APPROACHES TO COLLECTING DATA ON FERTILITY AND MORTALITY FOR THE ESTIMATION OF VITAL RATES[1]

United Nations Statistical Office

In spite of an increasing demand for reliable estimates of fertility and mortality, civil registration systems in most developing countries still do not yield the complete and accurate data required for the direct estimation of basic demographic measures. To fulfill the demand, two other methods of data collection—population censuses and sample surveys—have contributed by providing the data required for the estimation of crude birth and death rates, general and total fertility rates, gross and net reproduction rates, and life expectancy.

This article presents an overview of the various approaches available to collect fertility and mortality data in censuses and various types of sample surveys to supplement the defective data from civil registration systems. It discusses the potential of each method to overcome some of the most serious errors and biases and to obtain reliable data down at least to the major subdivisions of the country. It brings out the limitations of the data from these methods in light of past experiences around the world. Finally, it briefly discusses indirect techniques for demographic estimation.

The immediate potential offered by the various indirect estimation techniques makes them attractive alternatives for generating measures of fertility and mortality if data from censuses and surveys are available. But the usefulness of these techniques depends on the purposes to be served by the estimates and the limitations of the various methods in satisfying those purposes. The underlying assumptions must be carefully considered before selecting a particular technique. Once a technique has been selected, the parameters derived must be evaluated by internal and external comparison using all available data sources.

Approaches in Population Censuses for Collecting Data on Fertility and Mortality: 1965–1984

The population census was originally seen as providing data only on the population at risk, that is, the denominator needed to estimate birth and death rates and age-sex specific fertility and mortality rates. Numerators for the rates were to be obtained from the civil registration system. However, in many developing countries, the rates so obtained were too low to be accepted as true values. Consequently, other questions were devised to gather information on fertility and mortality in population censuses and sample surveys.

Current births and deaths

Population census takers have attempted to collect information on live births and deaths in the 12 months preceding the interview (or another fixed period, such as 24 months). This approach was clearly intended for the direct estimation of birth and death rates. When sex and age of the deceased were collected, age-sex-specific mortality rates could, in theory, also be calculated and from them other mortality measures derived. Both numerators and denominators are built into the census.

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The earliest attempts were made in the censuses of the United States of America in the nineteenth century, when data from civil registration were largely unsatisfactory. More recently, countries have included retrospective questions on births and deaths in the past year in their censuses. Thirty-four out of 160 censuses during the 1970 census decade and 55 out of 160 censuses during the 1980 census decade[2] asked a question on the number of births in the 12 months preceding the census date. The information was collected by inquiring of the head of the household the number of children born alive in the household in the past 12 months. A second approach, believed to provide better results than the former, asked each woman of childbearing age of any civil status, "How many children have you had in the past 12 months?" Thus, current age-specific fertility rates could also be calculated. The 1981 census of Togo, for example, included two independent questions to obtain a better approach to the true number of births in the past year. One set of data was gathered from the head of the household and the other from all women aged 12 years and above regardless of their civil status. The reference period was the calendar year preceding the year of the census.

Similarly, data on deaths in the past year among members of the household were collected in 10 censuses in the 1970s and 29 in the 1980s. Sex and age of the deceased were queried in 6 censuses in the 1970s and 17 in the 1980s. These censuses were mainly in Africa and Asia.

Each country has paraphrased the questions in different ways; below are some of the most commonly used forms:

Deaths in the previous 12 months (addressed to the head of the household):

- How many deaths have there been in your household last year?
- How many deaths have there been in this household during 1981? (the reference period in this case was the calendar year preceding the census year)
- Any death in this household last year?

Births in the previous 12 months:

- How many children were born alive in this household the past year? (addressed to the head of the household)
- Any child born alive in this household last year? (addressed to the head of the household)
- How many children did you give birth alive to last year? (addressed to women in their childbearing period)

The relatively small number of censuses that included these retrospective questions is not surprising, as countries have been aware of the poor quality of the data generated by such approaches. Analysis of the data in many countries has not produced useful results. The poor performance of these questions is attributable to recall lapse; misconception of the reference period; misreporting of ages, if applicable; inclusion of fetal deaths; or simply misunderstanding of the nature of the question. Despite all these problems, there is still hope that at least the data on deaths by sex and age would be useful inputs to indirect estimation due to new developments in methodology.

