Technical Papers

Number 37
September 1989

APPROACHES TO DATA COLLECTION ON FERTILITY AND MORTALITY FOR THE ESTIMATION OF VITAL RATES

International Institute for Vital Registration and Statistics
9650 Rockville Pike
Bethesda, Maryland 20814
U.S.A.

TABLE OF CONTENTS

* * * * * * *

FOREWORD

In recent decades, demographers and statisticians have attempted to meet some of the need for birth and death rates for countries lacking adequate vital registration systems by developing various alternate estimation methods, both direct and indirect. This paper describes how the data required for application of such methods are collected in population censuses and sample surveys. Reference is also made to indirect estimation methods.

Problems of data quality limit the usefulness of much of the data collected. Nevertheless, the birth and death rate estimates derived from nonregistration sources will continue to contribute data needed for a number of important purposes, particularly at the national level. For programs needing data below the national level and data on an annual or more frequent basis, there appears to be no substitute for an adequate vital registration system.

Although this paper was prepared for presentation at a meeting held some years ago, the qualifications and limitations of birth and death rates estimated by these methods still apply. The users of such data need to be aware of these problems.

There are no restrictions on the use of materials published by IIVRS. Materials from this publication may be quoted or duplicated without permission.

APPROACHES TO DATA COLLECTION ON FERTILITY AND MORTALITY FOR THE ESTIMATION OF VITAL RATES

Prepared by the United Nations Statistical Office
for presentation at
Asian Seminar on Civil Registration and Vital Statistics
Economic and Social Commission for Asia and the Pacific
10-16 December 1985
Bangkok, Thailand

INTRODUCTION

Most of the civil registration systems, except for developed countries, are still far from yielding the complete and accurate data required for the direct estimation of basic demographic measures. In fact, births and deaths are still recorded very incompletely in the majority of the developing countries. While the lack of reliable series of birth and deaths from the civil registration system was apparent in the last four decades, the demand for estimates of fertility and mortality has grown over the same period for a number of uses. To fulfill these needs, two other methods of data collection, i.e., the population census and the sample surveys, have greatly contributed by providing the data required for the estimation of the vital rates: crude birth and death rates, general and total fertility rates, gross and net reproduction rates, life expectancy. This approach has brought to light much interesting information on levels, patterns, and trends in fertility and mortality.

This paper intends, first, to give an overview of the various approaches available to collect fertility and mortality data in censuses and sample surveys to supplement the defective data from the civil registration system. The particular case on how those approaches have evolved in population censuses[1] is illustrated in the light of recent research conducted by the United Nations Statistical Office on 320 censuses undertaken between 1965 and 1984 for which country files on census materials have been maintained[2]. The approaches made in sample surveys to obtain data on fertility and mortality are briefly discussed by type of survey, whether a single-round retrospective survey, a multi-round survey or a dual-records system.[3] The potential of each method to overcome some of the most serious errors and biases, and their potential to obtain reliable data down at least to the major subdivisions of the country are also discussed. Next, the limitations of the data from these methods are brought out in the light of past experiences around the world. Second, this paper broadly refers to the indirect techniques for demographic estimation, as a detailed description is provided in various United Nations publications.[4]

The immediate potential offered by the various indirect estimation techniques makes them attractive alternatives in generating measures of fertility and mortality if data from censuses and surveys are available. But the application of these techniques depends much on the purposes to be served by the various estimates and the limitations of the different methods in satisfying those purposes. The underlying assumptions supporting those techniques must be carefully considered before selecting any particular technique. Once the technique has been selected, the parameters derived need to be evaluated by internal and external comparison, for which all data sources available should be used.[5]

APPROACHES IN POPULATION CENSUSES TO COLLECT DATA ON FERTILITY AND MORTALITY: 1965-1984

The population census was originally seen as providing only data on the population at risk, i.e., the denominator needed to estimate the birth and death rates, the age-sex specific fertility and mortality rates, to complement the data from the civil registration system. The rates so obtained in a sizeable number of developing countries were too low to be accepted as true values. Therefore, other questions were devised to gather information on fertility and mortality in the population censuses or sample surveys. The various approaches used in population censuses to collect data on fertility and mortality are illustrated in this section. As proper wording of the questions are relevant to the completeness and quality of the data collection, some examples are provided.

Current births and deaths

Attempts have been made in population censuses to collect information on live births and deaths in the 12 months preceding the interview (or any other fixed period, such as, 24 months and so on). 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.

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, as shown in tables 1 and 2 (Appendix). Thirty-four out of 160 censuses during the 1970 census decade (1965-1974), and fifty-five out of 160 censuses during the 1980 census decade (1975-1984) 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 about the number of children born alive in his household in the past 12 months. A second approach, believed to perform better than the former, asked each woman of childbearing age of any civil status, "how many children have you had in the past twelve 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, deaths among members of the household in the past year were collected in 10 censuses in the 1970s and in 29 censuses in the 1980s. Sex and age of the deceased were collected in 6 censuses in the 1970s and in 17 censuses in the 1980s. These were mainly censuses in Africa and Asia (see table 2).

