

Measuring Fertility From a Census

*Select Topics in International Censuses*¹

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INTRODUCTION

Fertility is a primary engine of population growth. Knowledge of fertility levels and trends can help us formulate and evaluate policies related to population change. Furthermore, analysis of fertility trends helps



to predict needs for public services, such as health facilities and schools.

While civil registration and vital statistics systems are the preferred ways to collect data on fertility, a census can provide valuable information on fertility, particularly in countries where birth registration is incomplete. Unlike household surveys, fertility data from a census can provide estimates at desired sub-national levels. In addition, even in countries where birth registration is complete, census data on fertility can serve as a basis for evaluating the registration data. Furthermore, censuses provide information on fertility and other associated indicators that may not be available through the registration system. This document introduces the information required to estimate fertility from censuses that are in line with the United Nations' *Principles and Recommendations for Population and Housing Censuses, Version 3*. It will also provide an overview of data evaluation and the methods to calculate common fertility measures from census data.

RECOMMENDED QUESTIONS ON FERTILITY

The *Principles and Recommendations* advise two sets of core questions about fertility in a census. The children ever born alive questions ask about lifetime fertility, while the question on date of birth of last child born alive collects information about recent fertility.

¹ This technical note is part of a series on *Select Topics in International Censuses*, exploring matters of interest to the international statistical community. The U.S. Census Bureau helps countries improve their national statistical systems by engaging in capacity building to enhance statistical competencies in sustainable ways.

Children Ever Born Alive (Core)

Asking questions on children ever born alive is recommended in all situations, even in countries with good vital registration, to assess completeness of the registration system and for estimating levels of lifetime fertility for older cohorts. All women 15 years and over should be asked the questions, regardless of their marital status.² While there may be sensitivities to asking questions about fertility to never-married women, the United Nations recommends that efforts should be made to collect this information regardless of marital status. Doing so will improve the accuracy of the data. If it is not possible to ask the questions of all women, then at least ask of all women who are or have ever been married or in a union, including widowed, divorced, and separated.

The number of children ever born alive should include all children who were born alive to a woman during her entire lifetime up to the census date. It should include any child:

- Who showed any sign of life at birth even for a very short time.
 - Regardless of whether the child was alive or dead at the time of the census.
 - Regardless of whether born in or out of marriage or in the present or prior marriage.
 - Regardless of whether the child lives with the mother, the age of the child, or the marital status of the child.

It should not include:

- Stillbirths or other fetal deaths.
- Adopted children.
- Stepchildren.

In the case of multiple births (like twins), each child should be counted as a separate birth.

The recommended set of questions is the following sequence:

- a. Total number of sons ever born alive during the lifetime of the woman.
- b. Total number of sons living (surviving) at the time of the census.
- c. Total number of sons born alive who have died before the census date.

² In some countries, it may be appropriate to ask the questions to women 12 years and over.

Then ask:

- d. Total number of daughters ever born alive during the lifetime of the woman.
- e. Total number of daughters living (surviving) at the time of the census.
- f. Total number of daughters born alive who have died before the census date.

Asking about sons and daughters separately improves the accuracy of the data and allows for calculation of fertility measures by sex. While only responses to questions about sons or daughters ever born alive (a and d) are used for fertility analysis, the other questions serve as checks. Enumerators can add the number of children living and dead to compare against the total number of children ever born alive. They can then resolve any discrepancies at the time of the interview.

Date of Birth of Last Child Born Alive (Core)

The UN recommends asking about the date of birth (day, month, and year) and sex of the last child born alive (as an addition to the children ever born alive questions) to women 15–49 years regardless of marital status. The date of birth of last child can be used to obtain current fertility at national and subnational levels instead of asking about the number of births within the last 12 months. Asking about the date of birth of last child is considered more accurate than asking about births in the last 12 months because of errors and omissions in the reporting of live births within a 12-month time period. In cases where a woman has more than one birth in a 12-month period, using date of birth of last child to calculate births within the last 12 months could lead to under-reporting of births, but these cases are rare and do not affect the fertility estimate much.

Additional Questions

Additional questions that aid fertility analysis from census data are listed below, but are of low priority:

- Age, date, or duration of first marriage.
- Age of mother at birth of first child born alive.

Both questions may be considered for countries where birth rates are high among adolescents and large proportion of women are married before age 18. The age of mother at birth of first child born alive may be considered for countries with low fertility and mortality and where vital registration is not reliable.

