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The National Research Council

COMMITTEE ON
POPULATION AND DEMOGRAPHY

Report No. 3

Fertility and Mortality Changes in Honduras, 1950–1974

Kenneth Hill

Committee on Population and Demography
Assembly of Behavioral and Social Sciences
National Research Council

NATIONAL ACADEMY OF SCIENCES
Washington, D.C. 1980

NOTICE: The project that is the subject of this report was approved by the Governing Board of the National Research Council, whose members are drawn from the councils of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine. The members of the Committee responsible for the report were chosen for their special competences and with regard for appropriate balance.

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Preface

The Committee on Population and Demography was established in April 1977 by the National Research Council, in response to a request by the Agency for International Development (AID) of the U.S. Department of State. It was widely felt by those concerned that the time was ripe for a detailed review of levels and recent trends of fertility and mortality in the developing world. Although most people in the demographic community agree that mortality has declined in almost all developing countries during the last 30 years, there is uncertainty about more recent changes in mortality in some countries, about current levels of fertility, and about the existence and extent of recent changes in fertility.

In 1963, a Panel on Population Problems of the Committee on Science and Public Policy of the National Academy of Sciences published a report entitled *The Growth of World Population*. The appointment of that panel and the publication of its report were expressions of the concern then felt by scientists, as well as by other informed persons in many countries, about the implications of population trends. At that time, the most consequential trend was the pronounced and long-continued acceleration in the rate of increase of the population of the world, and especially of the population of the poorer countries. It was estimated in 1963 that the annual rate of increase of the global population had reached 2 percent, a rate that, if continued, would cause the total to double every 35 years. The disproportionate contribution of low-income areas to that acceleration was caused by rapid declines in mortality combined with high fertility that

remained almost unchanged: the birth rate was nearly fixed or declined more modestly than the death rate.

Since the earlier report, however, the peak rate of growth in the world's population has apparently been passed. A dramatic decline in the birth rate in almost all the more developed countries has lowered their aggregate annual rate of increase to well below 1 percent, and the peak rate of increase has also apparently been passed in the less-developed parts of the world as a whole. A sharp decline in fertility in many low-income areas has more than offset the generally continued reduction in the death rate, although the rate of population increase remains high in almost all less-developed countries.

The causes of the reductions in fertility—whether they are the effect primarily of such general changes as lowered infant mortality, increasing education, urban rather than rural residence, and improving status of women or of such particular changes as spreading knowledge of and access to efficient methods of contraception or abortion—are strongly debated. There are also divergent views of the appropriate national and international policies on population in the face of these changing trends. The differences in opinion extend to different beliefs and assertions about what the population trends really are in many of the less-developed countries. Because births and deaths are recorded very incompletely in much of Africa, Asia, and Latin America, levels and trends of fertility and mortality must be estimated, and disagreement has arisen in some instances about the most reliable estimates of those levels and trends.

It was to examine these questions that the Committee on Population and Demography was established within the Assembly of Behavioral and Social Sciences of the National Research Council. It was funded for a period of three years by AID under Contract No. AID/pha-C-1161. The Committee has undertaken three major tasks:

1. To evaluate available evidence and prepare estimates of levels and trends of fertility and mortality in selected developing nations;
2. To improve the technologies for estimating fertility and mortality when only incomplete or inadequate data exist (including techniques of data collection);
3. To evaluate the factors determining the changes in birth rates in less-developed nations.

Given the magnitude of these tasks, the Committee decided to concentrate its initial efforts on the first two tasks; it initiated work on the third task in 1979.

The Committee approaches the first task through careful assessment, by

internal and external comparison, and through analysis, by application of the most reliable methods known, of all the data sources available. Each of the country studies therefore consists of the application of a range of methods to a number of data sets. Best estimates of levels and recent trends are then developed on the grounds of their consistency and plausibility and the robustness of the individual methods from which they were derived.

The Committee's second task, refinement of methodology, is seen as a by-product of achieving the first. The application of particular methods to many different data sets from different countries and referring to different time periods will inevitably provide valuable information about the practical functioning of the methods themselves. Particular data sets might also require the development of new methodology or the refinement of existing techniques.