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 last year? (addressed to women in their childbearing period)

The relatively small number of censuses that included these retrospective questions is by no means surprising. Countries have been aware of the poor quality of the data generated through these approaches. In fact, the analysis of the data in many countries have not produced useful results. Those approaches are regarded as the weakest of all the approaches in census questionnaires[6]. The poor performance of these questions is attributable to the recall lapse, misconception of the reference period, misreporting of ages, if applicable, inclusion of foetal 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[7].

Children ever born and children still living

Questions asked of women on children ever born and still living, and those dead at the time of the census also have a long tradition in population censuses. The approaches of the countries in the last 20 years to obtain the number of children ever born were either made by the straightforward question "how many children have you ever borne alive?" (108 censuses in the 1970s and in 102 censuses in the 1980s) or by a derived information from two independent questions:

"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 censuses in the 1980s have used this latter approach. The reason to split children ever born in these two categories was initially to minimize omissions of children who died shortly after birth. Early in the 1960s, information on children dying (or surviving) were viewed as sources to estimate mortality in infancy and childhood.[8]

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 to 10. Furthermore, as in some societies questions on children ever born and surviving become a sensitive issue for single women, a sizeable number of countries have restricted these items to ever-married women or currently-married women. This was the case of 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 could 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, children ever born collected through this approach were clearly omitted, especially by the oldest cohorts of women, i.e., 35 years and above. It was argued that women might underreport their children who have left home and are living elsewhere and those who died in early infancy. Therefore, new 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 have approached the problem in the above way, although, they are more suitable for a survey as they are more lengthy and time consuming (see table 1).

Date of the most recent birth born alive

At the same time that improvements in techniques to collect data on living and dead children were made, another strategy was sought to collect data on recent fertility and mortality[9]. It was proposed to collect the date of the most recent child born alive and whether or not this child was alive at the time of the census inquiry. 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 the misconception of the reference period. The follow-up question of the last birth was intended for improving the counts on infant deaths. Twenty-seven censuses in the 1970s and 32 censuses in the 1980s have approached data collection on current fertility through this question.

The earliest censuses to include these questions were those of Zambia (1969) and the Solomon Islands (1970). Survival of the last child born alive was included only in 14 censuses in the 1970s and in 23 censuses in the 1980s. The 1981 census of New Zealand made a somewhat different approach. It inquired about the "number of years since last child was born".

To improve studies on sex differential in infant mortality, sex of the most recent death among the most recent live born have been collected only in 2 censuses in the 1970s and in 2 censuses in the 1980s.

Aside from these approaches, 5 censuses in the 1970s and 13 censuses in the 1980 decade have included a straightforward question to collect information on infant deaths with reference to a retrospective fixed period, generally one year. Sex among the infant deceased was investigated in Rwanda (1978), Burundi (1979), Comoros (1980), Djibuti (1983) and Zaire (1984). This approach obviously has all the limitations described for deaths of all ages in the previous 12 months.

The censuses of Zambia (1973,1983), Mauritius (1972,1983) and the Sudan(1973) took a quite different approach. They have inquired about date of birth of each child born alive, and whether or not alive at the time of the census, i.e., a maternity history. This is an unusual approach in a population census, as it is a more refined technique and more suitable for sample surveys due to the lengthy interviews they require and added complexities in the coding, editing and tabulation stages.

Undoubtly, inquiring about the date of the last birth and whether or not that birth was alive at the time of the census have performed much better than the traditional straightforward questions on children ever born in the past year and how many were dead among them. They, in fact, have reduced the problem of misconception of the reference period and therefore the infant mortality estimates and current age-specific fertility rates have been improved. However, they did not overcome all the existent problems of information derived from retrospective questions. There are a number of analytical techniques for the assessment and correction of basic data.

Data on orphanhood

Developments on 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[10]. 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. Both data on orphanhood of mother and father were collected in 10 censuses of the 1970s and in 13 censuses of the 1980s. Maternal orphanhood only was collected in 5 censuses of the 1970s and in 15 censuses of the 1980s. The earliest attempts are found in the censuses of Kenya and Uganda (1969), Cuba (1970) and Portugal (1970).

A question intended for overcoming duplications of parents that were commonly reported by siblings was then proposed: "Are you the oldest surviving child of your mother/father?" Thus, tabulations on orphanhood from mother/father will be restricted to the eldest surviving children. These questions were included in the 1974 census of Bangladesh, and in the 1978 censuses of the United Republic of Tanzania and Kirabati. Unfortunately, further analysis of these data in different countries of the world, have 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, misreporting of the respondents age.