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[2]The 1970 census decade ran from 1965 to 1974 and the 1980 census decade from 1975 to 1984. In this article, these census decades are also referred to as "the 1970s" and "the 1980s," respectively.

Children ever born and children still living

Questions asked of women about children ever born and still living, and children dead at the time of the enumeration also have a long tradition in population censuses. The approaches of countries in the last 20 years to obtain the number of children ever born were made either by the straightforward question, "How many children have you ever borne alive?" (108 censuses in the 1970s and 102 censuses in the 1980s) or by derived information from two independent queries about "the number of children still living at the time of the census" and "the number of children who have died up to the census date." Fifteen censuses in the 1970s and 23 in the 1980s used the latter approach. Initially, the two categories were split to minimize omissions of children who died shortly after birth. Early in the 1960s, data on children dying (or surviving) were viewed as sources to estimate mortality in infancy and childhood.

Information on children ever born should be gathered from all women in their reproductive ages, regardless of civil status. However, some countries have defined other universes. For example, countries in which births to mothers at ages below 15 were important, from the statistical point of view, have lowered the age limit to 14, 13, 12, 11 or even 10. Furthermore, in some societies questions on children ever born and children surviving are a sensitive issue for single women, so a sizeable number of countries have restricted these items to ever-married women or currently married women. This was the case in most Asian and European countries. Below are some of the other subgroups of women from whom data were collected in the censuses of the last 20 years:

- All women aged 12 to 49 years
- All women aged 15 to 54 years
- All women aged 10 years and above
- Ever-married women under 50 years of age
- Ever-married women under 70 years of age
- Ever-married women aged 15 to 54 years
- Currently married women

The main limitation of data on lifetime fertility is that no timing can be inferred for the age-specific fertility rates estimated on the basis of these data, except for the latest developments in methodology. Similar problems occur with mortality estimates. In all censuses, some children ever born collected through this approach were clearly omitted, especially by the oldest cohorts of women, 35 years of age and above. It was argued that women might underreport children who have left home and are living elsewhere and those who died in early infancy. Therefore, rewording of the questions was suggested to minimize those errors, as follows:

Of the children you have ever borne alive:

- How many are currently living with you in this household?
- How many are currently living elsewhere in another household?
- How many have died?

Seventeen censuses in the 1970s and 28 censuses in the 1980s approached the problem in the above way, although the questions are more suitable for a survey, as they are more lengthy and time consuming.

Date of the most recent live birth

Simultaneously with improvements in techniques to collect data on living and dead children, another strategy was sought to collect data on recent fertility and mortality. It was proposed to determine the birth date of the most recent child born alive and inquire whether or not the child was alive at the time of the interview. Data on children born alive in the preceding 12 months and children dead in the same period could then be obtained at the processing stage. This approach would minimize misconception of the reference period. The follow-up question about the last birth was intended for improving the count of infant deaths. Twenty-seven censuses in the 1970s and 32 in the 1980s approached data collection on current fertility through this question. Survival of the last child born alive was included in only 14 censuses in the 1970s and 23 in the 1980s. The 1981 census of New Zealand used a somewhat different approach, inquiring about the "number of years since last child was born."

To improve studies of sex differentials in infant mortality, data on the sex of the most recent death among the most recent live born were collected in only two censuses in the 1970s and two in the 1980s. Aside from these approaches, five censuses in the 1970s and 13 in the 1980s included a straightforward question to collect information on infant deaths with reference to a retrospective fixed period, generally one year. This approach has all the limitations described for deaths of all ages in the previous 12 months.

Some other censuses took quite a different approach, inquiring about the date of birth of each child born alive and whether or not the child was alive at the time of the census; that is, a maternity history was taken. This approach is unusual in a population census, as it is a refined technique more suitable for sample surveys due to the lengthy interviews required and the added complexities in the coding, editing and tabulation stages.

Undoubtedly, the inquiry about the date of the last birth and whether or not the child was alive at the time of the census has performed much better than the traditional straightforward questions on children ever born in the past year and how many were dead among them. It reduces the problem of misconception of the reference period, and therefore the infant mortality estimates and estimates of current age-specific fertility rates have improved. However, this inquiry has not overcome all the existent problems of information derived from retrospective questions. A number of analytical techniques are available for the assessment and correction of basic data.