The Committee set three criteria for identifying countries to study in detail: that the country have a population large enough to be important in a world view; that there be some uncertainty about levels and recent trends of fertility or mortality; and that sufficient demographic data be available to warrant a detailed study. After a country has been selected for detailed study, the usual procedure is to set up a panel or working group of experts, both nationals of the country and others knowledgeable about the demography and demographic statistics of the country. The role of these panels and working groups, which generally include at least one Committee member, is to carry out the comparisons and analyses required. A small staff assists the Committee, panels, and working groups in their work.

As of early 1980, 120 population specialists around the world were members of one or more panels or working groups. This number includes 77 specialists from developing nations. The Committee, the Assembly, and the National Research Council are grateful for the unpaid time and effort these experts have been willing to give.

Each country being studied has a different mix of data sources and different problems with data errors. Therefore, there is no standard pattern for all the reports. However, each report includes a summary of the main findings regarding estimates of fertility and mortality, a description of the data sources available, and a presentation of the analyses that were carried out, classified by type of data analyzed; detailed methodological descriptions are included where necessary in appendixes.

In some of the reports the estimates of fertility and mortality are presented as ranges. The use of a range is deliberate. It indicates that the panel and the Committee are confident that the range includes the true value, but have concluded that the evidence does not warrant selecting a

single figure as best. The range conveys an important aspect (uncertainty) of the estimation. Ideally, in constructing an average for several populations in each of which estimation is presented as a range, an aggregate range should be calculated (as the population-weighted average of the constituents). The user who selects a single figure from the middle of the range does so at the risk of misleading simplification.

This report, on levels and recent trends of fertility and mortality in Honduras, is No. 3 in a series produced by the Committee. The Committee's thanks for this study are due to Kenneth Hill, who was largely responsible for its preparation, in collaboration with Committee members and with other members of the Committee staff. All the permanent staff of the Committee have helped in some way with the production of this report, but special thanks are due to Brenda Buchbinder, administrative assistant, to Mary Anne Fitzgerald, for carrying out many tedious and repetitive calculations, and to Solveig Padilla, for coping with the tables.

Thanks are also due to the staff of the National Research Council, in particular to David A. Goslin, executive director of the Assembly of Behavioral and Social Sciences, and Eugenia Grohman, associate director for reports of the Assembly, for their support, assistance, and advice. We are also grateful to reviewers of early drafts of this report, in particular to Shea Rutstein of the World Fertility Survey. Hitherto unpublished data from a sample of the 1974 census, which were obtained from the Centro Latinoamericano de Demografia, Santiago, Chile, have proved to be of great value in the analysis.

ANSLEY J. COALE, *Chairman*
Committee on Population and Demography

Summary and Conclusions

Estimates of fertility for the period from 1950 to the early 1970s are available from registered births and from the age structure of the population. Total fertility rates have been calculated for each year from 1951 to 1974 after inflating registered births by a factor of 1.18 to allow for underregistration and after inflating the 1974 census population by a factor of 1.11 at all ages to allow for estimated underenumeration relative to 1961; these rates are shown in Figure 1. Figure 1 also shows total fertility rates for 1971–1972 obtained from a multiround survey and from a retrospective survey. The pattern shown, of total fertility rising from a level of 6.74 in 1951 to a peak around 7.75 in the early 1960s and declining somewhat toward the middle 1970s, may be somewhat distorted by bunching of delayed birth registrations and by changes in the completeness of registration. It is clear, however, that fertility is very high and has been since the early 1950s; there is no firm evidence of any trend in fertility, although there is some indication that fertility in 1973 and 1974 may have been 3 or 4 percent lower than in 1972. The total fertility rate for the period 1950–1974 was probably between 7.0 and 7.5.

In combination with estimates of child mortality or of the rate of population growth, the age and sex composition of a population can be used to estimate the birth rate. The observed rates of population growth for the population of Honduras are seriously distorted by changes in the completeness of enumeration, which probably increased from 1945 to 1950, and again from 1950 to 1961, but then declined in 1974. Child mortality estimates were therefore used to obtain estimates of the birth