Data on widowhood

Questions about the survival of the first spouse were suggested to improve estimations of adult male and female mortality[11]. The earliest attempts in population censuses are found in Bangladesh (1974), Fiji (1976) and more recently in the United Republic of Tanzania (1978), the United States of America (in a retrospective survey of fertility and mortality tied to the 1980 population census) and in Mauritius (1983). The universe from which these data were 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 more likely that respondents might have given information from their present and not from their first spouse. Another source of error arose in those countries having a sizeable proportion of their population living in consensual unions. It is assumed that these people might have been confused on what should be considered a former marriage.

Other relevant data from population censuses for the measurement of fertility and mortality

The population census collects other data for the 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, allows 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 the group of countries with defective registration data, some of the same variables can be extremely 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. It is believed that date of marriage is much more easily recalled than age (or date of birth), because marriage is a very 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 the 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 of the 1970s and in 55 censuses of the 1980s.

Other data relevant to fertility estimation are mother's age at the time of her first live born child. Thirty censuses in the 1970s and 23 censuses 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 these data to identify the natural mother, when possible, of each child enumerated in the correspondent census questionnaire, then fertility histories are reconstructed and from them aggregate fertility and age structure of fertility can be estimated provided that age misreporting is not severe.[12]

Advantages and disadvantages of census data for fertility and mortality estimation

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

The general limitations of the 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 larger 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 is a factor that leads to mis-statements of age, under-reporting of births and deaths, misdating of births and deaths, among others. Even though errors in the data were minimized, a population census can never provide, as does the civil registration and vital statistics system, data for estimation of current fertility and mortality. Such limitation stems from the fact that detailed census data are generally not available until at least 2 or 3 years after the field work has ended. A further shortcoming is that a census can collect very little information about each vital event thus limiting the in-depth study of differentials. The most common errors found in population censuses relating to data on fertility may be listed as follows[13]:

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

In addition to the question of complete counts, there are problems of misstatements in reconstructing personal histories of individuals. In many developing countries there are people who do not know their age, and age is not of particular significance to them. In the absence of some specific reference points for the reckoning of age, it may not be possible to obtain even a reasonably accurate statement of age. This poses a special problem in estimating fertility as well as mortality from census questions. Therefore, the conditions and cultural factors of the population being studied have also important effects on the data collection process.

The failure to enumerate vital events is due to a number of other reasons. In some societies, there are deliberate efforts to conceal the fact of birth or death for superstitious reasons. There are also memory lapses 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, there are difficulties in the accurate dating of events which results in the underreporting or overreporting of the number of events during the reference period.

If age structure is distorted, all specific fertility and mortality rates and derived indicators would be affected. Even though there are a number of methods for smoothing the age distribution, they are mostly suited for closed population, thus, making very difficult the adjustment of age-sex structure at the subnational levels. Otherwise, net internal migration should be known.

Finally, as a census is a very costly operation and requires long advance planning, it is taken only periodically at about ten-year intermals. Therefore, population estimates and projections are essential in 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 the population growth and to evaluate a number of programmes. Household sample surveys provide an important vehicle for the collection of the fertility and mortality data offering even more flexibility to combine different techniques for data collection on fertility and mortality.

FERTILITY AND MORTALITY DATA FROM SAMPLE SURVEYS

The developments in sampling theory and household survey techniques in the last three decades have led to the growing use of sample survey 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 the beginning, these surveys approached the problem in a similar way that population censuses did, i.e., through retrospective questions. In the period of 1960-1980, 81 developing countries have conducted at least one major survey: 33 countries 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 Programme[14]. Follow-up sample surveys (named also a prospective survey, a multi-round survey, the household change technique) were undertaken by a number of countries to assess their current levels and patterns of fertility and mortality and the population growth. A more complex approach of data collection, the dual-records system, that combines a multi-round survey with a continuous recording of events in the sample areas have gained considerable popularity mainly in Asian countries.

The various approaches devised to collect births and deaths and other relevant data for the estimation of basic demographic measures through various types of sample surveys are broadly discussed in this section.

Approaches to collect data on fertility and mortality in single-round retrospective surveys

Countries have conducted two types of single-round retrospective surveys. One type used a short questionnaire similar to the census type. The other has combined a short household questionnaire with a more extended individual questionnaire. The latter was intended for a subsample of the population only. In both types of questionnaires, the households in the sample were interviewed once.

Most of the single-round retrospective surveys using a short questionnaire have included questions to obtain the number of children ever born, the surviving children up to the interview, the date of the most recent birth and whether or not 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 survivial of the first spouse. Another similarity to censuses is that the information is obtained from a responsible adult member of the household. The main difference stems from the fact that a survey is in a better position than a census to gather quality data. This is so because it covers a small part of the population and, thus, the interviewers are less numerous compared to those required for a population census. This allows for better training of the staff and a closer supervision of the field work. Similarly, all the subsequent stages up to the dissemination of the data can be controlled.

