared by the Population Division, Department of Economic and Social Affairs. Tabulated data taken from United Nations, Secretariat (1974:372).
[b]This portion of the table is based on countries and territories listed by the United Nations in the 1 January 1981 report on dates of national population and/or housing census for the 1970 and 1980 census rounds. Population figures for 1970 were taken from the 1977 U.N. Demographic Yearbook. The estimates of the 1980 population were obtained from the Population Reference Bureau, Inc. World totals are the sum of continental totals.

abundance. In Colombia, the 1973 census was hampered by a teachers' strike on census day--the teachers were the (often unpaid) enumerators. Burma's 1953-54 attempt at a census was disrupted by civil disorders. Saudi Arabia's censuses are considered by the Saudi government to suffer from heavy underenumeration, and the 1962-63 census was officially rejected. Lebanon has not taken a census since 1932 (under the French Mandate), presumably for fear that competing religious factions would cause civil disruption if information about their comparative size were released.

While increased efforts to improve the quality and timing of censuses in LDCs are possible, it may well be that for some countries a truly "modern" census is many years in the future. Problems such as taboos on mentioning the number of one's children, the existence of many different languages and dialects within a country; lack of knowledge of one's age; special difficulties with terrain, transportation, and communications in rural areas; widespread illiteracy; and a general lack of perception as to the value of a census on the part of the general population can be expected to provide serious obstacles in the foreseeable future. Even the typical age structure of an LDC operates to make complete enumeration more difficult. For example, young children are among the most seriously underenumerated groups in LDCs; the fact that they constitute very large proportions of the populations in these countries tends to increase the impact of that underenumeration.

2.6.1 Availability of Census Data on Fertility and Mortality

Table 2.3 indicates whether questions providing specific items of information used in estimating fertility and mortality were included in the censuses that appear in Table 2.1. As shown, a substantial number of countries included in their censuses questions on children ever born and children surviving, and many countries have provided tabulations based on these data to the United Nations for publication in the U.N. Demographic Yearbook. A number of countries have collected information on children born in the past 12 months or other reasonably recent periods up to a few years. The table also indicates which countries have included questions for women on age at marriage or date of first marriage and on deaths in the household during the last 12 months.

Only a handful of countries, most of them in Latin America, have included a question on age of mother at the most recent birth or date of that most recent birth; only Latin American countries have included a question on the age of mother at the date of her first live birth. The small number of countries that have included these questions is not surprising given the difficulty of collecting this type of retrospective information, particularly in a census. In a census, a more satisfactory approach is to ascertain the current age of each woman who has given birth and the date of the most recent birth or the date of the first birth. The question on age of mother at the date of first live birth can be useful in surveys or in small samples of censuses that utilize more carefully trained and supervised interviewers.

2.6.2 Delays in Availability of Census Data

A key issue in the usefulness of census data is the time delay between the date of a census and the availability of provisional and final population counts and an age-sex distribution. Table 2.4 lists by region the censuses in Table 2.1 that were conducted in 1970 and later and shows how many months elapsed after the census date before provisional and final totals were made available in the U.N. publication Population and Vital Statistics Reports (PVSR). It also indicates which (if any) U.N. Demographic Yearbook contains the age distributions and age distributions by urban/rural breakdowns from each census.

Among the countries that have released provisional totals for 1970s censuses, the median delay is 11 months among African and Asian nations and 8 months in Latin America. The median number of months to publication of final population counts was 49 among the 15 of 36 countries in Africa that have reported so far. For the 18 of 25 Asian countries that have released final totals, the median delay was 28.5 months. In Latin America only two of the 23 nations have not yet published final population counts for censuses taken in the early 1970s. For those that have published final counts, the median number of months to publication was 39.

Table 2.4 indicates the number of months (as of January 1981) since a census was taken for those countries that have not yet released final census

TABLE 2.3 Presence of Retrospective Questions on Fertility and Mortality on Census Schedules in 1960, 1970, and 1980 Census Rounds: 95 Developing Nations with Estimated Mid-1980 Population of 1 Million or More, by Region.

Region, Country or Area	Year of Census	Fertility Questions: Children Ever Born Alive	Children Still Living	Children Born in Past 12 Months (or other period)	Mother's Age at or Date of First Live Birth	Mother's Age at or Date of Most Recent Birth	Age at or Date of First Marriage	Universe for Fertility and Marriage Questions	Mortality Question: Deaths in Household in Past 12 Months	Sources Used to Determine Whether Questions Were Asked[a]
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Africa										
Algeria	1960	--	--	X	--	--	X	Females with a Birth in 1960	u	(1,6)
	1966	--	--	--	--	--	--	--	--	(2,4,6)
	1977	--	--	--	--	--	--	--	u	(2)
Angola	1960	X	--	--	--	--	--	All African Women	--	(1)
	1970	u	u	u	u	u	u	u	u	n.a.
Benin	1979	--	--	--	--	--	--	--	--	(2)
Burundi	1979	u	u	u	u	u	u	u	u	n.a.
Cameroon	1976	--	--	X	--	--	--	Households	X	(2,4)
Central African Republic	1975	X	X	X	--	--	--	All Ever-Married Women	--	(2,4)
Congo	1974	X	X	X	--	--	u	All Women, 12+	X	(2,4)
Egypt	1960	X	X	--	--	--	X	All Married Females	u	(1)
	1966	X	X	--	--	--	--	All Married Females	u	(2)
	1976	X	X	--	--	--	X	Ever-Married Women	u	(2)
Ghana	1960	--	--	--	--	--	--	--	u	(1,7)
	1970	--	--	--	--	--	--	--	--	(2,4)
Guinea	1972	--	--	--	--	--	--	--	--	(2)
Ivory Coast	1975	--	--	--	--	--	--	--	--	(2,4)

Kenya	1962	UN 71	X	X	u	u	--	All Women, 15+	--	(1,7)
	1969	UN 75	UN 75	--	--	X	u	All Women, 12+	--	(2)
	1979	u	u	u	u	u	u	u	u	(2)
Lesotho	1956	--	--	--	--	--	--	--	--	(1)
	1966	--	--	--	--	--	--	--	--	(2,4)
	1976	X	X	X	--	X	--	All Women, 15+	X	(2)
Liberia	1962	--	--	--	--	--	--	--	u	(1)
	1974	X	X	X	--	--	--	All Women 10+	X	(2,4)
Libya	1964	--	--	X	--	--	--	Households as a Whole	u	(1)
	1973	UN 78-H	UN 78-H	--	--	--	X	n.a.	--	(2,4)
Madagascar	1974-75	--	--	--	--	--	--	--	--	(2,4)
Malawi	1966	--	--	--	--	--	--	--	--	(2,4)
	1977	X	X	X	--	--	--	All Women, 10+	X	(2)
Mali	1976	--	--	X	--	--	--	n.a.	X	(2,4)
Mauritania	1976	u	u	u	u	u	u	u	u	n.a.
Morocco	1960	X	UN 78-H	X	--	--	--	All Women	u	(1)
	1971	--	--	--	--	--	--	--	--	(2,4)
Mozambique	1960	X	X	--	--	--	u	All African & Non-African Women, 14+	u	(1)
	1970	u	u	u	u	u	u	u	--	(2,4)
	1980	u	u	u	u	u	u	u	u	n.a.
Namibia	1960	u	u	u	u	u	u	u	u	n.a.
	1970	u	u	u	u	u	u	u	u	n.a.
Niger	1977	--	--	--	--	--	--	--	--	(2)
Nigeria	1963	--	--	--	--	--	--	--	--	(1,2)
	1973	--	--	--	--	--	--	--	--	(2,4)
Rwanda	1978	X	X	X	--	X	--	All Women, 14+	X	(2)
Senegal	1976	--	--	--	--	--	--	--	--	(2,4)
Sierra Leone	1963	--	--	--	--	--	--	--	--	(1,2)
	1974	X	X	X	--	X	--	All Women, 12+	--	(2,4)
Somolia	1975	X	u	X	u	u	u	n.a.	X	(4)
South Africa	1960	--	--	X	--	--	--	All African Women	u	(1)
	1970	--	--	X	--	--	--	All Women	--	(2)
	1980	u	u	u	u	u	u	u	u	n.a.
Sudan	1955-56	u	u	u	u	u	u	u	u	n.a.
	1973	X	u	X	u	--	u	n.a.	u	(4)
Tanzania	1957	X	X	--	--	--	u	All African Women	u	(1)
	1967	UN 75	UN 75	X	--	--	--	n.a.	X	(2,4)
	1978	u	u	u	u	u	u	u	u	n.a.

TABLE 2.3 (continued)

Region, Country or Area	Year of Census	Fertility Questions: Children Ever Born Alive	Children Still Living	Children Born in Past 12 Months (or other period)	Mother's Age at or Date of First Live Birth	Mother's Age at or Date of Most Recent Birth	Age at or Date of First Marriage	Universe for Fertility and Marriage Questions	Mortality Question: Deaths in Household in Past 12 Months	Sources Used to Determine Whether Questions Were Asked[a]
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Togo	1958-60	X	X	--	--	--	--	All Women	u	(1,2)
	1970	--	--	--	--	--	--	--	--	(2,4)
Tunisia	1956	X	--	--	--	--	X	All Women	u	(1)
	1966	X	X	--	--	--	--	Ever-Married Women	--	(2)
	1975	X	X	--	--	--	X	Ever-Married Women	--	(2)
Uganda	1959	X	X	X	--	--	--	Adult African Women	u	(1)
	1969	X	X	--	--	X	--	All Women, 13+	--	(2,4)
	1980	u	u	u	u	u	u	u	u	n.a.
Upper Volta	1975	--	--	--	--	--	--	--	--	(4)
Zambia	1963	--	--	--	--	--	--	--	u	(1)
	1969	UN 75	X	--	--	X	--	All Women, 15+	X	(2,4)
	1980	u	u	u	u	u	u	u	u	n.a.
Zimbabwe	1961-62	u	u	u	u	u	u	u	u	n.a.
(Southern Rhodesia)	1969	UN 75	UN 75	--	--	X	--	African Women, 15+	--	(2,10)
Asia										
Afghanistan	1979	--	--	--	--	--	--	--	--	(2)
Bangladesh	1961	X	--	--	--	--	--	Ever-Married Women	u	(1)
	1974	UN 78-H	--	--	--	--	--	Married Women	u	(2,5)
Bhutan	1969	u	u	u	u	u	u	u	u	n.a.
Burma	1973	--	--	--	--	--	--		--	(5)
China (PRC)	1953	u	u	u	u	u	u	u	u	n.a.

Hong Kong	1961	--	UN 65	--	--	--	--	All Ever-Married Women	u	(1)
	1966	UN 75	UN 75	u	u	u	u	All Ever-Married Women	u	(10)
	1971	UN 75	UN 75	--	--	--	X	All Ever-Married Women	--	(5)
	1976	UN 78-H	X	u	u	X	X	All Ever-Married Women	u	(11)
India	1961	--	--	--	--	--	--	--	u	(1)
	1971	--	--	X	--	--	X	All Married Women	u	(4,5)
Indonesia	1961	X	X	--	--	--	--	All Ever-Married Women	u	(1)
	1971	UN 75	UN 75	--	--	--	--	All Ever-Married Women	--	(2,5)
	1980	X	X	--	--	X	X	All Ever-Married Women	u	(11)
Iran	1956	--	--	--	--	--	--	--	u	(1)
	1966	--	--	--	--	--	u	--	u	(2)
	1976	--	--	--	--	--	u	--	u	(2)
Iraq	1957	--	UN 65	--	--	--	X	All Married Women	u	(10)
	1965	X	X	--	--	--	u	All Ever-Married Women	u	(2)
	1977	X	X	--	--	--	--	All Ever-Married Women	u	(3)
Jordan	1961	UN 65	UN 65	--	--	--	--	All Ever-Married Women	u	(1)
	1979	u	u	u	u	u	u	u	u	n.a.
Kampuchea (Cambodia)	1962	UN 71	UN 71	X	--	--	--	All Women, 15+	u	(1)
Korea, S.	1955	--	--	--	--	--	--	--	--	(5)
	1960	UN 65	--	--	--	--	--	All Women	--	(1,5)
	1966	UN 75	--	X	--	--	--	All Ever-Married Women	--	(5)
	1970	UN 75	UN 78-H	--	--	--	--	All Ever-Married Women	--	(2,5)
	1975	X	X	--	--	--	X	All Ever-Married Women	u	(2,11)
	1980	X	X	--	--	--	X	All Ever-Married Women	u	(11)

TABLE 2.3 (continued)

Region, Country or Area	Year of Census	Fertility Questions: Children Ever Born Alive	Children Still Living	Children Born in Past 12 Months (or other period)	Mother's Age at or Date of First Live Birth	Mother's Age at or Date of Most Recent Birth	Age at or Date of First Marriage	Universe for Fertility and Marriage Questions	Mortality Question: Deaths in Household in Past 12 Months	Sources Used to Determine Whether Questions Were Asked[a]
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Kuwait	1957	UN 65	X	--	--	--	X	All Ever-Married Women	u	(1)
	1961	u	u	u	u	u	u	u	u	n.a.
	1965	u	u	u	u	u	u	u	u	n.a.
	1970	UN 75	u	u	u	u	u	n.a.	u	(10)
	1975	UN 78-H	UN 78-H	u	u	u	u	n.a.	u	(10)
	1980	u	u	u	u	u	u	u	u	n.a.
Malaysia	1957	UN 65	--	--	--	--	--	All Women, 10+	u	(1)
	1960	UN 65	UN 65	--	--	--	--	All Ever-Married Women	u	(1)
	1970	UN 75	UN 75	--	--	--	--	Ever-Married Women	u	(2,5)
	1980	X	X	--	--	--	X	Ever-Married Women, 10+	u	(11)
Mongolia	1956	u	u	u	u	u	u	u	u	n.a.
	1969	u	u	u	u	u	u	u	u	n.a.
	1979	u	u	u	u	u	u	u	u	n.a.
Nepal	1961	UN 78-H	--	--	--	--	--	Ever-Married Women, 15+	u	(1)
	1971	UN 75	UN 75	X	--	--	--	Ever-Married Women	u	(2,11)
Pakistan	1961	X	--	--	--	--	X	All Ever-Married Women	u	(1)
	1972	X	X	--	--	X	X	All Ever-Married Women	--	(2,5)

Philippines	1960	X	X	--	--	--	--	All Ever-Married Women	u	(1)
	1970	UN 75	UN 75	--	--	--	X	All Ever-Married Women	--	(2,5)
	1975	X	X	--	--	--	--	Ever-Married Women	u	(11)
	1980	X	X	X	--	--	X	Ever-Married Women	u	(11)
Saudi Arabia	1962-63	u	u	u	u	u	u	u	u	n.a.
	1974	--	--	--	--	--	--	--	--	(3)
Singapore	1957	--	--	--	--	--	--	--	u	(1)
	1970	UN 75	UN 75	--	--	--	X	Ever-Married Women	--	(2,5)
	1980	X	--	--	--	--	X	Ever-Married Women	u	(11)
Sri Lanka	1963	--	--	--	--	--	--	--	u	(1)
	1971	UN 78-H	UN 78-H	--	--	X	X	All Ever-Married Women	--	(2,5)
Syria	1960	X	UN 78-H	--	--	--	X	All Currently-Married Women	u	(1,3)
	1970	UN 75	UN 75	--	--	--	u	n.a.	u	(2,3)
Taiwan	1956	u	u	u	u	u	u	u	u	n.a.
	1966	X	u	u	u	u	u	All Ever-Married Women	u	(8)
	1970	--	--	--	--	--	--	--	--	(5)
	1975	u	u	u	u	u	u	u	u	n.a.
Thailand	1960	UN 65	--	--	--	--	--	Ever-Married Women, 13+	u	(1)
	1970	UN 75	X	--	--	--	--	Persons, 11+	--	(2,5)
	1980	X	X	--	--	--	X	Ever-Married Women	u	(11)
Turkey	1955	u	u	u	u	u	u	u	u	n.a.
	1960	--	--	--	--	--	--	--	u	(1)
	1965	u	u	u	u	u	u	u	u	n.a.
	1970	UN 75	UN 78-H	--	--	--	u	All Ever-Married Women	u	(2)
	1975	UN 78-H	--	--	--	--	u	Ever-Married Women, 12+	u	(2,10)
	1980	u	u	u	u	u	u	u	u	n.a.
Vietnam	1960	u	u	u	u	u	u	u	u	n.a.
	1974	u	u	u	u	u	u	u	u	n.a.
	1979	u	u	u	u	u	u	u	u	n.a.
Yemen (Aden)	1973	--	--	--	--	--	--	--	u	(3)
Yemen (San'a)	1975	--	--	--	--	--	X	Total Population	u	(3)

TABLE 2.3 (continued)

Region, Country or Area	Year of Census	Fertility Questions: Children Ever Born Alive	Children Still Living	Children Born in Past 12 Months (or other period)	Mother's Age at or Date of First Live Birth	Mother's Age at or Date of Most Recent Birth	Age at or Date of First Marriage	Universe for Fertility and Marriage Questions	Mortality Question: Deaths in Household in Past 12 Months	Sources Used to Determine Whether Questions Were Asked[a]
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Latin America										
Argentina	1960	UN 69	--	--	--	--	X	All-Ever Married Women	u	(1)
	1970	UN 75	X	--	--	--	--	All Women, 12+	--	(2)
	1980	u	u	u	u	u	u	u	u	n.a.
Bolivia	1950	u	u	u	u	u	u	u	u	n.a.
	1976	UN 78-H	X	--	--	X	u	n.a.	u	(2)
Brasil	1960	UN 78-H	X	--	--	--	X	All Women, 10+	u	(1)
	1970	UN 75	UN 75	X	--	--	--	All Women, 15+	--	(2)
	1980	u	u	u	u	u	u	u	u	n.a.
Chile	1960	UN 69	--	--	--	--	--	All Women, 12+	u	(1)
	1970	UN 75	X	--	--	--	--	All Women, 15+	--	(2)
Colombia	1964	--	--	--	--	--	--	--	u	(1)
	1973	UN 75	UN 75	--	--	X	--	All Women, 15+	--	(2)
Costa Rica	1963	--	--	--	--	--	--	--	u	(1)
	1973	UN 75	UN 75	--	--	--	--	All Women, 15+	--	(2)
Cuba	1953	UN 59	u	u	u	u	u	n.a.	u	(10)
	1970	u	UN 75	u	u	u	u	n.a.	u	(10)
Dominican Rep.	1960	--	--	--	--	--	--	--	u	(1)
	1970	UN 75	UN 75	X	--	--	--	All Women, 15+	--	(2,9)
Ecuador	1962	--	--	--	--	--	--	--	u	(1)
	1974	UN 75	UN 78-H	--	--	X	--	All Women, 15+	--	(2)
El Salvador	1961	--	--	--	--	--	--	--	u	(1)
	1971	UN 75	UN 75	X	--	--	--	All Women, 14+	--	(2,9)
Guatemala	1964	X	--	--	X	--	--	All Women Who Have Borne Children	u	(1)
	1973	UN 75	UN 78-H	--	--	X	--	All Women, 15+	--	(2)

Haiti	1960	u	u	u	u	u	u	u	u	n.a.
	1971	--	--	X	--	--	--	All Women, 15-49	X	(2,9)
Honduras	1961	--	--	--	--	--	--	--	u	(1)
	1974	UN 78-H	X	--	--	X	--	All Women, 15+	--	(2)
Jamaica	1960	UN 69	UN 69	X	X	--	--	All Women, 14+	u	(1)
	1970	X	--	X	X	X	X	All Women, 14+	--	(2,9)
Mexico	1960	UN 69	--	--	--	--	--	All Women	u	(1)
	1970	UN 75	--	--	--	--	--	All Women, 12+	--	(2)
	1980	u	u	u	u	u	u	u	u	n.a.
Nicaragua	1963	UN 71	--	--	--	--	--	All Women Who Have Borne Children	u	(1)
	1971	UN 78-H	UN 78-H	X	--	--	--	All Women, 15+	--	(2,9)
Panama	1960	--	--	--	--	--	--	--	u	(1)
	1970	X	--	X	--	--	--	All Women, 15+	--	(8,9)
	1980	u	u	u	u	u	u	u	u	n.a.
Paraguay	1962	UN 69	--	--	X	--	--	All Women, 12+	u	(1)
	1972	UN 75	UN 78-H	--	--	X	--	All Women, 15+	--	(2,9)
Peru	1961	UN 65	--	--	X	--	--	All Women	u	(1)
	1972	UN 75	UN 78-H	X	X	--	--	All Women, 12+	X	(2,9)
Puerto Rico	1960	UN 69	--	--	--	--	X	Ever-Married Women, 14+	--	(1)
	1970	UN 75	--	--	--	--	X	All Women, 14+	--	(9)
	1980	X	--	--	--	--	X	All Women, 15+	--	see notes
Trinidad and Tobago	1960	UN 78-H	--	X	X	--	X	All Women	u	(1)
	1970	X	--	X	X	X	X	All Women, 14+	--	(9)
	1980	u	u	u	u	u	u	u	u	n.a.
Uruguay	1963	--	--	--	--	--	--	--	u	(1)
	1975	UN 78-H	UN 78-H	X	--	--	--	All Women, 15+	--	(2)
Venezuela	1961	UN 69	--	--	X	--	--	All Women, 12+	u	(1)
	1971	X	--	--	--	--	--	All Women, 15+	--	(2)

Notes:

UN(year) = Question asked and data available in indicated issue of U.N. Demographic Yearbook.

X = Question asked.

-- = Question not asked.

u = Status of question unknown (not determined).

n.a. = Not Available.

TABLE 2.3 (continued)

Provided below is additional information for some countries. The census questions are referred to by column number. In some cases the notes indicate a published source for the data obtained from a given question.

[a]Column 9 numbered sources:

1. United Nations, 1974 (Handbook of Census Methods): Tables IV.1, IV.7, and IV.8.
2. United Nations Statistical Office files.
3. United Nations Economic Commission for Western Asia, 1978.
4. United Nations Economic Commission for Africa, 1977.
5. Cho, 1976.
6. Cairo Demographic Centre, 1970.
7. Caldwell and Okonjo, 1968.
8. U.S. Bureau of the Census 1977-78, pertinent country issue.
9. Organization of American States, 1977.
10. U.N. Demographic Yearbook.
11. United Nations Economic and Social Commission for Asia and the Pacific, 1980.

AFRICA

Algeria 1960: (3) By sex. (6) Year of present or last marriage asked.

Angola 1960: (1) By sex. (3) Children born alive in the last 12 months and last 5 years asked of non-African population.

Congo 1974: (8) Questions on paternal and maternal orphanhood also asked.

Egypt 1960: (1) Duration of marriage asked for total married life. 1966: (1) Children born dead also asked. (7) For present and previous marriages. 1976: (1) and (2) Available from CAPMAS; also by urban/rural.

Ghana 1960: Retrospective fertility questions were included in the Post-Enumeration Survey (Caldwell and Okonjo 1968, p. 124). 1970: the 1971 Supplementary Inquiry included retrospective fertility questions (USBC; UNECA, 1977).

Kenya 1962: (1) Data exclude women in Northern Province and 437,043 women with an unknown number of children ever born (UNDY 1965, footnote to Table 9). (2) Data shown in UNDY 1971 for non-African population only. 1969: (8) Questions on paternal and maternal orphanhood asked.

Lesotho 1976: (1) and (2) By sex. (5) Also asked if child is still living. (8) Also asked age at death.

Liberia 1974: (7) Census form also states that questions on children ever born and children surviving are to be asked of "all women over age 14 regardless of marital status."

Libya 1973: (6) Total duration of marriage.

Malawi 1977: (8) Questions on paternal and maternal orphanhood also asked.

Mozambique 1960: (1) By sex.

Rwanda 1978: (5) Also asked about deaths to infants born in the last 12 months.

Sierra Leone 1974: (8) Questions on paternal and maternal orphanhood asked.

South Africa 1960: (1) Children ever born was asked for all ever-married non-African women and published in UNDY 1965, Table 9. (3) Also asked if child died before 12 months of age.

Zimbabwe (Southern Rhodesia) 1969: (5) Also asked if child is still living.

Sudan 1973: (3) Children born in the past 12 months who died also asked.

Tanzania 1957: (3) Births since January 1, 1956 asked of ever-married non-African population. 1967: (1) and (2) Also shown by urban/rural. (8) Asked sex and age at death.

Tunisia 1966: (1) and (2) Republique Tunisienne (1973). 1975: (1) and (2) Available in unpublished tables at CPD.

Uganda 1959: (1) Children who died before or after age 1 also asked. 1969: (8) Questions on paternal and maternal orphanhood asked.

Zambia 1969: (8) By sex for deaths to persons under age 5 and 5 and over.

ASIA

Bangladesh 1961: Bangladesh was a part of Pakistan in 1961. (6) Duration of marriage asked for total married life. 1974: Detailed fertility questions asked on a postcensal survey; see Bangladesh, 1977. (6) Duration of current marriage asked.

Kampuchea (Cambodia) 1959: (1) Data collected by sex.

Hong Kong 1976: The 1976 By-census has associate status with the World Fertility Survey. (2) and (5) Asked of ever-married women aged 15-49.

Indonesia 1971: (1) and (2) Also by urban/rural.

Iraq 1957: Data in UNDY 1965 are for December 1957 census, but the U.N. Handbook (U.N., 1974) indicates questions were not asked. (6) Date or duration of present/last marriage asked of all women.

Korea, S. 1966 and 1970: (1) Also by urban/rural. 1975: (1) USBC.

Kuwait 1957: (1) By broad age groups. (2) By sex. (6) Age and duration for total married life for all ever-married persons. 1970: (1) Kuwaiti population only.

TABLE 2.3 (continued)

Malaysia 1970: (1) and (2) Also by urban/rural. (2) For West Malaysia only total for ever-married women aged 10 and over shown. (6) Number of times married and years married asked for present and prior marriages.

Nepal 1971: (3) Nepal, 1975.

Pakistan 1961: (6) Duration of total married life asked. 1972: Questions shown here were asked in a survey taken as a part of the overall census program. (1) and (2) By sex.

Philippines 1970: (1) and (2) Also by urban/rural.

Saudi Arabia 1962-63: Census officially rejected.

Singapore 1970: (1) and (2) Data by broad age groups. (6) Age at and date of first marriage asked.

Sri Lanka 1971: (5) Within past 5 years. (6) Age and duration asked for present and prior marriages.

Syria 1960: (1) Present or last marriage only. (2) Asked for present marriage (ECWA, 1978) but not listed in U.N. Handbook (U.N., 1974). (6) Duration of present marriage also asked. 1970: (1) and (2) Syrian population only; also by urban/rural. (7) CEB asked of married women; children surviving for ever-married women.

Taiwan 1966: (1) USBC.

Thailand 1970: (1) Also by urban/rural.

LATIN AMERICA

Argentina 1960: (6) Year of most recent marriage asked.

Brasil 1960: (6) Year of most recent marriage asked. 1970: (1) and (2) Also by urban/rural.

Chile 1970: (1) Also by urban/rural; data by broad age groups.

Colombia 1973: (1) Also by urban/rural.

Cuba 1970: (2) Also by urban/rural. (5) Asked of women aged 15 to 49.

Dominican Republic 1970: (1) and (2) Also by urban/rural. (3) Births in 1969 asked of women aged 15 to 49. (6) Duration asked for persons aged 15 and over and living in "union libre" (consensual unions).

Ecuador 1974: (1) Also by urban/rural.

El Salvador 1971: (1) and (2) Also by urban/rural. (3) Number of children born in 1970 asked of women aged 14 to 49; also asked how many of those born in 1970 died in that year.

Guatemala 1973: (1) Also by urban/rural. (5) Whether last child living also asked.

Haiti 1971: (3) By sex. (8) Also asked age and sex.

Honduras 1974: (5) Whether last child living also asked.

Jamaica 1960: (1), (2), (3) By sex. 1970: (1) USBC (3) Data on live births/still births collected separately. (6) Duration of current union for women under age 45 and duration of union at age 45 for women aged 45 and over.

Nicaragua 1971: (3) Children born in 1970 asked of women 15-49; also asked how many of those born in 1970 died in that year. (8) Question on maternal orphanhood asked.

Panama 1970: (1) USBC. (3) Asked of women aged 15 to 50.

Paraguay 1972: (1) Also by urban/rural. (5) Whether last child living also asked. (8) Question on maternal orphanhood asked.

Peru 1972: (1) Also shown by urban/rural. (8) Question on maternal orphanhood also asked.

Puerto Rico 1970: (1) Also shown by urban/rural. 1980: (9) Francese, 1979.

Trinidad and Tobago 1960: (6) Duration of present or last marriage asked (at age 45 if older than 45) including common law unions. 1970: (3) Data on still births also collected. (6) Duration of current union for women under age 45 and duration of union at age 45 for women aged 45 and over.

TABLE 2.4 Length of Time Between Censuses and International Availability of Provisional and Final Counts and Age-Sex Distribution: 1970 and Later, in Selected Nations in Developing Regions

		International Availability of Data[a]				
			Final Totals		Age Distribution (first UNDY to include data)	
		Provisional Totals	Published in PVSR	Not Yet Published		
Region, Country	Date of Census	(months since census)	(months since census)	(months since census, as of January, 1981)	By Sex	By Sex and Urban/Rural Residence
Africa						
Median	--	11.0	49.0	46.0	--	--
Algeria	2/77	37	--	46	--	--
Angola	12/70	18	--	120	--	--
Benin	3/79	--	--	21	--	--
Burundi	8/79	13	--	16	--	--
Cameroon	4/76	26	44		1978	1978
Central African Republic	12/75	--	--	60	--	--
Congo	2/74	7	--	82	--	--
Egypt	11/76	4	49		--	--

Ghana	3/70	12	36		1971	--
Guinea	12/72	--	--	96	--	--
Ivory Coast	4-5/75	4	40		1977[b]	1977[b]
Kenya	8/79	7	--	16	--	--
Lesotho	4/76	20	--	56	--	--
Liberia	2/74	--	37		1978	--
Libya	7/73	11	62		1975[c]	1975[c]
Madagascar	12/74-6/74	--	--	66	--	--
Malawi	9/77	6	--	39	--	--
Mali	12/76	3	45		--	--
Mauritania	12/76	6	--	48	--	--
Morocco	7/71	5	--	113	1972[c]	1972
Mozambique	12/70	18	78		1977	--
	8/80	--	--	4	--	--
Namibia	5/70	--	61		--	--
Niger	11/77	--	--	37	--	--
Nigeria	11/73	--	--	85	--	--
Rwanda	8/78	16	--	28	--	--
Senegal	4/76	5	53		1977	--
Sierra Leone	12/74	6	39		1977	--
Somalia	2/75	--	--	70	--	--
South Africa	5/70	19	82		1972[c]	1976
	5/80	--	--	7	--	--
Sudan	4/73	17	62		--	--
Tanzania	8/78	22	--	28	--	--
Togo	3-4/70	5	17		1977	--
Tunisia	5/75	22	64		--	--
Uganda	1/80	--	--	11	--	--
Upper Volta	12/75	3	--	60	--	--
Zambia	8-9/80	--	--	3	--	--

TABLE 2.4 (continued)

Region, Country	Date of Census	International Availability of Data[a]: Provisional Totals (months since census)	Final Totals: Published in PVSR (months since census)	Final Totals: Not Yet Published (months since census, as of January, 1981)	Age Distribution (first UNDY to include data): By Sex	Age Distribution (first UNDY to include data): By Sex and Urban/Rural Residence
<u>Asia</u>						
Median	--	11.0	28.5	18.0	--	--
Afghanistan	6/79	6	--	18	--	--
Bangladesh	3/74	9	27		1978-H	1978-H
Burma	4/73	8	74		--	--
Hong Kong	3/71	6	18		1973	--
	5-8/76	--	--	52	1978-H	--
India	4/71	2	23		1972	1973
Indonesia	9/71	12	54		1973[c]	1973[c]
	10/80	--	--	2	--	--
Iran	11/76	4	--	49	1978	1978
Iraq	10/77	5	--	38	--	--

Jordan	11/79	4	--	13	--	--
Korea, South	10/70	--	11		1973	1973
	10/75	5	50		1977	1977
	10/80	--	--	2	--	--
Kuwait	4/70	--	20		1972	--
	4/75	11	26		1975[b]	--
	4/80	--	--	8	--	--
Malaysia	8/70	16	43		1973	1973
	6/80	--	--	6	--	--
Mongolia	1/79	17	--	23	--	--
Nepal	6/71	15	30		1973	1973
Pakistan	9/72	12	42		--	--
Philippines	5/70	--	16		1973	1973
	5/75	13	--	67	--	--
	5/80	--	--	7	--	--
Saudi Arabia	9/74	18	--	75	--	--
Singapore	6/70	--	9		1970	--
	6/80	--	--	6	--	--
Sri Lanka	10/71	2	14		1978-H	1978-H
Syria	9/70	6	42		1973	1973
Thailand	4/70	11	44		1973	1973
	4/80	--	--	8	--	--
Turkey	10/70	11	--	122	1972[b]	--
	10/75	14	32		1976[b]	--
	10/80	--	--	2	--	--
Vietnam, North	4/74	29	--	80	--	--
	11/79	--	10		--	--
Yemen (Aden)	5/73	13	46		1974	1978-H
Yemen (San'a)	1/75	5	--	71	--	--

TABLE 2.4 (continued)

Region, Country	Date of Census	International Availability of Data[a]				
			Final Totals		Age Distribution (first UNDY to include data)	
		Provisional Totals (months since census)	Published in PVSR (months since census)	Not Yet Published (months since census, as of January, 1981)	By Sex	By Sex and Urban/Rural Residence
Latin America						
Median	--	8.0	39.0	7.0	--	--
Argentina	9/70	6	--	123	1973	--
	10/80	--	--	2	--	--
Bolivia	9/76	3	18		1977	--
Brazil	9/70	6	30		1972	1972
	9/80	--	--	3	--	--
Chile	4/70	8	83		1972[b]	1972[b]
Colombia	10/73	14	50		1976[b]	--
Costa Rica	5/73	10	22		1974	1974
Cuba	9/70	3	54		1972[c]	1972[c]
Dominican Republic	1/70	8	26		1972	1974

Ecuador	6/74	3	33		1975[b]	1975[b]
El Salvador	6/71	9	18		1972	1972
Guatemala	3/73	15	48		1974[c]	1974[c]
Haiti	8/71	7	43		1978-H	1978-H
Honduras	3/74	9	39		1977	1977
Jamaica	4/70	11	83		1973	--
Mexico	1/70	5	14		1972	--
	6/80	3	--	6	--	--
Nicaragua	4/71	14	44		1974	1974
Panama	5/70	1	22		1973	--
	5/80	4	--	7	--	--
Paraguay	7/72	23	41		1975	1975
Peru	6/72	6	21		1978-H	1978-H
Puerto Rico	4/70	8	23		1972	1972
	4/80	--	--	8	--	--
Trinidad and	4/70	17	77		1978-H	--
Tobago	5/80	--	--	7	--	--
Uruguay	5/75	1	--	67	1978[b]	1978[b]
Venezuela	11/71	13	67		1978-H	--

[a]International availability was measured as the appearance of the data in one of two United Nations publications: Population and Vital Statistics Report (PVSR), published quarterly; and the United Nations Demographic Yearbook (UNDY), published annually. 1978-H indicates the Historical Supplement to UNDY 1978.

[b]Provisional; no final figures yet published.

[c]Provisional, but final figures published in a subsequent volume.

totals. The median number of months in this last category is 46 among African nations and 18 among Asian nations. For many of these countries, especially in Africa, the indicated census is the first. Not surprisingly, the first census often requires more time between field work and the publication of results, especially time for data processing. However, even before the results of these first censuses are published, the data are made available to and used by governments in their planning. These first censuses also provide important baseline information for the long-term development of statistical systems. Many countries in Africa, and a few in Asia and Latin America, have not yet provided age distributions for publication in the U.N. Demographic Yearbooks for censuses conducted in the 1970s.

2.7 MEASURING ERROR IN CENSUS DATA

Although a census is an effort to enumerate every eligible person within the defined area, it is known that this is an ideal that is not attained in actual practice. Moreover, it is futile to expect that each item of information will be reported correctly. In order to use census data, some measure of its accuracy is needed. To meet this need, a number of methods have been developed for assessing the quality and completeness of a census. In the following discussion, several general error problems in censuses are discussed first, and then attention is focused on completeness of enumeration and the accuracy of the age data because of the importance of these items in estimating fertility and mortality.

Errors arise most fundamentally through the failure of respondents to provide full and accurate information. This is more likely to happen when the information relates to another person in the household, that is, when there is proxy reporting. Errors may arise through a failure to include all the persons living in the specified area, or the respondent may fail to report all of the persons in the household. Entire households may be omitted. Overcounts and double counts may occur. There may be misunderstanding of the concepts being used, with the result that the respondent supplies information for a question that was not asked. Errors may be entered on the questionnaire if the interviewer makes a recording mistake or misunderstands an answer. Errors may also arise during the processing of data. Electronic computers have greatly increased the ability to apply uniform rules for editing and coding, but they are also capable of applying the wrong rule--with great faithfulness to the instructions and disastrous results for the data.

Quality control at all phases of the operation is an essential part of a good census. Equally important is documentation of all steps in the collection and processing of the data. Effective use of census results often requires information on exactly how the operation was carried out and other measures of the quality of the data. The final census reports should include at least summary information on the types and extent of the editing that has been performed.

One way to measure the accuracy or completeness of coverage is to compare census results with other related data, such as that from a post-enumeration survey. Another procedure is to compare the results of one census with those of a previous one, taking into account migration and the number of births and deaths during the period between censuses. In applying this measure one needs some assurance that the degrees of completeness of the two censuses are approximately equal or, if not, that suitable adjustments can be made. The application of these qualifications frequently is not possible in developing nations.