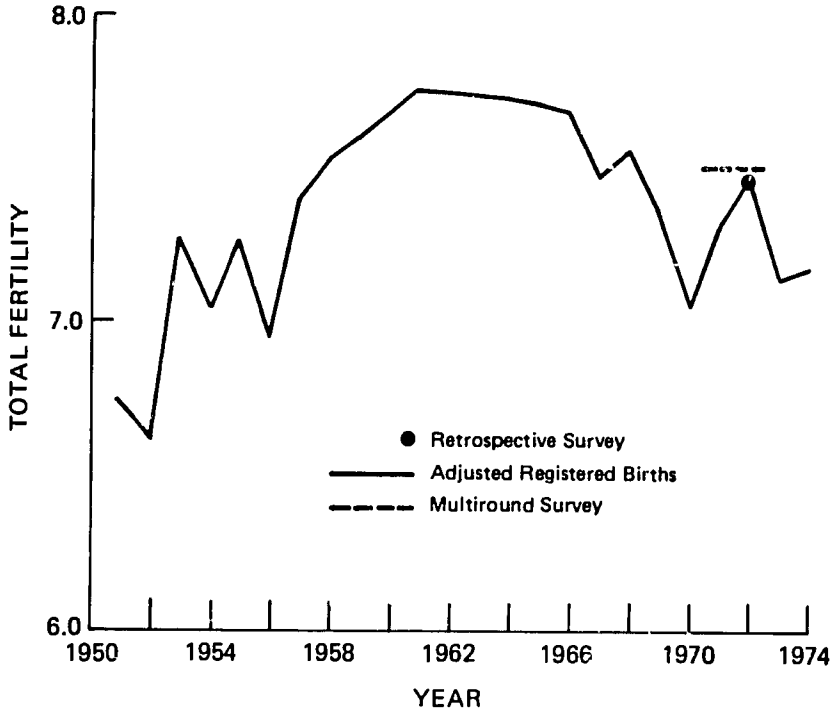

FIGURE 1 Total fertility rates from adjusted registration data, by year, 1951–1974, with comparable estimates: Honduras.

NOTE: The estimate for each year refers to the middle of the calendar year.

rate from the 1974 age structure of the population, and an extrapolation of child mortality trends was used for an analysis of the 1961 age distribution. Further extrapolation to 1950 was not considered justified, but an attempt was made to analyze the 1950 age structure by using the observed rate of population growth between 1945 and 1950. The resultant estimates of fertility and mortality were so low, however, in relation to those obtained for 1961 and 1974 that the calculations were repeated with a much lower rate of population growth, and more consistent results were obtained. The estimates of the birth rate obtained by analyzing the age structure are shown in Table 1; for comparative purposes, estimates for census years from adjusted registered births are also shown. The general picture is one of consistently high fertility, with birth rates around 50 per 1000 throughout the period. With the exception of 1950, the birth rates based on the age structure are consistent with those obtained from adjusted registered births.

TABLE 1 Estimates of the Birth Rate from Population Age Structure and Other Sources: Honduras

	1950	1951-1955	1956-1960	1961	1964-1968	1969-1973	1974
Age structure	46.4[a]	55.8[b]	49.6[b]	53.7[a]	50.7[c]	45.5[c]	50.7[a]
Adjusted registered births	50.9[d]			54.1			49.9
Multiround survey						49.2[e]	

[a] Stable population analysis, census age distribution (r = 1.5 percent in 1950).
[b] Reverse survival of 1961 census age distribution.
[c] Reverse survival of 1974 census age distribution.
[d] 1951.
[e] 1971-1972.

Useful information on mortality is somewhat more scanty than that on fertility, since registration of deaths was undoubtedly improving in the 1950s. The stable population analysis of the 1950 age distribution using a rate of growth of 1.5 percent per year gives a crude death rate in excess of 30 per 1000, suggesting a level of mortality around level 7 in the "North" family of the Coale-Demeny (1966) model life table system. Doubts about the accuracy of the 1950 age distribution make all mortality estimates for 1950 very uncertain, though what evidence there is suggests that mortality may have fallen very rapidly between 1950 and 1961, by which time the crude death rate is estimated to have been about 19 per 1000, mortality level 12 in the "North" family. Mortality continued to decline from 1961 to 1974, albeit somewhat more gradually: the crude death rate in 1974 was about 14 per 1000, mortality level 14.5 in the "North" family. Estimates of the overall level of mortality are rather consistent for the early 1970s, although some doubts remain about the age pattern of mortality. Estimates for the 1960s are somewhat less soundly based, but fit together well. Mortality estimates for 1950 are really little more than guesses, since the observed rate of population growth is not consistent with the age structure and the level of fertility. Table 2 shows various mortality indicators by period and source.