A retrospective survey of this type is also more suitable than a census to phrase the questions in the most desirable way. This is the case, for example, on 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 asked on lifetime fertility 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. They have resulted in overcounts as well as undercounts of the number of children ever born alive, particularly due to errors of memory lapse. The estimated median percentage of birth coverage in 7 Asian population growth estimation studies involving single round surveys was 67 percent and range was 28 to 96 percent when compared with estimates from the dual-records system. The median average for deaths was 51 percent and range was 23 to 90 percent.[15]

The undercount of infants and young children mentioned in the case of the census is generally not any different in retrospective surveys of this type either. High quality of data are difficult to obtain especially when large numbers of individuals are sampled. Even if highly skilled personnel were used and the training and organization of the field work staff were adequate, still social conditions of the population can distort simple facts as age, historical data regarding births and deaths, and so on. The experience with retrospective surveys of this kind in obtaining complete counts of vital events 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. Still further, it has been suggested that the value of this type of survey could be greatly enhanced if they were repeated at regular intervals. Such repetition does not imply re-interviewing the same households, but the successive samples should all be representative either of the country as a whole or of the same subdivisions within it.[16]

The main advantages of the single-round approach can be found in cost effectiveness and timeliness. Thus, survey data could be available in about two years including the length of advance planning, pretest, fieldwork, data processing and dissemination of the data compared to the longer periods for a population census, a multi-round survey or a dual-records system.

The other type of single-round retrospective survey, using extended questionnaires, have proved to be even more flexible than the regular one. Examples of these surveys are those of the World Fertility Survey Programme. A maternity history (or a pregnancy history) is included for this purpose and completed for each ever-married woman or other well-defined subuniverse. This approach overcomes the lack of information about timing in estimates of fertility and mortality derived from lifetime fertility, thus avoiding the reliance on theoretic 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 dates and sex for every child born alive for each ever-married woman and, if applicable, the date (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 numerators and denominators of the 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 including a maternity history, a wider range of social, economic and other variables have been included, namely, a marriage history, attitudes towards size and family planning, knowledge and practice of contraceptive methods, level of education, occupation, religion, and so on. They have proved very useful in identifying those factors that can explain changes in fertility and mortality. Furthermore, a shorter household questionnaire with retrospective questions on fertility and mortality, when coupled with the more extended one, gave the opportunity for mutual evaluation and plausibility of the parameters they yielded.

It is worth noting that the interviewers for this type of approach need to be more skilled and better trained than those for censuses and regular retrospective surveys, and preferably women. The fieldwork requires closer supervision. Furthermore, the respondent must be the woman herself and not a proxy respondent, due to the large amount of historical data that have to be provided.

Experience gathered from analyzing these data have shown, however, that maternity histories are subject to several sources of error arising from date and age misstatements and underreporting of children.[17] Systematic errors persisted even when a detailed questionnaire has been 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 Programme revealed that the time per interview (to ever-married women only) ranged from 25 minutes in Thailand to 57 minutes in Bangladesh,[18] thus increasing significantly the cost of the survey. Furthermore, the complexity of data collected for every woman called for very skilled personnel at the data processing stage.

The follow-up (multi-round) survey approach to collect current data on fertility and mortality

A prospective survey was devised to collect data on fertility and mortality, thus memory lapse and misconception of the reference period would be minimized. It uses the household change technique due to live births, deaths, and in-out migration. For these purposes, clusters of households are interviewed repeatedly within a certain period of time. Based on various countries' experiences, three or more rounds were 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 the 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 be sure that a death is not omitted in order to minimize the well-known problem of omissions of deaths in this kind of survey.

To improve the reports on infant deaths, a question on whether or not the interviewed woman (in childbearing age) is pregnant at the time of each interview is sometimes recorded. Thus, in the subsequent rounds, the outcome of those pregnancies can be obtained and infant deaths registered.

A perfect consistency of numerators and denominators can be secured with this approach 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 on fertility and mortality can be directly calculated 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 finally, the effect of in-out migration is controlled for every sampled subdivision within the country.

Furthermore, the fact that the survey comprises various rounds 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.[19]

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

Among the disadvantages is the need for a large sample in order to secure a sufficient number of births and deaths as they have low frequency in the population, especially when differentials are to be studied. Other drawbacks of this method are those concerned with timing, cost and administration. The fieldwork itself is never less than two years, to which length of the advance planning and length of data processing must be added. The cost is larger compared to that of a single-round retrospective survey, because the need to maintain the 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 excercises 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.[20]

To these factors, one has to add that the results from these approaches have also 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 present problems of locating individuals in the sample household in subsequent rounds. The median completeness for deaths in the 13 follow-up surveys conducted in Asian countries was 72 percent and range was between 50 and 89 percent. The median completeness for births was 83 percent and range was between 66 and 92 percent.[21]

Dual-records system approach

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 is one whereby a vital event record is compiled on a current basis for each birth and death occurring in the sample households by some form of continuous vital event recording. This may involve regular visits to the household or it may rely on a network of informers, and the recorder verifies the occurrence of the events.