Data on orphanhood

Developments of indirect techniques for demographic estimation of adult male and female mortality have led to the inclusion of specific questions in censuses and sample surveys to collect data on survival of natural or biological mother and father. Most recently, the survival of the first spouse has been sought for the same purpose. Questions in census questionnaires read as follows:

- Is you mother still alive?
- Is your father still alive?

Data gathered from these questions contain no information about timing either, as the expected responses were simply yes, no, or unknown. Data on orphanhood resulting from the death of both mother and father were collected in 10 censuses in the 1970s and 13 in the 1980s. Maternal orphanhood was collected in only five censuses in the 1970s and 15 in the 1980s.

A question intended to overcome duplicate reporting of parents by siblings was then proposed: "Are you the oldest surviving child of your mother/father?" Thus, the tabulation on orphanhood resulting from the death of mother/father would be restricted to the eldest surviving child. Unfortunately, analysis of the resulting data in various countries has shown that an unacceptable number of people claimed to be the eldest child of their mother. The most common biases of these data arose from the adoption effect, multiple reporting of the same parents by siblings, the effect of declining mortality and misreporting of the respondent's age.

Data on widowhood

To improve estimations of adult male and female mortality, questions about the survival of the first spouse were suggested. The universe from which such data have been collected was the ever-married population. The most common wording of the question was, "Is your first husband still alive?" The poor performance of the suggested approach has been attributed to the effect of remarriage, as it is likely that respondents gave information about their present and not their first spouse. Another source of error arose in countries where a sizeable proportion of the population lives in consensual unions, as such people might be confused about what to consider a former marriage.

Other relevant data from population censuses

The population census collects other data for direct as well as indirect estimation of basic demographic parameters. Data on age, sex, place of birth, usual place of residence and other economic and social variables, down to the smallest geographical subdivision of the country, allow for estimating age-specific and character-specific fertility and mortality rates, life tables and other basic parameters, in combination with high-quality data from the civil registration system. For countries with defective registration data, some of the same variables can be useful for demographic estimation through a number of indirect techniques.

Nuptiality variables collected in the population censuses can play a significant role in improving indirect estimates of fertility and mortality when age misreporting is a major problem. Date of marriage appears to be more easily recalled than age (or date of birth) because marriage is an important event and more recent than birth. Therefore, a question to define "time in marriage" was suggested, which in census questionnaires often read as follows:

- What is the date of your first marriage? (or, age at first marriage?)
- Time, in years, since your first marriage? (or, time elapsed, in years, from the first marriage?)
- How many years have you been married?

Any one of these alternatives needed an additional question: "Are you still in your first marriage?" Information on time in marriage was collected in 59 censuses in the 1970s and 55 in the 1980s.

Another item relevant to fertility estimation is mother's age at the time of her first live-born child. Thirty censuses in the 1970s and 23 in the 1980s collected this information.

Finally, an item that is usually collected in population censuses for control purposes, "the relationship of each reported household member to the head or reference member of household," has also been used since the 1970s for fertility estimation in some countries. The so-called own-children technique uses such data to identify the natural mother, when possible, of each child

enumerated in the correspondent census questionnaire, then reconstructs fertility histories and from them estimates aggregate fertility and age structure of fertility, provided that age misreporting is not severe.

Advantages and disadvantages of census data for fertility and mortality estimation

The strength of census data—population figures by sex, age, place of birth, usual residence and other social and economic variables—stems from their ready availability at all desired levels of geographical subdivision of the country. This is the population at risk used to calculate various basic demographic parameters. Furthermore, the figures are free of most kinds of sampling errors. These are advantages not shared by sample surveys.

The general limitations of census data are those common to information gathered from retrospective questions. Any historical reconstruction of personal data is subject to recall lapse. Timing and cost are greater than in the case of sample surveys. Moreover, the respondent in a population census is, in general, the head of the household who also serves as a proxy respondent for other household members. This factor leads to misstatements of age, underreporting of births and deaths, misdating of births and deaths, and other errors. Even if errors in the data are minimized, a population census can never provide data for estimation of current fertility and mortality as does the civil registration and vital statistics system. This is because detailed census data are generally not available until at least 2 or 3 years after the fieldwork has ended. A further shortcoming is that a census can collect little information about each vital event, thus limiting an in-depth study of differentials. The most common errors found in population censuses relating to data on fertility may be listed as follows:

- Errors of omission: children who died or left home, children born of a husband other than the current one, children given out in adoption.
- Errors of inclusion: Fetal deaths reported as children who died in infancy, children born by another wife to current husband, adopted children, grandchildren.