Information on international migration is incomplete because data on place of birth are not available either from the 1974 census of Honduras or from censuses of certain neighboring countries. From what information there is, however, it seems unlikely that international migration has

TABLE 2 Estimates of Mortality Measures for the Period from 1950 to 1974: Honduras

Mortality Measure	1950[a]	1961[a]	c. 1969[b]	1971-1972[c]	1974[a]
Crude death rate	30.7	19.2	14.3	14.2	14.5
Infant mortality rate	(204)	(127)	118	117	(98)
e_0 Male	(32.0)	(44.3)	50.7	50.9	(50.3)
e_{10} Male	(42.3)	(49.1)	53.5	55.4	(52.1)
e_0 Female	(35.0)	(47.5)	54.4	55.5	(53.8)
e_{10} Female	(44.6)	(52.7)	56.3	56.7	(54.8)
${}_5q_0$ Male	(.356)	(.226)	.183	.208	(.170)
${}_5q_0$ Female	(.324)	(.204)	.162	.152	(.151)

Note: Figures in parentheses are derived from model life tables, "North" family.

[a] Obtained by stable population analysis of census age distribution (see Table 6).
[b] Obtained by application of indirect mortality estimation procedures to data from 1972 Retrospective Survey (see Table 19).
[c] Obtained from 1970-1972 Multiround Demographic Survey (see Table 21).

affected population growth significantly, in either direction, in the period under consideration. It is possible that some net immigration, largely from El Salvador, has taken place, but without birthplace data from the 1974 census there is no firm evidence.

Assuming that net migration has been negligible, population growth will have been equal to the rate of natural increase. It seems likely that the rate of growth in 1950 was about 1.5 percent per year and had increased by 1961 to about 3.3 percent, partly as a result of a small rise in fertility but more importantly as a result of a very sharp drop in mortality. The rate of growth continued to increase after 1961, though much more slowly, as mortality declined more slowly; in the early 1970s, it is estimated to have been about 3.6 percent per year. Registration figures for 1973 and 1974 suggest a modest decline in fertility, though there is some reason to suppose that birth registration may have decreased slightly in those years.

Fertility and Mortality Changes in Honduras, 1950–1974

INTRODUCTION

Honduras has a relatively small population, enumerated as 2.66 million in the 1974 census, and therefore does not meet the first criterion of the Committee for a detailed country study. However, there is clear evidence that mortality has declined in the recent past, and there is a variety of types of demographic data available covering a fairly long time period. Thus for reasons of methodology alone, the recent demographic history of Honduras seemed worth looking into, and it was decided that the Committee staff should undertake a national-level study.

DATA SOURCES

Honduras has a relatively long history of censuses, stretching back to early in this century, and a relatively long-established vital registration system, although registration of both births and deaths is classified by the U.N. Statistical Office as being less than 90 percent complete. The only information available from the censuses before 1950 is total population size; from 1951 onward, the vital registration system provides births by five-year age group of mother and deaths by age group and sex. The data sources available are therefore limited to the population censuses of 1950, 1961, and 1974, registered births and deaths for the years 1951–1974, a four-round national sample survey carried out between the end of 1970 and late 1972, and a retrospective survey included in the last round of the

TABLE 3 Data Sources by Evidence Available: Honduras

Type of Evidence	Censuses 1950	Censuses 1961	Censuses 1974	Vital Registration 1951-1974	Multiround Survey 1970-1972	Retrospective Survey 1972
Age/sex distribution						
Five-year age groups	X	X	X		X	X
Single years			X			
Own children						
Births by five-year age group of mother				X	X	X
Deaths by five-year age group and sex				X	X	
Children ever born by age of mother			X[a]			X
Children surviving by age of mother			X[a]			X
Survival of mother (orphanhood)			X[a]			X
Survival of first husband (widowhood)						X
Marital status by five-year age group and sex		X			X	X

[a] From 10-percent sample of census households.

multiround survey. Table 3 summarizes the data relevant to this study by source.