In some instances, reinterviewing a sample of the households included in a census has shed light on the quality of that census, as described earlier. However, reinterviewing in a sample of areas or of households does not necessarily lead to discovery of the persons who were missed in the original enumeration. Social conditions which may have led to underenumeration of specified groups in the population may have the same effect on the second enumeration. For example, highly mobile young men may be no easier to enumerate in a well controlled sample survey than in the census itself. Also, some certain items are equally likely to be underenumerated in both situations, such as a death that occurred during the past 12 months. Similarly, checks against external sources of information--such as school registration, summary information available from income tax returns, and social security records--can be helpful in evaluating the quality of a census, but they are of limited value if they are themselves subject to the same types of errors, for example, missing individuals in certain age groups, or age reporting problems.

2.7.1 Estimating Completeness of Coverage

Table 2.5 (panel A) summarizes information on estimated underenumeration in selected censuses in the 1960, 1970, and 1980 rounds. Estimates are available for 15 censuses (12 countries) in Africa, 29 censuses (17 countries) in Asia, and 33 censuses (21 countries) in Latin America. The median estimated levels of underenumeration are about 3 percent in Asia, 4 percent in Latin America, and 5 percent in Africa, but the range is considerable--from 0.1 to 12.5 percent. Most of the estimates shown were collected from national governments or prepared by the International Statistical Programs Center at the U.S. Bureau of the Census, and the methods used are subject to several limitations. For example, the population enumerated in one census is compared with the population expected on the basis of projections from an earlier census. Ideally, such projections should be based on demographic models or on analysis of the relevant and available demographic experience.

Although some of the estimates shown in Table 2.5 are very low and probably unreliable, they provide useful and probably minimum average indicators of the levels of underenumeration. Where such computations are available for two or three censuses, they tend to indicate different patterns over time. In some countries (e.g., Iran and Costa Rica) available data suggest that completeness of coverage has increased in recent censuses. In other countries (e.g., Sierra Leone, South Korea, and the Dominican Republic), later censuses have higher levels of reported underenumeration, which may be explained in part by improved methods for measuring underenumeration in some of the more recent censuses.

2.7.2. Imputation

A question related to coverage completeness is what procedures should be adopted for handling partial or missing information? A census interview or proxy reporting by neighbors may produce little information beyond the number of people in the household, or a household may not be interviewed despite information that the household exists, or information on one or a few items may be missing. In data collection processes as large as censuses, it is necessary to have relatively uniform procedures for handling such cases. Repeat

TABLE 2.5 Measures of Accuracy and Completeness of Censuses in the 1960, 1970, and 1980 Rounds: Selected Developing Countries by Region

Measure	Africa	Asia	Latin America
Total Number of Countries	40	32	23
Total Number of Censuses	69	78	49
A. Estimated Percentage Underenumeration			
Number of censuses for which data are available (percentage of total censuses)	15 (22%)	29 (37%)	33 (67%)
	(number)	(number)	(number)
Percent: 0-1.9	1	11	5
2.0-3.9	5	5	10
4.0-5.9	5	9	10
6.0+	4	4	8
	(percent)	(percent)	(percent)
Median	4.8	2.9	4.0
Mean	5.1	3.1	4.5
Range	1.6-11.0	0.1-7.5	0.4-12.5
B. U.N. Index of Age-Sex Accuracy			
Number of censuses for which data are available (percentage of total censuses)	39 (57%)	52 (67%)	43 (88%)
	(number)	(number)	(number)
Index Value: 0-19	2	3	13
20-39	7	23	28
40-59	19	16	2
60+	11	10	0
	(index)	(index)	(index)
Median	49	40	25
Mean	53	47	25
Range	11-109	18-123	10-52
C. Myers Index of Age Heaping			
Number of censuses for which data are available (percentage of total censuses)	20 (29%)	32 (41%)	37 (76%)
	(number)	(number)	(number)
Index Value: 0-0.9	0	1	1
1.0-9.9	6	16	24
10.0-19.9	8	6	10
20.0-29.9	4	4	2
30+	2	5	0
	(index)	(index)	(index)
Median	15.4	8.4	8.4
Mean	18.8	12.3	8.4
Range	6.4-66.4	0.8-34.7	0.9-22.2

Source: Table 2.1

visits to the field are not feasible in all cases, and even if possible, multiple return visits would not produce complete information. One common procedure is to impute missing information on the basis of past or current information (United Nations, 1980).

In earlier censuses a standard technique during the editing of census data was to treat inconsistencies or missing information (blanks) as "don't know" responses, with published distributions showing the number of "don't know" cases. However, data users wanted to present distributions or otherwise analyze the findings, and they disregarded "don't know" cases. This practice implicitly assumed the same distributions among the "don't know" responses as among the known cases, for example on age or number of living children, an assumption often not valid. Also, problems were presented in multivariate analysis by the presence of different numbers of "don't know" cases for selected study variables. Hence the data users directed pressure to census organizations to make more complex allocations of the unknown cases. Three procedures were developed.

The first procedure is the application of a deterministic rule to assign particular values to an inconsistent or unknown case. For example, if the census questionnaire provides information on the occupation and industry of a given individual, the recorded response "never worked" might be changed to the category "worked last year." The second procedure is the cold deck method which involves the insertion of some values that do not depend on material directly observed in traditional ways. The cold deck method is a stochastic process that makes use of more detailed information in the imputation process, e.g., the age distribution of women married to husbands of a particular age (determined from a previous census or survey). The cold deck procedure, sometimes carried out manually with decks of cards containing the appropriate distributions of values to be imputed, is time consuming.

The third procedure is the use of a hot deck in which the information on a recently processed person with similar characteristics, i.e., who falls in the same cell on some selected matrices from the same census or survey, is used to impute the missing information. It is possible to impute all characteristics for a missing person or household with this technique, depending on the rules adopted. The basic idea is to maximize the information available to the statistical office responsible for processing census data, based on the assumption of similarity between persons whose characteristics are known and persons for whom some or many characteristics are unknown. The availability of large-memory computers has enhanced the possibilities for use of the hot deck method. In the 1960 census in the United States, a total of 776,665 persons were imputed or 0.4 percent of the official national count. Subsequent analysis suggested that there may have been an overimputation of 100,000 to 400,000 persons (Taeuber and Hansen, 1964; Shryock and Siegel, 1973).

Imputation rules should avoid the generation of much false information. A decision must be made also whether to impute data on all variables or only on certain items. (For surveys the hot deck method can present more problems because there are fewer cases. Therefore, for surveys the imputation rules cannot be as specific as for censuses.)

A particular problem arises in subsequent analysis of small area data from censuses if much imputation has occurred in some or many of the small areas, such as inner city census districts or sections of shantytowns. However, users can be alerted to potential problems caused by imputation if the tabulations are marked in italics or with a selected symbol when the proportion of imputed cases is above a stated level. An alternative is to suppress data in small area tabulations for those areas that have imputed data above stated proportions.

For variables used in fertility and mortality estimation the imputation rules require consideration of possible circularity for the assumptions underlying indirect estimation techniques. In general the understanding of the effects of imputation, including effects on fertility and mortality estimation, are not well understood and hence require further research.

2.7.3 Assessing the Accuracy of Age Reporting

It is well known that there are certain preferences in age reporting, such as the tendency for people to report ages that end in 0 or 5. In some cultures the preference runs to other digits. Under ordinary circumstances it is reasonable to expect that each terminal digit in an age report is as likely as any other, except when dealing with groups of young ages. Any departure from an equal distribution of terminal digits in the age report is thus a signal of a problem in the quality of the age data.

Interpretation of the computations to measure "age heaping" must take into account the cultural traditions that affect age reporting. Also, one must consider the possibility that changes in digit preference from one census to another may reflect changes in procedures rather than changes in the quality of the data. In one instance there seemed to be a change in digit preference from 0 to 9. The explanation turned out to be very simple. One census had asked for current age, the other had called for year of birth. In the latter case there apparently was a tendency for many people to report a year ending in 0 (e.g., 1930, 1940), with the result that at the time of the census the age at last birthday for most of those people was a number ending in 9.

Another common preference in age reporting is a tendency to favor certain threshold ages, such as the age for entering or leaving school, the age at which legal majority is attained, the minimum age at which an individual can take a job, get married, retire or enjoy certain privileges, such as driving a car. Tendencies for age reports to be biased systematically upward or downward have also been detected. For example, among females in many African countries the bias is systematically upward among older teenagers and women in their early twenties, and in some cases systematically downward for girls aged 10-14. If not adjusted (see Brass et al., 1968; Pison, 1978), these biases cause problems in fertility estimation, because they lead to underestimates of women aged 10-14 and 15-19, and to overestimates of women aged 20-35.

A simple but crude measure of the extent of age misreporting is the United Nations Age-Sex Accuracy Index, which is based on the relative magnitudes of age and sex ratios. In effect, this index is a measure of deviations from expected values based upon a life table population. It does not take account of migration or of critical events in the history of a population that may be very age-selective, for example, high infant and child mortality due to war and famine conditions or heavy losses of military and civilian personnel in wars. (These factors may be less troublesome in many LDCs than they are in developed nations, because many LDCs have not experienced major international migration or large-scale population losses in major wars.) The United Nations has described age-sex data as "accurate," "inaccurate," or "highly inaccurate" depending on whether the U.N. index is under 20, 20-40, or over 40 (Shryock and Siegel, 1973:222). However, some countries with good age reporting have scores in the 20-30 range, e.g., South Korea.

A second summary measure of age misreporting is the Myers Index of Age Heaping, which indicates the extent of concentration on or avoidance of particular terminal digits. It is calculated by determining what proportion of the total population is the group whose reported age ends in a given digit (Shryock and Siegel, 1973, based on Myers, 1940).

Panels B and C in Table 2.5 summarize the U.N. Age-Sex Accuracy Index and the Myers index information presented in Table 2.1. Note that the ranges of these indexes are considerable. The most accurate age reporting in the three regions, as indicated by these indexes, occurs in Latin America, where at least one age misreporting index was calculated for every country. Age reporting has more errors in Asia and more yet in Africa, although the number of countries for which data were not available is substantially larger in these two regions. In general, the two indexes have a high degree of correlation.

There is some evidence that the quality of age data from censuses in LDCs is improving. In the case of Latin America, Kamps reports a median Myers index of 27.3, 17.1, and 12.5 for the 1950, 1960, 1970 rounds respectively (1976:8). However, while the index indicates that reporting improved in the second and third rounds, the decrease in the index from 1960 to 1970 is only half of the 1950-60 decrease, suggesting that improvements from "poor" to "good" data are more likely than changes from "good" to "very good" in the future. A similar impression is conveyed by the U.N. Index for the same three rounds, which has values of 35, 25, and 22, respectively (Kamps, 1976:19).

An analysis of age misreporting for a particular census requires more information than is provided by either or both of these indexes, which are subject to deficiencies. Of the two, the Myers index is subject to fewer biases and is preferable for measuring age misreporting. However, its computation requires that age data be available by single years. The U.N. Index has a considerable advantage in that it requires only tabulations by five-year age groups by sex; such data are often more available than single-year age detail. (For a more detailed discussion of the problem of age misreporting, see Ewbank, 1981.)

Errors in age reporting are not necessarily indicative of errors in reporting other characteristics of the population. Although poor-quality age data probably indicate that the quality of the data on other characteristics is also poor, one cannot assume that high-quality age data imply equally high-quality data on other characteristics.

2.8 CENSUS QUESTIONS RELATED TO FERTILITY

Questions designed specifically to measure current or past fertility have been included in the censuses of many developing countries. As indicated in Table 2.3, there is diversity in the specific questions asked. Children ever born (live births) is the one most frequently included. Some censuses also ask for the number of children still living at the time of the interview and whether they are living at home or elsewhere, or the number of children born during the last year, or during the last five years. In some censuses additional questions ask the age of the mother at first marriage and/or her age at the time of the most recent birth. Such questions normally are asked only of women who have been married, with marriage including consensual unions if this is a common occurrence in the country. The practice of early marriage is reflected in the fact that the target population for such questions is often specified as women 12 years old or over; in at least one country, 10 years is used as the minimum age.

Practices vary. In some cases the questions relating to fertility are included in the full censuses; in others they are included as part of a built-in sample or a sample added to a census. The latter choice may be preferable, for such data are not normally required for small areas within the country; national or regional estimates may satisfy the data needs perfectly well. Appendix B provides further details on the collection of data on children ever born, for use in the estimation of cumulative fertility (and childhood mortality when data on surviving children are also collected).

Table 2.6 summarizes information in Table 2.3 for the period 1965-74, using only the most recent 1970 round census for each country. For many countries the existence or availability of information on particular items is unknown. This is particularly so in Africa. Nevertheless, the available data sources indicate that among the 69 countries with a census in this period, at least 46 definitely included a question on children ever born (19 of 21 in Latin America) and 38 countries included a question on children surviving. These are impressive numbers. (Mortality measures are discussed in the next section, but the item on children surviving is noted here because it is so closely linked to the children-ever-born item in data collection and data analysis.)

As indicated above, one of the advantages of census data for the estimation of fertility and mortality is that even when tabulated only on a sample basis, sufficient numbers of cases are available to allow determination of regional patterns. However, a much smaller number of countries actually tabulate this information than collect it. If each country that collected information on children ever born and children surviving tabulated these data by age of mother (in five-year age groups) in addition to tabulating the age-sex distribution of the population, a considerable amount of fertility and child mortality analysis could be accomplished with relative ease, given current indirect estimation techniques.

Indirect estimation techniques that use data on children ever born and children surviving require tabulations by age of women aged 15 to 34 (Hill et al., 1981), and adjustments are needed if there are obvious errors in the age structure. Also, when fertility and mortality are changing, the estimated levels will refer to a point in time usually a few years prior to the census. Hence, a single census that includes simple questions on children ever born and children surviving can provide the data needed to estimate both relatively recent fertility and child mortality levels; however, there is the concurrent disadvantage that in countries in which fertility and mortality are changing (as is the case in many developing nations) the estimates will refer to a time period perhaps four to six years before the census. This time lag, when combined with the time that elapses between census taking and the availability of tabulations, means that when estimates are calculated and published, they often refer to a time period six, seven, or as much as ten years earlier.

Census data can also be used in applying other techniques for estimating fertility. (Many of these techniques are appropriate with survey data also.) A list of these techniques and the data they require are shown in Table 2.7, part A.

TABLE 2.6 Number of Countries Including Fertility and Mortality Questions in Their Census Schedules and the Availability of Information About Those Questions: 1970 Census Round in Selected Developing Countries, by Region

Part A. Number of Countries Including Fertility and Mortality Questions in Census

Questions	Africa			Asia			Latin America		
	Yes	No	N.D.[a]	Yes	No	N.D.[a]	Yes	No	N.D.[a]
1. Children Ever Born Alive	12	9	3	15	6	3	19	1	1
2. Children Still Living	11	9	4	13	7	4	14	7	0
3. Children Born in Past 12 Months (or other period)	6	15	3	2	18	4	9	11	1
4. Mother's Age at or Date of First Live Birth	0	20	4	0	20	4	3	17	1
5. Mother's Age at or Date of Most Recent Birth	5	16	3	2	18	4	7	13	1
6. Age at or Date of First Marriage	1	17	6	6	10	8	3	17	1
7. Deaths in Household in Past 12 Months	4	16	4	0	11	13	2	18	1

Part B. Availability of Information About Census Questions

	Africa	Asia	Latin America
Countries with a Census	24	24	21
Full information found[b]	17	10	20
Partial information found[c]	5	11	1
No information found[d]	2	3	0
Countries with no Census	15	8	2
Total Number of Countries	40	32	23

Note: Countries with more than one 1970 round census were counted only once.

[a]N.D. = not determined.
[b]A copy of the form or questionnaire was located, making a complete check possible.
[c]Available information suggests that at least one of the questions was included; a full check on the inclusion of all seven questions was not possible from available sources.
[d]Sources available included U.N. Demographic Yearbooks and historical supplements, census files at the U.N. Statistical Office, and sources listed in the notes to Table 2.3.

TABLE 2.7 Techniques for Estimating Fertility and Mortality Using Data Collected from Censuses[a]

Technique	Data Required
A. Fertility Estimation	
1. Brass-type methods that compare cumulated fertility rates (F) with reported average parity (P). [Cumulated fertility rates are obtained from data on children born during a recent period, frequently one year. Reported average parity is obtained from data on children ever born (CEB).]	
a. P/F ratio method: age version	Number of CEB, classified by age of mother. Total number of women in each age group. Number of children born during the year preceding the census, classified by age of mother, Or, alternatively, number of registered births in the year of the census, classified by age of mother.[b]
b. P/F ratio method: age version applied to first births only	Number of women who have had at least one child (mothers), classified by five-year groups. Total number of women, classified by five-year age groups. Number of first births occurring during the year preceding the census, classified by five-year age group of mothers. If the census does not include a question on date of most recent birth, these data may be obtained from a vital registration system.[b]

c. P/F ratio method: duration version (based on duration of first marriage, which is defined as the time elapsed since first union [marriage or consensual union], regardless whether subsequent unions have occurred)	Number of CEB, classified by duration of mother's first marriage. Number of ever-married women, classified by five-year marriage-duration groups. Number of children born during the year preceding the census, classified by duration of mother's first marriage, Or, alternatively, registered births in the year of the census, classified by duration of mother's first marriage.[b]
d. The P/F ratio method: duration version applied to first births only	Number of women (mothers) who have had at least one child, classified by duration of first marriage. Number of first births occurring during the year preceding the census, classified by five-year marriage-duration groups of mothers. If the census does not include a question on date of most recent birth, these data may be obtained from a vital registration system.[b] Total number of women, classified by five-year marriage-duration groups.
e. Comparison of cumulated cohort fertility with the average parities reported by the same cohorts at the time of the census	Number of CEB, classified by age of mother. Number of women in each age group from the current census and from one or more earlier censuses. Registered births, classified by age of mother for each of 15 or 20 years prior to the census.[b]
f. Comparison of registered intercensal cohort fertility with the cohort parity increments observed between two censuses	Number of CEB, classified by age of mother for two points in time 5 or 10 years apart. Number of women in each age group at both census dates or enough information to estimate the mid-year female population for each year for which birth registration data are available. Registered births, classified by age of mother for each year between two census dates.

TABLE 2.7 (continued)

Technique	Data Required
2. Intercensal fertility estimation based on cohort parity increments	Number of CEB, classified by age of mother for two points 5 or 10 years apart. Number of women aged 15 to 50, classified by five-year age groups at both points in time.
3. Estimation of the level of natural fertility from parity by duration of first marriage	A value of a(0), the earliest age at which a significant number of marriages take place. Number of women, classified by age and marital status. Number of CEB, classified by duration of mother's first marriage and current marital status.
4. Estimation of fertility by reverse-survival methods	
a. Reverse survival of the population under age 10	Population under age 10, classified by age (in single- or five-year age groups) and by sex. Total population at the time of the census. An estimate of the growth rate. Estimates of the probabilities of surviving from birth to exact x (l_x) for x = 1, 2, ..., 10.
b. Own-children method	Enumerated children (under age 15) whose mother was identified, classified by single years of own age and single years of mother's age. Enumerated children whose mother could not be identified, classified by single years of own age. Total number of women aged 15 to 65, classified by single years of age. Estimates of child mortality for the 15 years preceding the census. Estimates of female adult mortality for the 15 years preceding the census.

B. Mortality Estimation

1. Estimation of childhood mortality from information on CEB and children surviving (in the following four techniques having data classified by sex is useful but not essential)

a. Using data classified by age	Number of CEB, classified by sex and by mother's age. Number of children surviving (or number of children dead), classified by sex and by mother's age. Total number of women in each age group.
b. Using data classified by duration of mother's first marriage (time elapsed since first union)	Number of CEB, classified by sex and duration of mother's first marriage. Number of children surviving (or number of children dead), classified by sex and duration of mother's first marriage. Total number of women in each marriage-duration group.
c. Estimation of intercensal child mortality using hypothetical cohort data derived from two censuses	Number of CEB, classified by five-year age groups of mother (or five-year marriage-duration groups) from two censuses 5 or 10 years apart. Number of children surviving (or dead), classified by five-year age (or marriage-duration) group of mother from the same two censuses. Total number of women in each five-year age (or marriage-duration) group.
d. Estimation of child mortality when the fertility experience of true cohorts is known	Number of CEB, classified by five-year age (or marriage-duration) group of mother for two censuses 5 or 10 years apart. Number of children surviving (or dead), classified by five-year age (or marriage-duration) group of mother for the more recent census. Total number of women in each five-year age (or marriage-duration) group for both censuses.

TABLE 2.7 (continued)

Technique	Data Required
2. Estimation of conditional adult survivorship functions from information on orphanhood	
a. Brass method and regression method (regression method suitable only for information on maternal orphanhood)	Proportion of persons with surviving mother (or father) in each five-year age group. Number of births in a given year, classified by five-year age group of mother (or father)
b. Using data from two censuses	Proportion of persons with surviving mother (or father) in each five-year age group from two censuses 5 or 10 years apart. Number of registered births classified by five-year age group of mother (or father) for one of the census years, an intermediate year, or both census years.[b]
3. Estimation of conditional adult survivorship functions from information on widowhood	
a. Regression method: age version	Observed singulate mean ages at marriage (SMAM) for men and women. Proportion of ever-married men (or women) whose first wives (or husbands) were alive at the time of the census, classified by five-year age groups.
b. Regression method: duration version	Observed SMAM for males (or females). Proportion of ever-married women (or men) whose first husbands (or wives) were alive at the time of the census, classified by five-year marriage-duration groups (years elapsed since first union).

c. Using data from two censuses	Observed SMAM by sex at two censuses 5 or 10 years apart. Proportions by sex of ever-married population whose first spouse was alive at the time of each census, classified by five-year age (or marriage-duration) groups.
4. Estimation of adult mortality from information on the distribution of deaths by age	
a. Preston-Coale method	Number of deaths occurring in a specific time period, classified by age of decedent in five-year age groups.[b] Population classified by age in five-year age groups for the mid-point of the period to which the deaths refer. An estimate of the growth rate.
b. Brass method	Number of deaths occurring in a specific time period, classified by age (in five-year age groups) and by sex (if available); last age group must be open-ended. Population for the mid-point of the period to which the deaths refer, classified by age and sex to match the classification of deaths.
5. Estimation of adult mortality using age distributions of successive censuses	
a. Intercensal survivorship probabilities	Population at two censuses, classified by sex and age. (If the interval between censuses is not a multiple of five, at least one age distribution should be by single years of age.)
b. Intercensal survivorship probabilities with additional information on age pattern of deaths	Population at two censuses not more than 15 years apart, classified by age and sex. (One age distribution by single years of age is necessary if the intercensal interval is not a multiple of 5.) Number of deaths by age and sex for intercensal period, obtained from a registraion system or estimated using model life tables.[b]

TABLE 2.7 (continued)

Technique	Data Required
C. Estimation of fertility or mortality using stable or quasi-stable models	
1. Assuming stability and using an estimate of the growth rate	The population, classified by five-year age groups and by sex. Total population by sex for at least two points in time. An estimate of net migration during at least the last intercensal period. An estimate of the sex ratio at birth (unless the analysis is to be carried out for males and females separately).[b]
2. Assuming stability and using an estimate of l_2, the probability of surviving from birth to exact age 2	The population, classified by five-year age groups and by sex. An estimate of net migration during the period preceding the census. Number of CEB and number of children surviving, classified by age of mother. An estimate of the sex ratio at birth and the overall sex ratio of the population.
3. Assuming quasi-stability, caused by a long-term trend of mortality decline	Information necessary to obtain stable population estimates (as specified in 1 or, preferably, 2 above). Some basis for estimating the duration and pace of mortality decline, such as evidence of an increasing growth rate, estimates of child mortality from two censuses, or changes in the age composition of deaths.

[a]Many of these techniques can also be applied to data collected by surveys. For a more detailed description of these methods including examples, see Hill et al. (1981).
[b]Data that must be obtained from sources other than censuses.

2.9 CENSUS QUESTIONS RELATED TO MORTALITY

Major emphasis has been placed on securing evidence regarding fertility and child mortality from census data, but other data on mortality in general and on migration (not covered here) may be secured as well. In the absence of complete registration of deaths, some countries have used a census to secure information on the number of deaths during the previous year, or some other time period. (See column 8 of Table 2.3.) Results have generally been unsatisfactory. In some cultures any mention of persons who have died is routinely avoided, and any effort to secure information on deceased persons is likely to meet with resistance. Moreover, the death of an adult may lead to dissolution of the household, with any surviving members of the household being incorporated into one or more other households.

Reasonable estimates of child mortality frequently can be made from data on children ever born and children surviving. (Detailed explanations of the estimation procedures, including examples, are found in Hill et al., 1981). In doing so, care must be taken in the selection of a model life table to make sure that it is applicable to the conditions of the country--for example, when using child mortality estimates to construct infant mortality estimates. For the estimation of adult mortality, the work of Lotka (Lotka and Sharpe, 1911; Lotka, 1939) and model life tables generated by Coale and Demeny (1966) have led to the development of techniques for estimating adult mortality on the basis of age structure and an estimate of the rate of population growth obtained from two successive censuses. (The techniques require estimates of net migration also.) Here also, the selection of appropriate model life tables is critical. This presents a special problem in Africa where the model life tables are quite different from the mortality patterns observed in direct measurement data, usually collected in surveys. In other places, frequently two model life tables must be used, one for children under about age 10 and the other for the population age 10 and over. The techniques of mortality estimation that can be applied using census data, and the data required, are listed in Part B of Table 2.7.

2.10 DESIGN ISSUES AND OPTIONS

Figure 2.3 lists some of the major design issues and options to be considered when planning a census. The issues and options fall into five categories:

- I Institutional settings and arrangements
- II Cartography
- III Enumeration
- IV Data Processing
- V Dissemination of results

FIGURE 2.3 Major Design Issues and Options in Conducting a Population Census

I. Institutional settings and arrangements

- A. Place of census in government
    1. Responsibility of national statistical office
    2. Responsibility of some other permanent department or agency
    3. Independent ad hoc program
    4. Other arrangement
- B. Permanency of census organization
    1. Significant staff and related infrastructure maintained on a permanent basis
    2. Little or no staff or related census infrastructure maintained during intercensal years
- C. Integration of census and related programs
    1. High degree of integration, including common subject-matter staff, common field organization, etc.
    2. Little or no integration, with separate subject-matter staffs for census and other programs, separate field organizations, etc.
    3. Mixed
- D. Degree of centralization of census activity
    1. All activities carried out by the central census authorities
    2. Responsibility for significant aspects of the census (e.g., field work) decentralized, carried out by provincial or local authorities
    3. Mixed
- E. Transportation
    1. Vehicles obtained from permanent government agency pools or from Army
    2. Vehicles hired in private sector
    3. Extent to which public transportation can be used
- F. Logistics
    1. Forms and materials printed centrally and distributed to regions
    2. Forms and materials printed in regions
    3. Transport of forms, etc. to local areas
        - a. Census vehicles
        - b. Private vehicles
        - c. Public transportation or postal service
    4. Transport of completed forms from local areas to central office

II. Cartography

A. Mapping
1. Full mapping
a. Enumerators provided with maps of their individual enumeration area
b. Enumerators not provided with maps of enumeration areas
2. Village lists only
3. Mixed

B. Addresses
1. Full reliance on existing addresses and house numbers
2. All dwellings or structures specially numbered as part of census preparations
3. Mixed

C. Procedures for area identification in the personal and household record
1. Traditional system of hierachical coding of geographic areas down to place (village, town, city, etc.) and/or the minor civil division
2. Extension of the traditional system to include the enumeration area and possibly census tracts
3. Extension of the traditional system to incorporate detailed information on the exact location of the person or household in terms of geographic coordinates, block-face, address, etc. (that is, so-called geo-coding)

D. Extent of quality control required in all aspects of the cartography processes

III. Enumeration

A. Reporting method
1. Census forms completed by enumerator (enumerator or canvasser method)
2. Census forms completed by respondent (self-enumeration or householder method)

B. Counting rules
1. De jure
2. De facto
3. Mixed

C. Use of sampling to collect data on fertility or mortality items
1. Not used
2. Used
a. Some items not included in main census included in supplementary sample survey
b. Some items asked only in a sample of enumeration areas
c. Some items asked only for a sample of households
d. Mixed

D. Type of schedule (see also footnote a, Figure 4.1)
1. Questionnaire (contains full text of all questions to be asked, e.g., "How old is that person?")
2. Form (contains only indication of the topic or items of information sought, e.g., "Age")

Figure 2.3 (continued)

E. Field staff recruitment
   1. Staff temporarily deputed from other government ministries
   2. Staff temporarily hired from general public
   3. Other arrangements

F. Method of paying hired field staff

G. Management of field operations
   1. Duration of enumeration
   2. Enumerator workload
   3. Nature and extent of enumerator training
   4. Nature and level of field supervision

H. Extent of quality control required in all aspects of the enumeration process (including pretesting of forms and questionnaires)

IV. Processing

A. Method of data capture
   1. Entries on schedule converted electronically to computer tape using systems such as (FOSDIC, OMR, OCR, etc.)[a]
      a. Forms completed at time of enumeration
      b. Forms completed subsequently
   2. Keyboard input to diskette, disk, etc.
   3. Punch cards
   4. Hand count
   5. Mixed

B. Location of data-capture operations
   1. Centralized
   2. Multiple locations

C. Type of editing
   1. Manual editing
      a. in field
      b. in regional or central office
   2. Editing as part of data-capture operations
      a. in field
      b. in regional or central office
   3. Computer editing
      a. with imputation
      b. without imputation

D. Location of computer
   1. Within statistical office
      a. centralized
      b. decentralized
   2. Within other government agency
      a. centralized
      b. decentralized
   3. Elsewhere

E. Source of computer programs
   1. Ad hoc programs written specifically for census
   2. Existing, locally-developed editing or tabulation programs adopted for census
   3. Standard census software packages adopted for census (e.g., COCENTS, CENTS, TAB-68, TPL, UNEDIT, CONCOR, CANEDIT, GTS)[a]
   4. Mixed

F. Extent of quality control required in all aspects of data processing

V. Access to and dissemination of results

A. Method of publication for main census reports
1. No census report
2. Typeset
3. Offset copies of typed report
4. Offset copies of computer printouts
5. Computer-driven composition
6. Other or mixed

B. Other forms of access and dissemination
1. No other access or dissemination
2. Microfiche or microfilm copies of unpublished tables
3. Census data base
4. Summary tapes
5. Public-use sample tapes
6. Mixed

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[a]Explanation of data processing acronyms:

CANEDIT (Canadian editing package)--requires large machine, sophisticated processing capability.

CENTS (Census Tabulation System)--IBM assembler version of COCENTS; requires 24K memory.

COCENTS (COBOL Census Tabulation System)--developed by the U.S. Census Bureau. Requires 64K memory, COBOL compiler, and disk storage.

CONCOR (Consistency and Correction)--performs data editing and imputation. Assembler version developed by CELADE; U.S. Census Bureau has developed COBOL version. Census version (COBOL CONCOR) requires 128K memory, COBOL 74 compiler, and disk storage in the millions of characters.

FOSDIC (Film Optical Sensing Device for Input to Computers)-- transfers data from forms to magnetic tape.

GTS (Generalised Tabulation System)--U.S. Census Bureau package designed for use with UNIVAC machine.

OCR (Optical Character Reader)--reads hand-printed letters, figures, symbols, etc. and converts them to codes.

OMR (Optical Mark Reader)--senses bars, dots, etc. filled in on forms.

TAB-68--cross-tabulation package developed in 1968 by the Swedish Statistical Office. Requires IBM/OS.

TPL (Table Producing Language)--developed by U.S. Bureau of Labor Statistics. Requires IBM/OS with PL1 compiler and 256K memory.

UNEDIT--U.N. editing package designed for use on small computers with small files. Requires 32K memory. COBOL version being developed.

Most of the issues listed in Figure 2.3 have been discussed in greater detail above, but a few of them deserve special emphasis. Perhaps the primary point to be noted is the great range of options that confront planners of a census. Items in the first category, institutional settings and arrangements, seem reasonably straightforward when displayed in a simple list, but they are all factors that can have a huge effect on the ultimate success or failure of the census operation. Likewise, appropriate cartography and carefully defined geographical coding procedures are essential elements of a smoothly conducted census. In addition, the question of quality control is critical in all stages; this includes, for example, pretesting of forms and training and supervision of staff.

The expanding use of electronic computers, noted under Data Processing and Dissemination of Results, is likely to have significant effects on the future use of census data. Census data are fully exploited only rarely; tabulation and publication of results, including those related to fertility and mortality, are usually limited to only a fraction of what would be possible. The widespread application of computers in tabulating census results has opened up additional possibilities for extracting useful information from the census questionnaires, including the study of differentials by geographic region and socioeconomic groups. It is expected also that prospective improvements in programming will increase the timeliness of tabulations and publication of data as well as make possible more effective use of the information collected. Another significant development is that of making data tapes with individual identifiers deleted, available to analysts and other users outside the census offices. This practice increases the possibilities for additional skilled analysis of the data.

2.11 SUMMARY

The ideas and comments presented in this chapter suggest the following five summary points:

1. Census data are important and valuable for the estimation of levels and trends of fertility and mortality. They are useful for the direct computation of some basic measures, such as crude birth and death rates and age-specific rates, although these estimates normally

can be made only in conjunction with data from other sources--either surveys or CR/VS systems. (In theory, it is possible to calculate crude birth and death rates from census data only, that is, to obtain the numerator, as well as the denominator, from census data. Unfortunately, past experience suggests that this procedure so often yields such erroneous results that it is of limited practical value.) Censuses also provide the data for the denominator values needed to calculate vital rates. Where CR/VS systems are well developed, the combination of CR/VS and census data makes possible the estimation of birth and death rates for sub-regions and districts.

2. In developing nations, censuses can be particularly useful for the estimation of fertility and mortality via indirect estimation techniques. The necessary questions are not elaborate, but this is not to suggest that they are automatically easy to administer, transcribe, code, tabulate, and analyze. Collection and tabulation can be simplified by using built-in samples or samples added to censuses, generally samples of 10 percent or 5 percent and in some cases even 1 percent. Failures in the collection of data designed for indirect estimation techniques have occurred in some places, but in other places the techniques have proved to be powerful estimation tools.

3. To provide for the best use of census data for fertility and mortality estimation, as well as for estimating other parameters, attention must be directed to minimizing, detecting, and measuring errors in census data. Age misreporting is a primary problem.

4. Because censuses do not occur frequently, great care can be devoted to their design and execution. However, the infrequent nature of censuses also means that the baseline data they provide for estimating crude rates are often out of date. This is particularly true for geographic subdivisions of countries, because levels of internal migration may be unknown even when reasonably reliable estimates of vital rates can be constructed at the national level. For the same reason, census data are not the most appropriate basis for estimating trends in vital rates, except in a broad context and in the absence of other data collection mechanisms. However, censuses are useful for obtaining data to construct extended time series. In countries where quinquennial censuses are taken (e.g., Korea and Turkey), censuses can provide better information on recent trends.

5. Censuses will continue to be taken, with fertility and mortality estimation being only a marginal purpose. Given this fact, the best role for those concerned with understanding fertility and mortality in developing nations is to press for the inclusion of, and then the careful tabulation and analysis of, census questions that allow indirect estimation of these parameters.

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3 The Civil Registration and Vital Statistics System

3.1 INTRODUCTION

Another approach to the collection of basic fertility and mortality data is through civil registration and vital statistics systems (CR/VS). This chapter reviews the state of the art of CR/VS systems and includes six sections: definitions and background; advantages of CR/VS; disadvantages of CR/VS; the status of systems in developing countries with regard to actual operating efficiency; attempts at improvements; and a summary.

There is a vast technical literature on civil registration and vital statistics systems, stretching as far back as the seventeenth century, when such systems began to be officially established on a national basis. There are also reports on even older systems that existed in parts of countries--for example, regional registration systems that operated 500 years ago in China, Japan, and Korea and the parish record systems of Europe, which have been used to estimate fertility and mortality. No attempt is made here to comprehensively review this literature, however some of the more relevant recent documents include the following: the various United Nations handbooks on vital registration (U.N., 1953, 1955, 1958, 1973), Methods for Measuring Population Change: A Systems Analysis Summary (Linder, 1969), Systems of Demographic Measurement, General Evaluation: The Measurement Problem (Linder and Lingner, 1975), Systems of Demographic Measurement, Data Collection Systems: The Conventional Vital Registration System (Powell, 1975), Organizational Arrangements for a Vital Registration System (Powell, 1977). Many of the points in the following discussion have been drawn from these documents.

3.2 DEFINITIONS AND BACKGROUND

The United Nations defines civil registration as "the continuous, permanent, compulsory recording of the occurrence and characteristics of live birth, death, fetal death, marriage, divorce, annulment, judicial separation, adoption, legitimation and recognition, as provided through decree or regulation, in accordance with the legal requirements in each country. Civil registration is carried out primarily for the value of the legal documents as provided by law" (U.N., 1973:156). The statistical uses of these records are also specified (U.N., 1973:17):

> The compilation of vital statistics should have as its ultimate minimal goal (1) the provision of total monthly or quarterly summary counts of live births, deaths, marriages and divorces (and of foetal deaths if these are included in the collection programme) on a time schedule prompt enough to provide information for administrative or other needs; and (2) the production of detailed annual tabulations of such type and on such time schedule as will make possible their effective use for scientific analysis of the interrelationship between demographic, economic, and social factors, for planning, operating and evaluating public health programmes, and for other purposes as required, particularly in regard to the formulation and evaluation of economic and social plans. In so far as possible, such statistics should be comparable on an international basis and lend themselves to international analysis.

