PROBLEMS IN DESIGNING INTERVIEW SURVEYS TO MEASURE POPULATION GROWTH*

D. G. Horvitz, Research Triangle Institute

Introduction

There is an urgent need for reasonably accurate measures of the rate of population growth in many areas of the world today. The demand is particularly great in countries where programs for economic development are hampered by rapidly growing populations. Satisfactory measures of the components of population change are easily obtained in countries which have adequate registration of births and deaths and which also conduct accurate periodic censuses. Unfortunately, the efficiency of the vital registration systems in many countries leaves much to be desired. It will take some years before the statistics generated from registration data in these latter countries can be considered sufficiently accurate for demographic analysis and planning purposes. In the interim, other procedures are necessary.

A number of alternative procedures for obtaining basic demographic measures in situations where census and registration data are lacking or defective have been reviewed by Brass (World Population Conference held in Belgrade September 1965). Of particular interest here is the measurement of birth and death rates by means of personal interviews in a sample of households.

In recent years, periodic personal interview surveys to estimate vital rates have been conducted in a number of countries throughout the world. At last year's World Population Conference, papers reporting on experimental projects which utilize data on vital events collected by survey methods included such countries as Pakistan (Krotki), United Arab Republic (Vukovich), Morocco (Sabagh and Scott), Senegal (Cantrelle), and Thailand (Lauriat and Chintakananda). Since it is generally recognized that the accuracy of household interview data suffers from reporting errors of unknown magnitude, each of these experiments, Morocco excepted, also makes use of vital registration records. It is of more than passing interest to note here that both the Pakistan Population Growth Estimation Experiment and the Thailand Population Change project are using the method developed by Chandra Sekar and Deming in 1949[1/] for estimating birth and death rates more accurately by individual matching of registration data with household interview data.

It is apparent, however, that there is no generally accepted procedure for accurate, yet inexpensive, measurement of vital rates in countries where there is a critical lack of this information. The Research Triangle Institute (RTI) has undertaken a research project to study and develop appropriate basic procedures for the measurement of population growth by means of interview surveys. It is our purpose in this paper to discuss various problems which arise when one attempts to design an interview survey to measure birth rates, death rates and net migration for a designated population. Particular attention will be given to the nature and magnitude of non-sampling or measurement errors. Some preliminary results obtained from interviews in a sample of households located in seven counties in North Carolina, and in which births and deaths were known to have occurred, will be reported.

There are several reasons for conducting the research in the United States, not the least of which is that the means for evaluating alternative survey methods are readily at hand. In particular, there is access to birth and death registration records in a system which is highly efficient and almost complete. It is not expected that techniques found to work satisfactorily in the United States would be directly transferrable to other areas of the world. Some local studies will be necessary for adaptation of recommended methods.

Population Survey Design Problems

There are numerous problems to be faced in the design of a sample survey to measure population growth. They may be classified broadly as problems of coverage and problems of response.

A. Problems of Coverage

In ideal terms, one would like to estimate accurately (1) the size and age distribution of the population of interest at the beginning of a designated reference period, (2) the number of live births that occur in the resident population during the reference period, (3) the number of deaths by age that occur in the resident population during the reference period, (4) the net additions (or subtractions) to the populations, by age, due to migration, and (5) the size and age distribution of the population at the end of the reference period. It is sufficient to have information to estimate four of these five components, since the fifth will then be determined.

If the survey is confined to interviews in a sample of households, coverage problems are introduced. It is clear from the list of items to be estimated that the universe of interest extends beyond the population residing in households during the entire reference period (or some part of the reference period) to include the population in institutions and other group

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1/ Ansley J. Coale proposed in 1961 that the Chandra Sekar and Deming procedure by used with sample registration areas and periodic household surveys.

quarters, as well. It can be argued that excluding the non-household population from the survey universe will not particularly affect the population estimates when it constitutes but a small part of the total population. In some countries, however, it is likely that a disproportionate number of annual deaths will occur to residents of long-stay institutions. For example, in the seven county North Carolina study (referred to previously) more than 12% of the total deaths occurred in institutions.

Some individuals in institutions are considered to be members of specific households, both by themselves and by the other household members. Others are definitely not attached to any household. Thus, it is not likely that an accurate estimate of total deaths in a designated period can be achieved if the survey universe is confined to the household population. This contention is supported in part by our North Carolina study in which the households associated with a sample of 66 individuals who died in long-stay institutions were interviewed. Only 70% of these deaths were reported in the household interviews, compared to 85% of a sample of 462 adult deaths not occurring in institutions.