In addition to incomplete counts, there are problems of misstatements in reconstructing personal histories of individuals. In many developing countries, some people do not know their age, and age is not of particular significance to them. This poses a special problem in estimating both fertility and mortality from census questions. If age structure is distorted, all specific fertility and mortality rates and derived indicators are affected. Even though a number of methods exist for smoothing the age distribution, they are mostly suited for closed populations, making difficult an adjustment of the age-sex structure at subnational levels if net internal migration is unknown.

The failure to enumerate vital events is due to a number of factors. In some societies, the fact of birth or death is deliberately concealed for superstitious reasons. Memory lapses also exist even on so important an event as birth or death. In cultures where a greater premium is placed on males, births and deaths of females are more likely to be underenumerated. In addition to the problems of recall, difficulties in the accurate dating of events result in the underreporting or overreporting of the number of events during the reference period. Finally, a census is costly and requires long advance planning, so it is taken only periodically at about 10-year intervals. Population estimates and projections are essential for the intercensal periods. These are some of the reasons to seek other methods of data collection to measure recent changes in fertility and mortality, to assess population growth and to evaluate programs. Household sample surveys provide an important vehicle for the collection of fertility and mortality data offering even more flexibility to combine various techniques.

Approaches in Sample Surveys for Collecting Data on Fertility and Mortality

Developments in sampling theory and household survey techniques in the last three decades have led to the growing use of sample surveys to collect data needed to estimate basic parameters of fertility and mortality. Shortly after World War II, retrospective surveys began to be used in developing countries. At first, these surveys approached the problem through retrospective questions, as population censuses do. In the period 1960-1980, 81 developing countries conducted at least one major survey: 33 in Africa, 24 in Asia and 24 in Latin America. More than half of the 81 fertility surveys were conducted as a part of, or in association with, the World Fertility Survey program. A number of countries took follow-up sample surveys (also called prospective surveys, multi-round surveys, or the household change technique) to assess their current levels and patterns of fertility, mortality and population growth. The dual-records system, a more complex approach to data collection that combines a multi-round survey with a continuous recording of events in the sample areas, has gained considerable popularity, mainly in Asian countries.

The single-round retrospective survey

Countries have conducted two types of single-round retrospective surveys. One type uses a short questionnaire similar to the census type, while the other combines a short household questionnaire with a more extended individual questionnaire; the latter is intended for a subsample of the population only. In both types of questionnaires, the households in the sample are interviewed once.

Most of the single-round retrospective surveys using a short questionnaire have included questions to obtain the number of children ever born, children surviving up to the time of the interview, the date of the most recent birth and whether or not the last child was alive at the time of the survey (or births and deaths in the past 12 months), data on orphanhood from mother and father and data on survival of the first spouse. As in a census, the information is obtained from a responsible adult member of the household. A survey, however, is in a better position than a census to gather quality data because the survey covers a small part of the population and thus requires fewer interviewers. This allows for better training of the staff and closer supervision of the fieldwork. Similarly, all the subsequent stages up to the dissemination of data can be controlled. A retrospective survey of this type is also more suitable than a census to phrasing the questions in the most desirable way. This is the case, for example, regarding children still living and children who have died, for which the following questions can be asked for each sex:

Of all boys/girls that you have ever borne alive:

- How many are living with you in this household?
- How many are living elsewhere in another household?
- How many have died?

The most common question on lifetime fertility asked in single-round surveys has been the number of children ever born alive. Although this is a straightforward question asked by better-trained enumerators, it is subject to the same kinds of response errors as the census method. It has resulted in overcounts as well as undercounts of the number of children ever born alive, due particularly to errors of memory lapse. Compared with estimates from the dual-records system, the estimated median birth coverage in seven Asian population growth estimation studies

involving single-round surveys was 67 percent, and the range was 28 to 96 percent. The median coverage for deaths was 51 percent, and the range was 23 to 90 percent.

