THE PREGNANCY HISTORY APPROACH TO MEASUREMENT OF FERTILITY CHANGE

by
Donald J. Bogue and Elizabeth J. Bogue
Community and Family Study Center
University of Chicago

I
The Problem of Measuring Fertility Change

All over the world there are underway massive programs to reduce high birth rates. Unhappily, as yet no adequate statistical procedure has been devised to evaluate whether these programs are succeeding or failing, and if they are succeeding by how much they are reducing the birth rate each year. The present paper proposes a system which, it is believed, begins to fill this need. Despite the fact that it also has serious limitations, it seems to yield measures which are more reliable, more valid, and capable of more detailed explanatory analysis than any other system yet proposed. It is called the "pregnancy history" approach to fertility study. The central idea is to collect complete pregnancy histories for samples of women in the subpopulations where fertility and fertility change are to be studied, to use techniques of formal demography to adjust these data for known deficiencies and biases, and to devise computer programs that convert these data into conventional demographic measures. This procedure not only is correct in terms of demographic theory, but also seems to be practicable when put to use under the conditions that exist in the developing countries where the "crash" programs for fertility reduction are especially in need of a technique to measure fertility change. This technique has still another interesting virtue: because it is a longitudinal measure, it generates exactly the data needed to pursue some of the newer and more challenging theoretical problems in fertility analysis: fecundability, pregnancy intervals, conception rates under various conditions of use of contraception, and the development of mathematical models of reproduction.

The exposition which follows:

(a) Reviews the "ideal" demographic system for measuring fertility change.
(b) Describes the pregnancy history as a substitute for vital registration.
(c) Spells out the steps for converting the pregnancy history into vital rates.
(d) Lists the biases of pregnancy history data and presents techniques for adjusting for each type of bias.
(e) Describes the procedures to be followed in measuring fertility change from pregnancy history data.
(f) Presents two examples of use of the pregnancy history approach.
(g) Makes a summary evaluation of the technique in comparison with other methods.

II
The "Ideal" System for Measuring Fertility Change

The "ideal" procedures for measuring the level of fertility in a population and short-run changes in fertility are a well established part of demographic methodology. Three sets of measures need to be calculated for two dates:

(a) Age-specific fertility rates (ASFR).
(b) Total fertility rate (TFR)--the sum of ASFR for all ages.
(c) General Fertility Rate (GFR)--ratio of births to women of childbearing age.

The absolute and relative differences in these measures between the first and the second date are universally accepted by demographers as valid measures of fertility change. Table 1 is an example of these procedures, using data for the U.S.

The ASFR, GFR and TFR are superior to the crude birth rate because they exclude the population not exposed to childbearing and maintain a rigorous control over age composition. Moreover, they have a clear and unambiguous meaning. The ASFR is the probability (number of chances in 1,000) that a

woman of a given age selected at random from a specified population will bear a child within the next year. The GFR is a similar probability for a woman of childbearing age, without respect to any particular age. In other words, it is a weighted average value of the ASFR probabilities. The TFR is a statement of the average size of completed family (at end of childbearing) that will result if a particular schedule of ASFR were to be in effect for the complete duration of a reproductive span.

In nations with reliable systems of vital registration the data needed to calculate these measures are readily available. For this reason, the nations of Europe, North America, Australia, Japan, Argentina and a few others are able to know precisely at any point in time what their fertility level is and how it is changing. However, in all but a few of the developing nations of Asia, Latin America and Africa births are so incompletely registered that the official vital statistics cannot be trusted, and the calculations of Table 1 cannot be performed. There is little hope that this situation can be remedied within the next fifteen years. There is urgent need to measure fertility change now. This leads to the question,

> "How can fertility levels, fertility changes, and fertility differences between subgroups of the population be measured in the absence of reliable vital statistics?"

III
The Pregnancy History as a Substitute for Vital Registration

A pregnancy history is a chronological record for each woman of childbearing age in a population or a sample, of each pregnancy she has experienced. In addition to the fact of the pregnancy itself, the following information is obtained for each pregnancy.

(a) Outcome of the pregnancy:
  (1) Live birth
  (2) Spontaneous abortion
  (3) Induced abortion
  (4) Stillbirth or other pregnancy loss
(b) Date at which the pregnancy terminated (month and year)
(c) Months of gestation (especially important for all pregnancy losses)
(d) Sex of live-born children
(e) Type of pregnancy (single or multiple birth)
(f) Survival of live born children--is child still living at time of survey?
(g) Age at death of deceased children: Month and year of death or estimated age at death.

A battery of interview questions and a special reporting form have been developed for obtaining these data reliably. These are reproduced in Appendix A. The interviewers are given special intensive training on this phase of the interview. They are required to probe and reprobe to help the respondent recall each and every pregnancy and the pertinent facts about it. Every interval of two or more years without a pregnancy is brought to the attention of the respondent, to try to remind her of any pregnancies that have been overlooked. When the pregnancy history is properly completed, the only unreported pregnancies are due to (a) failures of memory despite the best efforts of especially trained interviewers to assist recall and (b) willful misreporting to hide illegitimate births or induced abortions.

For purposes of analysis we accept this set of data as a substitute for vital registration. In fact, when completed the pregnancy history may be looked upon as a set of certificates for the pregnancies of a particular group of women. In this register has been included not only live births but pregnancy losses as well. By a few calculations it is possible to transform these data into bonafide birth statistics which can then be used to follow the "ideal" system of fertility measurement described above.

IV
Transformation of Pregnancy Histories into Fertility Rates

For a correct interpretation of the fertility measures that are computed from pregnancy histories, it is essential to begin with an appreciation that the data are longitudinal, and pertain retrospectively to the fertility

experience of a set of real cohorts, each of which has arrived at a particular stage in its reproductive span at the time of the pregnancy history survey. These data must be manipulated in such a way as to provide cross-sectional data that refer to particular calendar years. (This is the reverse of the cohort fertility problem as it is usually encountered.) The system developed here permits a study of fertility both in the cross-sectional (calendar year) and the longitudinal (real cohort) contexts.

Each fertility rate has two parts: a numerator and a denominator and takes the prototype form

$$N_i = \frac{B_i}{F_i} \cdot K \qquad (1)$$

where i = age of woman
N_i = fertility (natality) rate specific for age i
B_i = number of births to mothers who were age i at time of delivery
F_i = female population who were age i during the interval of time to which the rate refers
K = base of the rates, usually 1,000

The transformation of pregnancy history information into fertility rates requires three related but distinct procedures: one to obtain raw data for the numerators, one to obtain raw data for the denominators, and one to divide the former by the latter.