The accuracy of the estimate of total births occurring in a reference period may also be affected adversely if coverage is confined to the household population. It is somewhat less likely that illegitimate births will be reported in household interviews in cultures where these births are socially stigmatized. For example, only 50% of a sample of 82 white infants registered as born out-of-wedlock in North Carolina were reported in personal interviews with the mother's household (i.e. the household to which the mother belonged at the time the birth occurred). This compares with 94% reported of a sample of 257 white legitimate births. It seems advisable, therefore, to supplement the household interviews by coverage of institutions and agencies which accept infants with illegitimate birth status in cultures where this is a problem. The household interviews can then be confined to reporting of infants (born in the reference period) who are currently members of the household or who have died.

It is expected that some type of area sampling frame will be used to select the households to be interviewed in population growth surveys and that the ultimate sampling unit will consist either of all of the housing units located within the boundaries of an area segment, or some defined portion of these housing units. Since information is required for a sample of all households (persons) resident in the region covered by the survey <u>at some time</u> during the reference period, special coverage problems are created.

Ordinarily, the households in the sample would be those which occupy the housing units associated with the selected set of ultimate sampling units. If this procedure were followed, however, households which are no longer resident in the survey region (i.e. those which have migrated out of the region or have dissolved due to death or other reason since the beginning of the reference period) would have no chance to be represented in the sample. It is necessary, therefore, to list for the sample the occupied housing units, plus those that are vacant and also those that existed at sometime during the reference period, but were demolished prior to the end of the reference period.

All households that were resident at any time during the reference period in the vacant housing units or in those housing units which no longer exist must be identified, presumably by neighbors. The households in this group which did not migrate out of the region or did not dissolve, but merely moved, intact, to some other location within the survey region are dropped from further consideration, since they are associated with some other sampling unit.

Similarly, it is necessary to identify all households which were resident at some time during the reference period in the occupied housing units and to exclude from the sample those that merely moved as a household to some other housing unit in the survey region. The procedure is somewhat involved, but necessary for appropriate coverage, particularly since death is one of the principle reasons for households to dissolve.

Interviews with neighbors were conducted in the North Carolina study concerning deaths known to have occurred in households previously in residence. The proportion of adult deaths reported by the neighbors in these cases was almost exactly the same (84%) as reported by respondents who were members of households where deaths had also occurred during the reference period. The proportion of births reported by neighbors for households that had moved was somewhat less (74%) than when the household itself was interviewed (92%).

Coverage in surveys is also affected by the proportion of sample households which cannot be contacted in repeated attempts or which refuse to be interviewed. Interviews for households in these categories in the North Carolina study were completed with neighbors whenever possible. In these interviews the proportions of births and adult deaths (known to have occurred in the households of interest) reported by the neighbor respondents were higher than for neighbors reporting these events for households which had moved away.

B. <u>Problems of Response</u>

It is generally recognized that births and deaths occurring in a specified reference period will be under-reported in personal interview surveys. Sabagh and Scott report 8% under-enumeration of births and 17% under-enumeration of deaths occurring in the 12-month period prior to interview in their methodological study in Morocco. In the Thailand project, analysis of the second quarterly round of household interviews showed an estimated 16% of the registered births and 17% of the registered deaths were not reported. The U. S. Bureau of Census 1950 Infant Enumeration

Study estimated 3.6% of infants born in the United States in the first three months of 1950 were not enumerated in the Census. Excluded from the data in the Census study are infants who died before April 1, 1950, illegitimate infants identified as such from birth records, and infants born in a State which was not the usual residence of the mother.

As indicated previously, the RTI study in North Carolina was directed toward investigating the accuracy with which known births and deaths are reported by respondents in the households involved. An initial sample of 2,777 addresses was selected from birth and death registration certificates for the period August 1964 through July 1965. This sample was later supplemented by 191 births and 106 deaths occurring in August and September 1965. The field work was carried out during October and November 1965. Two types of reference periods for vital events were employed with separate questionnaires and portions of the sample. The first covered events occurring during the 12 months prior to interview and the second covered events occurring since January 1, 1965. In addition to requesting the age, sex and marital status of each current member of the household, the questionnaires contained several direct questions concerning births, deaths in general, and infant deaths during the respective reference periods.