The baseline household interview survey is very much like the initial visit in the multi-round surveys where all the members of the household are identified and the personal particulars recorded. In the subsequent surveys, the changes in the population composition of the households that took place since the last visit are recorded. After each household interview survey, the births and deaths observed independently in the two subsystems are matched to ascertain the events reported by both data collection methods, the events reported by the special recording subsystem only, and the events identified in the household survey only. An estimate of the vital events missed by both subsystems is made using the Chandrasekaran-Deming formula, which permits an estimate of total events. This provides an internal check on the completeness of reporting by the individual system.

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 the unmatched out-of-scope events can be deleted after a thorough field check. This will be a problem in the developing countries where manual matching is more likely to be used. Manual matching is a difficult and laborious process even if the identifying information on the two sets of records is fairly clear. In some countries, the primary match cannot be by name of the child because babies are not given a name until they are past the new born 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 lose, there will be an underestimate of the vital events.

Adding to the cost of the matching procedure is the necessary field checks of the unmatched records. Unless the facts are verified, it is possible that the counts will 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. These studies have been well documented.[22] The Indian Sample Registration Scheme, which is basically a dual-records system, has been operating on a continuous basis for more than twenty years.

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

INDIRECT TECHNIQUES FOR ESTIMATION OF 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 utilize 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 different kinds of fertility and mortality estimates.

A manual on indirect techniques of demographic estimation has been published by the United Nations.[23] This manual is the most complete compilation to date of methods suitable for the analysis of incomplete or defective demographic data. It includes the basic hypothesis underlying the available methods, examples of how to apply the techniques, and provide some guidance on the interpretation of the results.

The major advantage of the indirect methods of estimation is the relative ease with which fertility and mortality estimations can be made once the required demographic data are available. Questions on children ever born alive, children still living, current births, infant deaths among current births are frequently included in censuses and surveys, but those on orphanhood and widowhood are questions 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 the indirect methods adds considerably to the cost of the estimation. Consideration needs to be given to the usefulness of the estimates to justify the cost.

The indirect method has been applied to data for countries with a well developed civil registration system with success.[24] This, however, does not mean that the method will work in countries with poor survey or census data. The methods have also been tested in countries where demographic surveys had been made, and the comparisons with the survey results judged to be reasonably good. Without calibration of the survey results, it is difficult to evaluate the precision of the indirect estimation techniques. For measures which do not have a specific time reference, it is not possible to expect more than a qualitative assessment.

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 for subnational levels. However, sample survey data will not usually go below the national level without considerable increase in cost of data collection.

The accuracy of estimates is an important consideration depending on how the estimates are to be used. Unfortunately, the lack of suitable standards in the developing countries makes calibration of the various methods of estimation difficult. Non-sampling problems in the collection of demographic data are almost greater than the sampling errors, and they are difficult to assess. The indirect estimation methods pose a further problem in determining the error arising from the 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 will not be possible to measure the effectiveness of family planning activities or of public health programmes. Current estimates from surveys can reflect annual changes in fertility and mortality, but estimates from indirect methods are averages centered on a period some distant past and cannot be used for evaluation purposes. However, countries without any information of the fertility and mortality levels may find the approximation from the indirect methods useful.

CONCLUSION

The national requirements for fertility and mortality statistics include, as a minimum, crude birth and death rates, age-specific fertility and mortality rates for the country as a whole and for the major geographical 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 will be necessary to group data for a number of years for analytical purposes.

In conclusion, there exists no single source or approach that adequately serve 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. Depending on the nature of use, 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 emerging, as a common practice, to complement the results of one approach of estimating vital rates with those of others with a view to confidently establish, within a reasonable range, the vital rates of a country and its subdivisions. The prime source still is, and will be, a sound civil registration and vital statistics system and, therefore, 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.