(a) Numerators. Each pregnancy must be simultaneously classified according to the calendar year in which it occurred and the age of the mother at time of occurrence. This is accomplished by establishing a large matrix in which each row represents one calendar year and each column represents one year of age of mother. For each pregnancy we cumulatively add "1" to the appropriate cell of this matrix according to the age of the mother and calendar year. The calendar year of occurrence is given directly by the pregnancy history. Age of mother at time of occurrence is easily derived from the relation.

$$F_i = D_B - D_F \qquad (2)$$

where F_i = age of mother at date of birth of child
D_F = year and month of birth of mother
D_B = year and month of birth of child

(b) Denominators. Inasmuch as birthdays occur more or less evenly throughout each calendar year, there is no simple way to simultaneously classify women according to age and calendar year. Demographers conventionally resolve this problem by resorting to the concept of person years, and this is used here. We establish a large matrix in which each row represents one calendar year and each column represents one year of age of mother, identical to the one set up for numerators. We then calculate the number of months each woman spends in each age in each calendar year, cumulate these monthss months for all women in the sample, divide by 12 and label the result "person years" spent in age i during calendar year z. The relationship is given by the equations:

$$P_i^z = D_z - D_F \qquad (3)$$

$$P_z^{z+1} = (12 - P_i^z) \qquad (3a)$$

where P_i = number of person-months spent in age i in calendar year z
D_z = December of calendar year z
P_i^{z+1} = number of person-months spent in age i in calendar year z+1
D_F = birthmonth of woman

The sum of P_i^z and P_i^{z+1} for any woman is always 12 months, and each of these two values can vary from 0 to 12.[2]

(c) Calculation of rates. By dividing the numerator matrix of step 1 by the denominator matrix of step 2 and multiplying by 1,000 we obtain a rates matrix in which each cell is an age-specific rate for a particular age for a particular calendar year. In other words, the operation conforms exactly to the basic prototype form of equation (1). These rates are not estimates; they are an attempt to make an actual reconstruction of the past and are identical with rates that would have been obtained by a vital registration system,

if vital registration and the pregnancy histories were equally complete and accurate. Differences between registered vital rates and pregnancy history vital rates differ only by the degree of completeness between the two and the representativeness of the sample of women for which pregnancy histories are obrained. [3]

Table 2 illustrates the rates matrix that is produced by this procedure. It is one part of the output of a computer program "Pregnancy History Analysis" written by E. J. Bogue.

The longitudinal nature of the data are readily apparent from this table; each diagonal line represents one real cohort. Since the data refer only to women currently in the childbearing years, there are no rates above the principal diagonal.

For all except the very largest samples, data for single years of age and single calendar years are too detailed for practical use. They may be abridged in two ways; (a) by combining ages into 5-year intervals and (b) by combining years into any desired grouping. With the ASFR thus produced it is a simple matter to calculate TFR. GFR is generated directly by the program. Thus, the procedure extracts from pregnancy histories the three basic measures needed for the "ideal" demographic procedure for measuring fertility.

In most developing countries it is possible to collect by direct interview from representative samples of women pregnancy history data that are far more complete and reliable than the data obtainable from the vital registration system. Moreover, an attempt will be made below to demonstrate that the deficiencies of the pregnancy histories can be largely corrected by demographic techniques. It is these two facts which recommend the pregnancy history approach for measuring changes in fertility to evaluate the progress of family planning programs.

Table 1 is only one of several possible tabulations from the pregnancy history data. Before considering the other outputs of the "Pregnancy History Analysis" system, it is necessary to discuss the problem of bias and its correction.

V
Biases in Pregnancy History Data and Techniques of Adjustment

Pregnancy history data are subject to three unique biases:

(a) Misreporting the date at which a pregnancy occurred.

(b) Misreporting the age (date of birth) of the mother.

(c) Failure to report all pregnancies.

By an elaborate editing procedure, involving three separate edits on the electronic computer, gross errors of misreporting dates of events and ages of mothers are detected and adjusted by non-biasing corrections. (Impossibly short intervals between births, impossibly young ages at bearing children, improbably long intervals between marriage and birth of first child are indicators of error). It is believed that by careful interviewing and this editing the ages of mothers at the birth of each child can be fixed within two or three years, even in low-literacy populations, and year of birth of children can be ascertained even more precisely.

When ages of mothers are grouped into 5-year intervals in accordance with usual practice, and the experience of two consecutive calendar years are combined to obtain a two-year average set of rates, it is believed that the first two of the above three biases have been reduced to an acceptably low magnitude. [5]

The third bias, failure to report all events, is inherent in the data and must be corrected by an upward adjustment, according to the presumed nature and extent of the error. A plausible adjustment, and the one recommended is as follows:

(a) Assume that failure to report a pregnancy is strongly concentrated among infants who died during their first year of life. Therefore, discard the pregnancy history data for infants who died during their first year of life and substitute a demographic estimate. This calls for setting up an events matrix which cumulates only live births which survived at least one year.

(b) By independent research estimate what the true infant mortality rate was in the

population under consideration during the years for which a fertility measurement is to be made.

(c) Adjust the data for births-that-survived-one year or more for infant mortality by the following equation

$$B^z = \frac{B_s^z}{(1.0 - q_0^z)} = \frac{B_s^z}{S_0^z} \qquad (4)$$

where B^z is the estimated true number of births in year z

B_s^z is the number of births that occurred in year z which survived to the first birthday

q_0^z = the estimated true infant mortality rate in year z

S_0^z = survival factor for year z = $(1.0 - q_0^z)$

(d) Use the adjusted births to compute the ASR and other fertility measures. The procedure outlined above is algebraically equivalent to calculating the ASFR, TFR and GFR first, from the surviving births, and then adjust the rates upward simply by dividing by S_0^z.

Very often in developing countries there will be no estimate of infant mortality (q_0^z) for the years under consideration and for the particular population being surveyed. As will be explained below, the computer program "Pregnancy History Analysis" itself produces a tabulation of this rate. If no alternative source of information is available, it could be assumed that this calculation is only 75 percent of the true value (which will be approximately correct in most situations). As will be shown below, (a) the error that can result from this procedure can affect the estimate of the birth rate by only a negligible amount and (b) tends to be cancelled out when making estimates of change in fertility. For this reason, the technique is a superior one for evaluating the effectiveness of family planning programs.

An alternative strategy is to follow the procedure outlined above, except to use only live-born children still living, and use a life table to reverse-survive each year's births to estimate all deaths to live born children. Model life tables of the United Nations or those prepared by the Princeton Office of population Research may be used for this step. If one distrusts the memory of the respondents (especially where illiteracy is almost complete) this procedure may be preferable to the adjustment for infant mortality. Experience thus far has shown that this procedure yields results that are almost identical with the infant mortality adjustment procedure. Two facts account for this: (a) most child mortality occurs during the first year of life and (b) women appear to remember and report children who survived one entire year with a reasonably high degree of completeness.[6]

A recommended practice is to prepare a "high" "medium" and "low" estimate of fertility. The computed rates adjusted for infant mortality or for child mortality as described above, may be accepted as the "medium" (most plausible) estimate. The unadjusted rates, as they come from the computer, may be accepted as the "low" estimates, for the biases are in the direction of understating fertility. A "high" estimate may be made by assuming that the women failed to report all of their live births who survived by x percent, and to inflate the rates as calculated by a factor of (1.0 - x). Experience thus far suggests that a factor of 5 percent would be a moderate upward adjustment and a factor of 10 percent would be near maximum.