RESULTS CLASSIFIED BY TYPE OF EVIDENCE

POPULATION AGE DISTRIBUTIONS

Age and sex distributions of the population of Honduras are available from the censuses of 1950, 1961, and 1974; distributions obtained on a sample basis are also available for 1970–1972, based on person-years lived, and for 1972. The total population size is also available from the censuses of 1935, 1940, and 1945. Table 4 shows the total population (by sex, from 1950) for each census year, with the implied intercensal growth rates. The trend of these growth rates shows a rise from 1940 to 1961 and then a decline from 1961 to 1974. Table 5 gives a rough indication of each age structure, giving for each sex the proportions in the broad age groups 0–14, 15–44, and 45 and over, for 1950, 1961, 1970–1972, 1972, and 1974. From 1961 onward, the age distributions are rather similar, the two census-based distributions showing marginally older populations than the two sample-based distributions. The 1950 census age distribution is, however, quite different from the others, showing a substantially older population.

Age distributions can be used to estimate underlying parameters of fertility and mortality (1) by applying stable population analysis, using either an estimate of the population growth rate or an independent estimate of child mortality, and (2) by applying reverse survival to young children, also using an estimate of child mortality, to estimate births in a period before the census or survey. In both cases, the estimates depend only on the age structure of the population and not on its absolute size. The questions of completeness of enumeration of the various censuses, and thus of absolute population size, can therefore be left to the end of this section, which first presents estimates of fertility and mortality obtained from stable population analysis and fertility estimates obtained by reverse survival.

Stable Population Analysis, 1950, 1961, and 1974

A comparison of the proportions in each age group of the female age distributions from each census with suitable stable population distributions indicates that the age distributions were not seriously distorted. The procedure recommended by the United Nations Manual IV (1967) in such situations, to apply stable population analysis to the male age distribution, was followed. No estimate of child mortality was available for 1950, so the

TABLE 4 Total Population (thousands) for Census Years and Implied Rates of Growth, 1935-1974: Honduras

	Census Year										
Sex	1935	*r* (%)	1940	*r* (%)	1945	*r* (%)	1950	*r* (%)	1961	*r* (%)	1974
Male	n.a.	—	n.a.	—	n.a.	—	686	2.9	939	2.6	1317
Female	n.a.	—	n.a.	—	n.a.	—	683	3.0	946	2.7	1340
Total	962	2.8	1108	1.6	1201	2.6	1369	3.0	1885	2.7	2657

Note: n.a. is not available.

TABLE 5 Proportion of the Population in Broad Age Groups by Sex, 1950, 1961, 1970-1972, 1972, and 1974: Honduras

Age/Sex Group	1950	1961	1970-1972	1972	1974
Males					
0-14	0.415	0.489	0.500	0.504	0.492
15-44	0.427	0.390	0.377	0.376	0.386
45+	0.159	0.121	0.124	0.120	0.122
Females					
0-14	0.397	0.468	0.480	0.474	0.469
15-44	0.435	0.409	0.389	0.394	0.408
45+	0.168	0.123	0.131	0.132	0.123
Overall sex ratio, males/female	1.005	0.993	0.989	0.974	0.983

rate of population growth between 1945 and 1950 was used in matching the observed population with models. For 1961, an estimate of child mortality, obtained by extrapolating into the past from child mortality estimates for around 1970 (following the procedure described in the section, "Estimates of Child Mortality," below), was used to select model stable populations. For 1974, an estimate of child mortality was obtained by extrapolating forward from the same estimates. Stable populations based upon the "North" age pattern of mortality were used, in accordance with evidence from registered deaths that this regional pattern best represents mortality risks in Honduras (see the following section on vital registration).

Table 6 shows the proportions of the male population under each age, the implied male birth rates, and, for 1961 and 1974, the adjusted birth rates, making some allowance for increasing population growth. For 1950, two series of estimates are given, one based on the observed intercensal growth rate of 2.5 percent, the other based on a rate of 1.5 percent. The latter, obtained as the rate of growth in 1950 from a comparison of the age structure of deaths and the age structure of the population (see the section below on death registration), gives results clearly more consistent with those for later years, and the difference between the two provides a useful example of how sensitive the analysis is to the estimate of the growth rate that is used. Those series based on estimates of child mortality are somewhat less sensitive; for instance, the use of level 13 in the "North" family for 1974 instead of level 14.5 would simply add about a point to the birth rate, and two or three points to the death rate. It should be noted,