The undercount of infants and young children mentioned in the case of the census is generally the same in retrospective surveys of this type. High-quality data are difficult to obtain, especially when large numbers of individuals are sampled. Even if highly skilled personnel are used and the training and organization of the fieldwork staff are adequate, social conditions of the population can still distort simple facts such as age, historical data regarding births and deaths, and so on. Experience in obtaining complete counts of vital events from retrospective surveys of this kind has also been generally poor.

Despite all the limitations of the data, single-round retrospective surveys of the type commented on here have been the main sources of data for mortality and fertility estimates in developing countries. It has been suggested that the value of such surveys could be greatly enhanced if they were repeated at regular intervals. Such repetition does not require re-interviewing the same households, but successive samples should all be representative either of the country as a whole or of the same subdivisions within it.

The main advantages of the single-round approach are cost effectiveness and timeliness. Thus, survey data can be available in about two years, including time for advance planning, pretest, fieldwork and processing and dissemination of data. Population censuses, multi-round surveys and dual-records systems require much more time.

The other type of single-round retrospective survey, using extended questionnaires, has proved to be even more flexible. Examples of these surveys are those of the World Fertility Survey program. A maternity history (or a pregnancy history) is completed for each ever-married woman or other well-defined subuniverse. This approach overcomes the ambiguity about timing in estimates of fertility and mortality derived from lifetime fertility, thus avoiding the reliance on theoretical demographic models to estimate the basic measures. It also minimizes the errors generally found in simple single-round surveys and in population censuses.

The maternity history approach collects information on date of birth and sex for every child born alive for each ever-married woman and, if applicable, the date of or age at death. Recent infant and child mortality rates can be calculated from these data for about 20 years prior to the survey. Both the numerator and the denominator of rates are built into the maternity history. Similarly, age-specific fertility rates can be calculated for a number of years prior to the survey.

Aside from a maternity history, a wider range of social, economic and other variables can be included, namely, a marriage history, attitudes towards family size and family planning, knowledge and practice of contraceptive methods, level of education, occupation, religion, and so on. Such variables have proved useful in identifying factors that can explain changes in fertility and mortality. Furthermore, a shorter household questionnaire with retrospective questions on fertility and mortality, when coupled with a more extended one, gives the opportunity for mutual evaluation and plausibility of the parameters they yield. The interviewers for this approach, preferably women, have to be more skilled and better trained than those for censuses and regular retrospective surveys. The fieldwork requires closer supervision. Furthermore, the respondent must be the woman herself and not a proxy respondent because of the large amount of historical data that have to be provided.

Experience gained from analyzing these data has shown, however, that maternity histories are subject to several sources of error arising from date and age misstatements and underreporting of children. Systematic errors persisted even when a detailed questionnaire was used. Among the other limitations is the longer time required for each interview compared with that for a population census or a regular retrospective survey. A study conducted among countries participating in the World Fertility Survey program revealed that the time per interview (for

ever-married women only) ranged from 25 minutes in Thailand to 57 minutes in Bangladesh, thus significantly increasing the cost of the survey. Furthermore, the complexity of the data collected for every woman called for skilled personnel at the data processing stage.

The follow-up (multi-round) survey

A prospective survey was devised to collect data on fertility and mortality to minimize memory lapse and misconception of the reference period. It inquires about household change due to live births, deaths, and in/out migration. Clusters of households are interviewed repeatedly within a certain period of time. Based on the experiences of various countries, three or more rounds are conducted at about 6-month intervals. An inventory of all members of the household and certain basic particulars are recorded in the first round. At each subsequent round, changes in household composition are used to provide information on births, deaths, and in/out migration among members of the household since the last interview. Special instructions are given to the interviewer when emigrations occur to ensure that a death is not omitted, as often happens in this kind of survey. To improve the reporting of infant deaths, a question on whether or not the interviewed woman of childbearing age is pregnant at the time of each interview is sometimes included. In subsequent rounds, the outcome of the identified pregnancies is queried and any infant deaths are registered.