IMPROVING COLLECTION OF FERTILITY DATA

To improve the accuracy and completeness of fertility data, ask questions on fertility directly to the woman or mother involved because she is more likely to recall correctly the details of her fertility.

Further, enumerators should be trained to ask probing questions in order to avoid common errors and omissions. Some common errors and omissions are shown in Table 1.

Table 1.

Common Errors in Collection of Fertility Data

Type of Questions	Common Errors
General	<p>Not asking the fertility questions to all women who are supposed to be asked the questions. For example:</p> <ul style="list-style-type: none"> • Never-married, widowed, divorced, or separated women. • Older women. • Young women. <p>Age misreporting of the mother or child.</p>
Recent births	<p>Inaccurate date of birth of last child born alive.</p>
Children ever born	<p>Omitting some children from the total number of children ever born who should be included. For example:</p> <ul style="list-style-type: none"> • Children who have died. • Children who are no longer living with the mother. • Children from a previous marriage. <p>Erroneously including nonbiological children or nonlive births in the total number of children ever born. For example:</p> <ul style="list-style-type: none"> • Stepchildren. • Adopted children. • Other children in the household. • Stillbirths or other fetal deaths. <p>Recording childless women as having no response. The number of births of childless women should be recorded as zero. Enumerators instead may write “—” or leave the response blank. (See El Badry correction on page 4.)</p>

MEASURES OF FERTILITY

A number of measures of fertility may be obtained from census data using the core questions discussed above. These measures are discussed in Box 1.

Box 1.

Measures of Fertility

Number of births: Count of live births occurring in a given reference period.

Crude birth rate (CBR): Number of births occurring in a year divided by the population at mid-year times 1,000.

General fertility rate: Number of births in a year per 1,000 women aged 15 to 49 at midyear.

Age-specific fertility rates (ASFR): Births to women in a 5-year age group during a time period divided by the midperiod population of women in that age group. This measure indicates the age pattern of fertility in a population.

Total fertility rate (TFR): Average number of children a woman would have in her lifetime if she experienced the prevailing fertility rates at each age of her reproductive life.

Gross reproduction rate (GRR): Average number of daughters a woman would have in her lifetime if she experienced the prevailing fertility rates at each age of her reproductive life.

Average parity/children ever born: Parity refers to the number of children born alive to a woman so far. Average parity refers to the average number of children ever born alive per woman by age group.

Parity distributions: Number of women in each age group by number of children they have born.

Child-woman ratio (CWR): Number of living children aged 0–4 divided by number of women of reproductive age (15–49).

METHODS TO ESTIMATE FERTILITY

Direct Methods

Measures of fertility may be directly estimated if data on births are complete, accurate, and reliable. Information on date of birth (day, month, and year) and sex of the last child born alive is used for estimating fertility at both national and subnational levels. Before calculating the fertility measures, the data should be assessed for completeness and data quality checks should be performed. The extent of missing cases and edited or imputed data should be investigated. Data on the sex of the child can be used to evaluate the sex ratio at birth and to detect potential sex-selective birth omissions, misreporting or coding errors. Once births during the reference period are tabulated and other fertility measures are calculated, the estimates should be checked for plausibility and comparability with other data sources (such as household surveys and vital registration systems) and results from indirect methods.

Indirect Methods

Indirect techniques use information other than births to estimate fertility rates. Such methods often rely on information on age, sex, and children ever born from one or more censuses or surveys. Indirect methods are helpful because birth data collected from censuses often suffer from underreporting. Two groups of indirect methods are discussed here. The first relies on information on children ever born; the second on sex and age structure without data on births. Before using these methods, it is recommended that the analyst carefully examine the data for quality. Particular attention should be paid to age misreporting and missing data. It is also advisable to check for improbable parities relative to the age of the mother. One birth every 18 months from age 12 onward is a useful rule of thumb (Moultrie, et al., 2013).

1. Methods Using Information on Children Ever Born

The following set of methods rely on information on children ever born to estimate fertility. Additional details on the methods can be found in the sources listed at the end of this document.

Brass P/F Ratio

Brass P/F Ratio method uses information on children ever born to evaluate and adjust age-specific fertility rates from a census or survey. This is done by calculating ratios of the children ever born by age groups of women (P) to lifetime fertility equivalents (F) or cumulated current (period) fertility with adjustments.