Although civil registration systems by definition include vital events such as marriage, divorce, fetal death, adoptions, etc., the following discussion refers only to births and deaths. However, by extension, most of the points made below are generally applicable to other vital events.

3.2.1 The Special Case of Population Registers

It should be emphasized at the outset that this definition of a civil registration system does not extend to cover what is commonly termed a "population register." Generally maintained in the form of a ledger or computer file, a population register is a continuously updated file of basic demographic information for every individual in the population. It includes information on vital events and on the total population, and thus can provide the denominator data for calculating vital rates.

In general, a continuous population register is built from a base of census-type information to which continuous corrections and additions are made with data derived from a civil registration system and other administrative reports. Because of the necessity of making change-of-residence corrections, population registers typically are maintained at a local level. The method of extracting statistical information from a large number of local registers and consolidating it for national totals also varies from system to system. For a description of the many variations that exist in the design and purposes of such systems, see United Nations, 1962 and 1969.

The population register systems that operate most successfully are those in several northern and eastern European countries and the somewhat different Koseki system of Japan. Serviceable systems exist, for example, in the Netherlands, Denmark, Sweden, Israel, and Taiwan. In most instances the systems were not established for the purpose of creating statistics but for other administrative objectives; therefore, special efforts usually have to be taken to "align" the statistics derived from a population register with those obtained from censuses and surveys, even when the population register is considered essentially complete.

Population register systems are theoretically attractive because the same system produces data on the number of births and deaths as well as on the corresponding population base. However, the systems are highly sophisticated in that they require very precise input data, a disciplined and literate population that regularly reports changes in demographic status and location, and accurate procedures for matching records and compiling data from them. In addition, considerable resources are required to establish a population register, and there are many technical problems with maintaining it at an efficient level. As a result, it is of doubtful value as a method of collecting data for estimating fertility and mortality trends, levels, and patterns in any but a few special situations, situations rarely encountered in developing countries.

This is not to say that a population registration system does not have important purposes in either developing or developed countries. In fact, there is a significant trend toward establishing population identity numbers and national registers of such numbers, which can be useful for military conscription and health and social welfare programs, including social security. However, such registers frequently cover only certain segments of the population or have other major limitations that preclude their use as a major source of data on fertility or mortality rates. For example, such systems rarely include information on internal and international migration.

3.3 ADVANTAGES

The strength of any data collection system depends upon the quality of its statistical output, including content or variable coverage, geographic coverage, temporal coverage, and overall accuracy and completeness. In this regard, the special characteristics of CR/VS systems give them a number of advantages relative to other data collection methods. These include the legal rationale and strong legislative grounding of CR/VS systems, the fact that they provide documents that are of personal value to registrants, the broad geographic coverage they can provide, timeliness and associated gains in accuracy of data, and the administrative and cost benefits of operating as a part of an ongoing civil system.

3.3.1 History and Legal Rationale

Most countries have officially established civil registration systems that are continuous, permanent, and compulsory. A strong legislative basis for civil registration systems exists because registration has been and is still regarded as having primarily a legal rather than a statistical function. For example, civil registration records often provide the legal verification of an individual's eligibility for admission to public schools or qualification for work permits and assistance in old age. In addition, the documents generated by the system may be required for the disposition of dead bodies; may serve as a trigger for social or health programs, such as postpartum care for mothers; and may be used as a primary input to demographic or public health statistical programs.

The history of civil registration as a nationally organized process goes back to the seventeenth century; in more fragmentary and specialized forms, it dates to perhaps a thousand or more years before that. Very early registration systems were not designed to collect data on vital events that could be used as input to a statistical system; most were established for special purposes, such as those relating to conscription, revenue and taxation. Sometimes the systems were the concern of ecclesiastical authorities, who kept records of payments received for performing ceremonies such as baptisms or burials. (Some students of history suggest that civil registration as a nationally organized process began in the sixteenth century, with the almost simultaneous ordinances by Thomas Cromwell in 1538 for England and of Villers-Cotteret in 1539 for France. The former required Anglican priests to make weekly entries of burials, weddings, and baptisms; however, these entries were not complied into statistical totals for all of England.)

Although it is difficult to be precise, it would seem that at least 16 sovereign countries plus some non-sovereign areas established compulsory registration systems prior to 1850. (Although compulsory, these systems were not necessarily complete.) These nations were primarily the countries of Europe and those following the principles of the Napoleonic Code (1804). Some of the systems began before 1804. For example, the registration of births, deaths, and marriages became compulsory by law in Finland in 1628, Denmark in 1646, Norway in 1685, Sweden in 1686, and France in 1792 (United Nations, 1955:20). In Mauritius the first important legislation relating to the establishment of the civil registry for births, deaths, and marriages is the Royal Ordinance of 1667, although the first legislation devoted exclusively to the registration of these events is the Royal Declaration of 1736, registered in 1737 in the Superior Council of Ile de France (the former name of Mauritius). Between 1850 and 1925 more than 50 additional countries enacted legislation establishing a compulsory system of civil registration. This number includes some non-sovereign territories or colonies; in some cases the systems were only partial registration systems, covering certain geographic sections of the territory or selected ethnic groups.

A great deal of information about both the history and current status of civil registration and vital statistics systems was collected in a study conducted in 1977 by the United Nations. Table 3.1 summarizes some of the provisional results of that study, including information on the time of implementation of legislation establishing CR/VS systems. By 1925, 71 of the 100 countries or areas reporting had implemented CR/VS systems, including 8 in Africa, 10 in Asia, and 20 in Latin America. Another 7 countries implemented legislation in the period 1925-45, and 21 more during the post-1945 period, including 11 countries in Africa and 5 in Asia.

Table 3.1 also presents the characteristics of existing CR/VS systems, as reported in 1977. In Africa, Asia, and Latin America, nearly 90 percent of the systems have compulsory requirements for registration of vital events. One country in Asia has voluntary registration, and in six African countries the situation is mixed. (In some, this means that registration is compulsory for some ethnic groups but not for others; in others, it means the country is gradually expanding the geographic areas in which registration is compulsory.) Among the reporting countries, geographic coverage is total in all but seven countries in Africa. Nearly all the reporting countries outside of Africa compile and publish the vital statistics obtained on births and deaths. In Africa, 14 of the 20 reporting countries compile these vital statistics and 13 countries publish them.

The legal force behind registration systems is being strengthened by national legislation that requires individuals to have documented proof of birth or death as well as by international actions of a legislative character. For example, Resolution 2200(XXI) of the International Covenant on Civil and Political Rights, adopted by the General Assembly of the United Nations on 16 December 1966, states: "Every child shall be registered immediately after birth and shall have a name." Many other U.N. actions, entirely apart from statistical recommendations, state or imply the necessity for civil records.

(For a more detailed legal history of registration, see United Nations, 1955:3-5 and Powell, 1975:12-15.)

TABLE 3.1 Type and Time of Implementation of Civil Registration/Vital Statistics Systems, Classified by Region

Region	Number of Countries Reporting	Government Provisions for Civil Registration									Vital Statistics		
		Period of Implementation of Enacted Legislation[a]				Type of System			Coverage		Compiled		Published
		1925 or Earlier	1926–1945	1946–1965	1966 or Later	Compulsory	Voluntary	Mixed[b]	Total	Partial	Births	Deaths	
Africa	20	8	1	6	5	14	0	6	13	7	14	14	13
Asia (except Japan and Israel)	17	10	2	3	2	16	1	--	17	--	15	15	15
Latin America	23	20	3	--	--	23	--	--	23	--	23	23	23
Oceania (except Australia and New Zealand)	5	1	1	2	1	5	--	--	5	--	4	4	3
Subtotal	65	39	7	11	8	58	1	6	58	7	56	56	54
Europe	29	26[c]	--	2	--	29	--	--	29	--	29	29	29
Other Developed	6	6	--	--	--	6	--	--	6	--	6	6	6
Total	100	71	7	13	8	93	1	6	93	7	91	91	89

[a]In most cases the year of enactment and year of implementation are the same. In a few cases the year of enactment was a few years earlier than the year of implementation.
[b]Includes countries where registration is compulsory for some ethnic groups but not for others and cases where the country is gradually expanding the geographic areas in which registration is compulsory.
[c]If Faeroe Islands were included, the total would be 27. The U.N. study indicated the timing of the Faeroe Islands registration system as unknown, but on the basis of other information, it seems probable that the legislation was implemented before 1925.

Source: Derived from provisional results of a study on civil registration/vital statistics practices conducted in 1977 by the United Nations.

3.3.2 The Personal Value of Civil Registration Documents

In sharp contrast to other demographic data collection systems, the CR/VS systems create documents that are extremely valuable to the person to whom the document relates. In general, the value of the documents is closely tied to the legal underpinning of the registration system. The following excerpt from a United Nations publication (1973:4) indicates the wide range of needs such documents meet:

> For the individual, the civil registration records of birth provide legal proof of identity and civil status (including name, parentage, ancestry or lineage); age; nationality (citizenship); dependency status; legitimacy status; etc. on which depend a wide variety of rights, particularly in regard to the exercise of civil functions, entitlement to family allowances, care of children, tax deductions, insurance benefits, education, and other benefits; property ownership and inheritance, etc. The death records provide legal evidence relevant to claims to inheritance of property, to insurance on deceased persons, to rights of surviving spouse to remarry, to claims for family allowances where the death creates financial needs, etc. Marriage and divorce records are the basis for claims involving the status of women, such as dependency and alimony allowances, tax deductions, provision and allocation of specific types of housing and numerous other facilities which relate to a married man and his wife, including claims to a change of nationality on the basis of marriage. Divorce records are most important to establish the right to remarry.

A dramatic illustration of how heavy a demand there is for such documentation was provided by a recent article in a Chilean newspaper. Accompanied by a photograph that showed hundreds of persons lined up in front of the Chilean Central Registration Office to request birth certificates, the article reported that 4,500 to 5,000 copies of registration documents were being issued daily. The normal load at the office was 1,200 copies daily. The heavy demand at that particular time was due to the need to present a birth certificate to gain entrance to school. The more people need civil registration documents to function legally within society, the more likely they are to register; the fact that they have something personally at stake encourages compliance.

The pressing need for registration records also encourages governments to improve their CR/VS systems as quickly as possible and has made complete registration of certain vital events a high-priority goal in many developing countries. For example, the individual need for birth certificates is an important element in the relative completeness of birth registration in Egypt, Tunisia, Sri Lanka, and Peninsular Malaysia.

3.3.3 Geographic Coverage, Timeliness, and Accuracy

Since a civil registration system is based on established administrative uses of records, the system usually is legally in force throughout the national territory. This means that CR/VS data, like census data, can be used to produce national totals as well as totals for states, provinces, municipalities, and every civil subdivision down to the smallest village. However, unlike a census, a registration system produces a continuous flow of data rather than temporal cross-sections of a country's demographic status. CR/VS systems measure the incidence rather than the prevalence of vital events. This continuous flow of data permits monthly and quarterly reports as well as annual tabulations and also offers the administrative advantage of a data processing effort that is spaced evenly over time, except in cases of year-end spurts in registration.

A parallel advantage of CR/VS systems is that legislation usually requires that a vital event be registered within a short time after it occurs. Therefore some summary registration data useful for estimating fertility and mortality can be made available on a fairly up-to-date basis. For example, the Tunisian government, through its Institute of National Statistics, publishes a monthly statistics bulletin that shows registered births, deaths, and marriages by months of occurrence for 18 administrative divisions in the country (gouvernorats). These bulletins generally report data by month for the 13 months ending approximately three months before the month of publication.

The legal requirement that vital events be registered soon after they occur also means that in countries with relatively complete and timely registration, data are reported within a short recall period. This is a particular advantage in collecting fertility and mortality data, because it has been found in general that the shorter the recall period, the more accurate and complete the information. Another characteristic that tends to contribute to accuracy of registration data is the fact that civil registration acts are legal depositions, in which information usually is provided by persons closely associated with the individual whom the event concerns--often the parents, spouse, children, or attending medical personnel.

3.3.4 Administrative and Cost Advantages

Because of its legal and nationwide character, a registration system has the strong advantage of being administered through a local infrastructure that is continuously in place. The system operates through a network of hundreds or thousands of local government offices that in most countries exist continuously, although usually they do not exist exclusively for the registration of vital events. This network gives a certain stability to the system and makes it possible to effect changes and improvements gradually.

Because of the ongoing administrative character of the systems, the cost of document collection is routinely incorporated into regular governmental budgets. However, this routine provision of funds does not always cover the tabulation or other statistical aspects of the process, which are often subject to the same kind of fiscal vicissitudes and reporting delays as censuses or surveys.

It is almost impossible to appraise the costs of civil registration. Actual costs cover many elements, from the time and effort spent on basic design decisions to overhead costs related to physical facilities, equipment, and support services. However, the cost of administering a CR/VS system often seems low relative to the cost of other data collection systems. One reason is that many of its costs are shared costs, in that the same resources are used concurrently for more than one activity. Also, many of the costs may be considered built-in or mandatory costs, in that they would continue even if the civil registration system did not exist. For example, the costs of local government administration would continue with little change even if civil registration were not one of its tasks (Linder and Lingner, 1975:21-22).

3.4 LIMITATIONS

Along with its strengths, the CR/VS system has certain inherent and practical limitations as a source of fertility and mortality data. Among the major limiting factors are the level of incompleteness of a system, the fact that registration cannot provide the denominator data needed for calculating vital rates, the requirements for an efficient reporting network, and the necessarily narrow range of types of data collected.

3.4.1 Level of Incompleteness

The basic limitation of most CR/VS systems as a source of data for estimating levels and trends of fertility and mortality in developing nations is that in many of these countries they are currently incomplete. Furthermore, the extent of underregistration frequently is unknown or at best is known only within a substantial range of error. The solution to this problem is partly a question of time; it usually takes some decades to develop a registration system that is virtually complete in terms of registering all vital events. However, demographic techniques for estimating levels of completeness of registration have improved in recent years, making possible better use of incomplete data. It must be emphasized, though, that these methods tend to leave the user with fairly wide ranges of uncertainty; also, they are subject to errors of assumption as well as errors in the data (see Hill et al., 1982). Knowing use of such techniques, however, can provide the basis for reasonably good estimates based on registration data, particularly when other data sources are also incomplete or otherwise flawed. Even a registration system that is only 60 percent complete in terms of registering deaths of persons aged 10 and over often provides the best available basis for estimating adult mortality.

Direct checks on the completeness of registration have been undertaken in some countries, by means of sample surveys, e.g., Egypt in 1974-75. Through relatively inexpensive periodic checks of a sample of areas or households, the entire product of a national registrati n system can be mobilized. Much of the value of registration data in LDCs depends on whether the direct and indirect checks are carried out competently.

A recent study of Egyptian fertility and mortality trends used census data and indirect estimation techniques to construct estimates of the completeness o birth and death registration in Egypt (National Researc Council, 1981). The results of the recent study show that birth registration was about 96 percent complete during 1972-75, and that since 1960 the registration of deaths among persons above age 10 was about 100 percent complete for males and about 85 percent for females. Tle registration of infant deaths is much less complete, about 75 percent for the country as a whole in 1975-76 with a range from just above 50 percent in rural Upper Egypt to above 98 percent in Cairo and Alexandria.

3.4.2 Dependence on Other Data Sources for Denominator Data

Another limitation of the CR/VS system as a basis for fertility and mortality estimation is that it does not provide all the data necessary to compute birth and death rates. A good registration system can produce data on the number of births and deaths for national and subnational areas on a current basis, but these data represent only the numerators of the rates. The other component of the rates--namely the denominators, which indicate the population exposed to risk--must come from a source outside the registation system itself.

Most countries that conduct a periodic population census can produce a population denominator for the country as a unit and for subdivisions of the national area for the time of the census. And estimation procedures often make it possible to provide reasonably accurate population estimates for the total national area for intercensal and postcensal years. However, it is difficult to produce such estimates for subnational geographic units, except for years in which censuses are taken (or years just before and after census years) because of difficulties in measuring internal migration. Thus, unless the statistical output of a registration system is developed in close coordination with the output of the census organization, for example by having common geographic boundaries for census areas and for registration areas, the value of a registration system as a source for demographic rates is greatly weakened.

The disadvantage of a CR/VS system having to depend on external data sources for denominator information is tempered in situations in which it is possible to estimate adult mortality, or mortality above about age 10, in the absence of denominator information. This can be done even when the registration of deaths is considerably less than 100 percent, for example, as little as 60 to 80 percent complete. Brass (1975) and later Preston and Hill (1980) and Preston et al. (1980) have developed techniques for estimating adult mortality using incompletely registered death data and selected other information. All these methods require the acceptance of certain assumptions. The Brass method requires an age distribution of the population and three assumptions: (1) the population is stable; (2) the age at death is recorded correctly or nearly so; and (3) the omission of deaths is approximately constant with age. The Preston-Hill method requires two age distributions at different points in time but does not require the assumption that the population is stable. The Preston et al. method requires an estimate of the population growth rate and the assumption of stability, but assumptions 2 and 3 (noted above) are not necessary. Examples of countries where at least one of these methods has been applied successfully include Brazil, Egypt, South Korea, El Salvador, and a 1929-31 sample of Chinese farmers.

3.4.3 The Need for Well-Organized Reporting Networks

In a few systems, the primary legal responsibility for reporting births and deaths falls on the attending physician, the hospital, the funeral director, etc. However, in most systems this responsibility is placed on the parents or relatives and only secondarily upon attendants or official registrars. Some developing nations have established legal procedures requiring burial permits, which then become the basis for the official registration of deaths.

A registration system functions well only if the public is aware of its responsibilities and understands the value of compliance, and if it is reasonably convenient for the person responsible for registration to fulfill that obligation. Madigan and Herrin (1977:6) have stated the problem well:

> Good censuses can be taken by governments willing to pay the costs in consultation, training of personnel, careful execution of the census and analysis of its data. But the establishment, or the upgrading (where a system already exists), of a registration system (where households report births and deaths to the government), depends as much upon the understanding and cooperation of the citizenry as upon the registration officials. Where roads do not exist to link many villages with the town center, where distances are great between potential reporters of vital events and government offices in which the event should be reported, where attendance of a physician or nurse at a birth or death is unusual, and where considerable time and effort in making the trip to town are required to register an event, registration is likely to seriously underreport the number of vital events. The situation is not likely to improve until roads and other related infrastructure also improve. Some have said this will require 20 years. Others have called such statements optimistic.

One could add to this list of barriers the fee for registration that exists in some countries, particularly the cost of registering a birth or obtaining a birth certificate.

Improving the completeness of registration is likely to require the gradual transfer of the reporting responsibility to hospitals, physicians, and others acting officially on behalf of the government, as well as the establishment of comprehensive networks of local registration offices, located and administered so the public can more readily comply with its responsibilities for registering vital events. Some countries have tried to initiate CR/VS systems by staffing them with local registrars who have either full-time or part-time responsibility for registration. Examples include the chowkidars in India and Bangladesh, the Kepala Desa in Indonesia, and the penghulus in Malaysia.

While the efficient maintenance of a comprehensive network of local offices permits gradual improvement, the possibility of slow deterioration also exists. Not infrequently it is easier to generate enthusiasm and vigorous efforts for a major ad hoc project like an occasional census or survey than it is to maintain a high level of efficiency in an enterprise that operates routinely.

3.4.4 Scope of Coverage of Related Variables

The civil registration system exists originally and primarily as an official method of establishing the legal fact of birth and death; the statistical uses of the system are secondary. Accordingly, many items on registration documents are there essentially to establish identity and family relationships and other legal characteristics of the vital event, and have little value as analytical variables relevant to studying population change. Other items on the documents are evidentiary in nature, such as the signatures of witnesses. The priority of items, in combination with the administrative necessity of keeping the total number of items limited, results in a registration document that produces the basic facts of demographic change, but which provides information on few variables relating to the economic, social, and cultural aspects of such change. The restrictive nature of the legal document is not always a limiting factor, since in some countries vital statistics are compiled not exclusively from civil records but from other sources as well (Cavanaugh, 1963:18).

In its 1953 publication Principles for a Vital Statistics System, the United Nations suggested 19 statistical variables to be included on a birth registration record, 10 of which were designated first-priority items. A 1973 revision of the principles (United Nations, 1973) expanded the list to 37 variables, of which 12 were considered first priority. This expanded list appears in Table 3.2. A serious constraint on demographic analysis of registration data is that longitudinal variables--such as the time interval since the last previous birth and other birth intervals--usually are not included on birth registration forms, though there are exceptions. For example, in accordance with the U.N. recommendations, some countries collect parity data on the birth registration forms, then tabulate data on births classified by parity of mother, information that is particularly helpful in analyzing trends in fertility. Egypt collects and tabulates data on live births classified by duration of marriage of

TABLE 3.2 United Nations Recommendations for Items to be Included in Civil Registration Records

Part A. Births

	Data on Event	Data on Child	Data on Mother	Data on Father
Priority Items	*Date of delivery *Date of registration Place of occurrence (urban/rural) Type of birth (single or multiple issue) Attendant at birth	*Sex Legitimacy status Weight at birth	*Age *Children born alive during entire lifetime *Duration or date of marriage (for legitimate births) *Place of usual residence (urban/rural)	
Other Items	Hospitalization	Gestational age	Children born during entire lifetime and still living Fetal deaths during entire lifetime *Interval since or date of last previous live birth Educational attainment Literacy status Ethnic (and/or national) group Citizenship (nationality) Type of economic activity Occupation Duration of residence in usual (present) place Place of residence at a specified time in the past Place of birth	Age or date of birth Place of usual residence (urban/rural) Educational attainment Literacy status Ethnic (and/or national) group Citizenship (nationality) Type of economic activity Occupation Duration of residence in usual (present) place Place of residence at a specified time in the past Place of birth

* Items useful for estimating levels and trends in fertility.

Part B. Deaths

	Data on Event	Data on Decedent
Priority Items	**Date of occurrence	**Age
	**Date of registration	**Sex
	Place of occurrence	Marital status
	**Cause of death	**Place of usual residence
	Certifier	
Other Items	Hospitalisation	Legitimacy status (for deaths under 1 year of age)
	Attendant at birth (for deaths under 1 year of age)	Was birth registered? (for deaths under 1 year of age)
		Duration or date of marriage (if married)
		Age of surviving spouse (if married)
		Children born during entire lifetime (for females of child-bearing age and over)
		Children born during lifetime and still living (for females of child-bearing age and over)
		Educational attainment
		Literacy status
		Ethnic (and/or national) group
		Citisenship (nationality)
		Type of economic activity
		Occupation
		Place of residence at a specified time in the past
		Place of birth

** Items useful for estimating levels and trends of mortality.

Source: United Nations (1973).

mother, which makes it possible to estimate duration-specific fertility rates.

Seven of the priority birth items listed in Table 3.2 are directly useful for estimating levels and trends of fertility, plus one of the other 25 items, not including those associated with estimating fertility differentials, such as educational attainment and occupations of parents. Among the death items, six of the nine priority items are useful for estimating mortality levels and trends.

3.5 CURRENT STATUS OF CR/VS SYSTEMS

Despite the various difficulties in using registration data, many countries rely on CR/VS systems to supply information on births, deaths, and other vital events. Table 3.3 classifies 96 countries in six regions by source of vital registration data. The three sources shown are a civil registration system, a sample registration area scheme (which utilizes registration data from a subsample of the civil registration area), and a sample survey. As indicated, the use of CR/VS systems is widespread. Among the 96 countries, 88 depend on CR/VS systems for data on births and deaths; 68 for data on fetal deaths; and 81 and 61, respectively, for marriage and divorce data. Only three reporting countries use sample registration area systems to obtain birth and death data. Less than 20 countries use sample surveys to obtain birth and death data; in some of these countries, the surveys are used in addition to the CR/VS system. (A great many countries use surveys to obtain additional information on mortality and especially fertility, as described in Chapter 4.)

3.5.1 Organizational Differences Among Countries

The way in which civil registration and vital statistics systems are organized and administered varies widely. In a few countries, the responsibility rests with health ministries; in some, the responsibility for both registration and statistics rests with a central national agency, such as the Registrar General's Office; in others, registration may be overseen by the Ministry of the Interior (being handled as a local government function) or by the Ministry of Justice (as a judicial

TABLE 3.3 Sources of Vital Statistics Data: Number of Countries that Obtain Vital Statistics from Civil Registration Systems, Sample Registration Area Systems, and Sample Surveys, Classified by Region and Type of Vital Event

		Type of Data Collection System															
	Number of Countries	Civil Registration					Sample Registration Area System						Sample Survey				
Region	Reporting	LB	De	FD	M	Div	LB	De	FD	M	Div	P	LB	De	FD	M	Div
Africa	19	15	15	7	12	7	1	1	0	0	0	5	7	7	0	4	3
Latin America	23	23	23	18	23	7	0	0	0	0	0	5	5	4	1	1	1
East and South Asia	14	12	12	9	10	6	1	1	1	0	0	3	4	4	1	1	1
West Asia[a]	5	5	5	3	4	4	1	1	0	0	0	1	1	1	0	0	0
Europe	28	28	28	26	28	24	0	0	0	0	0	0	0	0	0	0	0
Oceania	7	5	5	5	4	3	0	0	0	0	0	2	2	2	0	1	1
Total	96	88	88	68	81	61	3	3	1	0	0	16	19	18	2	7	6

Key: LB = Live births
De = Deaths
FD = Fetal Deaths
M = Marriages
Div = Divorces
P = Population

Note: Some countries obtain data from more than one source.

[a]Includes Iraq, Israel, Jordan, Kuwait, and Syrian Arab Republic.

Source: Derived from provisional results of a study on civil registration/vital statistics national practices conducted in 1977 by the United Nations.

function) or by some other governmental entity, while vital statistics are the responsibility of a Central Statistical Office. Table 3.4, which shows the distribution of responsibilities for administering or monitoring civil registration and for compiling vital statistics in 102 countries, reveals the many different combinations in use as of 1977.

This organizational heterogeneity among CR/VS systems in different countries has tended to inhibit the evolution of a widely accepted, international professional organization for those who manage such systems. In contrast, general-purpose statistical agencies, though also not uniform from country to country, generally have much more similar patterns of organization and function. This has facilitated the development and implementation of internationally standardized concepts, for example, the almost universal and reasonably standardized application of the population census.

The heterogeneity of agencies responsible for national vital registration is also an obstacle to the international dissemination and exchange of technical information on new methods and the application of improved techniques. There is no international intergovernmental agency that serves as a forum where the varied group of statisticians, health officials, judicial officials, and local government officials can exchange information and ideas about CR/VS systems. This international heterogeneity is reflected in the United Nations, too, where responsibility for coordinating information about CR/VS systems is dispersed among various units, which has retarded development of U.N. programs for establishing more internationally uniform systems.

3.5.2 Dispersal of Responsibility Within a Country

Much more important from the standpoint of an individual country is how the operation of its system is affected by dispersal of responsibility for different tasks among different agencies within the government. In the 102 countries represented in Table 3.4 responsibility for compiling vital statistics rests with the Central Statistical Office in 79 cases; however, of these, only 4 have responsibility for civil registration as well. Looking at the table from another axis shows that

TABLE 3.4 Government Agencies Responsible for Civil Registration and Compilation of Vital Statistics at the National Level: 102 Countries

Agency with National Responsibility for Compiling Vital Statistics	Agency with National Responsibility for Civil Registration					
	Central Registration Office[a]	Central Health Office	Central Statistical Office	No Central Responsibility[b]	Not Ascertained	Total
Central Registration Office	9	--	--	--	--	9
Central Health Office	3	4	--	2	--	9
Central Statistical Office	46[c]	5	4	22	2	79
Not Compiled at the Time of the Study	3	--	--	1	--	4
Not Ascertained	1	--	--	--	--	1
Total	62	9	4	25	2	102

[a]Ministry of Interior, Registrar General's Department, Ministry of Municipalities, Ministry of Justice, Ministry of Home Affairs, etc.

[b]Includes cases "not ascertained" but where civil registration at subnational level was indicated in survey.

[c]In one case (Syrian Arab Republic), separate agencies are responsible for civil registration and compilation of vital statistics, but both agencies operate under the Ministry of Interior. Similar arrangements may exist in a few other cases, but detailed information is not available on the ministries in which the agencies may be located. However, the most common pattern is separate agencies in different ministries.

Source: Derived from provisional results of a study on civil registration/vital statistics national practices conducted in 1977 by the United Nations.

national responsibility for civil registration rests with a Central Registration Office in 62 countries, but in only 9 instances is that office also responsible for compiling vital statistics. All in all, only 17 of the 102 countries assign responsibility for both registration and compilation to the same national agency. However, in some countries it may be advantageous to have a division of responsibilities, because the collection can be handled most efficiently through a country-wide administrative network, while the statistical expertise for tabulation and analysis may exist only in a central statistical office. Such a division of labor, however, calls for close coordination between the two major responsible units.

A serious problem is that apparently in 25 of the 102 countries there exists no national agency that has clear responsibility for monitoring or improving civil registration. In many of these cases, registration is handled at a local level, through civil administrative or judicial offices. In such cases there may be a national ministry that has nominal jurisdiction over registration, but that jurisdiction may be melded, in an almost inseparable way, with numerous other aspects of local administrative work.

Table 3.4 indicates that there are many different ways of distributing CR/VS responsibility at a national level in countries that are governed as a single, geographic entity. An additional complicating factor arises in countries that are federations of states or provinces. There the distribution of powers between the national government and the provincial governments may vary widely. In some cases, registration may be the exclusive domain of the provinces; in others there may be some more or less well defined central government role as well.

3.5.3 Availability and Quality of Data

As noted earlier, incompleteness is probably one of the biggest problems with registration data, and the relative completeness of data in different countries is thus a major issue in comparative analysis. For example, a particular statistic, such as births classified by age of mother, may be available for one country in which the CR/VS system records 70 percent of the births, and for another country in which the CR/VS system records nearly all births. To develop reasonable estimates based on these data, analysts need to know how complete they are.

To help clarify this issue, the United Nations has defined three broad categories of completeness. A country is classified "C" if its CR/VS data are "estimated to be virtually complete, that is, representing at least 90 percent of the events occurring each year"; "U" (for underregistered) if the data are "estimated to be incomplete, that is, representing less than 90 percent of the events occurring each year"; and "...." in cases "for which no specific information is available regarding completeness" (UNDY 1978:11). (In the tables presented below, for countries in which there are two reporting areas or groups, for example, a country with a "C" for the European population and "U" for the national population, the classification has been made on the basis of the estimated completeness of the combined population.)

A weakness of this classification scheme is that the information on which the classifications are based is supplied by the reporting countries. To increase the meaningfulness of the classifications, the U.N. Statistical Office is encouraging countries to provide more information on how they arrive at their estimates of completeness of registration. In addition to the question of how the estimates are derived by each country, there is the considerable difference that exists between an estimated completeness level of 90 percent and one of 99.5 percent. If more information can be provided, the U.N. hopes to generate two classes of "C": soundly based estimates, and other estimates.

Table 3.5 shows the completeness classifications for birth and death registration reported by some 200 countries and published by the United Nations in 1961, 1971, 1978, and 1981. Although the level of registration completeness increased in some individual countries, the total number of countries reporting birth and death registration completeness levels of 90 percent or more did not increase very much during that 20-year period. The total number of countries with "C" levels of birth registration changed from 81 in 1961 to 92 in 1981, and only half of the increase was in developing-nation regions. For deaths, the pattern was similar: nine countries were added to the "C" category between 1961 and 1981, and seven of these countries are in Europe and "other developed" regions.

Table 3.6 shows what percentages of the world population and the population in developing regions live in countries for which data are available on selected

TABLE 3.5 Reported Levels of Completeness of Birth and Death Registration: Number of Countries Classified by Region, 1961-81, from United Nations Sources

	Data Source															
	UNDY 1961				UNDY 1971				UNDY 1978				1 Jan 81 PVSR			
Vital Events by Region	C	U	...	Total	C	U	...	Total	C	U	...	Total	C	U	...	Total
Births																
Africa	6	16	26	48	7	9	38	54	7	4	41	52	7	13	36	56
Asia	7	16	11	34	8	8	19	35	6	4	26	36	7	11	23	41
Latin America	28	14	3	45	25	14	4	43	26	10	7	43	29	14	3	46
Oceania	6	4	8	18	7	2	11	20	8	2	5	15	9	3	14	26
Subtotal	47	50	48	145	47	33	72	152	47	20	79	136	52	41	76	169
Europe	27	1	7	35	30	0	4	34	31	0	0	36	32	0	5	37
Other Developed	7	0	1	8	7	0	1	8	8	0	0	8	8	0	0	8
Total	81	51	56	188	84	33	79	194	86	20	79	180	92	41	81	214

Deaths																
Africa	5	20	23	48	5	10	39	54	5	5	42	52	6	14	36	56
Asia	9	14	13	36	7	9	19	35	6	6	24	36	6	12	23	41
Latin America	27	14	4	45	24	15	4	43	26	13	5	44	29	14	3	46
Oceania	6	4	10	20	6	3	11	20	7	3	5	15	8	4	14	26
Subtotal	47	52	50	149	42	37	73	152	44	27	76	147	49	44	76	169
Europe	27	1	8	36	30	0	4	34	32	0	4	36	32	0	5	37
Other Developed	6	1	1	8	7	0	1	8	8	0	0	8	8	0	0	8
Total	80	54	59	193	79	37	78	194	84	27	80	191	89	44	81	214

Note: C = data estimated by reporting country to be virtually complete, that is, representing at least 90 percent of the events occurring each year.
U = data incomplete (underregistered), that is, representing less than 90 percent of the events occurring each year.
... = data for which no specific information is available regarding completeness.

Sources: As indicated.

TABLE 3.6 Percentage of World and Region Population Living in Countries for Which Selected Fertility and Mortality Information is Available from CR/VS Systems Classified by Levels of Completeness of the CR/VS Systems: Circa 1975

Type of Information	Percent of World Population[a] Living in Countries Classified:		Percent of Population in Developing Region Living in Countries Classified:					
			Africa		Asia		Latin America	
	C or U	C Only	C or U	C Only	C or U	C Only	C or U	C Only
Live Births								
Annual totals	37	29	24	16	8	1	66	22
Reported live birth classified by:								
Sex	28	27	20	16	8	1	66	22
Age of mother	28	27	24	16	8	1	66	22
Birth order	26	25	12	12	5	1	65	21
Birth order by age of mother	26	25	6	6	5	1	50	10
Legitimacy	20	19	12	11	0	0	30	13
Urban/rural residence	27	25	2	2	0	0	5	1
Legitimate births by age of mother	18	18	14	12	2	0	61	19
Type of birth (single, twin, etc.)	18	17	2	2	2	0	23	11
Age of mother and sex of child	25	25	12	12	5	1	50	10
Age of father	13	13	7	6	1	1	32	8
Duration of marriage	18	18	11	10	5	1	17	13

Deaths								
General Mortality								
Annual totals	36	30	20	10	7	2	58	41
Reported deaths classified by:								
Age and sex	25	23	15	10	7	2	53	41
Cause of death	25	12	13	10	7	2	53	41
Cause and sex	24	21	7	0	6	1	51	33
Marital status, age, and sex	29	27	13	10	3	1	22	12
Urban/rural residence	23	21	2	0	3	1	42	31
Occupation and age	33	29	20	10	8	1	58	41
Infant Mortality								
Annual totals	34	27	19	0	6	1	51	13
Reported infant deaths classified by:								
Age and sex	25	22	19	0	6	1	51	13
Urban/rural residence	28	27	0	0	1	0	14	2

Notes: A similar table, reflecting the status of data availability circa 1970, was published by the U.N. in 1974. See attached list of countries classified as "C" or "U", which was used to prepare the percentages shown above.

[a]The denominator used was the 1975 world population (3,967,005,000); numerators were taken from the 1977 UNDY, 1977 estimates, or most recent census figure.

TABLE 3.6 (continued)

Countries Whose Registration Data Are Rated "C" or "U" for Selected Variables of Births, General Mortality, and Infant Mortality

Africa

"C"	"U"
Algeria*	Angola[1]
Cape Verde	Kenya
Egypt	Libya
Mauritius	Mozambique
Reunion	Rwanda*
Seychelles	
Tunisia*	

Asia

"C"	"U"
Brunei	Iran
Hong Kong	Iraq
Jordan*	Lebanon
Kuwait	Philippines
Malaysia[4]	Syria
Singapore	Thailand
Sri Lanka[5]	

Latin America

"C"	"U"
Antigua	Belize
Bahamas	Cayman I.
Barbados	Dom. Rep.
Bermuda	Honduras
Br. Virgin I.	Mexico[3]
Costa Rica	Neth. Ant.
Cuba	Nicaragua
Dominique	Bolivia
El Salvador	Colombia
Grenada	Ecuador
Guadelupe+	Fr. Guiana
Guatemala	Peru
Jamaica	Venuzuela
Martinique*	
Montserrat	
Panama	
Puerto Rico	
St. Kitts	
St. Lucia	
St. Pierre+	
St. Vincent	
Trinidad-Tobago	
U.S. Virgin I.	
Argentina*+	
Chile	
Guyana	
Uruguay	

Oceania

"C"	"U"
Amer. Somoa	Figi
Christmas I.	Pacific I.
Cocos I.	W. Samoa
Guam	
Nauru	
Norfolk	
Cook I.	

Europe

"C"	
Albania[2]	Ireland
Austria	Isle of Man
Belgium	Italy
Bulgaria	Luxembourg
Channel Is.	Malta
Czechoslovakia	Netherlands
Denmark	Norway
Faeroe I.	Poland
Finland	Portugal
France	Romania
Germany, D.R.	San Marino
Germany, F.R.	Spain
Gibraltar	Sweden
Greece	Switzerland
Hungary	United Kingdom
Iceland	Yugoslavia

Other Developed

"C"
Australia
Canada
Greenland
Israel
Japan
New Zealand
United States
U.S.S.R.