The sample data for births known to have occurred during the reference period were analyzed first. The percentages of these events reported in the interviews were approximately the same for both questionnaire versions. The combined results for both questionnaire versions for various segments of the population are shown in Table 1 by legitimacy status of the birth. Although not directly comparable, the estimated percentages of infants enumerated in North Carolina in the 1950 Census (based on the Infant Enumeration Study) are also shown in Table 1.

Except in one group (rural non-white), the proportions of births reported in the current study are less than estimated for the 1950 Census. Since the latter estimates excluded illegitimate infants, the results are not surprising. Under-reporting is seen to be quite severe for illegitimate births, particularly for the urban white group. The completeness of reporting is slightly higher for white births compared to non-white and for rural births compared to urban births. The latter comparison was influenced by the high reporting of illegitimate births by non-white rural households.

Additional analyses indicate that under-reporting tends to increase with age of head of household, but decreases with increasing income and education of the head of household.

Table 1

Births Reported in Household Interviews as a Percentage of Actual Births by Legitimacy Status; Estimated Percent of Infants Enumerated in 1950 Census in North Carolina

Group	RTI Study *			1950 Census **
	Legitimate %	Illegitimate %	Total %	%
All births	92.7	84.8	91.6	94.5
White births	93.9	50.4	92.6	95.7
Non-white births	90.3	89.8	90.2	91.7
Urban births	91.5	65.8	88.3	95.0
Rural births	93.4	94.9	93.6	94.3
White urban births	93.6	37.3	91.7	96.2
Non-white urban births	86.1	71.9	81.9	92.1
White rural births	94.1	62.4	93.2	95.5
Non-white rural births	92.2	98.5	94.0	91.6

* Based on interviews in households selected from birth registration lists in 7 counties in North Carolina; 12 months reference period.

** U. S. Bureau of the Census Infant Enumeration Study: 1950, births in first 3 months of 1950 excluding illegitimate births, infant deaths and births in States other than usual residence of mother.

There was no indication that under-reporting increased as the interval between the interview date and the birth date of the infant increased. This is contrary to the Indian National Sample Survey which has noted that the number of births reported decreases as the time interval between month of interview and month of birth increases, a phenomenon referred to in the demography literature as "recall lapse." This could be observed, by the way, if a high proportion of the under-reporting was confined to those births which did not survive the first year of life. In this situation the decrease in reported births would hardly be detectable in countries with a low infant death rate, such as the U. S., but would be magnified in a country with a high infant death rate, such as India.

Table 2, which is based on interviews in households selected from death registration lists in 7 counties in North Carolina, shows the percentages reported of those deaths known to have occurred in the 12 months prior to interview for all deaths, infant deaths and other sub-groups of interest. Under-reporting of deaths was greater than for births. Again, there was no trend in the data by date of occurrence of the event in relation to the interview date. Under-reporting is heavier among non-white households than for white households. Only slightly more than one-half of the infant deaths were reported.

Table 2

Deaths Reported in Household Interviews as a Percentage of Actual Deaths

Group	Percent Reported
All Deaths	81.6
White urban	82.4
White rural	85.0
Non-white urban	75.0
Non-white rural	78.2
All Infant Deaths	53.4
White urban	58.3
White rural	50.0
Non-white urban	45.8
Non-white rural	55.1
All Non-Infant Deaths	84.1
White	85.1
Non-white	82.1
Urban	82.3
Rural	85.3

A greater degree of under-reporting of deaths occurred among unmarried decedents (27.0% vs. 10.4% for married decedents). In addition, decedents 65 and older were under-reported to a greater extent than those less than 65 (infant deaths excluded). Female decedents were reported to a lesser extent than male decedents, which is probably related to marital status at death and the greater likelihood of a surviving household following a male death than a female death. We have referred previously to the fact that deaths occurring in long-term institutions are less likely to be reported than other deaths.

The proportion of infant deaths reported may be related to the age of the child. For example, 46% of a sample 66 infants who lived less than one day were reported compared to 57% of 97 infants who lived at least one day. When the mother was respondent, two-thirds of the infant deaths (90 in sample) were reported, whereas only 37% were reported (67 in sample) when the respondent was a household member other than the mother of the deceased infant.

Since vital events which occurred prior to the beginning of the reference period were included in the sample, an estimate of over-reporting was obtained. In 168 interviews in households in which it was known that the birth of interest had occurred more than 12 months prior to the interview date, the respondents reported 5% of these births as occurring during the reference period. The percentage in this situation will vary, of course, depending on the proportion of the sample with birth dates near the end point of the reference period. The proportion over-reported was higher for non-white births. It was also somewhat higher for the questionnaire version which had January 1, 1965 as the beginning date of the reference period.