VI
An Example of the Use of the Pregnancy History Procedure to Measure the Level of Fertility

In 1964, the United Nations Demographic Center in Santiago, Chile, sponsored the collection of fertility data from representative samples of females of childbearing age in seven Latin American capital cities. Included in the interview were questions that contained the major ingredients for the fertility history. These data have been processed with the "Pregnancy History Analysis" program, in an effort to establish the level of fertility in each of these places. Table 3 summarizes data for Mexico City, together with other estimates of fertility for Mexico

that may be relevant.

Some explanatory comments should be made of these estimates before they are analyzed. The value of the infant mortality rate obtained from the pregnancy history tabulations was 72 per 1,000 live births. This was divided by .75 to obtain an estimated "true" infant mortality rate; the estimated rate is therefore 96 infant deaths per 1,000 live births. The "official" infant mortality for all of Mexico, for 1960, published in the United Nations Demographic Yearbook, and ranked as one of the rates that may be accepted as reasonably correct, was only 69.9 in 1962, the midpoint of the 5-year span of time to which the pregnancy history rates refer. Thus, in this case the pregnancy history approach found a higher level of infant mortality than the official published data; when adjusted upward by 25 percent to obtain a corrected estimate of fertility, the correction for estimated error of memory for deceased infants should be regarded as fully corrected, if not over-corrected.

A close examination of Table 3 reveals the following:

(a) The "medium" estimate of TFR for Mexico City is 92 percent of Dr. Lee Jay Cho's estimate for all of Mexico, based upon census materials and 94 percent of the official estimates published in the Demographic Yearbook of the United Nations. These results seem highly plausible, inasmuch as one would expect a somewhat lower birth rate for the capital city than for the entire nation including rural areas. In fact, if one were to suspect the data of bias, it could be that the pregnancy history estimates for Mexico City are too high.

(b) The pattern of ASFR derived by the pregnancy histories are amazingly close to the estimates of Dr. Cho for ages under 35. The lower rates for Mexico City at ages above 35 are the pattern one would expect for a population just beginning to control its fertility. The pregnancy history ASFR are reasonably close to the United Nations Yearbook reports, for ages between 20-29 years; at ages 15-19 and 40-49 the UN. estimates seem to be less reasonable than the Cho or the pregnancy history estimates.

(c) Even the range between the "low" and the "high" estimate is quite small; the high estimate is only 8 percent greater than the low estimate. The range between the "medium" estimate and the "low" estimate is impressively small; the demographic adjustment for infant mortality increased the level of fertility above the uncorrected estimates by only 2.5 percent. The fact that a high estimate of infant mortality was used to obtain even this difference suggests that the "medium" estimate may lie very close to the true value indeed. In summary, it seems plausible to conclude that the pregnancy history estimates do indeed "bracket" the true level of fertility within a reasonably narrow margin and that the "medium" estimate is an unbiased estimate of the true schedule of ASF, GFR, and TFR for Mexico City.

These results for Mexico are not unique. The results for the other six nations of Latin America are equally consistent with other estimates of fertility levels and other estimates of infant mortality rate. [7]

VII
Use of the Pregnancy History Approach to Evaluate Family Planning Programs

If the pregnancy history approach is as successful in measuring the level of fertility as the above argument suggests, it is readily apparent that a powerful new device is available for evaluating family planning programs. There are two possible research strategies to the use of the pregnancy history technique to measure changes in fertility rates: the prospective and the retrospective design.

A. The prospective research design. To evaluate a family planning "action project" prospectively it would be necessary simply to follow the

following straightforward study design:

(a) Collect pregnancy history data for a representative sample of the "treatment" population to be subjected to the fertility control program immediately before that program begins or within one year of its start. Simultaneously take a similar sample for a "control group" of essentially the same characteristics not to be submitted to an action program. Compute "high", "medium", and "low" fertility rates for the "treatment" and the "control" populations.

(b) Launch the "action program" among the "treatment populations." Allow it to run for approximately three years. Absolutely no results upon the birth rate can occur for at least 9 months after the start of an action program, and it takes at least 3 months for an action program to get organized and operating on a wide scale. It is therefore completely unrealistic to expect any effect at all within one year. At least two years should elapse, and preferable three, before an attempt is made to measure impact. This amount of time is required for a change in birth rate sufficiently large to have taken place that it can be detected and measured by a sample.

(c) After three years, conduct a second round of pregnancy history inventory. Again compute birth rates for the "treatment" and "control" groups. Calculate the amount and direction of change, using the model of Table 1. If the decline in fertility level in the "treatment" population is significantly greater than the change in the "control" population, if no alternative hypothesis can be found to explain the change, it may be inferred that the action program accelerated the decline in the birth rate.

Unfortunately, no examples yet exist of this approach to family planning evaluation.

B. The retrospective research design. This approach takes advantage of the longitudinal aspect of the pregnancy history. It does not take a before-and-after measurement, as does the prospective design, but merely waits until after the program has been running for about three years and then makes the evaluation. The steps for conducting a retrospective evaluation are as follows:

(a) Conduct a sample pregnancy history inventory among the population where an intensive family planning action program has been underway for two or three years.

(b) Using the longitudinal aspect of the pregnancy history, compute a set of birth rates for the years that correspond to the span of family planning action.

(c) Compute a set of rates for an equivalent number of years immediately preceding the action program.

(d) Compare the fertility level for the period prior to the family planning action program with the fertility level during the program. A comparison of the fertility level for these two dates provides a measure of fertility change. If fertility has declined, the rates for the later date will be significantly lower than the rates for the earlier date, whereas if there has been no change they will be equal. If there has been a fertility increase, the rates for the later date will be higher than the rates for the earlier date. Thus, it is possible to measure recent fertility change with a single interview, taken after the change has taken place.[8]

The above procedure can be used to measure fertility change in populations where there has been no special family planning program, to ascertain whether a secular trend in fertility exists.

The power of the retrospective procedure can be greatly heightened if a retrospective measurement is made on a control group which has not been subjected to the intensive program. If the decline in the "treatment population" is greater than the decline in the "control group" and no alternative explanation can be adduced to account for the result, it may tentatively be assumed that the family planning action program has had a measurable impact upon the population.