* Births only.
+ Births and general mortality only.
1 Angola is included in general mortality and infant mortality group only.
2 Albania is not included in mortality lists.
3 Mexico is in the "C" column for general mortality.
4 Malaysia rated on basis of Peninsular Malaysia

variables related to registered births and deaths, circa 1975. For each region and the world, separate percentages are shown for the proportion of the population living in countries classified "C" and for the proportion in countries classified either "C" or "U." For example, annual totals for the number of reported births are available for 37 percent of the world's population ("C" and "U" countries combined); but only 29 percent of the world's population lives in countries in which 90 to 100 percent of the births are reported as registered in CR/VS systems. In Africa, 24 percent of the population lives in countries classified as either "C" or "U," while only 16 percent lives in "C" countries. For data on births classified by specific variables, the percentages are even lower. In Asia, for example, only 8 percent of the population lives in countries classified "C" or "U" for data on births by age of mother, a variable essential for estimating age-specific fertility rates. Only 1 percent of the Asian population lives in countries for which those data are classified "C."

An intriguing question not answered by Table 3.6 is what proportion of births in the world are registered in CR/VS systems. For the world as a whole it is probably around 40 percent, depending largely upon the completeness of birth registration in China. China is not included in Table 3.6 because its vital statistics were not reported to the U.N. for international publication in the 1978 U.N. Demographic Yearbook. However, there is some evidence that vital events in China, especially births, are recorded at least at a local level.

Table 3.6 also shows comparable percentages for death statistics, which are roughly similar to those for births. This is not unexpected, given that both sets of statistics are taken from the same basic CR/VS systems, however there are countries for which birth registration is "C" and death registration is "U" (e.g., Jordan and Tunisia), and Mexico is classified as "U" for births and "C" for deaths (PVSR, January 1981). However, the percentages shown for deaths classified by specific combinations of important variables (such as cause, and age and sex) are slightly lower relative to the percentages for comparably important combinations of variables for births (such as age of mother and sex of child).

3.5.4 Other Aspects of Data Quality

Other factors besides completeness affect the quality of vital statistics based on registration records. These include promptness of reporting, the reliability of reported data, compilation and publication procedures, whether data are tabulated according to date of birth or death as opposed to date of registration and by place of residence or place of occurrence, and the availability of appropriate population estimates required for the computation of crude and specific rates. Several of these factors are discussed below. For a more complete description of factors that affect the quality of registration data, see "Criteria for the Comparative Evaluation of Vital Statistics Methods" (Powell, 1975:11-40).

3.5.4.1 *Delayed Registration*

Information on the extent of delayed registration is available for only a very few countries, at least in internationally available literature. A few examples are presented in Table 3.7, which shows the proportions of births and deaths occurring in years before the year of registration in Costa Rica (births), South Korea (births and deaths) and Japan (deaths). In Costa Rica from 1951 to 1962 the proportion of births registered the same year they occurred hovered around 80 percent, then improved slightly in 1963 and 1964. With the exception of 1961, the percentage of births registered 6 or more years after they occurred remained constant at about 6 to 7 percent in the years for which data are available. (It should be noted that these registered births almost certainly do not represent all births that occurred in the country, since some births are not registered at all, especially those of infants who die before their birth has been registered.)

In South Korea during the period 1956-66, delayed registration was at a much higher level than in Costa Rica, with particularly large numbers of registered births representing persons born at least five years previously. In 1961, a special campaign was conducted to encourage registration of vital events not previously registered; in that year nearly half of all registered births and deaths represented events that occurred in 1956 or earlier. In the late 1950s and early 1960s,

Table 3.7 also shows available data on the very small amount of delayed death registration in Japan from 1956 to 1964. Most of the delayed registrations represent deaths that occurred several years previously rather than only a year or so earlier. Thus, even in a developed nation with a good CR/VS system there can be small amounts of delayed registration.

The last column in Table 3.7 presents the mean number of years delay in registration. In calculating these means, a half year was added to the last category; that is, 6.5 years was used for the category "6+", which means that the events were treated as having occurred during the sixth year preceding the year of registration. This addition of only a half year undoubtedly yields a conservative estimate for each of these residual categories.

3.5.4.2 *Variations in Reporting Requirements*

An important influence on the functioning of CR/VS systems is the extent to which governments place requirements on individuals who must register a vital event. Table 3.8 lists four requirements for birth registration and three for death registration that countries sometimes mandate, and specifies the number of countries with each requirement. Many countries have never had fee requirements or have eliminated them in recent years, but 13 countries still require a cash payment for the registration of a birth or death. Twelve of these 13 are developing nations. Also, there are some countries where a registration fee is not required by law but may be required informally in practice, either to a government employee or a third party.

Among the 100 reporting countries, 62 require a physician's or midwife's certificate to register a birth, although in a few of these cases witnesses can be substituted (for example, if no physician or midwife is in the immediate locale). Witnesses are listed as a requirement for birth registration and death registration in 31 countries, although these are not always the same countries. In some of these cases, witnesses are required only in the absence of medical certification; however, other countries require witnesses in addition to medical certification. The requirement of medical certification of death, widespread in European and other developed nations, now exists in 47 of the 64 developing nations.

TABLE 3.7 Delayed Registration of Vital Events in Costa Rica, Korea, and Japan: Percentage of Births and Deaths Occurring in Years Before the Year of Registration and Mean Number of Years Delay in Registration

Country and Year of Registration	Time of Birth							Mean Delay in Registration (in years)
		Number of Years Before Registration Year						
	Same Year	1	2	3	4	5	6+	
Part A. Births								
Costa Rica								
1951	80.1	19.9	--	--	--	--	--	--
1952	79.5	13.1	7.4	--	--	--	--	--
1953	81.7	11.2	1.4	5.7	--	--	--	--
1954	78.4	11.8	1.6	0.9	7.2	--	--	--
1955	78.4	12.4	1.5	0.9	0.6	6.3	--	--
1956	77.5	13.0	1.7	0.9	0.6	0.5	5.8	0.62
1957	78.2	12.4	1.5	0.9	0.6	0.5	5.9	0.61
1958	77.5	12.4	1.5	0.8	0.6	0.5	6.7	0.66
1959	79.9	10.8	1.6	0.8	0.5	0.5	5.8	0.59
1960	80.0	8.4	1.7	1.0	0.7	0.6	7.7	0.71
1961	77.3	8.0	1.2	0.9	0.7	0.5	11.4	0.93
1962	82.2	7.0	1.0	0.8	0.8	0.8	7.5	0.67
1963	86.0	6.2	0.8	0.6	0.5	0.6	5.3	0.49
1964	86.7	4.2	0.7	0.5	0.4	0.4	7.1	0.57
South Korea								
1956	34.6	65.4	--	--	--	--	--	--
1957	41.0	59.0	--	--	--	--	--	--
1958	37.0	63.0	--	--	--	--	--	--
1959	40.9	19.4	9.4	4.5	25.9	--	--	--
1960	37.3	11.4	6.9	5.0	3.2	36.3	--	2.53
1961[a]	23.3	16.0	5.6	4.5	4.0	46.7	--	3.14
1962	38.3	18.7	9.0	6.4	5.1	22.7	--	2.01
1963	36.7	27.6	9.6	5.8	3.8	16.6	--	1.71
1964	67.0	13.7	5.7	3.1	2.0	8.5	--	0.89
1965	54.8	16.4	10.0	5.6	3.3	2.0	7.8	1.27
1966[b]	49.5	18.5	9.2	7.4	4.3	11.2	--	1.38

approximately one third of the registered births in South Korea were not registered until one to three years after the birth.

The pattern of death registration in South Korea in the period 1956-66 was that about two thirds to three quarters of the registered deaths represented events occurring in the same year as registration. About a tenth of the registered deaths were deaths that occurred in the previous year or two years. Another tenth (and much more in the year of the special campaign and the years immediately thereafter) were for deaths occurring five or more years before registration.

TABLE 3.7 (continued)

Part B. Deaths

South Korea								
1956	62.4	37.6	--	--	--	--	--	--
1957	69.6	30.4	--	--	--	--	--	--
1958	71.4	28.6	--	--	--	--	--	--
1959	75.2	11.4	4.9	2.6	6.1	--	--	--
1960	75.4	13.4	4.9	2.0	1.6	2.6	--	0.50
1961[a]	37.4	10.8	3.1	1.6	1.1	46.0	--	2.79
1962	58.6	11.1	6.2	3.1	2.6	18.4	--	1.44
1963	49.0	17.2	5.5	6.0	3.0	19.3	--	1.64
1964	82.0	5.4	1.6	1.0	1.2	8.8	--	0.65
1965	75.9	7.5	3.1	1.8	1.2	10.6	--	0.82
1966	76.2	8.1	2.2	1.6	1.1	11.8	--	0.87
Japan								
1956	99.6	0.4	--	--	--	--	--	--
1957	99.5	0.1	0.4	--	--	--	--	--
1958	99.6	0.1	0.0	0.3	--	--	--	--
1959	99.6	0.1	0.0	0.0	0.3	--	--	--
1960	99.6	0.1	0.0	0.0	0.0	0.3	--	--
1961	99.7	0.1	0.0	0.0	0.0	0.0	0.2	0.01
1962	99.7	0.0	0.0	0.0	0.0	0.0	0.3	0.01
1963	99.7	0.0	0.0	0.0	0.0	0.0	0.3	0.01
1964	99.8	0.0	0.0	0.0	0.0	0.0	0.2	0.01

Note: Dashes indicate that the data were not available by single years after that point. For example, in Costa Rica in 1951, the data on delayed registration were tabulated in only two categories: same year and 1 or more years. Thus, the last entry in that row shows the percentage of births registered 1 or more years after they occurred.

[a]In 1961, a campaign to encourage registration of vital events never reported was initiated but not continued in subsequent years. This accounts for the comparatively high percentage of events that occurred 5 or more years before registration.

[b]Up to September 1966 only.

Sources:
Costa Rica: Costa Rica, Direction General De Estadistica y Censos (1964: Table 8).
Korea: Choe (1967).
Japan: Shryock and Siegel (1973:394).

Only four countries, including one European country, require the physical presentation of the newborn child in order for a birth to be registered. (The time and place at which the newborn must be presented are not specified in the available data.)

Place of Registration Most countries, 79 among 99 reporting, require that birth or death be registered by place of occurrence, as indicated in Table 3.9. This

TABLE 3.8 Number of Reporting Countries with Specified Requirements for Registration of Live Births and Deaths, Classified by Region

Region	Number of Countries Reporting	Registration Requirements[a]						
		Births				Deaths		
		F	MC	W	P	F	MC	W
Africa	19	5	12[b]	9[b]	1	6	13	11
Asia (Except Japan and Israel)	17	1	10	4	0	1	11	5
Latin America	23	6	15	13	2	5	20	11
Oceania (Except Australia and New Zealand)	5	0	3	2	0	0	3	3
Subtotal	64	12	40	28	3	12	47	30
Europe	30	1	17	3	1	1	26	1
Other Developed	6	0	5	0	0	0	6	0
Total	100	13	62	31	4	13	79	31

Note: If the existence of a particular regulation was not known, it was coded as "no" and hence not counted in this table. Cases in which the regulations were "recommended" but not required were also coded as "no." Cases where the requirement is in force in selected places or circumstances (e.g., in urban areas or "in the absence of a physician") were coded "yes" and hence included in the table.

[a]Key to requirements:

F = Fee
MC = Medical certification
W = Witness(es)
P = Presentation of child to registrar

[b]Includes cases of either MC or W, and cases where requirement exists for selected situations, e.g., non-hospital births.

Source: Derived from provisional results of a study on civil registration/vital statistics national practices conducted in 1977 by the United Nations.

TABLE 3.9 Requirements for Registering Births and Deaths by Place of Occurrence or Place of Residence, Classified by Region

		Registration Requirements					
		Births			Deaths		
Region	Number of Countries Reporting	By Place of Occurrence	By Residence of Mother	Both[a]	By Place of Occurrence	By Residence of Deceased	Both[a]
Africa	19	14	1	4	14	1	4
Asia (Except Japan and Israel)	17	15	1	1	15	--	2
Latin America	23	21	1	1	21	1	1
Oceania (Except Australia and New Zealand)	5	4	1	--	4	1	--
Subtotal	64	54	4	6	54	3	7
Europe	29	21	4	4[b]	21	4	4[b]
Other Developed	6	4	2[c]	--	4[d]	2[c]	--
Total	99	79	10	10	79	9	11

[a]It is possible that there was some confusion about this category among those who provided the information to the U.N.; it may be that some of the countries listed as "both" collect both types of information on their registration forms but that both are not required.
[b]Includes two cases of "either."
[c]In one case: by place where family registration book is kept.
[d]In one case: by place of burial.

Source: Derived from provisional results of a study on civil registration/vital statistics national practices conducted in 1977 by the United Nations.

means that the person reporting the event must do so in the registration area where the event occurred, which may or may not be the legal residence of the person concerned--the mother in the case of a birth or the deceased in the case of death. For collecting national totals to calculate national rates, the place of registration does not matter, but it becomes an important factor in dealing with regional data. Whether the CR/VS system requires registration by place of occurrence or by residence can affect the data in two ways. First, it affects tabulation. Some countries do not have resources sufficient to tabulate CR/VS system data two ways; hence, if data are collected by place of occurrence, that is the way they are tabulated. Second, the completeness of data may be affected. For example, if the CR/VS system rules require registration by place of occurrence, those responsible for registering events may not bother to travel to the registration office in the place of occurrence once they have returned to their usual places of residence, thereby contributing to incomplete registration.

Ten nations require registration of a birth by residence of the mother, eight require registration by both residence and place of occurrence, and two permit either. For deaths, nine countries require registration by place of residence of the deceased, nine by both place of occurrence and residence of the deceased, and two nations allow either. It is possible that there was some confusion about the "both" category among persons who filled out the questionnaires for the U.N. study. It may be that some of the responses listed as "both" were meant to indicate that data of both types are collected on the registration forms but are not necessarily required. Nevertheless, it is clear that most nations require registration of births and deaths by place of occurrence.

Age of Mother If data from a CR/VS system are to be used to ascertain patterns of childbearing among different age groups, registered births must be classified by age of mother. An important corollary is that the estimation of levels of completeness of both birth and death registration is enhanced by having registered births and deaths classified by age groups (Hill et al., 1981). Several countries tabulate and publish this information, making the data available for international purposes. Table 3.10 lists developing countries for which birth data are classified by age of mother and available in the 1975 and 1978 U.N. Demographic Yearbooks (UNDY). The 1975 UNDY covers the years 1966-74; the 1978 UNDY reports "latest available year." A total of 76 developing countries are listed (including a few areas, e.g., Puerto Rico), and many of them have series covering several years. Thirty-eight of these countries are in Latin America and the Caribbean. In Asia only three developing countries with populations over 10 million have included 1970s information: Malaysia, Thailand and the Philippines. Countries tend to fall into two categories in terms of "latest available year" for this data. For 25 countries the latest available year is 1976 or 1977, which means a lag of two to three years between the occurrence of births and publication of the data in an international yearbook (given that the 1978 Demographic Yearbook was published in 1979). The second category includes countries with much longer time lags, in the neighborhood of 8 to 10 years. Table 3.10 also shows the few cases in which birth data are available by both mother's age and urban/rural residence.

Birth Order The estimation of fertility levels and trends is also enhanced by data on birth order. In addition, geographic breakdowns of available data into urban/rural classifications permit the estimation of regional variations. Table 3.10 lists (in the last column) the years for which birth-order data from CR/VS systems in developing nations are available in the 1975 UNDY. The availability of information on birth order tends to parallel the availability of data by age of mother, although birth-order data are available for slightly fewer countries.

3.6 ATTEMPTS AT IMPROVEMENT

For registration systems to be effective, the required processes for registration need to be understood by the population. Research is limited on how well populations understand what they are required to do, how they feel about these requirements, and what they report they have or have not done regarding registration. A special survey was conducted in Thailand in 1966, as a supplement to the first Survey of Population Change in that country. The purpose was to obtain information about knowledge of, attitudes toward, and practices concerning

TABLE 3.10 Completeness of Birth Registration and Years for Which Selected Data on Births Are Available, as Reported in U.N. Sources: Selected Countries in Developing Regions

Region, Country or Area	Completeness of Birth Registration (as reported in PVSR, 1 Jan. 1981	Birth Data Available: Age of Mother — Years Available (as shown in UNDY 75)	Birth Data Available: Age of Mother — Latest Year Available (as shown in UNDY 78)	Birth Data Available: Mother's Age and Urban/Rural Residence — Latest Year Available (as shown in UNDY 78)	Birth Data Available: Birth Order — Years Available (as shown in UNDY 75)
Africa					
Algeria	U		1965		
Egypt	C	1966-73	1975	1975	1966-73
Ghana	...	1971[a]	1971[a]		1971[a]
Libya	U	1972	1976		
Madagascar	U	1966-67,1971-72[a]	1972[a]		
Mauritius	C	1966-74[a]	1977[a]		1966-74[a]
Reunion	C	1966-70	1970		1970
Seychelles	C	1966-74	1976		1967,1969-74
Tunisia	C	1966-72	1974	1974	1969-72
Asia					
Brunei	C	1970-74	1976	1976	
Burma	U	1967[a]	1967[a]		1967[a]
Cyprus	...	1966-74	1977		1966-67,1971-74
Hong Kong	C	1969-74	1977		1969-74
India	...		1964[a]		

Jordan	C	1969-74	1977		1969-74
Kuwait	C	1966-70,1973	1977		1966-73
Macau	...	1966-70	1974		1966-70
Malaysia	U	1966-72,1973[a]	1976[a]		1966-73[a]
Philippines	U	1966-72,1974	1974		1966-71,1974
Singapore	C	1966-74	1977		1967-74
Sri Lanka	C	1966-69	1969		
Thailand	U	1966-73	1976		1966-73
Latin America					
Antigua	C	1973-74	1975		1974
Argentina	C	1966,1968-70	1970		
Bahamas	C	1968-74	1976		1968-70,1972, 1974
Barbados	C	1966-73	1975		1967-73
Belize	U	1966-71	1971		
Bermuda	C		1965		
Bolivia	U	1966	1966		
Chile	C	1966-71	1974		1966-71
Colombia	U	1966-69	1969		1966-68
Costa Rica	C	1966-74	1976		1966-72,1974
Cuba	C	1966-71	1971	1971	
Dominica	C	1966	1969		1966
Dominican Rep.	U	1966-73	1975	1974	1966-73
Ecuador	U	1966-73	1974		1966-73
El Salvador	C	1966-73	1976	1976	1966-73
Fr. Guiana	U	1966-70	1966,1970		1970
Grenada	C	1966-69	1969		1967-69
Guadeloupe	C	1966-70	1970		1970
Guatemala	C	1966-72	1973		1968-72
Guyana	C	1967-71	1972		1971
Honduras	U	1966-71	1976		
Jamaica	C		1964		
Martinique	C	1966-70	1970		1970
Mexico	U	1966-72	1974		1966-73

TABLE 3.10 (continued)

Region, Country or Area	Completeness of Birth Registration (as reported in PVSR, 1 Jan. 1981	Birth Data Available: Age of Mother: Years Available (as shown in UNDY 75)	Birth Data Available: Age of Mother: Latest Year Available (as shown in UNDY 78)	Birth Data Available: Mother's Age and Urban/Rural Residence: Latest Years Available (as shown in UNDY 78)	Birth Data Available: Birth Order: Years Available (as shown in UNDY 75)
Neth. Antilles	U	1966-73	1973		
Nicaragua	U		1967		
Panama	C	1966-73	1975	1975	1966-73
Paraguay	U		1960[a]		
Peru	U	1967-69	1972		1969
Puerto Rico	C	1966-73	1977		1966-67,1969-70, 1972-73
St. Kitts	C	1966-72,1974[a]	1976[a]		1966-72,1974[a]
St. Lucia	C		1963		
St. Pierre and Miguelen	C	1967,1969	1969		1969
St. Vincent	C		1964		1969
Trinidad and Tobago	C	1966-72	1976		1966-68,1970, 1972
U.S. Virgin Is.	C	1966-67,1969-73	1973		1966-1973
Uruguay	C	1967-73	1976		
Venezuela	U	1966-74	1975		1966-68,1971, 1974

Oceania

American Samoa	C	1966-73	1976		1966-69,1971-73
Christmas Is.	C	1966-72			1966-72
Cocos Islands	C	1969-74			1969-72,1974
Cook Islands	C	1971-73	1973		
Fiji	C	1966-74	1976		1966-74
Fr. Polynesia	...	1968	1968		
Guam	C	1966-74	1977	1977	1966-68,1972-74
Nauru	C	1966-68	1968		1967-68
New Caledonia	...	1966-68,1970-74	1977		
Norfolk Is.	C	1966-74			1967-68,1970-72
Niue	...		1970		
Pacific Is.	U	1966-74	1976	1976	1966-74
Samoa	U	1967-74	1976	1976	
Solomon Is.	...	1969	1969		1969
Tokelau Is.	...	1971-72			
Wallis and Futuna Is.	...	1969	1969		

Note: Data reported for the following countries and years were derived from estimates based on sample surveys rather than civil registration:
Africa: Benin, 1961; Cameroon, 1964-65; Central African Republic, 1964-65; Chad, 1963-64; Congo, 1960-61; Gabon, 1960-61; Liberia, 1970-71; Malawi, 1971-72; Togo, 1961.
Asia: Indonesia, 1964; Pakistan, 1968; Turkey, 1967.

Data reported for the following countries and years are for ethnic subpopulations not representative of the country as a whole:
Africa: Namibia, 1963; South Africa, 1971; Zambia, 1968; Zimbabwe, 1976.
Oceania: Papua-New Guinea, 1971.

[a]Data reported are for selected areas of the country only and thus may not be representative of the country as a whole.

the registration of vital events as well as reasons for failure to register events. Arnold and Kuhner (1980:101) summarized the conclusions of the study:

> A major goal of the survey was to make use of the results for improvement of the registration system. The survey found that the legal regulations for registering births and deaths were generally quite well understood by the respondents. Over 90 percent correctly answered that events must be reported to the kamnan or at the municipality offices. The majority also knew whose responsibility it is to register events and approximately within what time period events should be registered. The majority also knew that no fee is charged for registration and that no documents have to be taken to the registrar. However, there was considerable misunderstanding of the correct procedure for registering events that occur outside the tambol (commune) of usual residence. Only 1/3 of the respondents knew that such events should be reported to the registration office where the event occurred. Failure to register events was evidently due to a lack of motivation on the part of the informant rather than to a lack of understanding or inconvenience in registering the event. It was also found that the registrars sometimes underestimated the necessity of recording all events within the specified period of time. The Supplementary Survey also showed that the maintenance of vital registration records was often rather low priority because registrars at all levels were usually overburdened with a variety of other tasks.

There are numerous actions that can be taken to improve the quality of CR/VS systems. The Conventional Vital Registration System (Powell, 1975:41-43) divides a number of possible improvements into two classes: (1) action needed on the national level, and (2) action needed at the international level. A document from the POPLAB Secretariat, Development of a National Strategy for the Improvement of Civil Registration and Vital Statistics (Laboratories for Population Statistics, 1976), gives a more detailed list of 24 possible actions classified into five categories:

(1) Assessment of problem and utilization of available resources
(2) General and interministerial activities
(3) Activities primarily the responsibility of civil registration authorities
(4) Activities primarily the responsibility of vital statistics authorities
(5) International activities

In considering feasible ways of improving CR/VS systems, government authorities and CR/VS experts recognize that some can be effective in a rather short time perspective, whereas others will achieve results only over a long time span. For example, actions that assume the urbanization of the population, that depend on increasing national literacy, that require education of the public regarding the obligations and benefits of registration, that rely on vastly improved transportation and communication facilities, or that assume substantial social and economic development of the nation certainly require a long-range time perspective. On the other hand, improvements that can be achieved by better coordination, increased administrative controls, revised and more timely tabulation programs, or by more intensive and systematic use of estimation and analytical methods, are all possible in a shorter time span. Allowing for exceptions, the evidence suggests a generalization that improvements in the compilation of vital statistics may be made on a short-term basis, while improvements in the civil registration system are more long-range.

3.6.1 Use of Indirect Estimation Methods

As indicated earlier, greater use of vital statistics data has become possible through the development of techniques that allow utilization of incomplete data and measurement of the quantitative deficiencies of data. There is a large scientific literature relating to methods for estimating underregistration of vital events and deriving estimates from defective data, for example: United Nations (1955:200-212), United Nations Manual IV (U.N., 1967), Brass (1975), and Indirect Techniques for Demographic Estimation (Hill et al., 1981). A description of these methods is outside the scope of this report, but the growing awareness, availability, and utilization of these indirect methods with incomplete vital registration data is leading to better estimates of fertility and mortality. (See Figure 2.7 in Chapter 2 for a list of some of these techniques.)

3.6.2 The Tabulation Area Approach

In many developing countries the registration system may be so defective that the tabulated results of the system as a whole cannot be used as a basis for estimating fertility and mortality rates. However, in many cases, even though the overall totals are defective, there are certain geographic areas of the country (such as some large cities, the more developed provinces, etc.) where the registration data are of an acceptable level of completeness and accuracy. Use of such data constitutes what is known as the "tabulation area" approach.

In practice, this means that at the tabulation stage the returns from all areas of the registration system are divided into two groups: (1) those that satisfy certain established criteria as to the quality of the civil registration records, and (2) those that fail to satisfy such criteria. The first group of areas constitute a "national vital statistics tabulation area," and data from this area form the primary basis for national tabulations and estimates of fertility and mortality. Data from the second group are given lower priority and less detailed treatment, and in some cases are not even tabulated. This concept is discussed in detail in the U.N. Handbook of Vital Statistics Methods (U.N., 1955:164-167). Because of the importance of this approach, the U.N. recommendations regarding it are quoted in full in Figure 3.1.

A disadvantage of the tabulation area approach is that it makes it more difficult to generate denominator data that correspond by area to the numerator. This is particularly troublesome if the tabulation area is regularly changing, as more areas of the country are included in the tabulation area. A further disadvantage of changing the area is that spurious trends can be introduced. Moreover, the practice of selecting certain areas to be tabulated according to some criteria of quality and then using the aggregated results as an approximation of national figures violates, of course,

FIGURE 3.1 U.N. Recommendations Concerning the Use of Tabulation Areas in Civil Registration/Vital Statistics Systems

1. Tabulation Areas

One of the basic premises of the vital-statistics system is that every vital event which occurs among the population of the geographic area should be first registered for legal purposes (Principle 203) and secondly, reported for statistical purposes (Principle 301). Ideally, therefore, the goal of tabulation coverage should be 100 per cent in respect of both geographic areas and population groups. Even in the most advanced societies, however, it is known that a small percentage of births and deaths may fail either to be registered or reported on time. Thus, for all practical purposes, the standard of tabulation coverage falls to a more realistic level, somewhat short of 100 per cent.

International recommendation

The United Nations recommendations on the matter of tabulation coverage have been set forth in Principles 402 and 403, both of which state the fundamental concept of complete geographic and ethnic coverage in tabulations. But these Principles, as will be seen below, also recognise the inevitability of less than perfect compliance, and the need for standards against which performance may be measured objectively.

402. Tabulation area--geographic aspect

(a) In accordance with individual national conditions and needs, specific standards for completeness of registration and data coverage should be set up, and every effort should be made to ensure that the data for the entire national territory meet these standards.

(b) Where it is impossible to secure figures for the entire national territory which meet the predetermined degree of completeness with respect to registration and data coverage, detailed tabulations should be made only for data from geographic areas which meet the specified conditions. Separate but regular tabulations should be made for data from areas falling below the determined criteria, and efforts should be made to improve registration in the sub-standard areas with a view to including them as soon as possible in the 'national tabulation area.'

(c) In such cases where the national tabulation area is less than the national territory, special care should be taken to explain limitations of coverage and the implications thereof wherever the statistics appear.

Source: United Nations (1955) Handbook of Vital Statistics Methods. Studies in Methods, Series F, No. 7, Sales No. 1955.XVII.1. New York: United Nations.

all the principles of probability sampling. However, if the areas or groups included are clearly defined, then the results are valid for that defined population.

In spite of the biases and problems just noted, the tabulation area method has been used successfully in a number of countries during the early stages of developing a nationwide registration system of adequate quality. In effect, no assumption is made about the vital rates being the same in the tabulation areas and nontabulation areas. Some of this experience is described in the U.N. handbook (U.N., 1955). Indonesia offers a recent example of this approach. During the 1970s special registration areas of about 30,000 population each were established to obtain information on how best to develop a national CR/VS system (Indonesia, 1979).

One major developing nation that used a modified version of the tabulation area approach for several years is Egypt. Until the early 1960s, Egypt classified the registration of births and deaths as occurring in health bureau areas (HBAs) or in non-health bureau areas. The initial registration of births and deaths in Egypt is linked to the health bureaus, which each serve the health needs of a population of 15,000 to 20,000. Areas with populations of this size and served by a health bureau within the area were designated HBAs, and those without health bureaus as non-HBAs. As the country established more health bureaus, the proportion of non-HBAs declined. During the years for which tabulations were made separately, major differences appeared in the levels of registration completeness in the HBAs and the non-HBAs. This tabulation area approach enabled the government to make more accurate estimates of vital rates in all of Egypt by using the estimates obtained from the HBAs as indicating levels closer to reality.

Perhaps the largest-scale application of the tabulation area concept was in the United States, where it was referred to as the "registration area" method. Early in this century the U.S. established certain criteria that would qualify a state to be admitted to the U.S. Registration Area. In general, these criteria specified that a state must (1) adopt registration legislation that corresponded to a model law drafted by federal authorities, (2) adopt a registration document corresponding more or less in form and content to the U.S. model certificate, and (3) achieve a registration completeness of 90 percent on the basis of federally conducted tests.

Using these criteria, the U.S. National Death Registration Area was established for data beginning with the calendar year 1900. The National Death Registration Area for 1900 consisted of 10 states, the District of Columbia, and a number of cities in other states. The area grew gradually as more and more states satisfied the criteria, until in 1933 it included the entire continental United States.

The U.S. National Birth Registration Area was not established until 1915. The original 1915 area consisted of 10 states and the District of Columbia. This area also grew gradually with admission of additional states until in 1933 it also included the entire continental U.S.

There is no way to demonstrate precisely how well the tabulated death rates for the growing Death Registration Area in the period 1900-33 and the birth rates for the growing Birth Registration Area from 1915 to 1933 corresponded with the rates for the complete U.S. At times after 1933, parallel tabulations were made for the total U.S. and for the original registration areas. Some biases were certainly evident for those post-1933 years, yet it is doubtful that the biases were of a magnitude that would have altered major U.S. policy decisions that had been based on the biased data (see Linder and Grove, 1943: Tables 2 and 45). Also, some of the indirect estimation techniques and general demographic methods permit estimation of birth and death rates for the indicated periods; these rates can be compared with rates generated by the Registration Areas.

3.6.3 The Sample Registration Approach

The general statistical technique called probability sampling is applied in various ways with different methods of collecting fertility and mortality data, however the term "sample registration" is used here with a narrow and precise meaning. It is restricted to the concept as defined in the U.N. Handbook (United Nations, 1955:167) and described in detail by Hauser (1954) in a paper presented to the 1953 International Conference of National Committees for Health and Vital Statistics. In his paper, Hauser presented a broad range of uses of sampling in civil registration and vital statistics and offered a detailed proposal for "a self-sufficient sample vital statistics system." The sample registration concept offers theoretical improvements over the tabulation concept, but it seems to have more intractable administrative difficulties.

Hauser envisioned a sample CR/VS system not only as a way to obtain useful data economically and quickly but as a first step toward the development of a complete national registration system. In proposing its establishment, he spelled out several principles (1954 and 1971:10):

1. The sampling unit should be complete primary registration units or combinations thereof.

2. The sampling method used must be administratively feasible with the resources available and should give assurance that the sample:

   (a) is representative of the entire universe for which vital statistics are desired;

   (b) provides a basis for the measurement of sampling error; and

   (c) minimizes the cost for any given level of sampling error or vice versa.

3. The sample should be large enough to provide vital statistics within agreed thresholds of sampling error for stipulated geographical areas of population subgroupings.

Hauser recognizes that a complete primary registration unit may not necessarily be the most effective sampling unit for the purpose of generating vital statistics. However, if the sample system is to be also an effective way of working toward the desired goal of a complete registration system, it must be tied tightly to the conventional civil system. In his words (1954 and 1971:11): "The sample system would be organized and staffed in the same manner as if a complete registration system were being established."

Perhaps the first, and possibly the only, experiment in applying the sample registration concept was that initiated in southern Peru in 1958 and reported by Cavanaugh (1963). The general plan of the Peruvian experiment was to select a representative sample of existing registration units, which were defined as administrative political entities; to improve registration of births and deaths in those sample units by a program of more intensive supervision and training of the regularly designated local registration officials; and to inflate the sample estimates to obtain estimates for the larger geographic universe from which the sample units were drawn. The universe area had a population of 2.4 million.

The Peruvian experiment was a pioneering project that helped identify operational and policy problems in attempting to improve vital registration. However, the project was designed to proceed with very limited resources, and the field work lasted only a year because of these financial limitations. Since the project was located administratively within an ongoing health program, overhead costs were at a minimum. Even so, the project funds could support only the project director, a supervisor, and two field workers. The task of the field workers was to improve the quality of registration in 110 sample areas (out of 372 registration districts) by developing coordination among public health, school, and ecclesiastical authorities; instructing the local registrars in correct registration methods; educating the public about the value of civil registration and in other ways decrease the number of registration omissions.

It is unfortunate that more attention has not been given to the sample registration method of developing national vital statistics estimates and gradually improving the whole registration system. The key point in this approach is that the sampling unit must be a complete primary registration unit. This enables the sampling activities to be used to improve the functioning of the registration unit; as progress is made, the sample can be extended to include ultimately all the registration units in the country. Many technical and administrative problems accompany the use of sample registration areas, but the approach deserves more theoretical exploration and field trials in nations with different organizational patterns.

A modified version of the sample registration concept is used in India to obtain annual estimates of vital rates. The Indian method is called a Sample Registration System (SRS), but it does not fit the above definition; rather it is a dual-record system (described in chapter 4) that uses both survey and registration methods. When the system was instituted in 1965, it covered only certain rural areas. It was subsequently expanded and during the 1970s produced estimates of birth and death rates by state and by urban/rural breakdowns. In 1972, the SRS had a sample size of approximately 5 million persons. Administration of the SRS varies among states.

In estimates based on the Indian SRS, birth rates for small villages appear to be higher than rates obtained for large villages. One suggested reason is that since the SRS covers the entire village when it is small and only a section of it when it is big, the effects of an expanding population (such as households splitting, enlargement of inhabited areas, etc.) are present in the data collected for small villages, where the SRS areal unit expands as the village expands, but are partially or completely absent from the data obtained from bigger villages, where SRS coverage is restricted to only part of the village.

3.6.4 Coordination

As indicated above, in many countries the registration of vital events and their processing into statistics is the responsibility of a fragmented system--fragmented between national and provincial responsibilities and, at the national level, fragmented between two or more ministries. The absence of a single agency that is responsible for all aspects of the system--from the local registration process to the systematic collection of registration documents through the apropriate chain of local, municipal, and provincial authorities to a national agency with responsibility for the legal uses of the documents--is a major cause of many of the defects of existing CR/VS systems. Furthermore, although in some countries the translation of the documents into statistics can be accomplished by a separate organization or ministry, in other countries the division of collection and tabulation responsibilities among two major organizations may lead to coordination problems and delays.

In most instances it is not feasible to contemplate the drastic legal restructuring that would create a completely unitary system. However, there is evidence that considerable progress can be made by creating mechanisms that help coordinate the scattered units of the system. In some federal systems such as the U.S., Canada, and India, associations of provincial registration officials have been notably successful in creating procedures that are standardized for the whole nation.

More than 30 years ago, the WHO Assembly formally recommended that countries establish national committees for health and vital statistics. Many countries have established such committees, and WHO maintains a Secretariat unit that disseminates information on the activities of the committees. Two international conferences of representatives of these national committees, one in London in 1954 and one in Copenhagen in 1973, were very well attended and provided a forum for considering how the work of the committees could be carried forward most effectively.

Some of the national committees have operated on a continuing basis; others have fluctuated between periods of activity and periods of dormancy. While useful to some extent in improving civil registration and vital statistics, the committees have two major flaws that limit their potential impact on registration. Since the international recommendation was issued by WHO, the response naturally came from national health ministries. Unfortunately, national health ministries usually have only a minor or peripheral responsibility for registration; in most cases, they are not the agencies with effective coordinating influence on the problem of improving registration systems. In addition, the committees' primary frame of reference is health statistics, which means they are concerned primarily with the wide array of health statistics other than those that arise from the civil registration system. Nevertheless, in many countries the effectiveness of the vital statistics system depends on cooperative effort among several disparate agencies, and some mechanisms for coordination are essential.

3.6.5 Logistical Improvements

A civil registration system often comprises an extensive network of administrative units, extending from the national capital out to thousands of local registration units. The continuous operation of this system implies a flow of forms, materials, and instructions from the center, and a constant reverse flow of completed registration forms to the places where they are permanently filed and to the statistical office for tabulation. The logistical problems of supporting this system are considerable and steps being taken to improve deficient systems include improved supervision of the routine operational aspects of the system and the establishment of controls and check lists on the flow of materials and documents.