It seems clear from this North Carolina experience that the problem of response error in personal interview surveys designed to measure the population growth rate can be sizeable. The reporting errors in surveys conducted in other areas of the world will, in some instances, be further affected by factors other than those already noted, such as strong preferences for male offspring, superstitious fears associated with reporting the first born, and vague notions about dates and ages. The North Carolina study has indicated, to some extent, the nature and source of response errors in interview surveys designed to measure vital rates in this country. It is expected that the observed under reporting levels can be reduced through improved questionnaire construction and interviewing procedures. The possibilities in this direction remain to be developed and tested.

Tightening up the survey procedures may still be insufficient for providing the accuracy required for the estimates of population growth. In recent years, the increased concern with measurement errors in interview surveys has led to consideration of designs which permit measurement error components to be estimated from the data collected. This is merely an extension of the notion of using the observed data to assess the sampling error in probability samples.

Madow recommends the increased use of double sampling designs, with appropriate allocation of a portion of total survey funds, for reduction or elimination of response bias. We have referred previously to the procedures now in use in the

Pakistan and Thailand population growth estimation projects. These projects combine vital registration data with data collected in periodic household interviews to arrive at adjusted estimates of the birth and death components of population change. There are other examples of survey designs which permit estimation of adjustment factors for response errors in interview data. One such procedure, which is receiving increased attention for surveys of events in human populations, distributes the interviews over time with overlapping reference periods. The U.S. Health Interview Survey, conducted by the National Center for Health Statistics, uses a 12 month reference period for its weekly samples distributed over a year. This is a particularly effective procedure, since it provides the requisite information for adjustment of reported events (such as hospital admissions) for response and procedural errors associated with the elapsed time between the event of interest and the interview date. The Indian National Sample Survey, using annual samples, requests information on births and deaths which occurred in the 24 month period prior to interview, yielding a 12 month overlap for two successive surveys. Other techniques which could be incorporated into the survey design in order to achieve an increase in accuracy through data adjustment include re-interviews with sub-samples, interpenetrating samples and randomized questioning procedures. The latter permits respondent to give answers (sufficient for making unbiased estimates of the proportion in a given class) without revealing their own classification to the interviewer.

A systematic research effort is needed to determine the requisite combination of data generating procedures necessary to achieve relatively unbiased estimates in population growth studies. As in the design of any investigation, whether experimental or survey, the allocation of resources to achieve the specified accuracy should be based on considerations of the relative costs of the alternative measurement procedures and the relative magnitude of the components of error in each procedure.

REFERENCES

Brass, William. "Methods of Obtaining Basic Demographic Measures where Census and Vital Statistics Registration Systems are Lacking or Defective." Paper presented at the World Population Conference, Belgrade, 1965.

Cantrelle, Pierre. "Observation Demographique Repetee En Milieu Rural Au Senegal Methode et Premiers Resultats." Paper presented at the World Population Conference, Belgrade, 1965.

Coale, Ansley J. "The Design of an Experimental Procedure for Obtaining Accurate Vital Statistics." Proceedings of the International Population Conference, New York, 1961, 2, 372-376.

Chandra Sekar, C., and W. Edwards Deming. "On a Method of Estimating Birth and Death Rates and the Extent of Registration." Journal of the American Statistical Association, 44 (1949), 101-115.

Krotki, Karl J. "The Problem of Estimating Vital Rates in Pakistan." Paper presented at the World Population Conference, Belgrade, 1965.

Lauriat, Patience, and Anuri Chintakananda. "Technique to Measure Population Growth: Survey of Population Change in Thailand." Paper presented at the World Population Conference, Belgrade, 1965.

Madow, William G. "On Some Aspects of Response Error Measurement." Proceedings, Social Statistics Section, American Statistical Association, (1965), 182-192.

Sabagh, Georges, and Christopher Scott. "An Evaluation of the Use of Retrospective Questionnaires for Obtaining Vital Data: The Experience of the Moroccan Multi-Purpose Sample Survey of 1961-1963." Paper presented at the World Population Conference, Belgrade, 1965.

Som, Ranjan Kumar. "On Recall Lapse in Demographic Studies." Proceedings of the International Population Conference, Vienna, 1959, 50-61.

Vukovich, G. "The U.A.R. Project for Measuring Vital Rates in Rural Areas." Paper presented at the World Population Conference, Belgrade, 1965.

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