APPENDIX

TABLE 1. TYPES OF DATA ON FERTILITY COLLECTED IN POPULATION CENSUSES BY CONTINENT: 1965 - 1984

Type of census questions on fertility	TOTAL		AFRICA		AMERICA,N.		AMERICA,S.		ASIA		EUROPE-USSR		OCEANIA	
	1965 1974	1975 1984	1965 1974	1975 1984	1965 1974	1975 1984	1965 1974	1975 1984	1965 1974	1975 1984	1965 1974	1975 1984	1965 1974	1975 1984
Total number of censuses collecting data on fertility	127	129	21	36	30	23	11	10	22	28	25	17	19	15
1. Number of children ever born alive	123	125	20	33	30	23	10	10	20	27	25	17	18	15
1.1 Number of children ever born alive only	108	102	11	17	30	23	10	8	17	25	24	17	16	12
1.2 Number of children ever born alive from:	15	23	9	16				2	3	2	1		2	3
a. Number of children still living														
b. Number of children dead														
2. Number of children living	72	86	18	29	7	9	7	9	19	22	7	4	14	13
2.1 Number of children still living only	55	58	9	12	6	7	5	6	16	18	6	4	13	11
2.2 Number of children still living from:	17	28	9	17	1	2	2	3	3	4	1		1	2
a. Children living at the household														
b. Children living elsewhere														
3. Number of recent births	63	91	17	35	22	17	6	10	7	16	6	4	5	9
3.1 Number of children born alive within the 12 months preceding the census	34	55	8	20	29	12	3	5	3	14			1	4
3.2 Children born alive within other fixed period	2	4	1	3	1					1				
3.3 Date of the most recent birth	27	32	8	12	2	5	3	5	4	1	6	4	4	5

Source: United Nations Statistical Office, unpublished data from the country files pertaining to population and housing censuses

TABLE 2. TYPES OF DATA ON MORTALITY COLLECTED IN POPULATION CENSUSES
BY CONTINENT: 1965 - 1984

Type of census questions on mortality*	TOTAL 1965 1974	TOTAL 1975 1984	AFRICA 1965 1974	AFRICA 1975 1984	AMERICA,N. 1965 1974	AMERICA,N. 1975 1984	AMERICA,S. 1965 1974	AMERICA,S. 1975 1984	ASIA 1965 1974	ASIA 1975 1984	EUROPE-USSR 1965 1974	EUROPE-USSR 1975 1984	OCEANIA 1965 1974	OCEANIA 1975 1984
Total number of censuses collecting data on mortality	49	81	30	47	6	6	3	4	5	11	2	2	3	11
1. All deaths in the household within some period preceding the census date	10	29	4	20	2	1	1	1	3	6				1
1.1 In the past 12 mos.	8	29	4	20	2	1	1	1	1	6				1
1.2 In other fixed period	2					2								
2. All deaths in household and specificity of data	10	29	4	20	2	1	1	1	3	6				1
2.1 Total number only	2	1	1				1							1
2.2 Total number and age at death		1		1										
2.3 Total number and sex		3		2						1				
2.4 Total number, sex and age (or age groups)	6	17	3	14	2				1	3				
2.5 Total number, sex age or date of death	2	5		2		1			2	2				
2.6 Total number, sex age (or date of birth) and date of death		2		1				1						
3. Deaths of infants	19	36	7	16	4	3	2	3	2	7	1	2	3	5
3.1 Born within specified period preceding the census date	5	13	1	8	2				1	4			1	1
3.2 Survival of the last child born alive	14	23	6	8	2	3	2	3	1	3	1	2	2	4
4. Maternal and/or paternal orphanhood	16	30	7	13	4	4	2	3	2	1	1			9
4.1 Maternal and paternal orphanhood	10	13	7	9	1				1	1	1			3
4.2 Maternal and paternal orphanhood and whether the eldest living child of mother/father	1	1							1					1
4.3 Maternal orphanhood only	5	15		3	3	4	2	3						5
4.4 Maternal orphanhood and whether the eldest living child of mother		1		1										
5. Survival of the first spouse	1	4		2		1			1					1

* Data collected in population censuses on surviving children for indirect estimation of infant and child mortality is included in Table 1.

Source: United Nations Statistical Office, unpublished data from country files on population and housing censuses

NOTES

1. As used in this document, the terms "1970s" or "1980s" refer respectively, to the 1970 census decade running from 1965 to 1974 and the 1980 census decade running from 1975 to 1984.

2. United Nations Statistical Office, "Handbook of Population and Housing Census Methods (in progress, 1985); and "Principles and REcommendations for Population and Housing Censuses" (United Nations Publication, Sales, No. E.80.XVII.8).

3. Handbook of Household Surveys (Revised Edition). United Nations Publication, Series F. No. 31 (Sales No. E.83.XVII.13); and Handbook of Vital Statistics Systems and Methods, Vol. 1, chapter VIII (United Nations Publication, in progress, 1985).

4. Manual IV, "Methods of Estimating Basic Demographic Measures from Incomplete Data" ("United Nations Publication, Sales No. E.67.XIII.2); and Manual X," Indirect Techniques for Demographic Estimation" (United Nations Publication, Sales No. E.83.XIII.2).