3.6.6 Personnel Improvements

Several countries have tried to upgrade their registration systems by improving the quality and performance of the personnel responsible for operating each part of the system. Training materials have been developed, training seminars organized, regional and national conferences for registration officers held, and in a few cases model offices have been established where procedures are demonstrated and training is conducted. However, such efforts are not widespread nor are they usually continuous. In some cases, special efforts to improve the registration system are carried out for a few months, but then not continued.

Although mandating the registration of vital events and establishing a registration system have not proved difficult, in many countries it has proved difficult to make more fundamental administrative changes that could improve the registration system. Some of these more fundamental changes include increased salaries or reclassification of positions involved throughout the chain of operation, new budgetary allocations, and administrative redefinitions of the registration function in relation to other responsibilities that registration officials may have.

3.6.7 Public Education

Countries have also established programs of public education, so that those responsible for reporting vital events to the local officials are aware of their responsibilities and also aware of the benefits and rights that the registration of a vital event can ensure for them. Probably more education of the public would help to improve compliance with registration systems, especially if carried out concurrently with training programs for registration officials.

3.6.8 Improvements in Tabulation

Many improvements have been made at the statistical tabulation end of the CR/VS process. It is possible to make these improvements rapidly and at the discretion and control of a central office. Among others, these improvements have included: (1) improving supervision and control of tabulation; (2) remodeling tabulation programs to bring them into accord with international recommendations; (3) modifying schedules and procedures to improve timeliness of tabulation and publication, perhaps even skipping alternate years altogether to make the current tabulation schedule coincide with census dates; and (4) tabulating vital events on a sample basis. Some countries have adopted the pragmatic principle that while 100 percent registration should always be the goal, vital statistics tabulations can be prepared using samples that include many fewer cases than tabulation on a 100 percent basis.

Because of delayed registration, it is good to update initial tabulations each year, perhaps with a cut-off after five years. After that point, the revised tabulations are likely to include most events whose registration was delayed.

3.7 SUMMARY

In evaluating the CR/VS system as a general source of data for computing fertility and mortality levels and trends, the Panel emphasizes that the quality of the systems among the countries of the world varies from excellent to very poor. In many countries the system is almost perfect, while in others it is rudimentary. For some of the latter countries the basic problems arise in the actual reporting of the event at the local level; for others the main problems are central, such as a lack of coordination among agencies or deficiencies in the tabulation process or the failure to collect systematically information that is in fact recorded in the field.

All the developed countries and a number of developing countries have fully adequate systems, as indicated in Table 3.5 and the related discussion in this chapter. Many of the 92 oountries whose birth registration data are classified "complete" in 1981 are developed countries; others are small special cases such as Hong

Kong and Singapore. However, also included among the 92 are Egypt, Tunisia, Costa Rica, El Salvador, Panama, Chile, Uruguay, Peninsular Malaysia, and other developing nations. Thus, even some countries usually considered to be in the developing category have CR/VS systems that may provide adequate information on levels of fertility and mortality, and for a few the level of accuracy is sufficient to ascertain trends. Many other countries are on the brink of having their registration systems become adequate for analytical purposes, particularly if they are able to utilize direct and indirect techniques for estimating levels of incompleteness of the registered events. These techniques have recently been applied to data in Korea, Bangladesh, Thailand, India, Egypt, Turkey, Brazil, Colombia, and other countries. For information on these applications, see the series of country reports produced by the Committee on Population and Demography (those published in 1980 and 1981 are listed on the inside back cover) and the Committee's manual on indirect estimation (Hill et al., 1982). Other applications are reported in the standard demographic literature.

The CR/VS system has a firm legal structure. It provides "flow" data on an annual basis and it can accommodate a sufficient number of variables to make possible estimation of basic fertility and mortality levels and trends. Moreover, it is the only data collection system that usually returns some benefit (a useful legal document) to the individual respondent or a close relative. In addition to providing data for the estimation of national and regional fertility and mortality, properly functioning CR/VS systems permit the analysis of such detail as trends in deaths by age among infants (how many in the first day, the first week, the first month, etc.), as well as by place of occurrence or place of residence.

The benefits and sanctions associated with CR/VS systems have important bearing on why these systems function at different levels of completeness. The population has to receive and perceive the benefits associated with the registration of vital events. Likewise, a government must be willing and able to enforce legal sanctions regarding registration. These factors are all affected by cultural patterns and by levels of development.

For the analytical use of CR/VS data to produce valid estimates of fertility and mortality, coverage completeness of 60 percent or more is usually necessary, although in some situations estimates are possible even if coverage is less than 60 percent. The level of registration completeness can be measured by using other CR/VS data to make internal checks on the levels of underregistration. In the case of births, this internal check can be performed by analyzing birth order by age; in the case of deaths, by analyzing deaths by age. Checks can also be carried out using information obtained from other data sources, including sample surveys.

The importance and basic soundness of the CR/VS system was underlined in the 1974 U.N. World Plan of Action (United Nations, 1974), which urged countries to improve their CR/VS systems and recommended the use of alternate systems "until this improvement is completed," thus implying that alternate systems are necessary as a interim measure. As noted earlier, the improvement of CR/VS systems in countries where they are now inadequate requires a long-range perspective in many cases; it is essential to lay the foundations of reliable CR/VS systems to produce analyzable data in the future. Programs to improve coverage, completeness, and quality in CR/VS systems merit careful consideration and action.

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4 Surveys

4.1 INTRODUCTION

Sample surveys using household interviews are a third method widely used to measure demographic phenomena. Surveys are used both to supplement data provided by censuses and civil registration and to substitute for such data when census and civil registration data are absent or deficient in content or quality. Covering only a sample of a population allows the flexibility to collect more detailed data than is possible in a census or civil registration, but it also introduces an additional source of uncertainty: namely, sampling error. More intensive training and supervision of field personnel are possible for surveys because the number of respondents is much smaller than in censuses or civil registration, but there is an additional requirement for carefully controlled field procedures to insure correct identification of sample units in the field.

A large number of surveys of varying types have been conducted to measure fertility and mortality. For example, an inventory by the World Fertility Survey (WFS) showed that 175 large-scale surveys were conducted in less developed countries (Baum et al., 1974a-d) from 1960 to 1973, and the WFS program itself includes national sample surveys in about 45 countries. This chapter reviews the experiences, problems, and contributions of surveys to the estimation of levels and trends of fertility and mortality. In addition to sections on background and definitions, the chapter includes a discussion of advantages and disadvantages of surveys and a checklist of major choices and decisions facing planners designing demographic surveys. It also presents information on surveys undertaken in developing countries to estimate the levels and trends of fertility and mortality and a summary.

A primary emphasis in this chapter is discussion of optimal procedures for collecting data on demographic change. Inevitably, the quality of data collected in a survey is directly affected by the sample design, the organizational arrangements, and the operational control of the survey. To keep non-sampling errors at acceptable levels, it is essential to use sound design principles and to apply good control practices in executing the design. Good survey design and execution are possible if sufficient resources, trained people, and adequate facilities exist. When they do not (which is the usual situation), trade-offs and compromises must be made between the ideal and the attainable to achieve a reasonably efficient design and execution to the extent that judicious allocation of resources permits.

The purposes of the sections that follow are to describe the state of the art in the design and execution of surveys to estimate fertility and mortality and to point out problems, aspects of surveys that require special attention, and the strengths and weaknesses of surveys as sources of data for demographic estimation. The issues discussed apply to samples built in to censuses and post-enumeration surveys as well as to sample surveys conducted independently.

Some surveys have produced good data; others have produced poor data, due to faulty design, poor execution, or both. In other cases, surveys have failed to produce valid estimates because of faulty data analysis. In particular, the traditional demographic surveys that use single-round retrospective questioning have generally produced data inadequate for fertility and mortality estimation, although the quality of the results from such surveys frequently can be improved by using indirect estimation and standard demographic techniques to adjust faulty data. Often survey data are accepted at face value without necessary corrections, leading in some cases to underestimates or overestimates of fertility and mortality. As emphasized earlier in discussing the complementarity of data collection sources, surveys can provide timely and rich data for fertility and mortality measurement, but they should not be looked upon as the only useful source.

This chapter is not intended to be a manual on how to design surveys of fertility and mortality, but it is more detailed than the chapters on the population census and

CR/VS system. This extra attention to details is necessary because there are so many more options to consider in the design of surveys, especially those whose primary aim is to collect information for estimating fertility and/or mortality. Because each step in the design and implementation of surveys is so important, there are separate discussions of general design considerations, sample design, coverage errors and biases, response errors and biases, and the precision of the estimates obtained. Another special feature in this chapter is the presentation of a checklist (Figure 4.1) that administrators may find helpful in planning, budgeting for, organizing, and monitoring a survey.

4.2 BACKGROUND

Attempting to design a survey that is judged to be the best that is feasible under a given set of resource constraints and political, administrative, and field conditions has been the practice of good survey statisticians for many years. General principles of household survey design and sample design procedures are relatively well known, and survey researchers have learned a great deal about how to maintain statistical and operational control over the data collection process in the field, which is a major difficulty in conducting any survey. Beyond these general concerns are the special data needs of surveys for estimating fertility and mortality. Certain design features may be more appropriate for demographic surveys than for other types of surveys. For example, demographic studies are often best served by samples that involve repeated interviews and exhaustive coverage of each sample area. Also, certain data, such as age, assume added importance in demographic surveys.

The inherent problems of obtaining useful data may or may not (depending on the circumstances) be compounded when demographic data are collected as a by-product in household surveys designed primarily for other purposes, such as measuring labor force participation or household expenditures. The special danger in that situation is that inadequate attention and time may be given to planning and collecting the demographic data, although that can also happen in surveys designed primarily to collect fertility and mortality data. Moreover, in surveys not focused primarily on collecting fertility and mortality data, the knowledge, experience, and priorities of the survey designers or administrators may not be those required for achieving adequate measurement of those data.

As indicated in Chapter 1, measuring even the clearest concepts--for example, age or children ever born--is not easy, and errors of varying magnitudes exist in virtually all data. Demographic survey planners, along with designers of censuses and civil registration and vital statistics (CR/VS) systems, have learned that better results are obtained if they try to insure first that the esssential concepts are clearly defined and, second, that questions related to the concepts are made clear to respondents during their interviews.

It is often difficult to communicate demographic concepts to survey respondents in such a way that they are both able and willing to respond. Difficulties may arise because the interviewer is unable to make the concepts clear to respondents (for example, to explain who is or is not considered a household resident for the purposes of the survey) or because the interviewer's introductory comments and general attitude fail to make respondents willing to answer questions. Also, respondents may have cultural constraints or inhibitions regarding certain topics. However, even if these problems can be overcome, there remains the problem of respondents' lack of knowledge about current or past events or characteristics--for example, not knowing exactly how old they are or exactly when a birth or death occurred.

In the past, the statistical literature on surveys has been dominated by sampling designs aimed at minimizing sampling errors rather than designs aimed at controlling nonsampling errors and biases. However, more attention is now being given to optimizing designs with respect to total error. As Cochran points out (1977:396). "The study of these [nonsampling] problems is slow and difficult. Nevertheless a good beginning has been made."

Statisticians and demographers increasingly recognize and emphasize the importance of practicability in survey design (O'Muircheartaigh, 1977; Verma, 1977; Kish, 1977, and Scott, 1980). Still, there remains a wide gap between survey theory and practice. For example, in 1975 the American Statistical Association subsection on survey research methods initiated a study of survey practices in the United States (Bailar and Lanphier, 1978). In a small purposive sample to develop methodology, 36 surveys were reviewed for the type of design, the use of probability samples, and whether an evaluation was made of the resulting estimates. Of the 36 surveys studied in the review, 22 were judged to have failed relative to one or more of these criteria.

There are a number of books and manuals that describe the steps for planning and conducting demographic measurement surveys. These include Warwick and Lininger (1975), a handbook on vital statistics measurement by Marks et al. (1974), Scott and Blacker's manual for surveys in Africa (UNECA, 1974), and a series of manuals on different aspects of survey design and control published by the International Program of Laboratories for Population Statistics (POPLAB), including: Cooke, 1971; Simmons, 1972; Sirken, 1972; Scott and Chanlett, 1973; Booth and Lingner, 1975; and POPLAB, 1978. A series of manuals by a francophone working group on African demography describes the experience of single-round surveys carried out in tropical Africa during the 1960s (INSEE-INED 1967), multi-round surveys (ORSTOM-INSEE-INED 1971), and problems associated with the collection, adjustments, and analysis of demographic data in Africa (INED-INSEE-ORSTOM-SEAE 1973, 1974, 1975 and 1976). Other French-language works include books by the Department of Demography of the Catholic University of Louvain (1976) and by Tabutin (1976). The World Fertility Survey (WFS 1975, 1976, and 1977) Basic Documentation series includes core questionnaires, together with manuals on all elements of survey design and analysis of the WFS surveys; much of this material is directly applicable to other demographic surveys. Good references on general sample design include Hansen et al. (1953), Cochran (1977), and Kish (1965). The U.S. Census Bureau Popstan series (1979), which covers all aspects of planning a multi-subject, continuing household survey program, includes special modules on demographic surveys. The Statistical Papers and other series of the United Nations also include reports specifically concerned with demographic sample surveys (e.g., U.N., 1970a and 1971) and household surveys in general (e.g., U.N., 1964; 1970b; 1972).

4.3 DEFINITIONS

Four general types of surveys have been used to collect data on fertility and mortality in developing nations:

single-round demographic surveys, multi-round surveys, dual-record systems, and fertility surveys. The many possible variations in the design features of the four types create some confusion in distinguishing among them. In an effort to minimize confusion, we define the first three types of surveys mainly in terms of the number of interviews and type of interviews used with the units in the sample. The defining characteristic of the fourth type, the fertility survey, is that it includes a fertility or pregnancy history; aside from this, it is normally a single-round survey.

To discuss the four types of surveys requires the definition of some common terms:

- A round is a complete set of single interviews with each unit in the sample, whether households or persons.
- The reference period in surveys and dual-record systems is that period of time for which vital rates or other demographic variables are to be estimated (for example, child mortality "in 1960-65").
- The recall period is the period for which respondents are asked to recall and report demographic events of interest (for example, births "in the past 12 months" or children "ever" born). A recall period may be bounded at one or both end points by the dates of events or by the interview(s) or it may be unbounded at the end further back in time. In the case of fertility surveys, the recall period is the number of years for which pregnancy information is obtained, for example, the last five years (bounded at both ends) or the entire pregnancy history (unbounded at the far end).

In a single-round survey the recall period must be at least as long as the reference period. In some multi-round surveys the recall period for one interview can partially or completely overlap recall periods used at previous interviews. Often the recall period and the reference period will coincide. However, in surveys that have overlapping recall periods or in dual-record systems in which the two recording systems cover the same time period, it is essential to distinguish carefully between reference periods, recall periods, and time intervals between rounds.

In its most general sense, a multi-round survey is one in which the same sampling units are followed and interviewed more than once. Other terms commonly used to refer to multi-round surveys are "panel" and "longitudinal" or "follow-up" survey, each of which has a usual definition and implies certain attributes. A panel usually refers to the practice of following a particular group of individuals, rather than households, over time. A follow-up survey usually implies interest in particular changes (e.g., household composition) or events (e.g., births and deaths). In the usual multi-round survey, all persons residing in the sample area at the time of each visit are covered.

Multi-round follow-up surveys to collect data on vital events may also be referred to as prospective surveys. They are prospective in the sense that the first round is used to establish a set of "baseline" information, then subsequent rounds investigate the vital events that occur after the first round (which clearly fixes the reference period and makes the recall period bounded at both ends). In operational terms, an interviewer may inquire in two ways about events that occurred prior to a follow-up visit: (1) by asking about the current status of household members, e.g., "Is X alive?" or "Is Y pregnant?"; and (2) by asking about changes or events that occurred before the follow-up visit, e.g., "Was anyone born or did anyone move into this household in the past N months?", "Was there any death in this household in the past N months?". The first type of question is considered prospective because it is based on prior information about the existence of X and Y; the second type of question is retrospective.

4.3.1 Single-Round Demographic Surveys

If each respondent is interviewed only once (except for possible followup visits to clarify certain responses) and retrospective questions on vital events are asked (but a fertility or pregnancy history is not collected), this is generally called a single-round retrospective survey. Occasionally such a survey is repeated in an entirely independent sample; to avoid confusing this approach with a multi-round survey, we refer to it as a "repeated single-round survey." Similarly, survey systems in which different (multiple) subjects are covered at different times will be referred to as a single-round demographic survey if only one round is devoted to covering vital events. A set of reinterviews done within a short time after the survey exclusively for the purpose of evaluating the quality of data or for checking on the interviewers ordinarily are considered part of the same round. Reinterviews for such purposes usually are done only in a comparatively small subsample; if they are conducted in the whole sample, the distinction between single and multiple rounds becomes less clear.

4.3.2 Multi-Round Surveys

A multi-round survey includes at least two rounds of interviews at each sample unit, separated by a given period of time. The composition and other characteristics of the household are recorded at the initial interview; changes in household composition and information on births and deaths after the initial visit are obtained in one or more follow-up visits. Retrospective data on vital events (e.g., children ever born or complete fertility histories of individual women) may also be collected in the initial baseline survey. The initial interview of a multi-round survey may be identical to a single-round interview except that sufficient information must be recorded to enable interviewers to locate the household or individual for one or more future visits.

In multi-round surveys, special questions and interviewer attention are needed to obtain information on babies who are born and die in the period between consecutive rounds and to obtain information on new persons who join the household. Also, it is important to update the sample at each round rather than to follow a "fixed" panel, which will suffer attrition as people move out of the sample area between rounds. The recommended approach is to use area sampling, in which all households in the sample areas are covered in each round, including all new households. In multi-round surveys that use area sampling, people who move out of the area between rounds are not included in subsequent rounds. Because the unit to be interviewed is a residential address, a new face sheet for the questionnaire, which tells who is currently living at the address, must be completed in each round.

A number of options are possible for follow-up visits; some have proved less desirable than others. One important distinction is whether interviewers at the follow-up interviews use the information recorded in earlier visits. If interviewers do not have information from previous rounds, an entirely new schedule, listing all persons present in the household and accounting for vital events that have occurred since the previous visit, is prepared at each round. Information thus collected can be utilized without reference to that from previous rounds. This approach is not very different from conducting independent, repeated single-round surveys; indeed it is generally more complicated than a single-round survey because of the difficulty of insuring that all interview units from previous rounds are included or accounted for in the subsequent round. As a result, it is not frequently used.

To gain the most from multi-round surveys, some use usually is made of the information from previous rounds. Data collected in the new questionnaire or schedule are reconciled with those from previous schedules, either in the office or, preferably, in the household immediately following completion of the new schedule. Alternatively, a further follow-up visit is made specifically to reconcile discrepancies between data collected in different rounds (Sabagh and Scott, 1973).

Using a schedule that contains information about persons present at previous visits provides the interviewer with a basis for updating information about the household and detecting vital events that have occurred in the intervening period. This "household change" method is the most direct approach and has the advantage that the interviewer can resolve differences in the household without a reconciliation visit. It is also the most commonly used. It does require very careful supervision, because interviewers may be tempted to simply report "no change" rather than visiting the household and conducting a follow-up interview or be tempted to accept a respondent's first reply that there has been "no change" without probing further.

The household change method also eliminates or reduces the need to explain to respondents who is covered by the questions and for what period. If information from the preceding round is provided to the interviewer, deaths, for example, can be pinpointed by naming the persons found alive at the preceding round and inquiring whether they are alive today. However, additional questions must be asked to obtain information on deaths of children born after the previous visit and deaths of other new residents. For births, the advantage is less clear but similar in principle; for example, the interviewer asks whether there are any new members of the household who were not listed at the previous visit.

Dual or multiple reporting of the same vital events may be attempted in multi-round surveys by using reference periods in follow-up interviews that overlap previous reference periods. Overlapping retrospective data of this kind create special problems of matching of vital events from various rounds in the past (Sabagh and Scott, 1973; Vallin, 1975) that are similar to those encountered in a dual-record system. There are also problems of linking persons (especially young children) recorded in one round with events (births) reported in previous rounds. It is important to distinguish such "dual measurement" surveys from independent dual-record systems, because the former do not utilize independent data collection systems.

4.3.3 Dual-Record Systems

A dual-record system for data collection is based on the principle that events missed by one system may be picked up by the other. Dual-record systems are designed expressly to attempt independent, dual or multiple reporting of the same individual vital events. A dual system usually has as one leg some type of more or less continuous, ongoing recorder subsystem that records vital events as they occur, and as the other leg an independent survey subsystem that collects individual reports of vital events for the same period.

Often a civil registration system acts as the recorder subsystem, but if not, a special subsystem can be created. A special recorder subsystem may involve regular visits at short intervals to each sample household expressly to ask for and record vital events or it may depend on a network of knowledgeable local persons who regularly report vital events to a recorder who then visits only those households for which events have been reported, verifies the events, and records them.

Usually, a baseline survey is conducted as part of the survey or the recorder subsystem, prior to activating either subsystem. As in a multi-round survey, the baseline information may or may not be used for follow-up, either by the recorder or by the interviewers in the survey subsystem. In a dual-record system, subsequent survey interviews are then done primarily to enumerate and report independently of the recorder subsystem the births, deaths, or migration that occurred during the reference period of interest. After each survey, reports from the two subsystems are matched to identify events reported in both subsystems, events reported in only one subsystem, and to make estimates of events missed by both subsystems.

The accurate matching of records requires that interviewers be carefully trained and supervised in recording identifying information. In order to minimize communication between the two subsystems, matching usually is done in the central office, in contrast to multi-round surveys, in which matching and reconciliation are usually performed at the time of interview. Usually, another field visit is required after the initial matching is performed; unmatched events and doubtful matches are returned to the field for reconciliation or for verification of the event and the reported details. After final matching, estimates of the total number of events are made, using data from both sources.

Problems have been encountered in the matching process in some dual-record systems, which can lead to over- or underestimates of fertility and mortality levels. Matching problems arise from the use of incorrect geographic boundaries for the sample areas in one or both systems or the use of incorrect recall periods in one or both systems. Also, inappropriate matching rules can lead to events being mismatched. For example, if the matching rules for the reporting of a birth require concurrence on name of child, name of father, and sample area, overly strict application of the rules could lead to a true match being classified as two nonmatches if the two workers collecting the data in the sample area each record the name of the child and the name of the father differently enough that they do not satisfy the matching rules. Difficulties arise also in the development and implementation of matching rules to allocate events that occurred to migrants before or after they entered or left the area covered by the system.

The survey component of a dual-record system can be like a multi-round survey, in that repeated visits to the same units are made, although in many survey subsystems reinterviews are conducted without using data from previous rounds. A recorder subsystem that entails repeated visits to every household also functions much like a multi-round survey. In contrast, a recorder subsystem that relies on community contacts to report events rather than visits to every household is more closely related to an active civil registration system (described in Chapter 3) than to a multi-round survey. We can thus distinguish two types of dual-record systems: (1) those in which both subsystems involve repeated interviews at each household and (2) those in which only the survey subsystem involves multiple visits. Both of these differ from "dual measurement" multi-round surveys that utilize overlapping reference periods to obtain dual reports.

4.3.4 Fertility Surveys

A fertility survey is a specialized type of single-round survey in which the principal body of data collected to measure past and current fertility (and in some cases child mortality also) is a fertility or pregnancy history. A fertility history is a set of information collected from each interviewed woman (or couple, but usually a woman) concerning all live births that have occurred to her in her lifetime or in a specified recent time period, such as five or ten years. For each child born, several items of information are usually collected: date of birth; sex; current age; if no longer living, age at death; whether or not still living at home; and whether single or multiple birth (in which case each birth is listed separately). A pregnancy history expands the scope of events to cover all pregnancies; it collects information on the outcome of each pregnancy, including stillbirths, miscarriages, and abortions as well as live births.

The persons interviewed in fertility surveys may be all women, ever-married women only, or currently married women only. Sometimes women over age 50 are included, but the most common practice is to interview ever-married women under age 50. Also, many fertility surveys include a full count by age and sex (and sometimes other characteristics) of all persons in the households selected as interview units, whether or not the household contains an eligible respondent for the fertility questionnaire. A fertility survey is much less useful for analysis if such complete counts are not obtained.

Some fertility surveys also attempt to obtain information on contraceptive use prior to the latest pregnancy or to each pregnancy, and some have tried to obtain data on whether or not certain pregnancies, usually the more recent ones, were desired by the respondent, either at that particular time or in general. For example, the survey may try to determine which of the following situations pertains to a woman who has four children: she wanted the fourth child when she had it; she wanted a fourth child at some time but not when she had it; or she did not want the child at all. Fertility surveys are often associated with KAP surveys, that is, surveys that collect data on knowledge, attitudes and practices related to family planning and family size. Some KAP surveys include summary questions about fertility, such as the number of children ever born, and hence they are similar to single-round demographic surveys. However, for the purposes of this discussion a KAP survey is not considered a fertility survey unless it includes a fertility or pregnancy history.

Fertility surveys usually are not carried out at frequent intervals, and many countries have conducted only one to date. A small number of countries (for example, Taiwan and Korea) have collected pregnancy history data at two-year intervals during certain periods in their development of family planning programs. Other countries have used longer intervals; for example, Turkey conducted a series of four fertility surveys at five-year intervals beginning in 1963. Sometimes fertility surveys are incorporated into one round of a multi-round survey or dual-record system or carried out in conjunction with a single-round survey. In these cases the fertility survey usually is administered only to women in a subsample of the households in the demographic survey.

If the data on the occurrence, timing, and survival of all live births are of good quality, fertility histories permit extensive analysis of period and cohort fertility and of infant and child mortality. As a result, the method has been widely used in developing countries and is the approach adopted by WFS. In addition to fertility or pregnancy histories, fertility surveys collect varying amounts of other information on personal and household characteristics, social and economic characteristics, marriage ages and marital history, knowledge of and attitudes toward family planning, past and current use of family planning, and migration experience, including urban and rural background. Sample sizes in national fertility surveys often range from 3,000 to 8,000 interviews, although many other fertility surveys are carried out on a local basis with smaller numbers of interviews.

4.4 GENERAL CHARACTERISTICS AND PROBLEMS OF SURVEYS

Surveys have many advantages and some disadvantages relative to the other two major methods of data collection, the census and CR/VS systems. In addition, there are relative advantages and disadvantages among the four types of surveys just described. This section describes characteristics of design and implementation that are shared by all types of demographic surveys. Two such aspects, the calculation of total error and the special problems involved in framing questions about fertility and mortality, are described in more detail in Appendixes A and B.

As a guide for the following discussion, we present Figure 4.1, which lists the major tasks and decisions facing survey planners and those who implement the plans. This checklist includes all major steps in the survey process, from sampling design and the actual collection of data in the field to editing and coding, data processing, and tabulation and publication of results. However, given the focus of this report, the discussion that follows emphasizes the steps that most directly affect the data collection process and not the logistics of tabulation and analysis, although these are also critical to obtaining good results. In fact, as a prefatory note to this entire subject it should be emphasized that success in designing and implementing surveys depends above all on meticulous attention to small details. No matter how trivial some details appear individually the integrity and reliability of most surveys stand or fall on their cumulative effects. We point out many of these details in the discussion below.

4.4.1 Type and Scope of Information Needed

The first major task is to determine what kind of information is needed. Are estimates of both fertility and mortality required for the total population--for example, estimates of the crude birth rate and total fertility as well as the crude death rate and a life table? Is it sufficient to obtain estimates of fertility and child (and infant) mortality, but not adult mortality? Will estimates of only fertility or only mortality suffice? Is the survey expected to produce data for estimating fertility trends as well as for estimating current or very recent levels?

Fertility surveys, which include pregnancy histories, can provide the data needed to estimate fertility trends, although extremely careful attention must be given to error and bias problems in such estimation. No acceptable method yet exists for estimating total and adult mortality trends from data collected in a single-round survey (of any type), although surveys that cover prospective periods of several years may provide data on trends during those periods. For both fertility and mortality, the measurement of trends is best accomplished by analyzing data collected over time in CR/VS systems and in separate censuses and surveys. Another task in this first step is to select the geographic divisions for which separate estimates are to be obtained (for example, national only, urban/rural, regions, major cities, etc.).

4.4.2 Advance Planning of Survey Operations

A second major set of tasks includes deciding who will plan the survey, who will carry out those plans, how much money can be made available for the survey, and when the fertility and mortality estimates are needed. The decisions will involve making trade-offs among many competing alternatives, as illustrated in item B of Figure 4.1.

4.4.3 General Design Considerations

General design considerations form the third major task for survey planners: Within the given budget and time constraints, what is the most reasonable and cost-efficient way to obtain the desired information?

The survey design is the complete plan for collecting and analyzing the data required to satisfy the survey objectives; hence, it should be based upon a detailed specification of the objectives, preferably in the form of the tabulations required. General objectives and general administrative and political factors may also influence the design. The design includes the following major elements: sample design and identification procedures, including cartographic requirements; questionnaire design; type of survey; the number of survey rounds; the data collection process (sources of information and how the field staff conducts interviews); design of field operations (how field staff is selected,

FIGURE 4.1 A Checklist of Major Tasks and Choices Facing Planners and Administrators of Surveys for Collecting Fertility and Mortality Data

Task	Choices
A. Decide on type and scope of information desired	1. Fertility or mortality or both 2. Current levels or levels and recent trends 3. Child mortality only or child mortality plus total population mortality 4. National estimates only or separate estimates for regions, urban and rural areas, etc. (affects type and size of sample) 5. Type of tabulations and richness of detail desired
B. Advance planning of survey operations: personnel, financial resources, and timing (who will be responsible for implementation, maximum available budget, and time frame)	1. Organization/department and individuals responsible for the survey 2. Trade-offs among subject-matter details 3. Trade-offs among geographic coverage possibilities 4. Where to obtain necessary skilled personnel for all phases of survey operations, including tabulation, analysis, and report writing 5. Trade-offs among survey objectives, time constraints, and budget constraints
C. General design considerations (how best to obtain the information within necessary time and budgetary constraints)	1. Type of survey (and whether separate survey or part of a multi-subject investigation) 2. Type and design of sample 3. Target population (whole country or some areas excluded)

	4. Levels of acceptable total error 5. Content and design of schedule 6. Maps and household identification procedures 7. Logistics, especially transportation
D. Detailed design of sample (chcosing the optimum sample design given the objectives, the circumstances in the country, and the general design choices made)	1. Balance between sampling errors and non-sampling errors 2. Stratification 3. Clustering and area units for sample 4. Accepting ranges of sampling error
E. Detailed design consideration to deal with coverage errors and biases	1. Rules for and supervision of interviewers to minimize non-coverage and non-response 2. Control processes to minimize/eliminate overcoverage errors
F. Detailed design considerations to deal with response errors and biases	1. Ways to collect information on the basic demographic variables, including age, migration and residence, and current (recent) demographic events 2. How to collect fertility information: summary questions or fertility (pregnancy) histories or both
G. Type of schedule[a]	1. Use of questionnaire or form 2. Content and design 3. Extent of pretesting and questionnaire revision 4. Number of linguistic versions of schedule to be developed and used

FIGURE 4.1 (Continued)

Task	Choices
H. Training of field workers	1. Type and duration of training 2. By whom
I. Detailed design of field operations	1. Timetable 2. Use of existing or newly created survey organization 3. Supervision 4. Transportation and other logistics 5. Size of field staff, especially number of interviewers 6. Making interview assignments on a team basis or for each individual interviewer
J. Control functions	1. Control during sampling phase 2. Control during field operations 3. Control during processing and tabulation phases 4. Management records
K. Data processing and tabulation	1. Where and by whom (including programming) 2. Extent of quality control 3. Use of imputation 4. Mechanism for interaction with survey designers
L. Methods of disseminating survey results	1. Number and type 2. Number and levels of professional staff to analyze data and prepare reports 3. Computer facilities for technical analysis beyond tabulations

4. Provision for generation of subsequent tabulations through data base, access to tapes, etc.

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[a]In this report, the word "schedule" is used as a general term meaning the tool used to physically record information. The two basic types of schedules are referred to as questionnaire and forms. As used here, a "questionnaire" is a schedule that contains each question exactly as it is to be asked in the interview or read by a respondent who is filling in the responses on a self-administered questionnaire. In a "form," subject items are listed only in summary terms, and instructions on how to ask for the information are provided in instruction guides and described in the training process. Forms are frequently arranged as tables, with one row for each respondent. For example, here is how the same information might be indicated on a questionnaire and a form.

<u>Questionnaire</u>

What is your name? ______________________________

How many years did you complete in school? __________years

What is your usual occupation? ______________________

<u>Form</u>

Name	Age	Education	Occupation
____________	_____	_______	______________
____________	_____	_______	______________
____________	_____	_______	______________

trained, and deployed, how they locate sample units, assignment and control of work); flow of records; office procedures; data processing; design of reports and analytical procedures; the timetable; and cost considerations. While the design is based upon the objectives, the costs depend upon the design; hence the initial design decisions, including the advantages and disadvantages of each, are sometimes reconsidered in matching detailed objectives with available resources.

Determining the objectives and design characteristics of a demographic or fertility survey involves an initial review of whether or not the survey should be part of a multi-subject investigation and whether it should be a new single-round survey, a multi-round survey, a dual-record system, or something else. This review cannot be made without knowledge of already available demographic data and the total statistical system within which the survey will be conducted. Unless sample design requirements for different subjects differ drastically, multi-subject surveys usually are more cost-effective than single-subject surveys. Hence, it is likely that demographic data will continue to be collected in multi-subject surveys because of perceived favorable cost ratios (Bhattacharyya, 1977).

In some surveys the decision is made to deliberately exclude certain regions or classes because of inaccessibility or on other grounds. Groups frequently excluded from the target population are nomadic tribes, the armed forces, and institutional populations, such as inmates of mental hospitals or prisons. For example, in Kenya the population dwelling in the arid northern half of the country (about 5 percent of the total population) was excluded from the National Integrated Sample Survey sample because of the disproportionate cost of collecting data from them (Kenya, 1975). For similar reasons, the Sahara region was excluded from the 1969-70 Algeria multi-round survey, except for a small quota sample that was not included with the survey results (Republique Algerienne Democratique et Populaire 1971:15).

Another general design consideration is what levels of total error (which includes sampling and non-sampling components of error) will be considered acceptable by the data users. For example, different designs will be required if the data users request a national estimate of the birth rate that has a high probability of being within 3 or 4 points of the true value as opposed to a situation in which users request a crude birth rate for each of six regions in a country and require accuracy of ± 2 or 3 points. (A more complete discussion of total error appears in Chapter 1 and Appendix A.)

Other examples of design details important in surveys, as well as in other methods of collecting data for fertility and mortality statistics, are counting rules, cartography, transportation and other logistics, and language. The determination of counting rules is crucial and difficult in surveys, with choices to be made about de facto versus de jure enumeration of survey households (see UNECA, 1974). Separate sets of rules must be developed for counting the population and for counting vital events.

Maps that show identifiable boundaries for each sample area are essential for identifying area units in the field. Maps are particularly important for sample areas in shantytown or slum areas of cities, and for scattered rural settlements; they are less important for compact villages, unless sample areas consist of only parts of those villages. Sometimes a recent census can provide maps and initial lists of dwelling units that can be used in a survey, although the lists must be updated. In the absence of household listings that correspond to areas or administrative units, it may be necessary to resort to two-stage or multi-stage sampling, that is, draw a sample of administrative units, then prepare maps and listings for those sample areas only. This approach depends on the availability of existing data adequate to define a sampling frame. Area sampling, in at least one stage, is required for virtually all surveys in developing countries. For this, maps are needed, and survey designers must determine how the maps will be obtained.

Arranging for adequate transportation is another seemingly straightforward but critical factor in launching a survey. Other logistical details to be planned for in advance include provision of office space, lodging for field staff, procurement of field equipment, and arrangements for the flow of records to the central office.

Language and ethnic differences are another design detail that requires careful attention. Many developing nations have more than one language or dialect and some have many. To collect the most accurate data, interviewers and respondents need to be able to understand each other clearly with minimum reliance on interpreters. Thus the need for more than one linguistic version of the questionnaire and special assignment of interviewers should be considered in the planning stages. Also, survey designers should attempt to anticipate potential problems arising from ethnic differences. In some cases, interviewers from one group should not be assigned to interview respondents from other groups.

Because all these elements of survey design cannot be considered in isolation, there is naturally interaction and feedback among the persons involved and decisions made in accomplishing tasks A, B, and C shown in Figure 4.1. Ultimately, the type of estimates desired defines the data requirements. Data requirements in turn determine questionnaire content, which determines how specific questions must be formulated. The nature both of the questions to be asked and of the respondents to be interviewed determines the ideal interviewer, which, along with available modes of transportation, lodging, and communications systems, determines what options may be available for selection, training, and organization of the field staff. Whether a field survey organization is already in place or must be created anew determines how much time it will take to conduct the survey as well as the quality of data and its production on a timely basis. These attributes determine in part the requirements for central staff and management, field strategy, and facilities for data processing and analysis. In turn, shortages of skilled staff and of data processing facilities can place constraints on the level of organization achievable, on the questionnaire design that can be utilized, and on the production of high-quality data on a timely basis.

The final design should be practical and simple enough to be implemented by the available staff, even when it may be considered to be inefficient in other respects. A useful maxim for the design process has been provided by O'Muircheartaigh (1977:82): "In real life, . . . optimization is impossible....Proximization implies an aspiration to excellence combined with sufficient understanding to realize that perfection is unattainable."