This approach can secure a perfect consistency of numerators and denominators in terms of age, place of residence and other characteristics. However, this does not apply to infants who were born and died between rounds or when deaths occurred among in-migrants between rounds. Current levels, structure and differentials of fertility and mortality can be calculated directly from these data without making use of any demographic model. Moreover, information on the population at risk is obtained directly from the survey, the reference period is readily fixed by the date of the first and the last rounds in which each person is covered by the survey, and the effect of in/out migration is controlled for every sampled subdivision within the country. Furthermore, because the survey comprises various rounds, it allows for correcting inconsistencies of the data found in previous rounds. For reciprocal checking, a retrospective survey can be included in the last round of the follow-up survey. Thus, two different approaches can be made without increasing the cost.

The follow-up approach seems to be a promising method of data collection to secure vital rates at the subnational as well as the national level without relying on theoretical models, provided that a high quality of data is secured.

Among the disadvantages of this method is the need for a large sample to secure a sufficient number of births and deaths, as these events have low frequency in the population. This is true especially when differentials are to be studied. Other drawbacks concern timing, cost and administration. The fieldwork itself never takes less than two years, to which must be added time for advance planning and data processing. The cost is higher than that of a single-round retrospective survey because of the need to maintain a well-trained staff during the whole period of the fieldwork. On the administrative side, a number of surveys taken in various countries have proved that such exercises are difficult to keep at high standards of quality, as commitment of the interviewers, enthusiasm and supervision are inevitably lowered with the passing of time.

To these factors, one has to add that the results of these approaches have been unsatisfactory. For example, the follow-up sample should be particularly helpful in the enumeration of deaths. However, deaths, especially those occurring to heads of households, often lead to the dissolution of the households and make it difficult to locate individuals in the sample household in subsequent rounds. The median completeness for recording of deaths in the 13

follow-up surveys conducted in Asian countries was 72 percent, and the range was 50 to 89 percent. The median completeness for births was 83 percent, and range was 66 to 92 percent.

The dual-records system

To obtain further refinements in the measure of current fertility and mortality, the dual-records system was devised. In this system, data on vital events are obtained in a defined area by two independent data collection methods, a periodic household survey and a separate reporting method. The reporting subsystem compiles a vital event record on a current basis by some form of continuous recording for each birth and death occurring in the sample households. This may involve regular visits to the household or it may rely on a network of informers, with a recorder verifying the occurrence of events.

The baseline household interview survey is very much like the initial visit in a multi-round survey which identifies all members of a household and records their personal characteristics. Subsequent surveys record changes in the population composition that took place in the household since the last visit. After each household interview survey, births and deaths observed independently in the two subsystems are matched to ascertain the events reported by both data collection methods, those reported by the special recording subsystem only, and those identified in the household survey only. The Chandrasekaran-Deming formula is used to estimate vital events missed by both subsystems, thus permitting an estimate of total events and providing an internal check on the completeness of reporting by the individual systems.

In the dual-records system, every event recorded by either of the subsystems is counted as an event. Therefore, it is crucial that the matching of records from the two subsystems be of high quality so that unmatched out-of-scope events can be deleted after a thorough field check. This is a problem in developing countries, where matching is likely to be done manually, as manual matching is a difficult and laborious process even if identifying information in the two sets of records is fairly clear. In some countries, the primary match cannot be done by name of the child because babies are not given a name until they are past the newborn stage. In some countries, nicknames are used freely, and the name used may vary depending on the occasion. In addition to the various cultural factors that complicate matching, the process itself is not easy to carry out because there are no clear criteria to determine what is a match. In general, if the matching criteria are too rigid, an overcount will result. If the matching criteria are too loose, vital events will be underestimated. Adding to the cost of the matching procedure are the necessary field checks of the unmatched records. Unless the facts are verified, the counts may be inflated by the inclusion of events that are out of scope in terms of time and defined population.

Experiments with the dual-records system have been conducted in Pakistan, India, Thailand, Turkey, Liberia, Colombia, Morocco, the Philippines and Kenya. The studies have been well documented. The Indian Sample Registration Scheme, which is basically a dual-records system, has been operating on a continuous basis for more than 20 years.

This is a good data collection approach to estimate demographic parameters at the subnational level by the direct method, that is, without relying upon indirect techniques for estimation. But cost and matching problems are factors that have to be carefully considered.