5. Manual X, "Indirect Techniques for Demographic Estimation", op. cit.

6. John G. C. Blacker, "Experiences in the Use of Special Mortality Questions in Multi-Purpose Surveys: The Single Round Approach" (Data Bases for Mortality Measures, United Nations Publication, Sales No. E.83.XIII.3).

7. William Brass, "Methods for Estimating Fertility and Mortality from Limited and Defective Data" (Chapel Hill, N.C., University of North Carolina, Laboratories for Population Statistics, 1975).

8. William Brass and others, "The Demography of Tropical Africa" (Princeton, N.J., Princeton University Press, 1968); Jeremiah M. Sullivan, "Models for the Estimation of the Probability of Dying Between Birth and Exact Ages of Early Childhood", Population Studies, vol. 26, No. 1 (March1972) pp. 79-97; James Trussell, "A Reestimation of the Multiplying Factors for the Brass Technique for Determining Childhood Survival Rates", Population Studies, vol. 29, No. 1 (March 1975), pp. 97-108.

9. See footnote 4, Manual X, United Nations Publication, op. cit. p. 3.

10. See footnote 4, Manual X, United Nations Publication, op. cit., and William Brass and Kenneth Hill, "Estimating Adult Mortality from Orphanhood". International Population Conference, Liege, 1973, vol. 3, pp. 111-123 (Liege: International Union for the Scientific Study of Population).

11. See footnote 4, Manual X. United Nations Publication, op. cit., and also: N.H. Carrier, "The Fertility, Mortality and Nuptiality of Rungus Dusun", Population Studies, vol. 13, No. 3 (March 1960), pp. 266-277; and Kenneth Hill, "Indirect Methods of Estimating Adult Mortality Levels". Unpublished Doctoral Dissertation, University of London, 1975; and "Estimating Adult Mortality Levels from Information on Widowhood, Population Studies, vol. 31, No. 1, March 1977), pp. 75-84.

12. Lee Jay Cho, "The Own Children Approach to Fertility Estimation: an Elaboration", International Population Conference, Liege, International Union for the Scientific Study of Population, 1973), vol. 2, pp. 263-280.

13. United States of America, National Academy of Sciences, National Research Council, Panel on Data Collection, "Collecting data for the Estimation of Fertility and Mortality", Committee on Population and Demography, Report No. 6 (Washington D.C., National Academy Press 1981) pp. 220; and Handbook of Vital Statistics Systems and Methods, chap. VIII (United Nations, in progress, 1985).

14. United States of America, National Academy of Sciences, National Research Council, Panel on Data Collection, op. cit., p. 251; and Handbook of Vital Statistics Systems and Methods, vol. I, chapter VIII (United Nations Publication, in progress, 1985).

15. Marks, E.S.; Seltzer, W.; and Krotki, K.J. "Population Growth Estimation a Handbook of Vital Statistics Measurement". 1974. The Population Council, New York.

16. John G.C. Blacker, op. cit.

17. See for example, Papers of the Seminar on Birth History Analysis held in London 9-11 April 1980 (World Fertility Survey, International Union for the Scientific Study of the Population and the Centre for Population Studies of the London School of Hygiene and Tropical Medicine); and also: William Brass, "Birth History Analysis", World Fertility Survey Conference, Record of Proceedings, London 7-11 1980 (Voorburg, The Hague, International Statistical Institute, 1981) vol. 3, pp. 143-169; and Kenneth H. Hill, "Methods for Estimating Fertility and Mortality Trends Using World Fertility Survey and Other Data", World Fertility Survey Conference, REcord of Proceedings,

London, 7-11 July 1980 (Voorburg, the Hague, International Statistical Institute, 1981) vol. 3, pp. 455-508.

18. Chris Scott and Susheela Singh, "Problems of Data Collection in the World Fertility Survey", World Fertility Survey Conference, op. cit., pp. 17-76.

19. See for example Reports 1 to 8 of the National Demographic Survey of Peru 2974-2976 (National Statistical Institute, General Directorate of Demography, Lima, Peru 1978).

20. United Nations Secretariat, "Approaches to the Collection of Mortality Data in the Context of Data Needs" (in Data Bases for Mortality Measures, United Nations Publications, sales No. E.83, XIII.3.

21. Mark, E.S., et al. op. cit.

22. Marks, E.S., et al. op. cit., pp. 41-52; Meyers, R.J., "The Dual Record System: An Overview of Experience in Five Countries". Scientific Report Series No. 26 pp. 61. Laboratories for Population Studies, University of North Carolina, 1976; Ligner, J.W. and Wells, H.B. "Organization and Methods of the Dual REcord System of India". Scientific REport Series No. 9, pp. 33. Laboratories for Population Statistics, University of North Carolina, 1973; Chanlett, E. and Fichet, M.D., "The Dual Record System: Vital EVent Recording System". Scientific Report Series No. 27, pp. 55. Laboratories for Population Statistics, University of North Carolina, 1976; Committee on Population and Demography. Report No. 6, op. cit. p. 108.