4.4.4 Effects of Sample Design on Error

As described above, the measurement of fertility and mortality data through household interviews and fertility surveys is subject to several types of error. As indicated in Figure 4.1, the first major choice affecting the detailed sample design concerns balance. A reasonable balance must be struck between (1) the sampling errors, which are decreased (for any given design) primarily by increasing the sample size; and (2) systematic biases and correlated measurement errors, which are decreased primarily by exercising better statistical control and using improved data collection techniques. This balance can be achieved only through the coordinated efforts of the subject-matter specialist, the sampling statistician, and persons with intimate knowledge of the administrative and cultural settings in which the survey will be carried out.

4.4.4.1 *Sample Size*

Sampling error is affected by the size and design of the sample. A frequent misconception is that the most important factor in sampling error is the sampling fraction. However, the key element is not the sampling fraction but rather the absolute size of the sample for the group or subgroup for which the estimates are desired. Also, work load considerations and other operating issues affect the choice of sample design.

If a smaller level of error is required for planning or evaluation purposes, a larger sample can be used. For example, if simple random sampling were applied in a population (it is almost never applied, although it is approximated) for which the true crude birth rate is around 35, a sample size of 5,000 persons would provide estimates of the rate that are within about 5 points of the true value 95 percent of the time, or 35 $\pm$ 5.2 (assuming that only sampling error is considered). Under the same conditions a sample size of 15,000 persons would reduce the estimated sampling error to 35 $\pm$ 3.0. As sample size increases, other survey conditions, such as supervision, training, amount of field work, and cost, are directly affected. The effects of cluster sizes and other design effects are discussed below.

4.4.4.2 *Stratification*

It is also possible to reduce sampling error by using a stratified design, creating strata such that sampling units within each stratum tend to be somewhat similar to each other with respect to the variable being measured than to units in other strata. For example, sampling independently within urban and rural areas of the country will reduce somewhat the sampling error of fertility measures. If estimates are required for subdivisions of the country, stratification may also be required in cases where a subdivision is so small that it would not get a large enough sample allocation; in this situation, the designer may treat that subdivision as a stratum and arrange to "over-sample" it, or perhaps use double sampling to oversample a subset.

4.4.4.3 *Clustering and Design Effects*

In demographic surveys that use a census-type questionnaire it is usually desirable to interview all people in the selected area units, a technique sometimes called compact cluster sampling. This simplifies the field work by eliminating the need to sample dwellings or households within each area unit. This kind of sample design is generally considered indispensable in a multi-round survey or dual-record system in order to ensure comparable coverage from round to round.

The survey designer always has some choice of the size of area unit to use for sampling. If the units for which a sampling frame already exists are too large, mapping and splitting can be used to create smaller units. The number of individuals selected from the final-stage area unit is usually called the "cluster size." In the case of compact cluster sampling this will equal the population size of the area unit. Thus, cluster size is under the control of the sample designer.

In real life, neighbors tend to resemble each other more than people who live far apart; this principle holds for mortality and fertility. Common sense suggests, therefore, that it is less informative to interview large numbers of people in each cluster than to spread the sample out over many clusters. This inference is correct and is reflected in the fact that, for a given total sample size, sampling error is higher the larger the cluster size. On the other hand, survey costs are higher the smaller the cluster size. These two effects are opposed, and in a survey to estimate a single variable there is thus an optimum cluster size per unit cost that minimizes sampling error and which can be estimated if certain assumptions are made (Hansen et al., 1953).

Resemblance between neighbors, the clustering of the population into groups of similar people, may be measured by the ratio of homogeneity _roh_. Essentially this measures the proportion of total variance between individuals that is attributable to variation between clusters. If within a stratum everyone in the same cluster falls in the same category on a given characteristic, and there is variability between and only between strata, then _roh_ = 1 for that characteristic. If the characteristic is distributed at random among clusters, then _roh_ = 0.

In the 1960s, Scott and Coker (1971) calculated the value of _roh_ for several variables, based on surveys in developing countries. Some examples of the range of _roh_ were .001 to .003 for the crude birth rate, and .002 to .004 for the crude death rate.

More recently, the WFS surveys have provided the basis for the investigation of the pattern of sampling error (Verma et al., 1980). Table 4.1 presents the median values of _roh_ for five groups of variables included in 12 WFS surveys. A total of 38 variables were used in these calculations, representing variables defined almost identically in the 12 countries and covering the estimates of substantive interest from the WFS core questionnaire for the women's survey (Verma et al., 1980:449).

There is much variability in these _roh_ values. Averaged over the 12 countries, the median _roh_ is around 0.02 for nuptiality and fertility variables, around 0.03 for fertility preference variables, and around 0.05 for contraceptive use variables, while values are much higher (around 0.08) for variables concerning contraceptive knowledge (Verma et al., 1980:445). These roh values are based on populations of ever-married women of childbearing age, and therefore they are not comparable to the roh values cited above for crude birth and death rates for which the base is the total population.

The value of _roh_ is reduced by efficient stratification. It also falls as the size of the area unit increases (Adlakha et al., 1977), but it does so only slowly. More important, as shown in Table 4.1, it varies widely according to the variable considered.

The fundamental formula for reasoning about cluster size is:

$$V = V_o[1 + (n - 1)\underline{roh}]$$

where V is the sampling variance for the actual survey design used

V_o is the sampling variance for a random (unclustered) sample of the same total sample size, and

n is the cluster size, assumed constant.

TABLE 4.1 Median Values of roh by Variable Group in WFS Studies in 12 Developing Countries

Country	Variable Group					
	Nuptiality	Fertility	Preferences	Knowledge	Use	All Variables[a]
Mexico	.03	.06	.03	.17	.11	.07
Peru	.01	.04	.05	.14	.09	.05
Jamaica	.04	.03	.07	.09	.04	.05
Indonesia	.02	.02	.05	.14	.06	.05
Sri Lanka	.02	.03	.03	.07	.07	.05
Thailand	.01	.01	.02	.08	.06	.03
Guyana	.02	.05	.03	.08	.03	.03
Nepal	.02	.02	.05	.05	.03	.03
Colombia	.01	.00	.01	.05	.04	.02
Bangladesh	.01	.01	.02	.06	.03	.02
Fiji	.02	.00	.02	.04	.02	.02
Costa Rica	.01	.02	.00	.01	.02	.01
All[a]	.020	.025	.030	.080	.050	.040

[a]Average of median values. Countries arranged according to last column.

Source: Verma et al. (1980:449).

The term in brackets [1 + (n - 1) roh] is called the design effect, or deff. The quantity square root of deff is sometimes called deft. For most subclasses, such as age or education, one should think of n' = $\bar{M}$n where $\bar{M}$ is the proportion in the subclass. For example, $\bar{M}$ equals about one-fifth for age-specific fertility rates in five-year age groups (Kish, 1965:257; Verma et al., 1980; Kish et al., 1976).

Verma et al. (1980) have also calculated values of deft for 12 WFS surveys. They note that by taking the ratio of a standard error (se) to its simple random sampling equivalent (sr), "one eliminates factors which influence se and sr in similar ways, factors such as the scale of measurement and magnitude of the estimate itself, the standard deviation and the overall sample size" (Verma et al., 1980:444). The results show generally little variation in average deft for the three groups of variables on nuptiality, fertility, and fertility preference, with most of these deft values between about 1.1 and 1.6 for the 12 countries. In fact, for variables other than contraceptive knowledge and use, average defts for the total sample do not exceed 1.3 in 8 of the 12 countries (Verma et al., 1980:Table 3). However, the authors note (1980:444-445):

> "Deft is much larger for variables concerning contraception, particularly contraceptive knowledge. This is not unexpected since, in many developing countries where the introduction of family planning is relatively recent, contraceptive use and, even more so, contraceptive knowledge tend to be localized effects which the geographical stratification usually employed is too coarse to remove. More surprisingly, the attitudinal variables on fertility preferences do not show notably larger design factors than the demographic variables. . . . The highest average deft found is for contraceptive knowledge variables in Nepal, where deft = 3.21 imples a ten-fold increase in variance due to clustering of the sample; in four other countries (Mexico, Thailand, Indonesia and Colombia) this increase is over five-fold; it is around two- or three-fold for other countries except for Costa Rica (in which the level of contraceptive knowledge is almost 100 per cent in any case)."

The basic formula for cluster size shows clearly that where roh is large the cluster size should be kept small. For example, where roh is .1, using a cluster size of 100 would mean a tenfold increase in the error variance, compared with a random sample.

If an assumption about costs is made, it is possible to relate costs within clusters to costs between clusters, in order to compute for a single statistic the cluster size that will yield minimal sampling error for a given cost. However, other design factors will also affect the optimal cluster size, including the type of survey, acceptable error limits, and the relationship between effective supervision and the extent of scattered sample areas.

By extrapolating roh (or deff) from earlier comparable surveys, the survey designer can make an advance estimate of sampling error for differing cluster sizes and differing total sample sizes and use these estimates in designing the details of the survey. If one believes that the stratification will be more efficient than in earlier surveys, a smaller roh can be assumed; if one is using smaller area units, a larger roh can be assumed; if team interviewing is used instead of individual interviewing, the cost function will be modified. Thus, in principle the survey designer has a tool for roughly optimizing the main parameters of the sample design. The main practical limitation is the fact that each of the survey variables being investigated (fertility, mortality, age distributions, etc.) is likely to lead to a different optimum, and therefore there is a range of the optimum that must be considered.

4.4.4.4 *Precision of Estimates (Sampling Error)*

For a simple random sample of n people (never practiced), if the birth or death rate is considered a proportion and if there is no clustering, the variance is approximately binomial, i.e., the variance of the rate is pq/n where p = rate per person and $q = 1 - p$. Using these relationships, the effect of cluster size and roh on the expected 2-sigma confidence intervals for different crude birth and death rates have been calculated and are shown in Table 4.2.

Examples of the ranges of these estimates are shown in Table 4.3. For example, with a sample size of 1,000, roh equal to .008, and a cluster size of 125, the size of the

TABLE 4.2 2-Sigma Confidence Intervals for Estimates of Crude Vital Rates Based on Given Sample Size, Cluster Size, and Ratio of Homogeneity

True Vital Rate	roh	Size of Sample (total number of persons)	Size of Cluster (number of elements per cluster) 1	125	250	500
Crude Birth Rate = 40	.008	1,000	27.6-52.4	22.5-57.5	18.6-61.4	12.3-67.7
		5,000	34.5-45.5	32.2-47.8	30.4-49.6	27.6-52.4
		10,000	36.1-43.9	34.5-45.5	33.2-46.8	31.2-48.8
		50,000	38.2-41.8	37.5-42.5	37.0-43.0	36.1-43.9
		100,000	38.8-41.2	38.2-41.8	37.9-42.1	37.2-42.8
	.001	1,000	27.6-52.4	26.9-53.1	26.1-53.9	24.8-55.2
		5,000	34.5-45.5	34.1-45.9	33.8-46.2	33.2-46.8
		10,000	36.1-43.9	35.8-44.2	35.6-44.4	35.2-44.8
		50,000	38.2-41.8	38.1-41.9	38.0-42.0	37.9-42.1
		100,000	38.8-41.2	38.7-41.3	38.6-41.4	38.5-41.5
Crude Birth Rate = 15	.008	1,000	7.3-22.7	4.1-25.9	1.7-28.3	0-33.2
		5,000	11.6-18.4	10.1-19.9	9.1-20.9	7.3-22.7
		10,000	12.6-17.4	11.6-18.4	10.8-19.2	9.6-20.4
		50,000	13.9-16.1	13.5-16.5	13.1-16.9	12.6-17.4
		100,000	14.2-15.8	13.9-16.1	13.7-16.3	13.3-16.7
	.001	1,000	7.3-22.7	6.8-23.2	6.4-23.6	5.6-24.4
		5,000	11.6-18.4	11.4-18.6	11.2-18.8	10.8-19.2
		10,000	12.6-17.4	12.4-17.6	12.3-17.7	12.0-18.0
		50,000	13.9-16.1	13.8-16.2	13.8-16.2	13.7-16.3
		100,000	14.2-15.8	14.2-15.8	14.1-15.9	14.1-15.9

TABLE 4.3 Ranges of Estimates (Confidence Intervals) Derived for a Crude Birth Rate of 40 as the Sample Size, Cluster Size, and Ratio of Homogeneity Are Varied

roh	Size of Sample (total number of persons)	Size of Cluster (number of elements)		
		125	250	500
.008	1,000	35.0	42.8	55.4
	100,000	3.6	4.2	5.6
.001	1,000	26.2	27.8	30.4
	100,000	2.6	2.8	3.0

Source: Table 4.2.

confidence interval (or range of estimates) is 57.5 - 22.5 = 35.0. Note that for a given sample size the range of the estimate increases with cluster size. Note also that when roh is very low (here .001), the effect of cluster size is much reduced. Naturally, the size of the sample has a major effect on the confidence intervals.

A comparison of the ranges of 2-sigma confidence intervals for estimated age-specific fertility rates and estimates of crude birth rates, given identical total population size and identical sample size, shows that there is a wider range for the estimates of age-specific fertility rates, that is, there is less precision in the measurement of the age-specific rates. Other factors being equal, estimates of cumulative fertility have substantially smaller sampling errors than estimates of the crude birth rate or age-specific fertility rates because they incorporate many more woman-years of experience. Age-specific fertility rates based upon periods longer than 12 months would also be subject to lower sampling errors, although they might be subject to greater nonsampling errors because of problems of recall (Seltzer, 1973).

4.4.5 Coverage Errors and Biases

There are two types of coverage error that can cause estimates to be biased: undercoverage and overcoverage.

Both of these may be reduced by adequate attention to planning and administration of the survey. The causes of undercoverage include the following:

(1) Omission of units from the survey due to use of an incomplete sampling frame. At best, this produces a sample that is representative of the incomplete or inappropriate sampling frame. For example, if only 14 out of 16 provinces in a country were covered, the results would be biased if they were taken to be representative of the country as a whole.
(2) Omission of units from the sampling frame because they are missed in the mapping or listing process.
(3) Units that are selected and correctly included in the mapping and listing process may be missed later for various other reasons:

(a) The interviewer may fail to contact the household and complete an interview even after repeated call-backs. For example, the interviewer may first attempt to contact the household when no one is at home; if no call-backs are made, this would become a missed interview. Thus, the level of coverage is strongly influenced by the rules for call-backs applied in the field.
(b) The eligible respondent may be incompetent or ill or have some language difficulty that renders the interview impossible.
(c) An eligible respondent may refuse to respond to the interviewer.
(d) Errors may exist in the interviewer's instructions or in the data used to determine a respondent's eligibility for interview.
(e) Errors may arise in the interpretation by interviewers or field supervisors of the instructions or data determining eligibility for interview.
(f) A serious omission can occur when a batch of completed questionnaires is lost in transit between the field and the headquarters or during processing.

A factor that enters into many of the above is laziness, which may occur on the part of interviewers (who cannot be bothered to visit all the households) or on the part of field supervisors (who are not alert in discovering such practices in the early stages of field work).

Overcoverage also arises from a wide variety of practices, including:

(1) Duplications in the sample frame, causing some units to be oversampled without detection. (This may happen, for example, in shantytown dwelling units, which have no addresses.)
(2) Listing or mapping errors that lead to the undetected inclusion of ineligible units in the sample. (A sample that includes ineligible units is not a problem in overenumeration if such units are treated properly, i.e., as ineligibles.)
(3) Inadequate control of field work that allows interviewers to obtain duplicate interviews or questionnaires from the same interview unit or parts of the interview unit.
(4) The creation of duplicate cards or data tapes that are erroneously included in tabulations at the data processing stage. (This is not meant to refer to the duplicate cards or tapes that are sometimes prepared and deliberately included in tabulations to give increased weight to certain sample units or to provide imputation of missing values. However, the practice of imputation has caused problems in both surveys and censuses. When imputation is used, it is best to produce two sets of tables, one including the imputed values and the other showing only the original values. See Section 2.7.2 in Chapter 2 for a discussion of imputation.)

Levels of coverage error can be controlled only by exercising extreme care in accounting for every sample area and interview unit at every stage of work. At the analysis stage all available data on coverage errors should be used to detect possible biases and to aid in adjustment and interpretation of the data.

In addition to the errors of undercoverage and overcoverage associated with sampling units, there can be under- and overcoverage on particular items or events. In addition to unit nonresponse, respondents may refuse to answer some of the questions, resulting in item nonresponse. For example, less complete information may be obtained from a question on "currently pregnant" or "occupation of head of household" than on other items.

Births in the last year may be under- and overreported. Deaths in the last year are frequently underreported.

In some circumstances, something generally considered a response error can contribute to coverage error. For example, a fairly common type of interviewer error (and consequent bias in fertility estimates) is the failure to distinguish between an answer of zero and a response of "don't know" or "not stated" to questions on parity. El-Badry (1961) describes this particular type of error and provides an estimation procedure for adjusting the data. The error frequently arises in the collection or processing of information on children ever born (CEB) if, for example, a survey interviewer or census taker puts a dash (--) on the form when a respondent's answer is zero or none and this dash is then coded or punched on data cards as "not ascertained." The problem arises particularly among women aged 15-19 and to a lesser degree among women aged 20-24, those most likely to be childless. In cases where the proportion of "not ascertained" cases is much larger in these younger age groups than for women as a whole, El-Badry's correction process transfers a portion of the "not ascertained" cases in these younger age groups to the zero-parity category.

This problem of distinguishing clearly between different answers that may appear similar to interviewers and coders can arise with other items, especially on those for which it is important to distinguish between "don't know" and "not ascertained." Coders should be instructed to distinguish these responses clearly, and questionnaires and coding should be designed with such potential errors in mind.

4.4.6 Response Errors and Biases

In theory, response variance and biases are separate components of total error. Response variance can be measured by replication methods, however the measurement of bias requires access to independent sources of information, which is not always possible. Usually it is difficult to obtain estimates of the combined error due to response variance and biases.

In many cultures, two of the most basic types of demographic variables--age at time of survey and the date of occurrence of past events such as births, deaths, marriages, and migration--are not reported accurately

(Seltzer, 1973; Ewbank, 1981). These and other difficulties are present in every demographic measurement system, but some present special difficulties. In the sections below we discuss response errors and biases in the two areas that have special bearing on the estimation of fertility and mortality: the collection of data on children ever born (CEB) and the collection of data related to mortality estimation.

4.4.6.1 *Response Errors in Data on Children Ever Born*

There are a number of typical response errors that occur in CEB data, regardless how they are collected. The errors fall into two general categories: faulty omissions and faulty inclusions.

(1) Faulty omissions
 (a) children who died in infancy
 (b) children who left the home
 (c) children born of a husband other than the current one
 (d) children given out in adoption
(2) Faulty inclusions
 (a) stillbirths reported as children who died in infancy
 (b) children borne by another wife to the current husband
 (c) adopted children
 (d) grandchildren

Clearly, the magnitude of these errors will determine the accuracy of fertility estimates based upon such data. Errors of omission and inclusion may tend to cancel each other.

<u>The Use of Fertility Histories vs. Summary Questions</u> Two ways in which surveys collect CEB data are (1) to sum up live-birth information obtained in a fertility or pregnancy history, and (2) to ask summary questions on the total number of births and surviving children (the summary Brass questions described in Chapter 1 and Appendix B). It has been generally believed that the fertility or pregnancy history approach yields more complete and accurate information on past fertility than can be provided by one question on CEB or by a set of three or six summary questions (Marckwardt, 1975).

However, Hobcraft's (1980) study in Colombia suggests that there may sometimes be little difference between the two approaches. Much of the other existing evidence is inconclusive, because while fertility histories are collected from the woman herself, the summary questions may be asked of proxy respondents, who may provide less accurate information than the primary respondent. Also, despite the advantages of the history approach, many surveys (and all censuses) are designed in ways that make it impossible to include a fertility or pregnancy history, except perhaps with a subsample. However, nearly all surveys (and many, if not most censuses) would not be overburdened by the inclusion of the three or six questions on CEB and children surviving. The WFS Core Questionnaire uses the summary questions as an introduction to the fertility history.

There are a number of studies that have compared the fertility history and summary question approaches to collecting CEB data. In the baseline survey conducted to begin the dual-record system used in Kenya, contiguous pairs of areal clusters were selected and individuals in each pair were randomly allocated to interviewers using one of two different schedules to obtain CEB data. One schedule asked for a fertility history (FH); the other contained the six summary questions (SQ) on children ever born. (However, it should be noted that the fertility history schedule used was an abbreviated one; interviewers did not ask specifically about "live-born children who are now dead.") On the average, the fertility histories reported fewer children in both categories, CEB surviving and CEB dead at the time of interview (Kenya, 1975 and 1977). Two years later, the same type of data collection was repeated in a subsample of the same pairs of clusters and a third (new) contiguous cluster was added to each pair. Respondents in the new clusters were asked the summary questions first and then the fertility history questions, and interviewers were instructed to reconcile any differences between the two sets of responses. The results of the two surveys are shown in Table 4.4 and plotted in Figures 4.2 and 4.3.

In the baseline survey of 1973 (Figure 4.2), differences between the summary questions and birth history are clear, with the summary questions producing higher averages for both children still living and children now dead, although for the latter the differences are much greater. In the retrospective survey of 1975 (Figure 4.3), the pattern of differences

TABLE 4.4 Average Number of Children Ever Born per Woman by Age Group, Type of Schedule, and Whether Children are Still Alive or Now Dead: Kenya

Part A. Baseline Survey, 1973[a]

Age Group of Woman	CEB Still Alive		CEB Now Dead	
	FH	SQ	FH	SQ
15-19	0.35	0.43	0.03	0.05
20-24	1.58	1.80	0.12	0.24
25-29	3.13	3.57	0.21	0.59
30-34	4.57	4.88	0.43	0.95
35-39	5.22	5.68	0.73	1.32
40-44	5.63	5.96	0.89	1.75
45-49	5.86	5.76	1.00	2.10
All	2.87	3.10	0.33	0.68
Average Difference (SQ - FH)		+0.23		+0.35

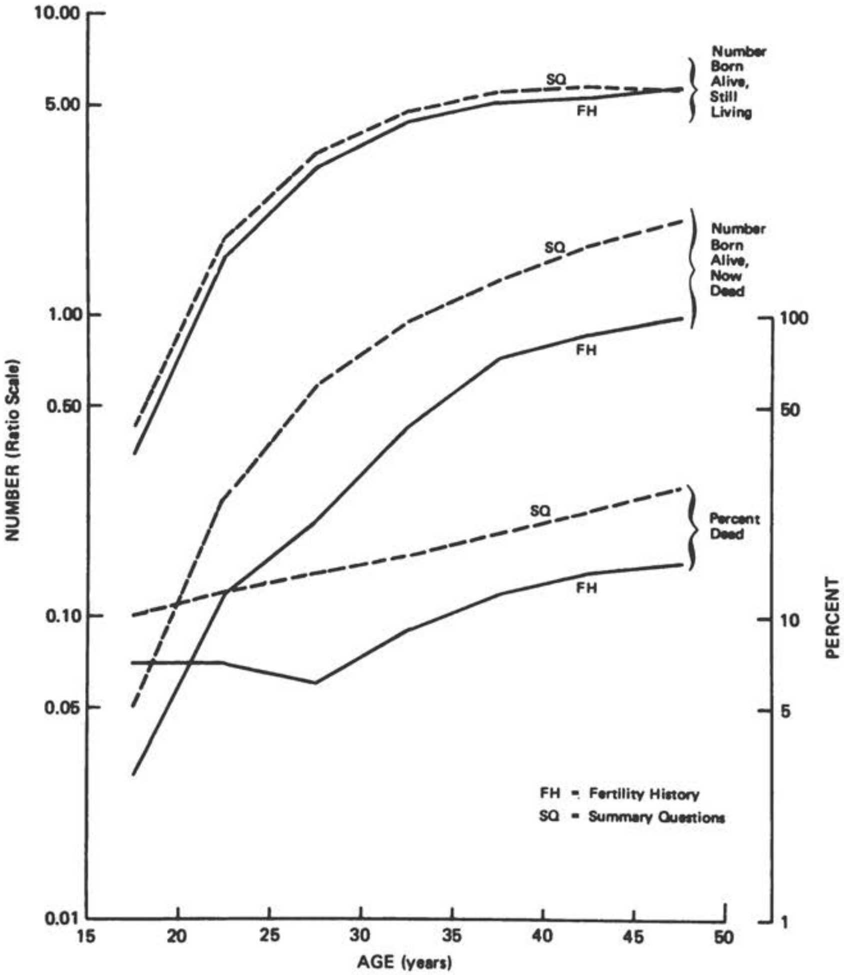
Part B. Retrospective Survey 4, 1975

Age Group of Woman	CEB Still Alive			CEB Now Dead		
	FH	SQ	R	FH	SQ	R
15-19	0.34	0.26	0.32	0.05	0.03	0.01
20-24	1.72	1.66	1.59	0.15	0.22	0.16
25-29	3.02	3.27	3.12	0.27	0.52	0.40
30-34	4.31	5.07	4.48	0.54	0.88	0.55
35-39	5.67	5.80	5.70	0.78	1.06	0.92
40-44	5.96	6.16	5.83	1.14	1.57	1.01
45-49	6.03	5.97	5.88	1.20	2.04	1.28
All	2.88	3.13	2.88	0.40	0.63	0.42
Average Difference (SQ - FH)		+0.25			+0.23	

Key: FH = Fertility history
SQ = Summary questions
R = Reconciliation method (see text for details)

[a]Includes only those clusters that were later covered by the Retrospective Survey 4.

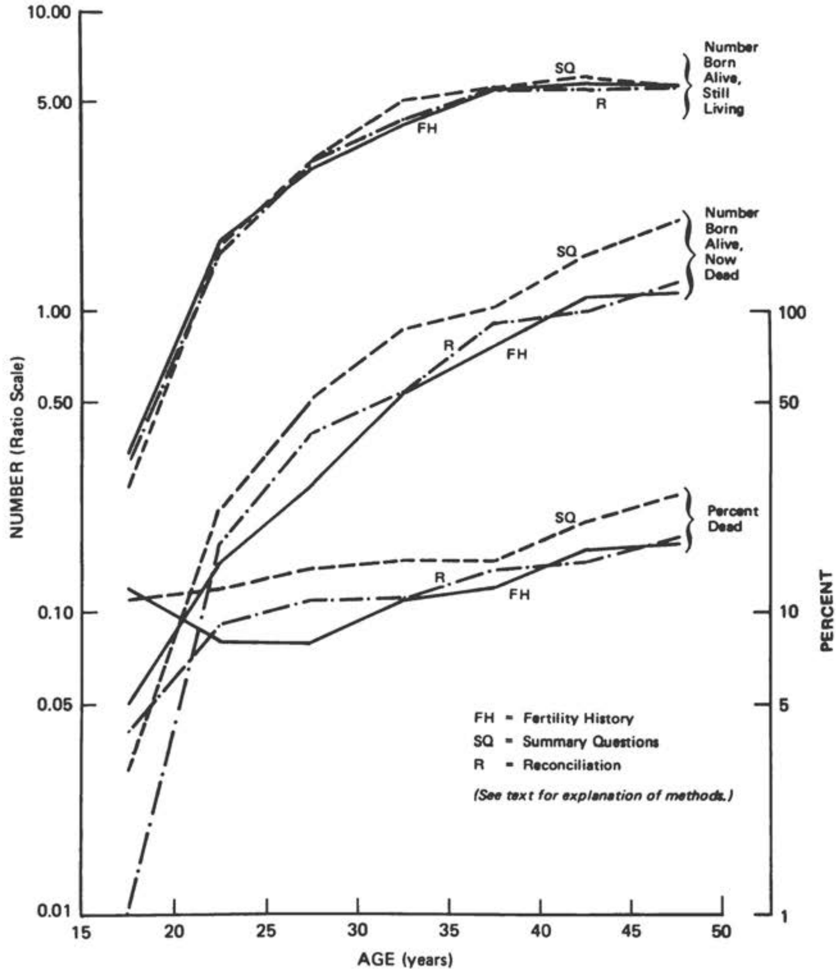
Source: Kenya (1977).



Source: Kenya, 1977: Table 4.2.

FIGURE 4.2 Average Number of Children Ever Born Alive by Survival Status at Time of Interview and by Type of Questionnaire: Kenya Baseline Survey, 1973

for children still living within age groups is more variable than in 1973 but the average difference is about the same in both years, 0.23 and 0.25 (Table 4.2). In 1975, fertility histories still yielded lower numbers of children now dead, with the exception of the 15-19 age group.



Source: Kenya, 1977: Table 4.2.

FIGURE 4.3 Average Number of Children Ever Born Alive by Survival Status at Time of Interview and by Type of Questionnaire: Kenya Baseline Survey, 1975

The reconciliation approach (R) used in 1975 yielded results that fell more or less between those for the two other approaches but somewhat closer to fertility history results. This suggests that in case of discrepancies either interviewers disobeyed instructions and adjusted the data from summary questions to conform with the fertility histories; that some fetal deaths were reported as infant deaths in responses to the summary questions; or both. Note that these findings would not necessarily apply in situations where a full pregnancy history (including stillbirths) was collected.

In two small subsamples in a survey in Niger (Piche, 1974), summary questions also produced reports of higher levels of CEB and surviving children than did fertility histories. However, in the Mysore Population Survey (U.N., 1961), fertility histories produced somewhat higher averages than did summary questions.

There are a number of possible reasons for these response biases. Perhaps women get tired of responding to a detailed fertility history and thus do not report all their pregnancies or live births. Alternatively, when summary questions are asked, there may be a tendency to report stillbirths and fetal deaths as children born live but now dead. Although the two approaches resulted in widely different estimates of infant mortality levels in Kenya, estimates of the crude birth rate based upon the reported number of births in the previous year were essentially the same for both sources (Kenya, 1975). Moreover in the Kenya Fertility Survey, executed under the WFS program, the fertility-history approach yielded substantially higher estimates of both fertility and child mortality than in any of the studies mentioned above (Kenya 1980). This suggests that the biases noted above are avoidable.

Using data collected in the Colombia 1976 National Fertility Survey, Hobcraft (1980) compared current fertility estimates based on data from a household survey, from an individual survey that included a pregnancy history, and from application of the own-children technique to responses to the household survey. The estimates are shown in Table 4.5.

Although it has been argued that the intensive pregnancy history collected in the individual survey should provide more accurate estimates of fertility than the simpler question on date of last live birth used in the household survey (for example, Marckwardt, 1975), this was not the case in the Colombia survey. For women included in both surveys, the total fertility rates reported were very similar for the two approaches, the household survey estimate being 4.55 and the individual survey estimate 4.48. This consistency, notes Hobcraft, "is perhaps surprising, because the individual woman was of necessity the respondent at the individual interview,

TABLE 4.5 Estimates of Total Fertility Rate Derived from Various Data Sources: Colombia 1976 Fertility Survey

Data Source	Total Fertility Rate
Household Survey[a]	
All estimates based on births in previous year, from a question on date of last live birth.	
All women	4.37
Women also interviewed in individual survey	4.55
Women not interviewed in individual survey	4.24
Individual Survey	
Estimates based on:	
Births in previous year, from pregnancy history	4.48
Twice the proportion 4 to 9+ months pregnant	3.62
Thrice the proportion 4 to 7 months pregnant	3.63
Own-Children Estimates	
Based on household survey data.	4.13

[a]The estimates for the three groups reflect different weighting schemes, used to account for differential representation by urban/rural residence and education. For all women, the estimate was weighted. For individual interviewees, it was unweighted (because that sample was self-weighting). For once-reported women (those interviewed only in the household survey), the estimate was adjusted by weighting it more heavily than the all-women sample, to account for the removal of the self-weighted sample of twice-reported women (the women interviewed in both surveys).

Source: Hobcraft (1980:16, Table 2.1.)

whereas a proxy may well have responded on her behalf at the household survey" (1980:16).

The Effects of Proxy Reporting Based on analysis of the 1969 Peruvian National Fertility Survey, Marckwardt concluded that a short interview form using summary questions was inferior to an in-depth fertility history interview in measuring current and cumulative fertility but noted, "Most of the deficiency...can be attributed to accepting information from other household members or neighbors when the woman herself was not available"

(Marckwardt, 1973:639). On the short form, information was collected about the woman's age, total live births, live births in the 12 months preceding the interview, children who had died and their ages at death. One third of the women in the survey were interviewed using the fertility history form and two thirds were interviewed with the short form.

Marckwardt suggests that analyzing data on type of respondent might improve estimation procedures: "Analysis of the characteristics of non-respondents to the [in-depth] interview and the short-interview proxies suggest that in Peru, as elsewhere, women who are difficult to interview are different" (1973:656). In 55 percent of the short forms, answers were provided by the woman herself, while in the remaining 45 percent of cases someone else answered; few call-backs were required. Through the use of repeated call-backs, 89 percent of the women selected for the fertility history were interviewed themselves. Presumably about 34 percent of them (89 percent minus 55 percent) required at least one call-back visit; however, all self-reporting women, regardless how difficult they were to reach, were lumped together for analysis. In Peru, unlike in Kenya, data on the proportions of children born alive and now dead by age of mother were similar for both schedules, and hence indirect estimates of infant mortality levels were also similar. The Peruvian experiment suggests that further work is necessary to sort out the effects on CEB reporting of different forms of interviews and of proxy reporting.

Tuygan and Cavdar (1975) describe the results of self reporting versus proxy reporting in an experimental survey in Turkey. In areas designated as "special," interviewers were instructed to interview the woman herself to obtain detailed CEB data. In other areas, designated "normal," the interviewers were instructed to interview "a responsible household member." The authors conclude that "reports from women themselves as well as from proxy respondents* may be relatively more accurate in the special than the normal interviewing situation," perhaps because the special instructions given to interviewers made them more sensitive to the problem of

*Although the instructions for the special areas were to interview the woman herself, in some cases proxy respondents provided the CEB information.

obtaining reliable data (1975:27). Women reported by proxy respondents had more schooling than women who reported for themselves.

For the Philippines, Madigan and Herrin (1973) and Madigan (1973) report that higher average numbers of CEB are reported by self respondents than by proxy respondents but that similar levels are reported for children surviving. Differences between self and proxy reporters were much greater for women below 30 years of age than for older women.

The Colombia survey described above (Hobcraft, 1980) also provides information on the effect of proxy reporting on estimates of current fertility. Table 4.6, which shows the proportions of women in different interview subgroups reporting a birth in the year prior to the survey, offers some evidence that the proxies underreported the women's fertility on average. However, Hobcraft urges caution in interpretation of the results (1980:16-17):

> On a superficial examination of the responses on births in the last year from the household survey alone [last two columns], it would have been tempting to infer that the substantial differences in current fertility levels between the self-reporters and the proxy reports were due to the very fact of proxy reporting. However, the availability of the individual interview with these same women makes such a conclusion untenable. A comparison of the first two columns of [Table 4.6] suggests that the differences arise mainly through the women for whom the proxy reports were made being different in fertility-related characteristics, such as urban/rural residence, work status. The women for whom proxy reports were made were also younger on average, but this should not unduly affect our comparisons on current fertility as we are controlling for age.

4.4.6.2 *Response Errors in Data Related to Mortality Estimation*

Direct questions about "deaths in the past 12 months" or some other recent period have not yielded plausible

TABLE 4.6 Effect of Proxy Reporting on Estimates of Current Fertility: Colombia 1976 National Fertility Survey

Age at Survey	Proportions Reporting a Birth in Year Prior to the Survey					
	Women Reported in Both Surveys (Unweighted)				All Women Interviewed in Household Survey (Weighted)	
	Proxy-Reported in Household Survey		Self-Reported in Household Survey			
	Household Survey Report (Proxy)	Individual Survey Report (Self)	Household Survey Report (Self)	Individual Survey Report (Self)	Reported by Proxy	Reported by Self
15-19	.025	.025	.162	.144	.030	.158
20-24	.129	.128	.257	.265	.113	.284
25-29	.126	.129	.234	.244	.128	.230
30-34	.134	.147	.194	.199	.109	.189
35-39	.153	.133	.147	.143	.098	.145
40-44	.027	.057	.085	.089	.020	.069
45-49	.000	.001	.018	.021	.015	.022
Total Fertility Rate	2.970	3.100	5.485	5.525	2.565	5.485

Source: Hobcraft (1980:17, Table 2.2.)

direct estimates of mortality rates. In some cases, techniques for evaluating and adjusting such data have provided satisfactory estimates, at least for adult mortality, but in other cases very low coverage or other severe distortions have meant that no serious mortality estimates can be salvaged from the data. For this reason, analysts have devised a number of indirect estimation techniques, which use data on the proportion of surviving children either by age of mother or by duration of marriage of the mother to estimate childhood mortality, and data on orphanhood or widowhood to estimate adult mortality.

The methods to estimate childhood mortality have been used extensively and have produced fairly satisfactory results. Orphanhood questions on survival of mother have been used in a number of censuses and surveys in Africa and Latin America, and the broad levels of adult mortality that they imply generally have looked reasonable, even though the detail of the results--for example, mortality by age--is often unsatisfactory. The use of data on widowhood to estimate adult mortality is more experimental and results have been mixed; in some cases the procedures have worked quite well and in other cases rather poorly. The value of both orphanhood and widowhood methods has been increased by the recent development of procedures that calculate a time reference for the estimates.

The age-of-mother and marital-duration estimates of childhood mortality are both affected by errors of omission or inclusion in CEB data. These and other potential problems must be considered and tested in the process of questionnaire design. In theory the marital-duration model is intended to be based on data from women in their first marriage, which would require a question on whether the current marriage is the woman's first marriage, as well as questions to determine either the date of the first marriage or the time elapsed since first marriage. (In practice the method is applied to all ever-married women by measuring marital duration as time elapsed since date of first marriage.) These data are used along with information on all children ever born and surviving in estimating childhood mortality.

The main problem in collecting data to be used in widowhood estimation techniques arises from the fact that the analysis is intended to be applied to survival of the respondent's first spouse, in order to reduce the effects of remarriage on the data. However, it is sometimes difficult to find out about the survival of a first spouse, especially if marital unions in the society are unstable or if polygamy is widespread.