TABLE 6 Stable Population Analysis of Male Age Distribution, 1950, 1961, and 1974: Honduras

	1950			1961			1974		
Age a	$C(a)^a$	Birth Rate b^b	Birth Rate b^c	$C(a)^a$	Birth Rate b^d	Adjusted Birth Rate $\hat{b}^e$	$C(a)^a$	Birth Rate b^f	Adjusted Birth Rate $\hat{b}^g$
5	.1601	38.1	44.9	.1926	50.0	50.4	.1868	46.4	46.4
10	.2924	37.4	46.5	.3597	53.1	54.0	.3505	48.8	49.4
15	.4146	38.9	49.9	.4886	53.1	55.9	.4924	51.0	52.4
20	.5163	38.9	49.7	.5840	51.4	56.0	.5985	50.9	53.2
25	.6059	39.4	49.9	.6651	50.4	55.8	.6808	50.1	53.4
30	.6785	38.8	48.4	.7314	49.4	55.3	.7412	48.5	52.7
35	.7387	37.9	46.1	.7896	49.0	55.2	.7927	47.2	52.3
40	.7945	38.0	45.4	.8392	49.0	55.1	.8397	46.8	52.5
Estimated Rates for Both Sexes (sex ratio at birth equals 1.05, sex ratio of population as reported)									
Birth rate		37.6	46.4			53.7			50.7
Death rate		12.6	30.7			19.2			14.5

[a] Proportion of male population under age a.
[b] Based on stable rate of growth of 2.5 percent.
[c] Based on stable rate of growth of 1.5 percent.
[d] Based on mortality level 12.0.
[e] Adjustment factor, k, for increase in rate of growth of .0220, $t = 17$ years.
[f] Based on mortality level 14.5.
[g] Adjustment factor, k, for increase in rate of growth of .0150, $t = 30$ years.

however, that not much confidence can be placed in the estimates obtained from stable population analysis of the 1950 age distribution. Even when a population growth rate of 1.5 percent is used, the estimate of the birth rate is only 46 per 1000, substantially lower than estimates for 1961 and 1974 and only marginally higher than the registered birth rate, prior to any adjustment, of 42 per 1000 for 1950. A comparison, age group by age group, of the 1950 and 1961 populations (see the next section) also indicates that one or the other is seriously distorted; consistency with estimates from other sources suggests that it is the 1950 age distribution that is wrong.

The set of estimates for 1950 based on a growth rate of 1.5 percent looks more plausible than that based on a growth rate of 2.5 percent, which gives implausibly low values of both fertility and mortality. The growth rate of 1.5 percent gives fertility estimates of the right order of magnitude, but implies very high mortality; mortality may very well have been high, but doubts about the quality of the age distribution itself render firm conclusions impossible. The estimates based on a growth rate of 1.5 percent per year correspond to an expectation of life at birth of about 34 years, around level 7 in the "North" family of the Coale-Demeny model life tables. The 1961 age distribution, showing high fertility and fairly high mortality, provides the most consistent set of estimates. The 1974 age distribution shows somewhat lower fertility and lower mortality; the relatively low birth rates obtained from the proportions under 5 and under 10 may be due to the effects of gradually declining fertility, but are more likely to be due to relative underenumeration of young children, in view of evidence that the 1974 census substantially underenumerated the total population (see the section below on completeness of enumeration). Estimates of the birth rate obtained from corrected registered births (shown in Table 10 below) agree reasonably well with the stable population estimates.

Estimation of the Birth Rate by Reverse Survival

Reverse survival of young children, to estimate births, and reverse projection of the total population, to estimate earlier population denominators, have been applied to the 1974, 1972, and 1961 populations classified by age group and sex. Mortality assumptions for five-year periods were obtained (see the section on estimates of child mortality), and an approximate population growth rate for the entire period was assumed; the value of the growth rate used has only a modest effect on the estimates of the birth rate. Estimated birth rates by sex and five-year period are shown in Table 7.