23. United Nations Publications, op. cit.

24. The Brass estimates of mortality in the first two years of life obtained from proportions of children dying to mothers aged 20-24 were first tested empirically with data from Canada and Hungary, where they were compared with the mortality rates derived from death registration. The test showed very satisfactory agreement. More recently, J. Somoza has made similar comparisons from data for Chile and Costa Rica (referred by John Blacker in "Experiences in the Use of Special Mortality Questions in Multi-Purpose Surveys: The Single Round Approach, op. cit.)

PUBLICATIONS OF THE IIVRS TECHNICAL PAPERS

1. A Programme for Measurement of Life and Death in Ghana, D.C. Mehta and J.B. Assie, June 1979
2. Vital Statistics System of Japan, Kozo Ueda and Masasuke Omori, August 1979
3. System of Identity Numbers in the Swedish Population Register, Karl-Johan Nilsson, September 1979
4. Vital Registration and Marriage in England and Wales, Office of Population Censuses and Surveys, London, October 1979
5. Civil Registration in the Republic of Argentina, Jorge P. Seara and Marcelo E. Martin, November 1979
6. Coordinating Role of National Committees on Vital and Health Statistics, World Health Organization, Geneva, January 1980
7. Human Rights and Registration of Vital Events, Nora P. Powell, March 1980
8. The Organization of the Civil Registration System of the United States, Anders S. Lunde, May 1980
9. Organization of Civil Registration and Vital Statistics System in India, P. Padmanabha, July 1980
10. Registration of Vital Events in Iraq, Adnan S. Al-Rabie, September 1980
11. Generation of Vital Statistics in México, General Bureau of Statistics, México, November 1980
12. Age Estimation Committee in Qatar, Sayed A. Taj El Din, December 1980
13. The Development of the Vital Statistics System in Egypt, Gamal Askar, January 1981
14. Vital Statistics Data Collection and Compilation System: Hong Kong, Donna Shum, March 1981
15. Major Obstacles in Achieving Satisfactory Registration Practices and Vital Events and the Compilation of Reliable Vital Statistics, IIVRS, May 1981
16. Methods and Problems of Civil Registration Practices and Vital Statistics Collection in Africa, Toma J. Makannah, July 1981
17. Status of Civil Registration and Vital Statistics in El Salvador, Enrique Olmado Sosa, July 1982
18. Recommendations from Regional Conferences and Seminars on Civil Registration and Vital Statistics, IIVRS, September 1982
19. Potentials of Records and Statistics from Civil Registration Systems for Health Administration and Research, Iwao M. Moriyama, September 1982
20. Improving Civil Registration Systems in Developing Countries, Forrest E. Linder, October 1982
21. Social Indicators Derived from Vital Statistics, Nora P. Powell, November 1982
22. The Operation of the Vital Statistics System of the United States of America, Anders S. Lunde, April 1983
23. Demographic Information from Vital Registration Offices in Mexico, 1982, Juan Carlos Padilla, José García Nuñez and Jaime Luis Padilla, June 1983
24. General Description of Population Registration in Finland, Hannu Tulkki, July 1983
25. The National Importance of Civil Registration and the Urgency of Its Adaptation to a Modern Society, Committee on Legal and Organizational Requirements for a Civil Registration System in Latin America, August 1983
26. Study of A Civil Registration System of Births and Deaths—An Experiment in Afghanistan, B.L. Bhan, October 1983
27. Actions for the Improvement of Civil Registration and Vital Statistics, IIVRS, December 1983
28. Urgently Needed Reforms in Civil Registration in Asian Countries, IIVRS, October 1986
29. Organization and Status of Civil Registration and Vital Statistics in Various Countries of the World, IIVRS, December 1986
30. The Status of Civil Registration and the Collection of Vital Statistics through Alternative Sources in Papua New Guinea, M.L. Bakker, July 1987
31. Organization and Status of Civil Registration in Africa and Recommendations for Improvement, IIVRS, April 1988
32. Registration of Vital Events in the English-speaking Caribbean, G. W. Roberts, June 1988
33. Organization and Status of Civil Registration and Vital Statistics in Arab Countries, IIVRS, October 1988
34. Recommendations from Regional Conferences and Seminars on Civil Registration and Vital Statistics: An Update, IIVRS, November 1988
35. Health Data Issues for Primary Health Care Delivery Systems in Developing Countries, Vito M. Ligrillo, N.Y. State Department of Health, May 1989
36. Considerations in the Organization of National Civil Registration and Vital Statistics Systems, Iwao M. Moriyama, July 1989
37. Approaches to Data Collection on Fertility and Mortality for the Estimation of Vital Rates, United Nations Statistical Office, December 1985