Indirect Techniques for Estimating Vital Rates

The deficiencies of direct estimation techniques, especially the single-round survey, and the attendant cost of the surveys, led to the development of indirect techniques of demographic estimation. These methods are based on mathematical models and use data from surveys and

censuses on demographic variables obtained retrospectively in answer to questions, such as lifetime fertility, widowhood, orphanhood, survival of the first spouse and the age distribution of the population, to generate various kinds of fertility and mortality estimates.

The United Nations has published a manual on indirect techniques of demographic estimation.[3] It is the most complete compilation to date[4] of methods suitable for the analysis of incomplete or defective demographic data. It includes the basic hypotheses underlying the available methods, presents examples of how to apply the techniques and provides some guidance on the interpretation of the results.

The major advantage of indirect methods of estimation is the relative ease with which fertility and mortality estimates can be made once the required demographic data are available. Questions on children ever born alive, children still living, current births and infant deaths among current births are frequently included in censuses and surveys, but questions on orphanhood and widowhood are specific for estimating adult survival probabilities and less likely to be readily available. Conducting a field survey to obtain needed data to estimate mortality by indirect methods adds considerably to the cost of the estimation. Consideration must be given to the usefulness of the estimates to justify the cost.

Indirect methods have been successfully applied to data for countries with a well- developed civil registration system. However, this does not mean they will work in countries with poor survey or census data. The methods have also been tested in countries where demographic surveys had been taken, and comparisons with survey results were judged to be reasonably good. Without calibration of the survey results, it is difficult to evaluate the precision of indirect estimation techniques. For measures which do not have a specific time reference, it is not possible to expect more than a qualitative assessment.

Conclusion

Minimum national requirements for fertility and mortality statistics include crude birth and death rates and age-specific fertility and mortality rates for the country as a whole and for the major geographic subdivisions on a continuous basis. Local area data on causes of death, and seasonal data, particularly of deaths, are highly desirable for public health purposes. The importance of the availability of data on a continuous basis should be emphasized. Annual data are needed for monitoring changes in birth and death rates. Also, for major subdivisions of the country and cities with relatively small frequencies of events, it is necessary to group data for a number of years for analytical purposes.

All the estimation methods now available are capable of producing birth and death rates by age and sex for the country as a whole with varying degrees of precision. Indirect methods utilizing demographic data from the population census can also make vital data available at the subnational level. However, sample survey data usually do not go below the national level without considerable increase in cost of data collection.

Accuracy is an important consideration depending on how the estimates are to be used. Unfortunately, the lack of suitable standards in developing countries makes calibration of the

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[3]United Nations, Manual X, *Indirect Techniques for Demographic Estimation*, United Nations Publication Sales No. E.83,XIII.2, 1983.

[4]Editor's note: More recently, the U.S. Bureau of the Census, together with the U.S. Agency for International Development and the United Nations Population Fund, has published the comprehensive, two-volume manual, *Population Analysis With Microcomputers*, by Eduardo E. Arriaga, 1994. It includes a thorough presentation of individual techniques as well as a diskette and a set of computer spreadsheets for conducting the analysis.

various methods of estimation difficult. Nonsampling problems in the collection of demographic data are almost greater than sampling errors, and they are difficult to assess. Indirect estimation methods pose the further problem of determining the error arising from failure of the basic assumptions underlying the models to fit the actual demographic situation.

To be useful for evaluation purposes, the various measures of fertility and mortality must be sensitive to changes. Otherwise, it is not possible to measure the effectiveness of family planning activities or of public health programs. Current estimates from surveys can reflect annual changes in fertility and mortality, but estimates from indirect methods are averages centered on a period in some distant past and cannot be used for evaluation purposes. However, countries without any information on fertility and mortality levels may find the approximation from indirect methods useful.

No single source or approach adequately serves the need for vital statistics for a variety of uses. Indirect estimates are important complements of vital data but they are not substitutes for them. Each data source and technique, direct and indirect, may be fully exploited by individual countries taking into account the specific national circumstances and demographic situation. It is increasingly common practice to complement the results of one approach of estimating vital rates with those of others with a view to confidently establishing, within a reasonable range, the vital rates of a country and its subdivisions. The prime source still is, and will continue to be, a sound civil registration and vital statistics system. Its steady improvement over the coming years should not be lost sight of amidst efforts in the short term to fill the serious data gap with approximate estimates concerning fertility, mortality and related factors of population change.