Very often it may not be possible to find a "control population," or there may not be sufficient funds and manpower to collect two sets of pregnancy history data. If one is willing to be content with the simple discovery that birth rates either are (a) remaining the same or (b) falling in the treatment area, then it is not necessary to take a measurement for the control group. Under this less rigorous design, the researcher is forced to assume that birth rates would have remained unchanged if there had been no action program, and that all declines in fertility may be attributed to the actions he has taken. In some cases there can be no alternative to this approach. If an entire nation has been inundated with family planning action, then no "control population" exists.

All over the world there are family planning projects which are candidates for evaluation by this retrospective procedure. They were begun without any baseline measurement of fertility and now are desperately in need of an evaluation to learn whether or not birth rates are falling. Although this retrospective design is not as rigorous as the prospective one, it is nevertheless believed capable of assessing whether there is a change in birth rates and the approximate amount.

VIII
Examples of Retrospective Evaluation of Family Planning Action Programs

In a very poor slum area on Santiago, Chili's, outskirts, the University of Chile has been conducting an intensive family planning action program since late 1964. This program was a major experimental effort to combat induced abortion by offering family planning as a substitute. Mass communication, conferences with women coming to a local clinic for health care for their children and themselves, and home visits were made to inform the residents of the area about family planning and to encourage them to come to the clinic for service. The intrauterine device was the principal method of contraception offered.

The director of this study, Dr. Anibal Faundes-Latham,[9] included the questions of Appendix A in a follow-up interview taken with a representative sample in January, 1967. The data were then brought to the University of Chicago and processed with the "Pregnancy History Analysis" program. The results are shown in Table 4. The statistics represented here are the "medium" estimates, making use of the correction for infant mortality. (An infant mortality rate of 90 for the five-year period preceding the interview was estimated by the pregnancy history. This has been inflated to 120 for purposes of calculating the birth rates. The same value is used for both the "before" and "after" period.)

According to the results of Table 4, the average size of completed family in this barrio bajo of Santigo was 7.1 children. After two years of family planning treatment it had fallen to 6.1 children, or by 14 percent. The decline in the general fertility rate (which is a more reliable measure from the sampling point of view) was 19.5 percent. This represents a decline from a crude birth rate of about 48.4 to 39.0 within a period of two years. The declines appear to have been concentrated among the women under 40 years of age. It thus appears that, unless some other explanation for this significant decline can be produced, the experimenters may assume that their program is promoting extremely rapid fertility decline in this area.

The results of the Santiago experiment

should be contrasted with the results that have been obtained for similar tabulations where no special family planning program has been available. In Table 5 we have divided the 5-year interval for Mexico City's medium estimate into two periods analogous to the intervals in Santiago. The period 1962-64 represents roughly 2 1/2 years preceding the interview (the interview was taken in mid-1964), and the period 1960-61 represents the full effort during these years, and the impact upon the total population was quite small. This is reflected in an estimated decline of only 1 percent in the GFR and of 2.6 percent in the TFR.

A. U.S. Family Planning Experiment. Table 6 summarizes the results of an experiment to reduce birth rates in the Old Plantation Belt of Alabama.[10] The data refer to a sample of women who had attended family planning clinics in 8 rural counties in the vicinity of Selma-Montgomery-Tuskegee in response to a special program offering birth control pills at subsidized prices and with Negro family planning educators doing motivational work at maternal and child health clinics and out in the community. This table illustrates the use of the Pregnancy History Analysis Program to compute nuptial fertility rates. Instead of the denominators referring to all women they here refer to all ever married women. (Because of the unusual marriage patterns of Southern Negroes, the data actually refer to "ever exposed" women; an estimated date at which sex relations began to occur more or less regularly was substituted for the date of marriage.) Because all unmarried women not exposed to pregnancy have been removed from the demoninators, these rates are very high.

Notes:

The infant mortality reported by the pregnancy history tabulation was 28 per 1,000 live births. This was inflated to 37 (presumed 75 percent complete). The sample is 480 women. It is not possible to compute a TFR for a nuptial population by simply summing ASFR, because this would presume that all females were married at age 15-19. For this reason it is omitted from Table 6.

Table 6 shows that this highly selected group of women who had attended the clinic reduced fertility rates by 42 percent in comparison with the two years preceding the program. In this instance, however, there is much less reason to attribute this result to the particular family planning experiment being conducted than in the Santiago case, for Negro birth rates were falling rapidly throughout the nation during these same years. However, the measured rate of decline is far greater than the U.S. trend, and we must conclude that by attending the clinics these women were highly successful in curtailing their fertility more drastically than the general Negro population. However, we have no experimental way of knowing what action these women would have taken had there been no accelerated family planning program; it is quite possible that they were a select group of highly motivated persons who would have used some other method had the birth control pills not been available. It would have been highly desirable to have a control group against which to compare this sample, but the entire State of Alabama began a free birth control pill program for all indigent citizens only a few months after this experiment began, so that no comparable program that could be truly considered to be a "control group" existed. (A sample of women in the study area who did not go to the clinics was interviewed, but this is not a genuine control group.)

IX
Other Measures Provided by the Analysis of Pregnancy History Data

The pregnancy history provides information concerning several aspects of fertility that hitherto have been researched insufficiently. It therefore offers some fresh opportunities for expanding our knowledge of human fertility. This information is exploited by two computer programs: the "Pregnancy History Analysis" program, described above, and a "Pregnancy Interval" program which is used as the third and final edit before the data are tabulated to obtain rates. Following is a brief listing of the information provided

by these two programs.

A. Pregnancy loss rates and infant mortality rates. Each of the following rates is tabulated by single year of age of mother for each calendar year and for any grouping of ages and years desired.

a. Rate of pregnancy loss--number of pregnancy losses per 1,000 women years
b. Probability of pregnancy loss--number of pregnancy losses per 1,000 pregnancies
c. Spontaneous abortion rate--number of spontaneous abortions per 1,000 pregnancies
d. Induced abortion rate--number of induced abortions per 1,000 pregnancies
e. Infant mortality rate--of the infants born in a particular year, the rate per 1,000 who die before reaching their first birthday

It must be acknowledged that all of these rates are subject to serious understatement, especially for events that happened more than three years preceding the interview. However, under good interviewing conditions, the reporting of these events is surprisingly good and provides useful information, as the work of several studies in Latin America has shown. The procedure developed here converts this information into exactly the measures that best permit its analysis.

B. Dates, events, ages

a. Date of conception of each pregnancy
b. Incidence of premarital pregnancy
c. Age at which first exposure to regular sex relations began, independently of marital status

C. Intervals

a. Interval between marriage (or first exposure) and first pregnancy
b. Interval between all successive pregnancies
c. "Open interval"--interval between last pregnancy and date of the interview
d. Length of exposure to pregnancy, with this interval divided into
(1) Time spent in a state of pregnancy
(2) Time spent in a state of non-pregnancy

D. Prevalance measures

a. Percentage of women who currently are pregnant (3 months or more)
b. Percentage of women who have experienced a pregnancy loss, by age
c. Percentage of women at each parity at each age
d. Percentage of women who have had a child die, by age
e. Number of children ever born to women, by age

It should be pointed out that the above items are some of the key elements in model-building and mathematical quantification of the conception and reproduction process. The Pregnancy History approach will provide factual data for testing these models.