Data required:

- Age-specific fertility rates in 5-year age groups.
- Average number of children ever born alive per woman by 5-year age groups of the mother.

Measures produced:

- Adjusted age-specific fertility rates.
- Adjusted TFR.

Relational Gompertz

The relational Gompertz model is similar to the P/F Ratio method, but uses a mathematical model to estimate the TFR based on reported ASFRs and the average number of children ever born by age of the woman.

Data required:

- Average number of children ever born per woman, by 5-year age groups of mothers in childbearing ages.
- Age-specific fertility rates based on information on recent fertility (optional).

Measures produced:

- Total fertility rates.

El Badry Correction

El Badry correction can be applied when childlessness is erroneously left blank or recorded as not stated. When a substantial number of women with zero births are misclassified as nonresponse, the average children ever born will be biased upwards. This is particularly a problem in younger age groups where the proportion childless is likely to be high. The method estimates the proportion of women who were classified as “parity not stated” who should have been classified as childless. The method can be used when the relationship between the proportion of childless women and the proportion of women whose parity was not stated at each age group is approximately linear.

Data required:

- Number of children ever born classified by age group of mother.
- Number of women with missing data by age group (i.e., where the field was left blank or contained an out-of-range code or a code for not answered or refused).
- Total number of women in 5-year age groups.

Measure produced:

- Corrected number and proportion of childless women by age group.
- Corrected average number of children ever born by age group.

2. Methods to Estimate Fertility Without Information on Numbers of Births

This section describes some methods to estimate fertility without using data on births.

Reverse Survival: Births From Age

The reverse survival method allows for estimation of fertility without data on births. The method requires data on age in single years by sex and estimated level of mortality to produce an annual series of births, crude birth rates, and general fertility rates for a maximum of 15 years prior to the census. Total fertility rates may be calculated if estimates of age patterns of fertility are available. Because this method relies on accurate reporting of age, careful examination of age data by sex should be done before applying this method.

Data required:

- Age in single years.
- Level of mortality.
- Estimate of age-specific fertility rates (if TFRs are desired).

Measures produced:

- Series of number of births.
- Crude birth rates.
- General fertility rates.
- Age-specific fertility rates (if estimated ASFR is used).
- Total fertility rates (if estimated ASFR is used).

Own Children Method

The own children method extends the reverse survival method by matching the children who are reverse survived to their mothers. By linking mothers and children, analysts can calculate age-specific fertility rates from the data. This method also allows analysts to produce disaggregated data by the characteristics of the mothers, such as education level. Matching can be done directly if the child is living with the mother and the line number of the mother was asked. When line number of the mother is not available, linkages may be inferred through relationship to the household head. Adjustments are made for children who do not live with their mothers. Data disaggregated by characteristics of the father may be produced by linking the child to the father.

Data required:

- Number of children in single years by age of their mothers in single years (matched children).
- Number of children not living with their own mothers by single years (unmatched children).
- Total number of women by single years.
- Level of mortality.

Measures produced:

- Series of number of births.
- Crude birth rates.
- General fertility rates.
- Age-specific fertility rates.
- Total fertility rates by characteristics of mothers (and fathers).

Rele Technique

The Rele technique relies on child-woman ratios (CWR) and estimated mortality to calculate fertility levels for one or two 5-year periods prior to the census date. Rele observed that in a stable population,

the relationship between CWR and fertility level are close to linear, and he derived a set of regression coefficients for different levels of mortality to fit the relationship. By applying Rele's coefficients for a given level of mortality to observed child-woman ratios, fertility levels can be estimated.

Data required:

- Number of children 0–4 years and 5–9 years.
- Number of women in age groups 15–44, 15–49, 20–49, and 20–54.
- Life expectancy at birth, both sexes combined.
- Sex ratio at birth.

Measures produced:

- Gross reproduction rate (GRR).
- Total fertility rate (TFR).

The Variable-r Method

The variable-r method estimates the average total fertility rate (TFR) between two censuses based on the age-specific growth rates of females between two censuses.

Data required:

- Number of females by 5-year age groups from two censuses.
- Intercensal estimates of:
 - Distribution of births by 5-year age groups of mothers.
 - Sex ratio at birth.
 - Proportion of females who survive from birth to the average age of childbearing.

Measure produced:

- Average total fertility rate for the period between the two censuses.

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