Questions on survival of CEB and on orphanhood should relate to "own children" (children actually borne by the woman) and to biological parents. Adopted children and foster parents pose particularly difficult problems in many countries. Errors can best be forestalled by wording the questions in ways to make it clear that the relationships refer to the own-children and own-parents, for whom suitable terms exist in most languages.

4.4.7 Adjusting Data to Correct for Errors

Because of these different types and magnitudes of error which can affect fertility and mortality data and the resulting estimates, it is generally important to evaluate the data, and adjust them if necessary and possible. The evaluation techniques, which often also offer a basis for adjustment if the results are sufficiently coherent, generally take the form of consistency checks, either internally with other information collected by the same survey, or externally with information available from other sources. Typical errors that need to be tested for are omission of children ever born or children dead from reports of older women, or misdating events, or misreporting of age, or straightforward omission of events. A battery of indirect evaluation and adjustment techniques has been developed over the last 20 years, and has greatly increased the usefulness of flawed survey data. Many of these techniques are described and illustrated in another report of the Committee (Hill et al., 1981).

It must be emphasized that adjustments should be made only with great care. The adjustment procedures generally take the form of forcing into consistency two related but not identical types of information, and such adjustments are dangerous because both types may be flawed, raising the possibility of consistent but wrong estimates. It is generally the case that major problems with an adjustment procedure cause unacceptable results by age, or some other warning flag that all is not well, but this is not necessarily the case, and results obtained after adjustment involve a measure of uncertainty not found in results obtained from reliable data. In the case of most surveys from developing countries, however, the data should not be accepted at face value, and consistency checks should be applied to evaluate their quality prior to drawing firm conclusions. The uncertainty introduced by adjustment also implies that small differences between adjusted measures should be interpreted with great caution.

4.4.8 Other Important Considerations in Surveys

The checklist in Figure 4.1 presents several other major decisions that face planners who choose the survey method to collect fertility and mortality information. Various advantages and disadvantages are associated with each choice. For example, deciding to use a form instead of a questionnaire (item G.1 in Figure 4.1; see also footnote a in Figure 4.1 for the definitions of "form" and "questionnaire") allows more information to be recorded in a smaller space, which is sometimes desirable, particularly in multi-round household surveys in which the number of questions must be limited. However, much greater precision of understanding between interviewer and respondent can be attained when a questionnaire is used, that is, when each question is listed exactly as the interviewer is required to ask it. Understanding is also improved when the questionnaire is translated into local languages and when field workers are carefully trained to make certain that both interviewers and their supervisors know how to cope with questionnaire complexities. In the World Fertility Survey, the average length of field worker training has been three weeks. Tape recordings of practice interviewing sessions are reviewed by senior staff to allow them to criticize and correct faulty procedures before workers are sent into the field. Both translation and training naturally require additional resources, including senior staff time and money.

The sample design should take careful account of the principal characteristics of field operations (O'Muircheartaigh, 1977): (1) the type of interviewer; (2) the number of interviewers available; (3) the number of visits to be made to each observational unit; (4) the length of the interview; (5) the number and mobility of supervisors; (6) the mode(s) of travel; and (7) the quality of communication between field headquarters and the field staff.

In addition to attention to field work details--such as quality control, design of field operations and schedules, and training of field workers--the survey method also requires attention to data processing. This must occur early on in the design process, with programming being initiated as soon as the final design and content of the questionnaire has been determined. A major defect of many surveys is the lack of early attention to data processing, tabulation plans, and the assignment of staff adequate to analyze the data and prepare reports of survey findings. The design, preparation, field implementation, coding and editing, tabulation, analysis of data, and report of findings for a survey all add up to a major, difficult, and time-consuming set of activities.

4.5 ADVANTAGES AND DISADVANTAGES OF THE FOUR TYPES OF SURVEYS

The four major types of surveys described earlier in this chapter--single-round demographic surveys, multi-round surveys, dual-record systems, and fertility surveys--have different features and consequently different advantages and disadvantages in measuring fertility and mortality. The sections that follow discuss the relative strengths of each type of survey.

4.5.1 Single-Round Surveys

Perhaps the major reason why single-round retrospective household surveys are used so frequently to obtain demographic data is that they can be done more easily on an ad hoc basis than repeated-visit surveys. Moreover, even when a separate survey is conducted strictly to collect demographic data, but especially in the case where demographic questions are simply added to an existing or planned survey, single-round surveys are cheaper than repeated-visit surveys of the same quality (that is, those that are similar in terms of interviewer training, supervision, field control, etc.). Also, rotation bias and respondent fatigue from repeated interviews present no problems in a single-round survey.

There is no general agreement about how useful single-round survey results are for generating estimates of vital statistics. Some argue for basing fertility and mortality estimates on single-round surveys with CEB summary questions (Brass, 1973) or orphanhood questions

(Blacker, 1977a) or a set of several fertility and mortality questions (Sullivan et al., 1980), and adjusting the data with indirect estimation procedures. Such arguments are based primarily on the rationale that developing countries cannot afford the more costly survey systems. Others (Krotki, 1978b; Seltzer, 1973; Marks et al., 1974; Wells and Horvitz, 1978) have argued for the built-in calibration features and long-range benefits of dual-record systems, or emphasize the advantages of using improved collection procedures in the context of multi-round surveys (ORSTOM-INSEE-INED, 1971).

An example of a widely used type of single-round survey is the Intercensal Population Survey (SUPAS) conducted in 1976 in Indonesia. The SUPAS served as a link between the 1971 and 1980 censuses, although it collected more information than is normally collected in a population census. The SUPAS was designed to achieve the following objectives: (a) to obtain detailed socioeconomic data for interregional comparisons, (b) to help estimate population trends in Indonesia, (c) to provide estimates of the labor force and information about manpower conditions and utilization, (d) to determine the validity of other sources of fertility and mortality estimates, (e) to provide several measures to assess the extent of family planning utilization, and (f) to participate in the World Fertility Survey.

The SUPAS was conducted in three integrated, multipurpose phases. Phase I involved a large household listing, for which selected information was collected on all members of the household, including name, family relationship, sex, age, marital status, and own-mother status. Phase II collected more detailed information from a subsample of selected respondents. This was the most comprehensive phase of the undertaking; topics covered included individual characteristics of household members, martial and divorce history, own children, desire for additional children, contraceptive knowledge and practice, religion, education, household composition, income, work status and conditions, population movement, and fertility. Phases I and II were both single-round surveys. Phase III, conducted in connection with the Indonesian family planning program, was a fertility survey carried out in conjunction with the World Fertility Survey.

4.5.2 Multi-Round Surveys

One advantage of the multi-round survey over the single-round is that repetition of visits to the same dwelling offers the opportunity to verify data recorded on previous visits, thus improving their quality. Although the initial round is conducted primarily to establish the base population to be used for follow-up, this interview or any of the follow-up interviews can be used to collect the same kind of data that would be collected in a single-round survey. Even when no analysis is to be done of data collected in the initial round, the recording of events that occurred prior to the baseline provides information that can be used to guard against forward telescoping of events into the reference period at the time of the first follow-up visit. Utilizing the principle of bounded recall at each follow-up visit--that is, asking specifically about events that occurred since the previous visit--can reduce errors of dating and erroneous inclusions. Utilizing the follow-up or household-change technique can reduce errors of omission, especially for deaths of persons who were listed in a previous round. In-migrants and children who are born but subsequently die between rounds or migrate before the follow-up visit present special problems that must be dealt with primarily through careful probing by the interviewers and updating of household lists. Clear counting rules must be applied to obtain the best agreement between numerator and denominator of vital rates being estimated; usually, events that occur to the de jure population are the events of interest.

An extensive literature exists on the use of multi-round surveys. Cantrelle (1974) describes the evolution of the approach in Francophone Africa and refers to the early efforts of Kannisto (1959, 1963) in Cambodia and Indonesia as well as efforts in Latin America by CELADE, the Latin American Demographic Center. During the 1960s, the Economic Commission for Africa (ECA) was improving methodology on the basis of African experience, which led to procedures used in surveys in Senegal (1970-71) and Lesotho (1971-73), and the development of a manual on demographic sample surveys in Africa (UNECA, 1974). In this manual Scott and Blacker discuss the merits and problems of both multi-round and dual-record systems in Africa. Somoza (1976) and Hill et al. (1977) describe the CELADE efforts in detail.

In calculating vital rates from multi-round survey data, CELADE obtained the denominators of the rates (person-years of exposure) by finding the differences between the dates of previous follow-up visits and dates of current follow-up visits. Perhaps the more common approach is to calculate the average date of interview (weighted mid-date of all interviews) over all households in each round, find the difference between those, and adjust the numerator to correspond to a one-year time span.

Measurement of infant mortality and perhaps fertility may be improved if the pregnancy status of eligible women is established in each round and the outcome of the pregnancy determined in follow-up rounds. Pregnancy may be established by asking questions or by interviewer observation of late pregnancies, or both. An alternative approach would involve pregnancy testing, although there have been few careful field trials of this approach. One study in Thailand, which compared the results of pregnancy testing and pregnancy questions in a follow-up survey in which women were visited every six weeks, concluded that the results of pregnancy testing added little to the information about live births obtained by asking the questions (Udry et al., 1971). However, the tests did produce better information on fetal mortality. As the availability of maternal care spreads, it may become more feasible to cooperate with local health officials in the use of pregnancy rosters in demographic follow-up surveys.

Multi-round surveys are more costly than single-round surveys; whether they are more cost-effective in achieving lower mean square error in results is an open question. Based on the results of an experiment in which the fourth round of the Honduras multi-round survey (EDENH) was treated as a single-round survey (RETRO-EDENH), Hill et al. concluded (1977:160):

> . . . retrospective surveys like RETRO-EDENH are quick, easy to organise, cheap, and give good national estimates of fertility and mortality [when mortality is estimated using orphanhood techniques]; they can also give some indication of migration. Multi-round surveys of the EDENH variety are slower, more difficult to organise, more expensive, provide a mass of information about fertility, mortality, and migration, but are not altogether satisfactory for the estimation of

> mortality levels. The type of survey that should be adopted depends on the objectives, in terms of information, and the circumstances, in terms of money, skilled personnel, and organizational ability.

Multi-round surveys require clear procedures for identifying households for follow-up visits; finding the original household and making sure it is the same household is not always easy, especially if some time has elapsed and the interviewers have changed. In addition, it is essential that all households in the sample areas be interviewed, according to the recommended system of area sampling. Questionnaires used in multi-round surveys may also be more complex than those for a single round and the completed ones often must be made available for use in subsequent visits. Moreover, interviewers must be well-trained, motivated, and closely supervised to guard against their making false reports of "no change."

The longer duration of a multi-round survey usually requires the use of permanent field personnel and may result in respondent resistance if too many rounds are included. To cover seasonal variations, the minimum duration should be one year. CELADE recommends that no survey be spread over more than 18 months. It is difficult to maintain consistency in the repeated application of procedures over time, and the quality of field work may change from round to round. Presumably the interviewer work of the latter rounds should be of better quality because of increased experience, but that might be offset by respondent fatigue or, more likely, interviewer complacency or boredom.

4.5.3 Dual-Record Systems

There is not universal agreement about the advantages and disadvantages of dual-record systems, especially when they are compared with multi-round surveys. Cantrelle (1974) points out that while the multi-round system effectively reduces the risk of error, it does not allow for the potential measurement of coverage error. The dual-record system permits measurement of the coverage error in each subsystem, although not in the system as a whole. In Fellegi's words (1980): "It is incorrect to describe the dual method as containing a built-in self-evaluation, as some writers have claimed; in fact, one component of the method provides some evaluation of the other component, but there is no 'self-evaluation' of the final estimate." Dual systems do not eliminate all possibility of error, although the calibration feature of dual systems has improved estimates of fertility and mortality.

Dual-record systems aim for high levels of event coverage from both subsystems, and matching is an extremely important component of dual systems. In most dual-record systems, matching has been done by hand, which is slow, laborious, and subject to errors of human judgment. A system was developed in Kenya for computerized matching of the later rounds (Kenya, 1977), but this required a long time to develop and rules were based upon first-round results. Because the quality of recorded data may change over time, it probably is necessary to do some hand matching every round as a check. After initial matching, unmatched events and doubtful matches must be returned to the field for rechecking to determine whether they are in-scope events or not. Out-of-scope events must be eliminated in order not to overestimate rates.

Thus, the dual-record system has a number of potentials for higher costs than single-round or multi-round systems: (a) maintenance of the recorder subsystem in addition to the survey component; (b) additional care in field identification (for example, maps and field identification systems must be even more carefully maintained than for a multi-round survey to insure that the two subsystems are covering the same sample); (c) matching of vital events; and (d) field recheck of unmatched events. Some of these costs also occur in multi-round surveys that attempt dual measurement by matching events in overlapping reference periods. Matching of vital events appears to be the most formidable technical problem to be solved in dual-record systems and "dual measurement" multi-round surveys with overlapping reference periods.

If resources and qualified personnel are available and the choice lies between a multi-round and a dual-record system, many options are available. The average dual system has been more expensive than the average multi-round survey, however even if the multi-round survey costs less, it is not clear that it is cost-effective in terms of adjusting for biases of omission.

Many of the concerns noted in the section on multi-round surveys also apply to dual-record systems, because the survey subsystem almost always involves repeated rounds at intervals of 6 or 12 months. In addition, a crucial organizational and supervisory problem is to maintain independence between the subsystems (see Marks et al., 1974). A particular bias of dual systems is a tendency to overestimate the number of events, which can occur because of errors in matching or coverage errors in space or in time. This possibility exists because of the basic philosophy of the method: any report of an event is to be counted as true, even if unsubstantiated by the other system. However, in practice, dual systems usually include some field checks for unmatched events, to detect false nonmatches caused by coverage errors and overly strict application of matching criteria.

Marks et al. (1974) provide a substantial reference on the dual-record system, which is sometimes also known as the population growth estimation system. In addition, many publications of the POPLAB program are devoted to various facets of the dual-record system, and Carver (1976) has developed an extensive bibliography. One scholar has severely criticized the dual-record system as a means of estimating fertility and mortality (Blacker, 1977b), and additional discussion is found in Krotki (1978a and 1978b).

4.5.4 Fertility Surveys

By providing data on both current and past fertility, fertility surveys make it possible to estimate current levels of fertility as well as trends over a period up to 15 or 20 years prior to the survey. This information has distinct advantages, especially when there is a desire to analyze fertility trends in relation to social, familial, economic, and fertility-regulation contexts, for which data are often collected at the same time.

Every fertility survey must be based on a prior data collection operation that created a list of household members, which can then be used to identify women to interview. This prior operation may be planned either independently or specifically to identify women for the fertility survey, and it may be a single-round or multi-round survey, a dual-record system or a subsample of a larger demographic survey.

One example of how fertility surveys can be incorporated into a larger data-collection effort is the Algerian 1969-70 three-round survey, in which a fertility survey was included in one round in a subsample of women. An approach such as this offers several advantages: use of an existing sample with field operations already in place, the availability of detailed household information provided by the main survey, and an existing survey apparatus that includes commitment of office staff and data processing equipment.

However, whether conducted independently or attached to other surveys, fertility surveys have special requirements. Female interviewers are required in almost all situations, which usually means the creation of separate, independently-trained interview teams. In comparison with the other three types of surveys, the fertility-survey interview usually takes more time, up to an hour or more, and thus fewer can be completed each day and the cost per interview is substantial.

Another issue that affects the cost-benefit ratio of fertility surveys is whether a small number of interviewers is used for a long period or whether a larger number of interviewers is used, thereby shortening the duration of field work. The World Fertility Survey represents the largest and most recent program to use pregnancy histories. In 38 WFS surveys with sample sizes that ranged from about 3,000 to 9,000, the number of interviewers ranged from 19 in Venezuela and 20 in Senegal to 60 in Thailand, 80 in Nepal, and 144 in the Philippines (Scott and Singh, 1980). The duration of field work ranged from 2 to 8 months (plus 2 countries in which field work interruptions increased the time to 12 and 13 months). The advantages of a short period of field work include additional sources of recruitment (for example, the opportunity to employ teachers during vacation periods), reduced drop-out of field workers, and quicker access to the survey results--all of which represent substantial advantages to analysts and planning agencies. The advantages of a survey of longer duration with fewer interviewers include the potential for better supervision and the need for fewer vehicles.

Another important design issue concerns the schedule (form or questionnaire) used to obtain the pregnancy (or fertility) history. The initial model questionnaire developed by WFS suggested the use of two separate tables, one to record data on live births and the second for data on all other pregnancies. Some countries used this format in their studies, but several used other, integrated approaches, including: (a) to first list data on all live births, then question the respondent about each birth interval to probe for information about other, unreported pregnancies; (b) to ask separately about living children, dead children, stillbirths, miscarriages, and abortions, and then probe for additional information about each interval larger than a specified number of years; (c) to obtain data on each pregnancy in sequence (Scott and Singh, 1980:40).

The WFS experience suggests that integrated approaches, especially method (a), produce better results than the simpler two-table approach of the initial model. There is still uncertainty about whether it is better to attempt to reconstruct a woman's pregnancy or fertility history by starting with first pregnancy and working forward to the present or by starting with the most recent and working backward in time. In either case, though, it is important for interviewers to review the history carefully and to probe for unreported pregnancies when an especially long interpregnancy interval appears.

In addition to questions of schedule design and field procedures, other topics that require attention include training, supervision in the field and during data processing, how to collect the dates of events (especially dating of events in the pregnancy history), the ways to collect data on marital history and use of contraception, and how to handle nonresponse (answers of "don't know" or "not sure"). Detailed descriptions of these and other survey design and implementation procedures are found in the WFS Basic Documentation Series and the U.S. Bureau of the Census Popstan series.

Much of the data collected in early fertility surveys remained unanalyzed, and in some cases only summary tabulations have been prepared. Skilled analysts have been in short supply in many of the countries conducting fertility surveys, their services being in considerable demand, for example, for other surveys or for the next census. The World Fertility Survey has tried to resolve this problem by providing skilled technical analysts as short-term professional assistants and by commissioning model studies using selected data.

Although fertility surveys often produce both highly detailed and accurate data, the data are by no means immune to error and adjustments are usually necessary. Some of the errors are similar to those of other data-collection methods and other types of surveys, for example, age misreporting, omission of events, and incorrect dating of events. Frequently, respondents to fertility history interviews know neither the day nor month--sometimes not even the year--in which a birth occurred.

Obtaining reliable estimates from fertility survey data depends very heavily upon accurate reporting of dates of live birth and ages of surviving children. This is especially true when attempting to estimate time trends in fertility. Using simulation, Potter (1977) has developed a model that fits empirical data from El Salvador and Bangladesh. The model suggests that telescoping effects can be especially troublesome if not taken into account. When reporting births, women tend to overestimate the number of births that occurred during the period five to nine years ago, producing an upward bias in the fertility estimate of that period and a corresponding downward bias in the neighboring time periods. Thus, unadjusted fertility estimates based on such data can suggest a decline in fertility when none exists or a decline of larger magnitude than has in fact occurred.

Other evidence of bias in fertility history data can be seen in the 1975 Survey of Fertility in Thailand (SOFT), a WFS survey that collected retrospective birth histories and which reported total fertility rates of 6.25 for 1965-69 and 4.85 for 1970-74 (Thailand, Institute of Population Studies and National Statistical Office, 1977). In subsequent analysis (NRC, 1980:23), it was noted that "the proportions of women ever married by age indicated from the household schedules collected in the SOFT were substantially lower than the proportions of women ever married by age indicated by either the 1970 census or the 1975 Survey of Population Change. The latter two sources agree quite closely with each other, suggesting that the SOFT results are probably not representative." To compensate for this, the SOFT data were adjusted in two ways. One adjustment, necessary because of a slight bias in the sample of women in the fertility survey, was made by applying the 1970 census proportions of ever-married women, by age, to the SOFT marital fertility rates. This adjustment, plus another adjustment that had a smaller effect, produced revised estimates of the total fertility rate: 6.46 and 5.09, respectively, for the periods 1965-69 and 1970-74 (NRC, 1980). (Note that the estimated levels of fertility changed as a result of the adjustment, but the amount of decline remained essentially the same.)

Another example of apparent bias in fertility history data was discovered in WFS data from Nepal (Goldman et al., 1979). In that case, three types of response error were investigated: misreporting of age and marriage durations, displacement of vital events, and omission of vital events. Adjustments led to the following conclusion (1979:18): "Although the data as reported in the individual histories indicate that (1) fertility has been rising for the past 20 or 25 years, and (2) age at marriage has been subject to no consistent trend over this period, when errors in the reporting of vital events have been corrected, the demographic picture is more likely to show (1) no trend in fertility, and (2) rising age at marriage."

Another type of error to which fertility surveys are susceptible is the propensity for women over age 35 to report their living and deceased children less completely than younger women. Brass and Rashad (1980) discuss other problems on fertility history data that require attention and adjustments, and Brass (1980) summarizes the papers presented at a seminar on birth history analysis organized in 1980 by the International Union for the Scientific Study of Population.

4.6 HOW GOOD ARE SURVEY ESTIMATES?

Without knowledge of the true demographic rates in a population, it is difficult to assess how well a specific survey approach performs in measuring the rates. In the preceeding sections, examples of standard and special adjustments were noted; such adjustments improve the estimates, but they cannot produce absolute demographic truths. Likewise, experiments such as those in Kenya (Kenya, 1977), Peru (Marckwardt, 1973), and Colombia (CIMED, 1973; Hobcraft, 1980) can compare results obtained by different procedures but cannot determine with certainty which yields results closer to the true rates. Even these comparative experiments are subject to the criticism that they are special study situations and therefore interviewers, training, and supervision are likely to be of better quality than would be the case in a survey conducted under more usual conditions.

As part of a WFS program to evaluate the quality of the data collected in the WFS fertility surveys, O'Muircheartaigh and Marckwardt (1980) undertook an assessment of the reliability of survey data from selected countries. Their results demonstrated that means and other measures of distribution can appear quite stable (based on interview/reinterview analysis) while the underlying individual responses are very inconsistent. In Bangladesh, for example, the means of the current age distribution based on two different sets of interviews agree to the nearest tenth of a year (28.7), despite the fact that 80 percent of the women reported their age differently in the two interviews and 40 percent reported differently with respect to their five-year age group. Similarly, in the 1969-70 three-round survey in Algeria, the single-round retrospective survey seems to give the same birth rate as the multi-round survey (50 per thousand) and a lower death rate (13 per thousand instead of 17 per thousand). However, close examination of the retrospective-survey data used to estimate the birth rate reveals both under- and overreporting of births; thus, the retrospective estimate only appears correct, due to compensating effects (Vallin, 1975).

O'Muircheartaigh and Marckwardt also discovered large differences among countries in the reliability of demographic measures based on dates of events. For example, discrepancies of two or more years in the dating of first births occur in only 10 percent of the cases in Peru and Fiji, while in Indonesia and Bangladesh approximately one third of the women gave responses that were discrepant by two or more years (O'Muircheartaigh and Marckwardt, 1980:43). In one country they found reports of age at marriage to be substantially better than those of current age; in other countries, the reverse was true.

In an analysis of surveys that were part of 18 dual-record systems operated in Asia from 1945 to 1967, Marks et al. (1974) showed that on average multiple-visit surveys missed fewer events than single-visit surveys, when compared with the overall estimates obtained from the dual-record systems. The results of the comparison, shown in Table 4.7, demonstrate the degree of under-reporting that can occur in surveys, especially single-round surveys. Note that in both types of surveys reporting of deaths tends to be less complete than that of births. The low coverage obtained in some of the multiple-visit surveys is almost certainly due in part to the practice of treating each visit as an independent survey, rather than using the household-change technique, which began to be used more widely in multi-round surveys in the 1960s. It should be noted that the standard used

TABLE 4.7 Estimated Average Completeness of Birth and Death Rates Reported in Surveys in Asia 1945-67: Estimates from Selected Single-Round Surveys and Repeated Single-Round Surveys[a] Compared to Dual-Record System Estimates

	Ratio of Completeness Relative to Estimates from Dual-Record System				
		Births		Deaths	
Type of Survey	Number of Surveys	Median	Range	Median	Range
Single-round	5	.67	.53-.93	.51	.32-.90
Repeated single-round	13	.83	.66-.92	.72	.50-.89

[a]In the source document for this table these surveys are referred to as "multiple-visit" surveys. Most of these surveys are similar to the type referred to in this report as "repeated single-round surveys." The latter should not be confused with multi-round surveys. (See definitions section in Chapter 4.)

Source: Based on Marks et al. (1974: Table 2.10). (One very low-reporting survey was considered an unrepresentative outlier and was not included in this table.)

in this analysis (estimates from the dual-record systems) could have an upward bias, for example, as a result of matching errors (false non-matches). Thus several surveys, especially the multiple-visit surveys, may have produced better reporting than is indicated in Table 4.7.

Another comparison of single-round vs. multi-round survey data is provided by Senegal's 1970-71 demographic survey. Table 4.8 compares the birth and death rates estimated for the 12 months before the baseline survey (based on data from the first round) with those estimated for the 12-month period after the baseline survey (based on data obtained through two follow-up visits). Overall, the estimates from the single-round baseline survey are 22 percent lower for births and 32 percent lower for deaths than the multi-round survey results for the following 12 months. In addition to overall lower

TABLE 4.8. Comparison of Crude Birth and Death Rates Estimated from Baseline Retrospective Survey and from Subsequent Rounds: Senegal 1970-71, Demographic Survey

	Source of Data					
	Retrospective Baseline Survey (First Round)		Multi-Round Follow-Up Survey (Rounds 2 and 3)			
	Crude Vital Rates for 12 Months Prior to Round 1		Crude Vital Rates for 12 Months Between Rounds Rounds 1 and 3		Ratio of Estimates (Retrospective/Multi-Round)	
Region	Births	Deaths	Births	Deaths	Births	Deaths
Cap-Vert	39.8	5.1	42.3	9.0	0.94	0.57
Casamance	33.2	12.8	37.4	25.2	0.89	0.51
Diourbol	34.0	21.0	49.0	24.0	0.69	0.88
Fleuve	33.6	11.7	37.1	11.6	0.91	1.01
Sen. Orient.	36.0	15.4	39.5	24.0	0.91	0.64
Sin. Saloum	36.5	16.3	56.5	24.6	0.65	0.66
Thies	36.0	15.0	49.0	22.0	0.73	0.68
Total	35.9	13.9	45.9	20.3	0.78	0.68

Source: Republique du Senegal, Enquete Demographique National 1970-1971--Methodologie et Documents Annexes, Ministere des Finances et des Affaires Economiques, Direction de la Statistique, Dakar (May 1973, p. 6.)

reporting of deaths than births by the single-round retrospective survey, there is greater variation in death reporting by region; the ratios of retrospective to multi-round estimates range from 0.51 to 1.01 for deaths and from 0.65 to 0.94 for births.

Similar to the Senegal example but somewhat more informative are the results of an experiment in Kenya, which permit comparison of CBRs and CDRs that are based on both actual and reconstructed data collection methods. The Kenya project (Kenya, 1977) was a methodological experiment that compared the following methods: a continuous surveillance survey, single-round retrospective surveys with 6- and 12-month recall periods, multi-round surveys with 6- and 12-month recall periods, and a community contact system. Table 4.9 presents CBR and CDR estimates based on the first two methods, plus various combinations of methods used to produce dual-system estimates. In addition, the table presents estimates based on the 1973 single-round baseline survey (Kenya, 1975) and estimates based on application of indirect estimation techniques.

Under the continuous surveillance system a full-time enumerator visited each household every two months to collect information on births, deaths, and migration. In effect, the enumerator updated the household roster for each household. Four single-round retrospective surveys were carried out, using both 6-month and 12-month recall periods. These surveys were independent, listing the household members anew at each visit, instead of updating a previous household roster. Although the surveys were part of a large experiment, the individual estimates can be studied, including comparison based on whether out-of-scope events are included or eliminated. Inclusion of out-of-scope events naturally affects the quality of estimates obtained.

Note in Table 4.9 the ranges of the CBR and CDR estimates: 39 to 57 for the CBR and 5 to 13 for the CDR. The indirect estimates from the single-round baseline survey agree with the dual-system estimates obtained after stratification by age and urban/rural residence when the latter use a 6-month recall period. However, the dual-system estimates for the CBR using 12-month recall periods (57, both with and without stratification) are higher than all other estimates. The rates based on data derived from only one system, either the single-round retrospective survey or the continuous surveillance, are substantially lower than the other

TABLE 4.9 Comparisons of CBR and CDR Estimates Based on Selected Data Collection Methods: Kenya

Data Source	Basis of Estimate	Recall Period	Estimated Vital Rates: Crude Birth Rate	Estimated Vital Rates: Crude Death Rate
Reconstructed and Actual Estimates from 1974-75 Dual-Record System				
Reconstructed single system (including out-of-scope events)	Retrospective Survey	6 months	45	7
		12 months	42	5
	Continuous Surveillance	Visits every 2 months to update household roster	41	8
Reconstructed single system (excluding out-of-scope events)	Retrospective Survey	6 months	41	6
		12 months	39	5
	Continuous Surveillance	Visits every 2 months to update household roster	40	7

Dual-system estimates based on retrospective survey and continuous surveillance system (latter with visits every 2 months)	Two systems, without stratification	6 months	52	11
		12 months	57	12
	Two systems, with stratification by age and urban-rural residence	6 months	52	13
		12 months	57	13
Baseline Survey, 1973	Question on date of last live birth	a	49	b
	Application of indirect estimation techniques[c]	--	52[d]	13[e]

[a]Data on births during last 12 months extracted from information on data of last live birth.
[b]No question on "data in the previous 12 months" was asked.
[c]Estimates derived from one half of sample household only.
[d]Using the Brass P(1+)/F(1) technique with several adjustments for non-response.
[e]Using Brass and Sullivan techniques to estimate childhood mortality and the orphanhood technique to estimate adult mortality.

Sources: Kenya (1975:48, 50).
Kenya (1977:26, 28, Tables 3.3 and 3.4; and 68-69, Appendixes F and G).

estimates. This is especially true for the CDR; CDR estimates from reconstructed single systems after adjustment for out-of-scope events are about half those from dual systems and indirect estimation techniques (5 and 7 as compared to 11 and 13). Even when "extra" out-of-scope events are included, estimates from the reconstructed single system are still lower than those obtained with the dual-system approach, much lower in the case of CDR.

4.7 THE EXTENT TO WHICH SURVEYS ARE USED IN ESTIMATING FERTILITY AND MORTALITY

Surveys have been used extensively during the past two decades to collect fertility and mortality data. Table 4.10 shows the number of major demographic and fertility surveys carried out in developing nations since 1960. The demographic surveys counted included single-round, multi-round, and dual-record surveys; all collected fertility data and nearly all collected at least some mortality data.

In creating the list, the attempt was made to include only national and major sub-national demographic and fertility surveys. Also included are a few surveys in which the main topics of interest were non-demographic but which provided demographic data because fertility and mortality questions were asked. A number of judgments were required in determining whether or not a given non-national survey was "major." In general, the category included surveys that were representative of all urban areas or all rural areas in a country and surveys that covered a major part of a country (for example, Maharastra State in India). Most follow-up surveys of family-planning acceptors were not included, because their samples are representative only of acceptors, not total populations; exceptions were contraceptive prevalence surveys that collected household information from samples of general populations, because such surveys include questions on fertility. For example, some of the prevalence surveys conducted with the help of Westinghouse Health Systems and the Centers for Disease Control ask representative samples of ever-married women or all women under age 50 for number of pregnancies, number of live births, number of living children, and date of last live birth. Table 4.11, which is the basis of the summary numbers in Table 4.10, presents a detailed accounting of surveys conducted in developing nations since 1960.

Table 4.10 lists surveys by two time periods: the 1960s and 1970-80. For the latter period, the WFS surveys are listed separately, to emphasize the major role the WFS program has played in the collection of fertility and child mortality data since 1974. Surveys that cut across the two time periods are listed in the decade that includes the larger number of survey years; footnotes indicate when arbitrary classification was necessary (for example, in the case of a survey conducted in 1969 and 1970).

Since 1960, 81 developing countries have conducted at least one major survey: 33 countries in Africa, 24 in Asia, and 24 in Latin America. In the 1960s, 37 national demographic and 19 national fertility surveys were carried out in developing nations; in the 1970s the numbers increased to 55 and 82, respectively. More than half the 82 fertility surveys (42) were conducted as part of or in association with the WFS program.

Although the numbers in Table 4.10 present an impressive picture regarding the use of surveys to collect demographic data, users interested in obtaining detailed information from these surveys frequently discover that much of the collected information has yet to be reported and that there are substantial delays between field work and the publication of results.

One example of the time delays in selected dual-system surveys and other estimation procedures is provided by Marks et al. (1974) and reproduced here as Part A of Table 4.12. In the eight dual-system studies conducted in developing nations the range was 11 to 76 months, but if the time considered is from the beginning of field work to publication of the final report, the range was 23 to 90 months. For the five single-round surveys (identified as "single system procedures"), the time lags between completion of field work and publication of final report ranged from 13 to 72 months.

The World Fertility Survey has placed high priority on improving the timing and the availability of its survey results. Among the 42 WFS surveys initiated in developing nations since 1974, at a rate of about 7 per year, detailed first reports by 23 countries had been published by the end of 1980. (See Part B of Table 4.12.) In addition, the number of publications generated by subsequent cross-national comparative research and research within individual countries is considerable; for

TABLE 4.10 Number of Major Demographic and Fertility Surveys Carried Out Since Approximately 1960, Classified by Region and Decade

	1960-1969				1970-1980				
	Sub-National		National		Sub-National		National		
	Demographic	Fertility	Demographic	Fertility	Demographic	Fertility	Demographic	WFS	Other Fertility
Africa	17[a,c]	4	19[a,b,c]	4[a,b]	6[c]	8[a,e]	18[a,c]	12[d]	4[a]
Asia (excluding Japan and Israel	3[c]	11	17[a,c]	11	7	13[g]	28[a,c]	15[d,f]	24[e,g]
Latin America	1	18	1	4	3	11[a,e]	8	14[f]	12[e]
Oceania (excluding Australia and New Zealand	--	--	--	--	--	--	1	1	--
Subtotal	21	33	37	19	16	32	55	42	40
Europe	--	--	2	4	--	1[f]	3	1	25[f]
Other Developed	--	1	--	4	--	2	2	--	11[f,g]
Total	21	34	39	27	16	35	60	43	76

Note: For details on all footnotes, refer to Table 4.11. The order of footnotes in Table 4.11 is used here for consistency.

[a]Includes survey(s) overlapping the 1960-69 and 1970-80 time periods.
[b]Includes multiple survey(s) combined to produce national coverage.
[c]Includes survey(s) classified in WFS Occasional Papers (Baum et al., 1974 a-d) as both demographic and fertility; counted once here under the demographic classification.
[d]One WFS survey in Africa and two in Asia are sub-national.
[e]Contraceptive prevalence surveys such as those conducted with the assistance of Westinghouse Health Systems and the Center for Disease Control generally do not include birth histories but are included in the listing of fertility surveys since they are being used in the analysis of fertility.
[f]Includes two surveys in Associate status with WFS (1 in Asia, 1 in Latin America). In addition, 17 surveys in Europe (16 national and one sub-national) and three in other developed nations have been carried out in collaboration with the WFS Program.
[g]Includes 7 Value of Children (VOC) Surveys in Asia (6 national and one sub-national), one in Europe, and one in Other Developed. Interviews were conducted only with currently married women and their husbands.

Source: Table 4.11.

example, a total of 34 research papers were presented at the World Fertility Survey conference in July 1980.