X
Pregnancy History Analysis as Part of a Larger Research-Evaluation System

The pregnancy history is not taken as an isolated set of observations, but is included as part of a larger more comprehensive "MAKE-UP" interview where the first letters of the term have the following significance:

M--motives for and against family planning
A--attitudes favoring and resisting adoption of family planning
K--knowledge of methods of contraception and of availability of family planning services
E--explanatory variables that account for differences in fertility behavior and family planning adoption
U--use of contraception and use-effectiveness of each method
P--Pregnancy history

This comprehensive interview provides data for a wide variety of variables which can be correlated with the items derived from the pregnancy history. Thus, the pregnancy history approach not only provides the data for measuring fertility change, but when included in a comprehensive interview it is

possible to trace the fertility change to the specific persons who accomplished it, and to learn their motives, attitudes, mode of contraception used, the reasons they adopted family planning, and the degree of effectiveness of the methods they employed. It is even possible to learn whether or not they have had contact with one of the official family planning programs, or whether they have received information via mass media. Thus, it offers unexcelled opportunities for linking family planning action to fertility changes for purposes of evaluation.

XI
Comparison of the Pregnancy History with other Systems of Fertility for Measuring Fertility Change

The following four systems have been advanced for measuring short-run changes in fertility in the absence of reliable vital statistics:

(a) Population Growth Estimation (PGE)--A combination of enumeration by repeated home visit (3 or 4 times per year) of births as they occur, linked to an independently maintained system of vital registration, with matching to include births found by one system but not the other. This system has been used successfully in Pakistan, under a program sponsored by the Population Council.

(b) "Open Interval" Analysis (OIA)--An enumeration, at successive intervals, of the time that has elapsed since women have delivered their last child. Under conditions of high fertility these intervals are short; as fertility declines they become longer. If the average length of the intervals increases it implies that birth rates are falling.

(c) Pregnancy Prevalance Analysis (PPA) --An enumeration of the current pregnancy status of samples of women. Under conditions of high fertility, the proportion of women who are pregnant at any particular moment is high; under conditions of lower fertility the proportion is low. If this percentage declines, it implies that birth rates are falling.

(d) Pregnancy History Analysis (PHA)--the system proposed in this article.

All of these systems are too new and too little studied to permit more than a few comparative comments. The following observations concerning the relationship between the pregnancy history approach and the other approaches are submitted in this spirit.

(1) The Pregnancy History Analysis provides, as routine items of output, both the "open interval" and the Pregnancy prevalance measures. As yet, neither of these measures has been "calibrated," that is, the average length of intervals and the average prevalance of pregnancy associated with given levels of birth rates have not yet been determined. The pregnancy history approach provides a highly feasible procedure for doing this, and the authors are pursuing this problem currently, using the data for Latin America and Alabama for the calibration process.

(2) There are some research projects to use laboratory methods (urine samples) to measure pregnancy prevalance. These procedures are costly; both in terms of equipment and personnel.
The combined difficulties of nonresponse and of inconclusive laboratory results may lead to the find that this procedure is no more valid and reliable than the results obtained simply by asking two questions: "Are you pregnant now?" and (if so), "For how long have you been pregnant?" ("How many weeks or months has it been since you menstruated last?") By limiting the tabulation to pregnancies beyond the third month, it is believed that the simple interview methods can match or surpass the field laboratory methods in completeness and precision.

(3) There have been some suggestions to "bobtail" the pregnancy history approach, such as taking a pregnancy history for only the past five years. (One such version is now being performed in Paskitan, under the sponsorship of Columbia University.) It is believed that the elements of imprecision introduced by this procedure are so great as to render the results unusable. Tying the rates to a fixed date so far in the past can lead to spurious inclusions and omissions far more serious than simple memory lapse. Only by asking low-literacy respondents to account for the totality of their reproductive experience

beginning with all of their living children and carefully reconciling all of the information pertaining to date at marriage, current age, and probing all long intervals without pregnancy is it possible to obtain maximally valid data. The difference, in terms of interviewing time, is small and the gains in terms of precision and additional information concerning intervals, pregnancy loss rates, etc. more than repays the modest extra effort.

(4) The Population Growth Estimation procedure is a completely different system and is the only clear-cut alternative to the Pregnancy History Analysis system. As yet, a rigorous comparative test has not been made, but it is believed that the estimates of fertility levels yielded by the PHA system are just as reliable as those yielded by PGE, and the estimates of change are more reliable. The PHA has the following advantages in comparison with PGE:

(a) PGE requires a sustained effort, over a prolonged period of time. In a one-shot inventory, it is possible to mobilize a crew of high quality workers, train them to peak efficiency, and then dismantle the organization. In the developing countries, a single one-shot effort of the PHA type can be mounted quite nicely through a medical school, a school of social work, or a demographic center--whereas it has proved difficult to employ, retain, and maintain a high level of enthusiasm for PGE operations.

(b) Poor quality of work in PHA results from failure to reduce memory lapse to the point where the demographic corrections produce valid results. Careless interviewing thus tends to underestimate birth rates for earlier years. This leads to an inference that fertility has risen or stayed the same. Poor quality work in PGE results in an undercount of births after a good start, with the result that birth rates apparently decline. Thus, there is a built-in bias against discovering a fall in birth rates in the PHA approach, while the PGE approach has a built-in bias in favor of discovering a fall in birth rates.

(c) The repeated visits of households for purposes of registering births while maintaining a duplicate registration system creates serious problems for contamination in PGE (the interviewer and the registrar both know of each other's work, and have many months to communicate with each other). Also, there are problems of irritating respondents by repeated interviewing, of low interviewer morale because births, deaths, and migration occur with such infrequency that on quarterly visits the normal response is "no event," and the perennial problems of migration, matching names, and reinterviewing in exactly the same household at repeated periods of time. The PHA system by-passes all of these problems.

(d) PGE requires very large samples of households and a long span of time before results are forthcoming. It is prospective only, and hence yields information only after one year or more of work. PHA provides the same level of precision with smaller samples and (because it can be retrospective as well as prospective) after a very short time.

(e) PHA, by reconstructing the past, can provide a baseline to evaluate family planning programs already in operation. PGE can only begin at the present and work into the future. Thus, PHA can evaluate family planning programs that have been underway for two or three years, whereas PGE cannot evaluate the work done previously, but can measure future programs only.