4.8 SUMMARY

Surveys constitute an important data collection technique for the measurement of demographic phenomena. The information in this chapter leads to five summary points:

1. Surveys have been used around the world to collect detailed information for the estimation and understanding of fertility and mortality. Surveys will continue to be used to provide basic data in the absence of complete CR/VS systems, and they will provide data sets that permit analysis of factors affecting fertility and mortality.
2. Each of the four major types of surveys has advantanges and disadvantages. The single-round survey probably yields the least accurate data in general, but

TABLE 4.11 Number of Major Demographic and Fertility Surveys Carried out in Developing Nations Since Approximately 1960, Classified by Time Periods 1960-69 and 1970-80

	1960-69				1970-80				
	Sub-National		National		Sub-National		National		
Area, Nation	Demo-graphic	Fert-ility	Demo-graphic	Fert-ility	Demo-graphic	Fert-ility	Demo-graphic	WFS	Other Fert-ility
Africa									
Algeria			1	1			1[a]		
Benin (Dahomey)			1					1	
Burundi			1				1		
Cameroon	2		1[b]				1	1	
Central African Republic							1		
Chad	1					1			
Congo	1				1				
Egypt	1		1		1			1	1
Ethiopia	1		1[a]			1			
Gabon	1		1		1				
Ghana		1	3[c]	1			1[c]	1	
Ivory Coast	1							1	

Area, Nation	1960-69 Sub-National Demo-graphic		1960-69 National Demo-graphic		1970-80 Sub-National Demo-graphic		1970-80 National Demo-graphic		
	Demo-graphic	Fert-ility	Demo-graphic	Fert-ility	Demo-graphic	Fert-ility	Demo-graphic	WFS	Other Fert-ility
Kenya			1		1		1	1	
Lesotho		1					1	1	
Liberia							1[a]		
Madagascar (Malagasy Republic)			1						
Malawi							1		
Mali			1						
Mauritania	1							1	
Morocco			1	1[b]	1			1	
Niger	1					1			
Nigeria	2[c]	1				2[a]	1		1
Rwanda							1		
Senegal	1		1			1	1	1	
Sierra Leone				1[a]	1[c]		1		
Sudan	1							1[d]	
Tanzania							1		
Togo			1				1		1[a]
Tunisia		1	1	1		1[e]		1	
Uganda			1		1[c]				
Upper Volta	1	1					2		
Zaire	1								
Zambia	1[a,c]						1		1
Total	17	4	19	4	6	8	18	12	4
Asia									
Afghanistan					1		1		
Bangladesh	1[c]	1	1				1	1	1[e]
Brunei			1						
Hong Kong				1				1[f]	1
India		2	2		2	3	3		1
Indonesia		1	2			3[g]	3	1[d]	
Iran		2					2	1	1
Iraq							1		
Jordan								1	1
Korea (South)			1	5			4	1	6[e,g]
Lebanon									2
Malaysia	1	1			1	2		1[d]	
Nepal	1						3	1	
Pakistan			3				2	1	
Philippines			3[c]	1	1	1	2	1	2[g]
Saudi Arabia							1		
Singapore									3[g]
Sri Lanka		1	1[a]					1	1
Syria					1			1	
Taiwan		1	1	2					2[g]
Thailand		2	1			3	2[a,c]	1	2[e,g]
Turkey			1	2			2	1	1[g]
Vietnam (South)						1			
Yemen Arab Republic					1		1	1	
Total	3	11	17	11 7	13	28	15	24	
Latin America									
Argentina		2							
Barbados				1					1
Bolivia		1				1	1		
Brasil	1	1				2[e]	1		

TABLE 4.11 (continued)

Area, Nation	1960-69 Sub-National Demo-graphic	1960-69 Sub-National Fert-ility	1960-69 National Demo-graphic	1960-69 National Fert-ility	1970-80 Sub-National Demo-graphic	1970-80 Sub-National Fert-ility	1970-80 National Demo-graphic	1970-80 National WFS	1970-80 National Other Fert-ility
Chile						1[a]			
Colombia		1		1	2	1		1	1[e]
Costa Rica		2						1	1[e]
Dominican Republic							1	1	
Ecuador		2						1	
El Salvador									2[e]
Guatemala		1				1			1[e]
Guyana								1	
Haiti							1	1	
Honduras							2		
Jamaica							1	1	1
Martinique/ Guadeloupe				1				1[f]	
Mexico		2						1	2[e]
Nicaragua		1				1			
Panama		2	1					1	1[e]
Paraguay					1	1		1	1[e]
Peru		2				1	1	1	
Puerto Rico				1					
Trinidad/ Tobago								1	1
Venezuela		1				2		1	
Total	1	18	1	4	3	11	8	14	12

[a]Survey overlaps the 1960-1969 and 1970-1980 time periods:

Algeria	1969-1971	Togo	1969-1970
Ethiopia	1968-1970	Zambia	1969-1970
Liberia	1969-1973	Sri Lanka	1969-1970
Nigeria	1969-1973	Thailand	1969-1973
Sierra Leone	1969-1970	Chile	1969-1970

[b]Multiple surveys combined to produce national coverage:

Cameroon	1960-1965	Morocco	1966-1967

[c]Survey classified in WFS Occasional Papers (Baum et al., 1974 a-d) as both demographic and fertility; listed once here under first classification, demographic.

[d]WFS Survey is sub-national:
Sudan - North only
Indonesia - Java and Bali only
Malaysia - West Malaysia only

[e]Contraceptive prevalence surveys; fertility questions include: number of pregnancies, number of live births, number of living children and date of last live birth. The contraceptive prevalence surveys such as those conducted with the assistance of Westinghouse Health Systems and the Centers for Disease Control generally do not include birth histories but they are included in this listing of fertility surveys since they are being used in the analysis of fertility. (One or more contraceptive prevalence surveys per country.)

[f]Associate status with WFS.

[g]Value of Children (VOC) Survey, interviews only with currently married women and their husbands. (One VOC survey per country.)

Sources:

Baum et al. (1974 a-d)
Bulatao (1979, Table 3)
World Fertility Survey (1980)
Centers for Disease Control
Roper Public Opinion Research Center
Westinghouse Health Systems
United Nations Economic and Social Commission for Asia and the Pacific (1980)

it is flexible and the easiest to organize. Multi-round surveys and dual-record systems provide more accurate estimates, but they are more costly, because of the need for multiple visits and, in the case of dual systems, matching procedures. Fertility surveys are the only type that provide the data required to measure fertility trends in the recent past. No one type is best in all situations.

3. Statisticians and subject-matter specialists charged with designing and implementing surveys and the policy makers and administrators to whom they report face many major and minor choices and a wide variety of options. Many of these choices concern sampling. Successful survey operations demand that careful attention be given to the implications of each choice made. Also, attention to all sorts of details is crucial in both the design and execution of surveys. Relatively small numbers of persons are interviewed in surveys compared with the number of people interviewed and events recorded in censuses and CR/VS systems; therefore, it is both possible and necessary to devote more careful attention to quality control, supervision, and potential sources of bias. Furthermore, surveys are not conducted frequently in most countries (usually there is a period of several years between surveys); thus, a poorly conducted survey can cause a major gap in information.

4. Surveys in developing nations have added quantity and quality to the stock of knowledge about fertility and mortality. However, they do not provide absolute truths about demographic phenomena, and it is appropriate to look for potential errors when analyzing survey data on fertility and mortality. Also, as with census and CR/VS data, the use of indirect estimation techniques can improve the estimates constructed from survey data.

5. The results of the largest fertility survey program (and probably the largest social science research project) ever attempted, the World Fertility Survey program, are becoming available. They constitute a major source of data for estimating fertility and child mortality levels in the 1970s, for estimating fertility trends since about 1960, and for understanding the processes involved in fertility change.

TABLE 4.12 Measures of the Time Lag Between Field Work and the Publication of Results, for Specified Dual-System Studies and Other Measurement Procedures

Part A. Population Growth Estimation and Other Studies

Country	Study and Reference Period	Date Field Work Began (1)	Date Field Work Ended[a] (2)	Date of Preliminary or First Report[b] (3)	Date of Final Report (4)	Elapsed Time in Months (1) to (3)	(2) to (3)	(2) to (4)	(1) to (4)
Dual System Studies:									
United States	Birth Registration Test, 1940	Dec. 1939	Apr. 1940	Apr. 1943	Aug. 1946	40	36	76	80
United States	Birth Registration Test, 1950	Jan. 1950	Apr. 1950	Dec. 1952	Sept. 1954	35	32	53	56
United States	Birth Registration Test, 1964-68	June 1969[c]	Mar. 1970	Apr. 1971	u	22	13	u	u
India	Singur Health Center Study, 1945-46	Feb. 1947	Apr. 1947	u	Mar. 1949	u	u	23	25
Pakistan	Population Growth Estimation Study, 1962	Jan. 1963	Mar. 1963	Dec. 1964	Dec. 1968	35	21	69	83
Pakistan	Population Growth Estimation Study, 1963	Jan. 1962	Mar. 1964	Sept. 1965	Dec. 1968	32	18	57	71
Pakistan	Population Growth Estimation Study, 1964	Jan. 1964	Mar. 1965	Mar. 1968	July 1971	50	36	76	90
Pakistan	Population Growth Estimation Study, 1965	Jan. 1965	Feb. 1966	Mar. 1968	July 1971	38	25	65	78
Thailand	Survey of Population Change, 1964-65	July 1964	June 1965	Aug. 1966	Mar. 1969	25	14	45	56
Turkey	Turkish Demographic Survey, 1966-68	May 1966	May 1968	Jan. 1969	1970[d]	32	8	25	49
Liberia	Population Growth Survey, 1969-70	Oct. 1969	Oct. 1970	Feb. 1971	Aug.-Oct. 1971[e]	16	4	11	23

Single System Procedures:

United States	Civil Registration System, 1968	Jan. 1968	Dec. 1968	Mar. 1969	Jan. 1970	14	3	13	24
Pakistan	Intercensal Growth Rate, 1951-61	Feb. 1951	Feb. 1961	Mar. 1961	June 1964	121	1	40	160
India	National Sample Survey, 1960-61	July 1960	June 1961	Apr. 1963-Feb. 1964[f]	1967[d]	38	27	72	83
Brazil	Guanabara Demographic Pilot Survey, 1961	Jan. 1961	Dec. 1961	u	1964[d]	u	u	30	41
Republic of Korea	Korean Fertility Survey, 1968	Sept. 1968	Oct. 1968	Sept. 1969	Dec. 1970	12	11	26	27

Part B. World Fertility Surveys

Region, Country	Date Field Work Began (1)	Date Field Work Ended (2)	Date of First Country Report (3)	Elapsed Time in Months (1) to (3)	Elapsed Time in Months (2) to (3)
Africa					
Kenya	Aug. 1977	Apr. 1978	June 1980	34	26
Asia					
Bangladesh	Dec. 1975	Mar. 1976	Mar. 1979	40	36
Fiji	Feb. 1974	Apr. 1974	Dec. 1976	34	32
Indonesia	Mar. 1976	June 1976	Jan. 1979	28	25
Jordan	June 1976	Sept. 1976	Mar. 1980	45	42
Korea	Sept. 1974	Dec. 1974	Feb. 1978	41	38
Malaysia	Aug. 1974	Nov. 1974	May 1977	33	30
Nepal	Apr. 1976	June 1976	Oct. 1977	19	16
Pakistan	May 1975	Dec. 1975	Oct. 1976	17	10
Philippines	Feb. 1978	June 1978	Dec. 1979	22	18
Sri Lanka	Aug. 1975	Oct. 1975	June 1978	35	32
Thailand	Mar. 1975	Aug. 1975	Oct. 1977	31	26
Turkey	Sept. 1978	Nov. 1978	Aug. 1980	23	21

TABLE 4.12 (continued)

Region, Country	Date Field Work Began (1)	Date Field Work Ended (2)	Date of First Country Report (3)	Elapsed Time in Months (1) to (3)	(2) to (3)
Latin America					
Colombia	May 1976	Aug. 1976	Apr. 1978	23	20
Costa Rica	July 1976	Nov. 1976	Oct. 1978	28	23
Dominican Republic	Apr. 1975	July 1975	Nov. 1976	20	17
Guyana	May 1975	Aug. 1975	Oct. 1979	53	50
Jamaica	Nov. 1975	Jan. 1976	Dec. 1979	50	47
Mexico	July 1976	Feb. 1977	Feb. 1979	31	24
Panama	Dec. 1975	Mar. 1976	Mar. 1978	27	24
Peru	July 1977	June 1978	May 1979	23	11

Note: u = unavailable

[a]Excluding field follow-up, if any.
[b]Providing estimates of vital events adjusted for omissions.
[c]Refers to the beginning of data collection in the Current Population Survey.
[d]Where the month of publication was unavailable, June was used for the calculations.
[e]Natality results published in August 1971 and mortality rates in October 1971. Mean (September) used for table.
[f]Draft reports submitted to the Government of India in April 1963 and February 1964. Mean (September) used for table.

Sources:
Part A: Marks et al. (1974:57-58).
Part B: Scott and Singh (1980).

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Appendix A
Calculating Total Error in Fertility and Mortality Estimation

In much of this report the concept of total error is discussed in non-technical terms; to avoid the associated risks of oversimplification and lack of statistical rigor, this appendix provides a more precise discussion of the topic.

THE COMPONENTS OF MEAN SQUARE ERROR

Total error includes both sampling and non-sampling errors. The total error of estimate or the mean square error (MSE) can be considered as the sum of at least four error components:

a. Sampling variance is a measure of the variability of results from one sample to another sample from the same population. It arises because a sample rather than the whole population is covered. For a simple random sample, sampling variance decreases as the sample size increases. However, simple random sampling usually is not done; instead, clusters are utilized. In cluster sampling, the sampling variance decreases as the sample size increases for a given cluster size, while the variance usually increases as the cluster size increases for a fixed sample size. (The "cluster size" is the number of units in each cluster selected for the sample.) Sampling variance may also be reduced by stratification, as described in Chapter 4.

b. Simple response variance is defined as the variance of the observed values of independent measurements for an individual unit taken under the same conditions and averaged over the individual units (individual people, deaths, births, etc.).

More technically, it is $E(x_i - X_i)^2$, where E indicates the expected value over all possible responses for this unit and over all eligible units in the population, x_i is the observed value on a particular independent trial on unit i, and $X_i = E(x_i/i)$ is the conditional expected value for unit i over the trials, all under the survey conditions.

c. Correlated response variance is a measure of the variability due to intra-interviewer or intra-recorder correlation and biases that persist from unit to unit and trial to trial, that is, the tendency for an individual enumerator, interviewer, or registration official to make the same errors repeatedly or consistently in all assignments. Correlated response variance may also result from the same supervisor managing a group of interviewers or from the same editor or coder processing the results for a given individual who originally recorded the information. An example of the latter would be a coder who codes all of a particular interviewer's census forms and consistently codes that interviewer's badly written 7s as 4s. Correlated response variance increases with the average size of interviewer assignments but decreases as the number of interviewers in the survey increases.

Simple and special sample designs are required to estimate this component of error. Correlated response variance, like bias, exists in all three data collection methods: censuses, CR/VS systems, and surveys.

d. Biases refer to systematic errors that affect any data collection process taken under specified design conditions with the same constant error (Kish, 1965:509). Biases have many components and have many sources in the measurement process; they include both noncoverage and nonresponse. Examples include noncoverage or consistent underreporting of infant deaths or any other vital event, consistent underreporting or overreporting of age through the use of inaccurate event calendars, telescoping of events in time, and memory decay. Such biases may be inherent in the measurement process or they may be a result of training or supervision errors. Theoretically, in sample censuses and surveys, bias is not related to sample size nor to the number of interviewers nor to the size of their assignments, provided that the same quality of effort can be maintained. Bias can be estimated only by comparing sample or survey responses with other results presumed to be more accurate, such as records from other systems or results based on superior techniques.

For sample censuses and surveys the <u>estimated variance</u> will include the simple random-sample variance together with the simple response variance--as long as the latter is computed properly in accord with the selection design, which it often is not. In many area samples, the work of one or more interviewers is limited to a primary sampling unit, and to the extent that this is so, error from correlated response variance due to interviewers is included in the computed variances between those units. The net bias component is not included in the estimated variance, and hence when it is present the total error is underestimated. Biases are the most difficult components of error to detect or to estimate. The MSEs of large samples tend to be dominated by biases, because the sampling errors are small. However, for statistics based on subclasses and their comparison, sampling errors increase relative to constant biases, and in these cases sampling errors often predominate.

Several distinctions between biases and variable errors should be noted:

1. Biases can be best considered as average values determined by specified "essential conditions" of the data collection process--whether census, civil registration system, or survey. Their values remain largely unknown unless measured by some method external to the collection process or by internal inconsistencies. Such methods can be quality checks attached to the data collection process or comparisons with external sources. Variable errors, however, can be measured by using proper randomization designs that are internal to the data collection process, e.g., interviewers randomly allocated, coders randomly allocated, etc.

2. The total bias is the algebraic $\sum B(g)$ of components of bias, which are largely unknown and which may or may not tend to cancel each other.

The error terms and error formula are defined as follows:

B(g) = a bias component (where g refers to the same general survey conditions).
V(g) = a variable error.
m(g) = the number of units.

$\sum \frac{[V(g)]^2}{m(g)}$ = the sum of all variable error terms, representing diverse sources, expressed as a unit variable error divided by the number of units. This formula applies to cases in which the variable error terms are independent. If these terms are correlated there will also be covariance terms.

3. Hence, biases can be reduced only by improving the quality and accuracy of operations, by doing something better. Overall variable errors can be reduced and reliability increased by deciding to reduce some individual $[V(g)]^2$ or by increasing m(g). For example, in censuses where fertility or mortality data are collected or tabulated on a sample basis, more units might be included in the sample.

4. The effects of biases and of variable errors vary according to the type of statistics being generated. For example, systematic biases, which have large effects on overall means, can have negligible effects on comparisons of means and on regression statistics. Contrariwise, variable errors, which have negligible effects on the means of large samples, can have large effects on means of small subclasses, on comparisons between subclasses, and on regression statistics. Regression coefficients can be biased if there are variable errors in the independent variables.

MINIMIZING ERROR

All components contribute to the total error of results of any survey or sample census, and correlated response variance and bias can exist in censuses and CR/VS systems, too. Reducing any of the error components generally involves added costs. For surveys, different types and designs have certain advantages and disadvantages in the trade-offs of balancing costs against the total error of survey estimates. In all three basic data collection systems, simple or correlated response errors can be controlled or minimized by sound design of questionnaires and forms, good training and supervision of field staff, and the use of standardized approaches to respondents in the interview or reporting situation. Variable and constant biases can also be controlled to some extent in the same manner.

In surveys, the detection or elimination of some underreporting and some overreporting biases is theoretically possible by means of multi-round and dual-record systems or by analytical methods based on demographic models. The use of repeated measurement of a subsample of units and of interpenetrating subsamples in the design can supply estimates of all components of the mean square error other than bias (Cochran, 1977).

Resources for surveys and census samples could be allocated much more effectively if adequate data were available on the size of variance components and the costs of the actions required to reduce error by specified amounts. However, most surveys and sample censuses serve many purposes, collecting data on a wide variety of variables and subclasses, and optimization for all is not possible; multipurpose design is not yet far advanced. In practice, neither adequate cost data nor knowledge of the size of the variance components is available. Furthermore, designers of data collection systems almost always face restrictions over which they can exercise little if any control: the budget may be fixed but inadequate, the field organization may be permanent but staffed with minimally qualified personnel, the registration form may be essentially fixed, and so on. Hence, a "proximal," or conditionally optimum, approach is needed and applied in most situations. Nevertheless, it is important for the data collection designers to continually attempt to minimize total error, keeping balance in mind so that one does not pay to make trivial reductions in total error. One way of keeping total error in mind is to always evaluate design and management alternatives in relation to how they might influence the various components of the MSE.

Appendix B
Collecting Data on Recent and Cumulative Demographic Events

Due to the errors encountered in using simple retrospective questions to collect accurate data on vital rates, demographers have developed means of correcting or adjusting the data as well as indirect techniques for deriving estimates based on the data. Information on children ever born (CEB) by age of women in five-year age groups (or by five-year marriage-duration groups) permits recent fertility rates to be adjusted for reference-period errors. If data are also collected on the number of children born alive and now dead, indirect estimation procedures based on the proportion of children now dead by age of mother can produce estimates of childhood mortality. To accurately determine total CEB from census or survey data, it is usually recommended that at least the following three questions be asked of all women aged 15 and over:

(1) How many children born alive are now living in the household?
(2) How many children born alive are now living elsewhere?
(3) How many children born alive are now dead?
These questions are sometimes referred to as the summary Brass questions, after William Brass who pioneered their use (Brass, 1964).

It is also very desirable to ask each of these questions separately for male and for female children, resulting in six questions. If there are differences in reporting completeness between the two sexes, it is then possible to utilize sex ratios and male and female mortality levels in evaluating the data. The procedures for applying demographic techniques that use these cumulative data on children ever born and children surviving are described in Indirect Techniques for Demographic Estimation (Hill et al., 1981).

In measuring demographic phenomena through censuses and household surveys, attempts are frequently made also to count vital events occurring in the "recent" past by asking retrospective questions about the events of interest--say, birth, death, marriage, or migration. The reporting of such events can be improved by following a sample of households over time and using information about changes in household composition in addition to retrospective questions. Besides direct analysis of the information, whether collected retrospectively or over time, additional indirect techniques can be applied--for example, the Brass P/F method (Brass, 1975), which is based on the combination of data on cumulative fertility (or parity, P) with data on recent fertility (F).

Most of the following discussion focuses on the measurement of current fertility, but many of the errors that arise in measuring fertility are even more serious for other demographic variables. It is generally agreed, for example, that deaths are much more difficult to measure by direct census and survey approaches than are births.

There are several approaches to collecting data on current fertility retrospectively. Some of the questions most commonly asked are the following:

(a) Events in recent period(s) for each woman.
  (1) Births in the past calendar year (for example, January 1 to December 31, 1980).
  (2) Births in the past 12 or 24 months.
  (3) Births since some fixed "well-known" date or event in the recent past.

(b) Date of the most recent live birth to each woman.
  (1) Date obtained from a direct question asked only for the last live birth.
  (2) Date obtained from a complete fertility history, which would also yield data on cumulative fertility for each woman, as described above.

Asking for the date of the most recent birth requires an answer for every woman, and requires that attention be given to the last child. It forces a higher proportion of the women to give a positive response. This may yield more accurate reporting of events than asking for events in a specified period. In some cases, information on the two most recent live births is obtained.

The questions may be asked of either the woman herself or some other eligible (proxy) respondent. Male or female interviewers may put the questions to the respondent. Other persons may or may not be present at the interview. The woman of interest may or may not be married. She may be unavailable for interview because of migration or a temporary absence. Because live births are relatively rare events--in many LDCs, perhaps an average of one household in five will have had a birth in the past year--interviewers may become complacent and tend to substitute a single question for the entire household rather than asking about births for each woman. These factors and others all interact and may result in varying levels of interviewer and response errors.

Even if interviewers are well trained and consistently probe for additional information, respondents may have difficulty remembering and reporting correct dates for births and other events. This may occur because of poor memory or because respondents, in their eagerness to be helpful, report events that are outside the reference period--for example, they report births that occurred 15 months ago when asked a question on births during the past 12 months. Misdating of events is called "telescoping." Forward telescoping occurs if events that happened prior to the reference period are reported as having occurred during the period. Backward telescoping is the reverse: events that happened during the reference period are considered by the respondent to have preceded it.

Vallin (1975) estimated the extent of forward telescoping of deaths in a multi-round survey in Algeria through the use of overlapping survey reference periods and by comparing results with the incomplete civil registration data. Data from three survey rounds permitted the construction of three retrospective estimates of the crude death rate: 12.9, 16.3, and 18.0 per 1,000. Estimates for the prospective (follow-up) period were 15.4, 16.2, and 16.7 per 1,000. The first retrospective estimate was based on data from questions asked in the first round. By the third round, the retrospective questions were leading to the forward shifting of deaths into the observation period, compensating for omissions, among other things.

In a North Carolina study that tested the ability of interviewers to discover through interviews the existence of vital events known to have occurred, Horvitz (1966) reported 5 percent forward telescoping. Telescoping was higher among nonwhites than whites and higher for the questionnaire version that asked for events "since January 1" than for the version that asked for events "in the past 12 months."

The data from Colombia and Kenya shown in Table B.1 are based on field rechecks of unmatched survey events from experimental dual-record systems. The column labeled "temporal" under "out-of-scope events" indicates events that were telescoped into the reference period. It is not known the extent to which these events would have been balanced by events that may have been forgotten altogether or that were telescoped out of the reference period. Few data are available to determine the extent to which events are telescoped out of the reference period.

TABLE B-1 Number of Out-of-Scope Vital Events Reported in Experimental Dual-Record Systems, as Measured by Field Rechecks of Unmatched Survey Events

		Out-of-Scope Events				
			(Percent)			
	Total Number of Events Reported	Total Number	Total[a]	Geographic	Temporal	Conceptual
Colombia						
1972-1973						
Births						
Santander	1,552	107	7	4	1	1
Bolivar	1,024	117	11	6	4	1
Deaths						
Santander	294	16	5	2	1	2
Bolivar	174	17	10	3	2	4
Kenya						
First 6 Mos, 1972						
Births	971	167	17	12	4	1
Deaths	131	25	19	8	9	2

[a]Percentages do not add to the "total" in all cases because of rounding.

Sources: Colombia: Colombia (1976: Tables 12, 14, 16, 17, pp. 120, 121, 123).
Kenya: Abernathy and Booth (1977:31, 45).

The only way to throw more light on these problems is to arrange for multiple coverage of events, with overlapping reference periods that allow matching to be done as in the Algeria example noted above. Another example comes from Morocco. Using data from the three rounds of the 1961-63 multipurpose survey of Morocco, Sabagh and Scott (1967) estimated that for a single-round retrospective survey the gross error (overenumeration plus underenumeration) would have been 17 percent for births and 36 percent for deaths, while the net error would have been an overenumeration of 3 percent and 9 percent for births and deaths, respectively.

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Glossary

AGE HEAPING A tendency for enumerators or respondents to report certain ages instead of others; also called age preference or digit preference. Preference for ages ending in 0 or 5 is widespread.

AGE PATTERN OF FERTILITY The relative distribution of a set of age-specific fertility rates. It expresses the relative contribution of each age group to total fertility.

AGE RATIO The ratio of the population in a given age group to the average of the populations in the two neighboring age groups, times 100.

AGE-SPECIFIC FERTILITY RATE The number of births occurring during a specified period to women of a specified age or age group, divided by the number of person-years-lived during that period by women of that age or age group. When an age-specific fertility rate is calculated for a calendar year, the number of births to women of the specified age is usually divided by the midyear population of women of that age.

AGE-SPECIFIC MORTALITY RATE The number of deaths occurring during a specified period to persons (usually specified by sex) of a specified age or age group, divided by the number of person-years-lived during that period by the persons of that age or age group. When an age-specific mortality rate is calculated for a calendar year, the number of deaths to persons of the specified age is usually divided by the midyear population of persons of that age. Age-specific mortality rates are generally denoted by ${}_nM_x$, the annual death rate to persons aged x to x + n.

AGE STANDARDIZATION A procedure of adjustment of crude rates (birth, death, or other rates) designed to reduce the effect of differences in age structure when comparing rates for different populations.

BIRTH HISTORY A report of the number and dates of all live births experienced by a particular woman; see also pregnancy history. The sex of each child, the survival of each child to the date of the interview, and, where pertinent, the date of death are also generally recorded.

BIRTH ORDER The ordinal number of a given live birth in relation to all previous live births of the same woman (e.g., 5 is the birth order of the fifth live birth occurring to the same woman).

BIRTH RATE See crude birth rate.

CHANDRASEKARAN-DEMING TECHNIQUE A procedure to estimate the coverage of two independent systems collecting information about demographic or other events, based on the assumption that the probability of an event being recorded by one system is the same whether or not the event is recorded by the other system. The events from both systems are matched to establish M, the number of events recorded by both systems; U_1, the number recorded only by system 1; and U_2, the number recorded only by system 2. The Chandrasekaran-Deming formula then estimates total events, N, as

$$\hat{N} = M + U_1 + U_2 + \frac{U_1 U_2}{M}.$$

CHILDBEARING AGES The span within which women are capable of bearing children, generally taken to be from age 15 to age 49 or, sometimes, to age 44.

CHILDREN EVER BORN(E) The number of children ever borne alive by a particular woman; synonymous with parity. In demographic usage, stillbirths are specifically excluded.

COHORT A group of individuals who experienced the same class of events in the same period. Thus an age cohort is a group of people born during a particular period, and a marriage cohort is a group of people who married during a particular period. The effects of a given set of mortality or fertility rates are often illustrated by applying them to hypothetical cohorts.

COHORT FERTILITY The fertility experienced over time by a group of women or men who form a birth or a marriage cohort. The analysis of cohort fertility is contrasted with that of period fertility.

CRUDE BIRTH RATE The number of births in a population during a specified period divided by the number of person-years-lived by the population during the same period. It is frequently expressed as births per 1,000 population. The crude birth rate for a single year is usually calculated as the number of births during the year divided by the midyear population.

CRUDE DEATH RATE The number of deaths in a population during a specified period divided by the number of person-years-lived by the population during the same period. It is frequently expressed as deaths per 1,000 population. The crude death rate for a single year is usually calculated as the number of deaths during the year divided by the midyear population.

CUMULATED FERTILITY An estimate of the average number of children ever borne by women of some age x, obtained by cumulating age-specific fertility rates up to age x; also often calculated for age groups.

DEATH RATE See crude death rate.

DE FACTO POPULATION A population enumerated on the basis of those present at a particular time, including temporary visitors and excluding residents temporarily absent. See de jure population.

DE JURE POPULATION A population enumerated on the basis of normal residence, excluding temporary visitors and including residents temporarily absent. See de facto population.

DIGITAL PREFERENCE See age heaping.

DUAL RECORD SYSTEM See Chandrasekaran-Deming Technique

EXPECTATION OF LIFE AT BIRTH The average number of years that a member of a cohort of births would be expected to live if the cohort were subject to the mortality conditions expressed by a particular set of age-specific mortality rates. Denoted by the symbol e(o) in life table notation.

FERTILITY HISTORY Either a birth history or a pregnancy history.

FORWARD SURVIVAL A procedure for estimating the age distribution at some later date by projecting forward an observed age distribution. The procedure uses survival ratios, often obtained from model life tables. The procedure is basically a form of population projection without the introduction of new entrants (births) to the population.

GENERAL FERTILITY RATE The ratio of the number of live births in a period to the number of person-years-lived by women of childbearing ages during the period. The general fertility rate for a year is usually calculated as the number of births divided by the number of women of childbearing ages at midyear.

GROSS REPRODUCTION RATE The average number of female children a woman would have if she survived to the end of her childbearing years and if, throughout, she were subject to a given set of age-specific fertility rates and a given sex ratio at birth. This number provides a measure of replacement fertility in the absence of mortality.

GROWTH RATE The increase or decrease of a population in a period divided by the number of person-years-lived by the number of person-years-lived by the population during the same period. The increase in a population is the result of a surplus (or deficit) of births over deaths and a surplus (or deficit) of immigrants over emigrants. (The annual increase is often expressed as a fraction of the total population at the beginning of the year, but this convention has the inconvenient characteristic of not being readily defined for a five-year interval and of being unequal to the difference between the birth rate and the death rate even in the absence of migration.) See also rate of natural increase.

INFANT MORTALITY RATE The number of deaths of children under 1 year of age occurring in the same year; also used in a more rigorous sense to mean the number of deaths that would occur under 1 year of age in a life table with a radix of 1,000, in which sense it is denoted by the symbol ${}_1q_0$.

LIFE TABLE A listing of the number of survivors at different ages (up to the highest age attained) in a hypothetical cohort subject from birth to a particular set of age-specific mortality rates. The rates are usually those observed in a given population during a particular period of time. The survivors of the radix to age x are generally denoted by l(x). The tabulations commonly accompanying a life table include other features of the cohort's experience: its expectation of life at each age x, denoted by e(x); the probability of surviving from each age x to age x + n, denoted by ${}_nq_x$; the person-years-lived by the hypothetical cohort as it ages from age x to age x + n, denoted by ${}_nL_x$ (also equivalent to the population aged x, x + n in a stationary population experiencing a number of births each year equal to the radix of the life table); and the person-years-lived by the hypothetical cohort from age x onward, denoted by T(x).

LOGIT The logit of a proportion p is 1/2 ln[p/(1 - p)]. As a linearizing transformation, the logit has been proposed as the basis of a model life table system in which the logit of a probability of dying by age x ($_xq_0$) is related linearly to the logit of a standard probability of dying by age x ($_xq_0^s$) so that

$$\text{logit}\ (_xq_0) = \alpha + \beta\ [\text{logit}\ (_xq_0^s)],$$

where α is a measure of mortality level relative to the standard and β is a parameter that alters the shape of the standard mortality function.

MARITAL FERTILITY Any measure of fertility in which the births (in the numerator) are births to married women and in which the number of person-years-lived (in the denominator) also pertains to married women. In some instances, the designation "married" includes persons in consensual unions.

MEDIAN The value associated with the central member of a set that is ordered by size or some other characteristic expressed in numbers.

MEAN AGE OF CHILDBEARING The average age at which a mortality-free cohort of women bear their children according to a set of age-specific fertility rates.

MEAN AGE OF CHILDBEARING IN THE POPULATION The average age of the mothers of the children born in a population during a year. This measure incorporates the effects of both mortality and the age distribution.

MIGRATION RATE Number of migrants during a specified period divided by the person-years-lived of the population exposed to migration. Also see population change due to migration.

MODEL LIFE TABLE An expression of typical mortality experience derived from a group of observed life tables.

MOVING AVERAGES The successive averaging of two or more adjacent values of a series in order to remove sharp fluctuations.

MYERS INDEX An index of digit preference that essentially sums in turn the population ending in each digit over some age range, often 10-89, expressing the total as a percentage of the total population, and which avoids the bias introduced by the fact that the population is not evenly distributed among all ages by repeating the calculations 10 times, once for each starting digit, and averaging the results. The difference between the average percentage for each digit and the expected value of 10 percent provides a measure of the preference for or avoidance of the digit over the age range considered.

NATURAL FERTILITY The age pattern of marital fertility observed in non-contraceptive populations where reproductive behavior is not affected by the number of children already born.

NET MIGRATION The difference between gross immigration and gross emigration.

NET REPRODUCTION RATE The average number of female children born per woman in a cohort subject to a given set of age-specific fertility rates, a given set of age-specific mortality rates, and a given sex ratio at birth. This rate measures replacement fertility under given conditions of fertility and mortality: it is the ratio of daughters to mothers assuming continuation of the specified conditions of fertility and mortality.

OWN-CHILDREN METHOD A refinement of the reverse-survival procedure for fertility estimation, whereby estimates of age-specific fertility rates for the recent past are obtained by relating mothers to their own children, using information on relationship and other characteristics available from a census or survey.

PARITY See children ever born.

PARTIAL BIRTH RATE The proportion of the population that enters (that is, is "born" into) a given age category in a year. The age categories used are normally open-ended, thus the partial birth rate x+ designates the proportion of the population becoming x years and older.

PARTIAL DEATH RATE The proportion of the population that leaves (that is, "dies" out of) a given age category in a year. See partial birth rate.

PERIOD FERTILITY The fertility experienced during a particular period of time by women from all relevant birth or marriage cohorts; see also cohort fertility.

P/F RATIO METHOD A consistency check for survey information on fertility. Information on recent fertility is cumulated to obtain measures that are equivalent to average parities. Lifetime fertility in the form of reported average parities by age group (P) can then be compared for consistency with the parity-equivalents (F) by calculating the ratio P/F for successive age groups. If certain assumptions about error patterns are met, an improved estimate of fertility can sometimes be obtained by correcting the age pattern of current fertility to agree with the level of lifetime fertility reported by younger women.

POPULATION CHANGE DUE TO MIGRATION The sum of in-migrants minus out-migrants during a specified period of time. The change may also be expressed as a rate by dividing the change by person-years-lived in the population during the same period.

PREGNANCY HISTORY A report of the number and the dates of occurrence of all the pregnancies experienced by a particular woman. The outcome of the pregnancy--live birth, stillbirth, fetal death--is also recorded.

RADIX The hypothetical birth cohort of a life table. Common values are 1, 1,000, and 100,000.

RATE OF NATURAL INCREASE The difference between the births and deaths occurring during a given period divided by the number of person-years-lived by the population during the same period. This rate, which specifically excludes changes resulting from migration, is the difference between the crude birth rate and the crude death rate.

RETROSPECTIVE SURVEY A survey that obtains information about demographic events that occurred in a given past period, generally terminating at the time of the survey.

REVERSE PROJECTION See reverse survival.

REVERSE SURVIVAL A technique to estimate an earlier population from an observed population, allowing for those members of the population who would have died according to observed or assumed mortality conditions. It is used as a method of estimating fertility by calculating from the observed number of survivors of a given age x the expected number of births that occurred x years earlier. (In situations for which both fertility and mortality are known or can be reliably estimated, reverse survival can be used to estimate migration.)

ROBUSTNESS A characteristic of estimates that are not greatly affected by deviations from the assumptions on which the estimation procedure is based.

SEX RATIO AT BIRTH The number of male births for each female birth, or male births per 100 female births.

SINGULATE MEAN AGE AT MARRIAGE (SMAM) A measure of the mean age at first marriage, derived from a set of proportions of people single at different ages or in different age groups, usually calculated separately for males and females.

STABLE POPULATION A population exposed for a long time to constant fertility and mortality rates, and closed to migration, establishes a fixed age distribution and constant growth rate characteristic of the vital rates. Such a population, with a constant age structure and constant rate of growth, is called a stable population.

STATIONARY POPULATION A stable population that has a zero growth rate, with constant numbers of births and deaths per year. Its age structure is determined by the mortality rates and is equivalent to the person-years-lived ($_nL_x$) column of a conventional life table.

SURVIVAL RATIO The probability of surviving between one age and another; often computed for age groups, in which case the ratios correspond to those of the person-years-lived function, $_nL_x$, of a life table. Also called survivorship probabilities.

SURVIVORSHIP PROBABILITIES See survival ratio.

SYNTHETIC PARITY The average parity calculated for a hypothetical cohort exposed indefinitely to a set of period age-specific fertility rates.

TOTAL FERTILITY RATE (TFR) The average number of children that would be born per woman if all women lived to the end of their childbearing years and bore children according to a given set of age-specific fertility rates; also referred to as total fertility. It is frequently used to compute the consequence of childbearing at the rates currently observed.

UNITED NATIONS AGE-SEX ACCURACY INDEX An index of age reporting accuracy that is based on deviations from the expected regularity of population size and sex ratio, age group by age group. The index is calculated as the sum of (1) the mean absolute deviation from 100 of the age ratios for males, (2) the mean absolute deviation from 100 of the age ratios for females, and (3) three times the mean of the absolute difference in reported sex ratios from one age group to the next. The United Nations defines age-sex data as "accurate," "inaccurate," or "highly inaccurate" depending on whether the index is less than 20, 20 to 40, or greater than 40.

WHIPPLE'S INDEX A measure of the quality of age reporting based on the extent of preference for a particular target digit or digits. The index essentially compares the reported population at ages ending in the target digit or digits with the population expected on the assumption that population is a linear function of age. For a particular age range, often 23 to 62, the population with ages ending in the target digits is divided by one-tenth of the total population, the result then being multiplied by 100 and divided by the number of different target digits. A value of 100 indicates no preference for those digits, whereas values over 100 indicate positive preference for them.