(f) The demographic adjustments that are made to control the biases and deficiencies for PHA are almost identical for the successive intervals of time, and therefore are of the nature of constants that cancel out when measuring fertility change, because they are present in both the "before" and the "after treatment" intervals. The demographic corrections that are made to PGE data can vary independently at each interval of time. For this reason, it is believed that the PHA measurements of fertility change are substantially more precise in most instances than PGE estimates of fertility change.

(5) The major weakness of the PHA is that it is highly sensitive to errors in following a sampling plan. If interviewers fail to interview unmarried but eligible women,

or women who are married but have born no children, the rates are affected directly and drastically. Utmost care in selection, training, and supervision of interviewing is required. The sampling plan must be near-perfect.

The above comments are not intended to argue that the pregnancy history approach should replace the PGE approach. They are only intended to emphasize that the PHA system merits serious consideration, and that it does have some assets for family planning evaluation that are urgently needed around the world today.

FOOTNOTES

[1] See Mortimer Spiegelman, Introduction to Demography, pp. 153-55, 167-68. The "total fertility rate" is equivalent to the gross reproduction rate" taken for all births instead of female births only. It is superior to the GRR for fertility measurement because differences in sex ratio at birth are not allowed to be confounded with fertility level.

[2] For a complete exposition of the concept of person years and the relationship between calendar years and time-in-age, see H. H. Wolfenden, Population Statistics and their Compilation, University of Chicago Press, 1954, especially Chapter 5.

[3] A minor difference is the fertility of women who die during the childbearing years. The pregnancy history approach includes only the fertility of women who survive to be interviewed at a particular age. The fertility of the women of the various cohorts who have died is left out of the numerator, and the person-years of these women is left out of the denominator. As a result, the fertility rates obtained by the pregnancy history approach may be slightly higher than those calculated from vital registers. To the extent that there is differential survival, the sample of surviving women is not representative of the cohorts at earlier years. These are well-known problems of all modes of longitudinal analysis, either prospective or retrospective.

[4] The authors have several versions of this program to accomplish specific types of tabulations, such as nuptiality-specific rates, spouse-present specific rates. Appendix B is the "standard" version of the program for generating rates based on all women of childbearing age.

[5] It should be emphasized that it is not essential that highly accurate data on month and year of birth be obtained to make this system workable. Season of birth may be accepted instead of month of birth, and current age may be accepted instead of year of birth, where more precise data are lacking. Thus, the system can never be worse than a census; with skilled interviewing it can be considerably better. The precision of the rates will depend upon the precision of the basic data. With even the crudest pregnancy histories (so far as dates are concerned), if the count of events is complete the resulting rates will be useful.

[6] The "Pregnancy Analysis" computer program sets up three matrix for life births (a) total live births, (b) births that survived one year and (c) live births still living. It calculates ASFR and GFR on the basis of each. The raw data and the rates for all three matrixes are printed out and therefore are completely available to the researcher for experimenting with alternative systems of adjustment.

[7] A detailed analysis of these data for the seven Latin American capital cities is contained in a forth coming monograph being published by the United Nations Demographic Center, Santiago. Prof. Carmen Miro, director of the Center, is senior author of this

[8] It should be pointed out that the major errors and biases in the pregnancy history data are of such a nature that they tend to hide a decline in fertility when in fact one has occurred, rather than to give a spurious indication of fertility decline:

(a) Women will have less memory loss for recent pregnancies than for ones more distant in the past, so recent birth rates will tend to be higher than earlier ones.

(b) Infant mortality is declining. Therefore, it an average correction for both periods is introduced, it will tend to un-

dercorrect the earlier period and overcorrect the later period, thereby understating fertility at the earlier period and overstating it at a later period.

(c) Women who are older may have more incentive and ability to successfully misreport or lie about illegitimate children. Thus, this type of misreporting may be much more serious for earlier than for current periods, because for current periods the children are present and visible.

(d) When interviewers make errors in selecting women for the sample, there is a tendency to omit single women without children, and especially at the younger ages. The tendency is to exaggerate the fertility of women of younger ages in recent periods.

Thus, when the pregnancy history is used to measure fertility change, it is conservative evaluative technique. If it finds that fertility has declined, this finding has been arrived at in spite of the major biases of the technique, not because of them.

[9] Department of Obstetrics and Gynecology, University of Chile. Dr. Faundes has a report of this experiment and its results to day in preparation. This table has been presented through his kind permission.

[10] For a description of this study see Donald J. Bogue, The Rural South Fertility Experiments, Community and Family Study Center, 1966.

See, for example, Helen M. Walker and Joseph Lev, Statistical Inference, New York: Holt, Rinehart and Winston, 1953, pp. 68-76. The practice of improving sample precision by aggregating data for fertility behavior of two or more years violates the principles for combining probability samples on a variety of grounds. The presumption made here that they are approximately additive is only a preliminary judgment. The problem is being pursued in more detail with the assitance of Prof. Leo Goodman.

Table 1.--ILLUSTRATION OF THE "IDEAL" DEMOGRAPHIC PROCEDURE FOR MEASURING FERTILITY CHANGE: DATA FOR THE UNITED STATES: 1960 AND 1965

Age	Age specific fertility rates		Change in rates: 1960 to 1965	
	1965	1960	Absolute	Relative
	(1)	(2)	(3)=(2)-1	(4)=(3)/2
15-19 years	71.2	89.9	-18.7	-20.8
20-24 years	196.8	258.1	-61.3	-23.8
25-29 years	162.5	197.4	-34.9	-17.7
30-34 years	95.0	112.7	-17.7	-15.7
35-39 years	46.4	56.2	- 9.8	-17.4
40-44 years	12.8	15.5	- 2.7	-17.4
45-49 years	0.8	0.9	- 0.1	-11.1
General fertility rate[a]	131.1	156.3	-25.2	-16.1
Total fertility rate	2928	3654	-726	-19.9

(a) GFR for U.S. is computed on the basis of women aged 15 to 44; most nations of the world use 15 to 49 or 10 to 49.

Table 2. ILLUSTRATION OF MATRIX USED FOR CUMULATING NUMERATORS AND DENOMINATORS AND CALCULATING BIRTH RATES BY PREGNANCY HISTORY ANALYSIS PROGRAM
PERSON YEARS - TOTAL WOMEN - CLINIC - ALABAMA

RATES-SINGLE YEARS TOTAL L.B. / PERSON YEARS

AGE	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
TOT.	134.	160.	245.	290.	357.	417.	395.	415.	443.	404.	399.	393.	372.	380.	349.	344.	309.	380.
1923	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1924	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1925	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1926	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1927	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1928	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1929	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1930	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1931	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1932	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1933	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1934	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1935	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1936	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1937	281.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1938	92.	281.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1939	92.	92.	375.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1940	283.	183.	92.	375.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1941	75.	283.	275.	92.	469.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1942	59.	75.	94.	275.	550.	188.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1943	123.	59.	75.	283.	92.	458.	281.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1944	111.	0.	178.	151.	378.	275.	366.	375.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1945	60.	111.	246.	0.	75.	472.	92.	550.	94.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1946	56.	241.	111.	185.	297.	226.	189.	183.	550.	188.	0.	0.	0.	0.	0.	0.	0.	0.
1947	53.	224.	181.	276.	246.	297.	226.	378.	366.	458.	281.	0.	0.	0.	0.	0.	0.	0.
1948	188.	212.	168.	422.	55.	246.	653.	302.	472.	366.	275.	281.	0.	0.	0.	0.	0.	0.
1949	249.	125.	159.	280.	362.	608.	431.	297.	604.	189.	458.	458.	188.	0.	0.	0.	0.	0.
1950	106.	187.	250.	372.	393.	482.	166.	308.	416.	226.	283.	550.	275.	188.	0.	0.	0.	0.
1951	41.	0.	311.	188.	425.	336.	543.	498.	308.	356.	302.	189.	550.	458.	375.	0.	0.	0.
1952	214.	162.	159.	249.	625.	372.	224.	302.	553.	246.	416.	377.	189.	275.	366.	0.	0.	0.
1953	79.	171.	122.	372.	373.	250.	372.	449.	422.	387.	615.	416.	377.	283.	458.	550.	188.	0.
1954	42.	199.	214.	284.	319.	560.	438.	265.	336.	663.	221.	431.	475.	377.	0.	275.	183.	375.
1955	44.	125.	199.	300.	365.	531.	746.	500.	372.	393.	603.	553.	308.	238.	604.	378.	550.	824.
1956	122.	177.	292.	437.	429.	365.	531.	435.	563.	319.	505.	543.	166.	554.	119.	377.	189.	183.
1957	254.	122.	221.	125.	278.	386.	405.	531.	435.	375.	531.	280.	482.	166.	492.	356.	377.	378.
1958	182.	109.	367.	354.	333.	517.	343.	324.	372.	435.	438.	425.	280.	543.	608.	431.	238.	453.
1959	286.	45.	363.	204.	399.	375.	437.	386.	446.	531.	249.	313.	265.	449.	543.	221.	369.	416.
1960	90.	229.	318.	218.	490.	531.	250.	636.	300.	365.	478.	497.	375.	531.	224.	663.	221.	246.
1961	329.	134.	343.	364.	290.	449.	399.	458.	517.	557.	405.	212.	187.	438.	212.	168.	362.	332.
1962	85.	247.	134.	229.	318.	689.	571.	443.	417.	477.	343.	486.	425.	497.	375.	478.	280.	422.
1963	97.	338.	329.	358.	629.	273.	399.	367.	664.	667.	397.	300.	527.	478.	560.	375.	425.	336.
1964	0.	387.	761.	658.	582.	457.	500.	580.	612.	399.	333.	318.	600.	568.	319.	311.	313.	478.
1965	0.	0.	387.	507.	247.	358.	400.	409.	435.	286.	531.	417.	278.	171.	162.	372.	187.	250.
1966	0.	0.	0.	0.	0.	424.	324.	379.	98.	303.	88.	0.	651.	94.	195.	103.	0.	145.
1967	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

Table 2. (continued)

CONT.	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	TOTAL
TOT.	307.	342.	293.	304.	255.	227.	181.	229.	66.	121.	199.	78.	333.	0.	0.	0.	0.	325.
1923	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1924	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1925	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1926	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1927	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1928	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1929	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1930	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1931	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1932	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1933	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1934	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1935	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1936	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1937	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	360.
1938	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	158.
1939	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	234.
1940	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	196.
1941	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	214.
1942	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	232.
1943	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	209.
1944	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	194.
1945	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	233.
1946	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	181.
1947	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	213.
1948	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	284.
1949	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	292.
1950	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	333.
1951	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	314.
1952	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	302.
1953	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	306.
1954	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	334.
1955	188.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	312.
1956	366.	281.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	380.
1957	275.	641.	281.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	349.
1958	378.	366.	366.	281.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	337.
1959	151.	283.	275.	458.	281.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	362.
1960	356.	75.	94.	92.	92.	188.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	338.
1961	492.	297.	453.	378.	458.	275.	375.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	331.
1962	276.	308.	356.	377.	94.	275.	92.	188.	0.	0.	0.	0.	0.	0.	0.	0.	0.	354.
1963	362.	442.	369.	297.	226.	94.	275.	275.	94.	0.	0.	0.	0.	0.	0.	0.	0.	373.
1964	449.	422.	387.	246.	475.	302.	189.	366.	0.	188.	0.	0.	0.	0.	0.	0.	0.	387.
1965	106.	168.	241.	55.	185.	238.	75.	283.	0.	92.	94.	0.	0.	0.	0.	0.	0.	437.
1966	304.	133.	0.	507.	120.	0.	0.	0.	0.	0.	164.	0.	0.	0.	0.	0.	0.	272.
1967	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	179.
																	0.	0.

Table 3.--ESTIMATED BIRTH RATE OF MEXICO CITY, DERIVED BY THE PREGNANCY HISTORY TECHNIQUE FROM A SAMPLE SURVEY: 1964; COMPARISON WITH OTHER MEASURES OF FERTILITY FOR MEXICO

Age	Pregnancy history estimates			Estimate for Mexico-Dr. Cho	United Nations Yearbook
	High	Medium	Low		
15-19 years.....	103	98	98	105	48
20-24 years.....	297	282	271	293	299
25-29 years.....	316	300	287	312	314
30-34 years.....	270	257	252	257	271
35-39 years.....	160	152	148	192	200
40-44 years.....	64	61	66	94	49
45-49 years.....	8	8	7	0	
General fertility rate.....	217	206	201	196	...
Total fertility rate.....	6091	5790	5645	6268	6150

Table 4.--ESTIMATE OF CHANGE IN FERTILITY IN SAN GREGORIO FAMILY PLANNING EXPERIMENTAL AREA, SANTIAGO CHILE, 1962-66

Age	Period of family planning: 1965-66	Period before family planning: 1963-64	Fertility change	
			Absolute	Relative
15-19 years.....	133	180	- 47	-26.1
20-24 years.....	325	374	- 49	-13.1
25-29 years.....	267	339	- 72	-21.2
30-34 years.....	240	258	- 18	- 7.0
35-39 years.....	163	199	- 36	-18.1
40-44 years.....	93	74	+ 19	+25.7
45-49 years.....	8	0	+ 8	.....
General fertility rate.....	182	226	- 44	-19.5
Total fertility rate.....	6145	7120	-975	-13.8

Table 5.--ESTIMATE OF CHANGE IN FERTILITY IN MEXICO CITY: 1960-64

Age	2 1/2 years preceding interview: 1962-64	Preceding two years: 1960-61	Change	
			Absolute	Relative
15-19 years.....	98	98	....	....
20-24 years.....	261	310	- 49	-15.8
25-29 years.....	300	300	0	0
30-34 years.....	270	238	+ 32	+13.4
35-39 years.....	137	171	- 34	-19.9
40-44 years.....	74	43	+ 31	+72.1
45-49 years.....	4	14	- 10	-71.4
General fertility rate.....	205	207	- 2	- 1.0
Total fertility rate.....	5720	5870	150	- 2.6

APPENDIX A

PREGNANCY HISTORY

1.. Have you ever given birth to a child or ever been pregnant?
No.....0 Yes.....1

RECORD ALL ANSWERS TO QUESTIONS 15-16 ON THE PREGNANCY HISTORY CHART. IF THE ANSWER TO 15 IS "NO" WRITE "NEVER PREGNANT" ON THE FIRST LINE OF THE CHART AND PROCEED TO QUESTION 19. IF "YES" ASK: (REMEMBER THAT THE ANSWERS TO THE FOLLOWING QUESTIONS ARE TO BE RECORDED ON THE CHART AND NOT ON THIS PAGE. DO NOT NUMBER PREGNANCIES UNTIL CHART IS COMPLETELY FILLED OUT.)

A. Please tell me the names of each one of your babies who was alive when born. Begin with the oldest.
PROBE: We want to be sure to include all of your children. Did you have any children by another husband(or boyfriend)that you have not mentioned?

WRITE THE NAME IN COLUMN A OF THE CHART - USE THE HEAVY BLACK LINES TO RECORD THE INFORMATION FOR CHILDREN BORN ALIVE. FILL IN THE OTHER COLS. B--J FOR EACH LIVE BORN CHILD.

B. (Outcome of pregnancy for live births is "LB")

C. What was the sex of the child? (ASK ONLY IF CANNOT TELL FROM FIRST NAME)

D. In what year was the child born? In what month of the year? (IF MONTH UNKNOWN ASK: IN WHAT SEASON?)

E. Were you pregnant the full 9 months with this child? IF NOT ASK: During which month of pregnancy was it born?

F. Was this a single birth pregnancy or was it one of twins? (triplets?)

G. Is the child still living?

IF NOT ASK: H-I-J-. IF "YES": PROBE WITH ITEM K.

H. In what year did death occur? In what month?

I. How old was he (she) when death occurred? (IN MONTHS, IF LESS THAN 1 YEAR)

J. What was the cause of death?

K. PROBE: (1) Are you sure you have mentioned all of your children who are living? Are there any who are living away from home that have been forgotten? We want to include sons and daughters who are married or have left home. (INCLUDE ONLY CHILDREN BORNE BY THE WOMAN HERSELF, NOT ADOPTED CHILDREN OR HUSBAND'S CHILDREN BY ANOTHER WIFE)
(2) Are there any other children who were born alive but have died? We want to include any babies that may have lived only a few hours or any that have died after growing up.

2. Many women have pregnancies that do not produce a live baby. Have you ever had a pregnancy that did not produce a live baby, that is, the baby was born dead, or have you ever been pregnant any other time and lost it, because of miscarriage or abortion?

IF "YES" ASK AND RECORD THE FOLLOWING ON BLANK LINES BETWEEN THE OTHER BIRTHS IN THE ORDER OF OCCURRENCE.

A. Between which of the children (live births) did it occur?

D. Date of pregnancy loss - What year was this? What month of the year? (COL. D OF CHART)

E. How many months pregnant were you when the pregnancy loss happened? During which month of pregnancy did the loss occur? (COL. E OF CHART)

B. What was the cause of this pregnancy loss? Sometimes women who become pregnant when they do not want to have another child do something to interrupt the pregnancy. Did you do anything or have anything done to cause the pregnancy to end (Have an abortion)?
Yes.....IA No.....SA or SB
RECORD TYPE OF PREGNANCY LOSS IN COL. B.

F. Do you know if this would have been a single birth or were you not far enough along to tell? RECORD SEX IN COL. C.

AT THIS MOMENT OF THE INTERVIEW PLEASE REVIEW THE ENTIRE HISTORY OF PREGNANCIES AND NOTE THE LENGTH OF THE INTERVALS BETWEEN PREGNANCIES. IF THERE IS AN INTERVAL OF TWO OR MORE YEARS BETWEEN ANY TWO PREGNANCIES OR PREGNANCY LOSSES, ASK:

How does it happen that there is an interval of _____years between the births of _____ and _____? This is an unusually long time. Is it possible that you were pregnant again and forgot to mention it? Perhaps you were pregnant for only a few weeks?

ENTER ANY ADDITIONAL PREGNANCIES ON PREGNANCY HISTORY CHART IN PROPER PLACE AND ORDER.

3. Are you pregnant now?

No.....0

Yes.....1*

Uncertain, probably...2*

*IF NOW PREGNANT:

A. Order of pregnancy_____

B. In which month of pregnancy are you? _____

C. Therefore baby is due (month and year) _____

AFTER RECORDING ALL INFORMATION ABOUT EACH PREGNANCY, NUMBER EACH PREGNANCY IN THE CORRECT ORDER OF OCCURRENCE AND FILL OUT THE FOLLOWING SUMMARY:

(a) Number of children still living.....

(b) Number of live born children now dead.....

(c) Total number of live born children (a+b).....

(d) Number of abortions: Spontaneous (less than 5 months gestation).....

(e) Number of abortions: Induced (less than 5 months gestation).....

(f) Number of stillbirths and miscarriages (more than 5 months gestation).....

(g) Is the woman pregnant now? If "yes", record "1"....

Total number of pregnancies.....
(Sum of c through g less any multiple births)

Table 6.--ESTIMATES OF CHANGE IN FERTILITY IN RURAL ALABAMA:

Age	Two years of family planning program	Two years preceding program	Change	
			Absolute	Relative
15-19 years.....	422	612	-190	-31.0
20-24 years.....	352	513	-161	-31.3
25-29 years.....	294	448	-154	-34.3
30-34 years.....	200	390	-190	-48.7
35-39 years.....	152	305	-153	-50.1
40-44 years.....	88	190	-102	-53.6
45-49 years.....	0	0	....	....
General fertility rate.....	252	433	-181	-41.8

PREGNANCY HISTORY

Preg-nancy order	Name of the child (if live born)	Outcome of Pregnancy LB=live born SA=spontane-ous abortion IA=induced abortion SB=stillbirth	Sex boy or girl?	Date of birth or pregnancy loss		Gestation for each live birth, abortion, miscarriage, stillbirth. In which month of pregnancy did you lose this child?	Type of birth. How many babies?	Is the child still living?	FOR EACH CHILD BORN ALIVE NOW DECEASED:			
									Date of death		Age when death occurred	Cause of death
				Year	Month				Year	Month or season		
	A	B	C	D		E	F	G	H		I	J