TABLE 7 Estimates of the Birth Rate Obtained by Reverse Survival: Honduras

Source	1951-1955[a]	1956-1960[b]	1959-1963[c]	1963-1967[d]	1964-1968[e]	1968-1972[f]	1969-1973[g]
1961 census							
Males	58.0	50.9					
Females	53.6	48.2					
1972 survey							
Males				54.6		49.2	
Females				50.6		45.2	
1974 census							
Males			56.8		52.7		47.0
Females			52.2		48.8		44.1

Note: Population denominators were obtained by assuming a constant rate of growth of 3.2 percent in all periods.

Mortality levels in "North" model life tables are as follows:

[a] 10.5
[b] 11.5
[c] 12.0
[d] 12.7
[e] 13.0
[f] 13.7
[g] 14.0

For each series, the birth rates are lower in the period immediately before the survey than in earlier periods, giving the impression of falling fertility. It may be concluded, however, that at least part of this apparent trend is spurious, since estimates for overlapping periods from different sources—for instance for 1956–1960 from the 1961 census and for 1959–1963 from the 1974 census—show the opposite trend. Omission of young children or exaggeration of their ages often reduces the relative size of the 0–4 age group. In support of some downward trend, however, it may be noted that the estimates obtained for the period immediately preceding each survey do decline by about 8 percent over a 13-year period indicating that the birth rate has fallen, that the relative enumeration of the reported 0–4 age group has worsened, or that the mortality decline assumed in the calculations was not correct.

Completeness of Enumeration

In many of the techniques used in this study, vital rates calculated from registered events are compared with population characteristics observed at a census or survey. When such comparisons are made, the population denominators used in calculating the rates affect their values and so also

affect the estimates of completeness of registration. It is therefore important to try to establish the relative completeness of enumeration of the successive censuses so that a consistent benchmark may be established, with reference to which the completeness of registration may be estimated. The variability of population growth rates by period shown in Table 4 suggests that completeness of enumeration has varied from one census to the next in Honduras; the decline in the growth rate for the most recent intercensal period is also suspicious in view of the high fertility rates and declining mortality rates estimated in other parts of this study.

A recently derived method for estimating the relative completeness of enumeration of two censuses and the completeness of registration of intercensal adult deaths has been proposed by Preston and Hill (1980). They show that, in a closed population, for any cohort the ratios of cohort size at a first census to cohort size at a second census and of intercensal cohort deaths to cohort size at the second census are linearly related if completeness of both death registration and enumeration are constant by age. The intercept of the straight line indicates the relative enumeration completeness of the two censuses, and its slope indicates the relative completeness of death registration. This method has been applied to the 1950–1961 and 1961–1974 intercensal periods. Table 8 shows, as an illustration, the basic data for the 1961–1974 application, and Figure 2 shows the points and fitted straight lines for both males and females. The estimates of completeness of enumeration and of death registration after childhood relative to the 1961 population enumeration are shown in Table 9.

The estimates for the 1950–1961 period are clearly unsatisfactory. Adjustment of the 1950 population by the amount shown leads to an implausibly low rate of intercensal growth with a substantial sex differential (the growth rates would be 2.1 percent for males, 1.7 percent for females), and adjustment of the intercensal deaths by the amount shown results in implausibly high mortality, in some cases off the scale of the mortality levels of the Coale-Demeny model life tables. A comparison, age group by age group, of the 1950 and 1961 populations raises some doubts about the accuracy of age reporting in 1950. The youngest age groups, 0–4 and 5–9, show very high rates of intercensal growth, between 4.5 and 5.0 percent per year, while the oldest age groups show negative growth, the population over 70 declining by more than 2.0 percent per year. An explanation of such growth rates would require complicated and dramatic changes in levels and age patterns of mortality or fertility that must be regarded as unlikely.

The estimates obtained for the 1961–1974 period seem much more reasonable; underenumeration in 1974 relative to 1961 does not vary with

TABLE 8 Population by Sex and Age Group, 1961 and 1974, by Cohort Age in 1961, with Registered Intercensal Cohort Deaths: Honduras

Age Group in 1961	Population 1961, $P(1)$[a]	Population 1974, $P(2)$[a]	Registered Cohort Deaths 1961-1973, D	$P(1)/P(2)$	$D/P(2)$
Males					
5-9	156,760	116,927	4,788	1.3307	.0410
10-14	121,024	93,765	4,354	1.2811	.0464
15-19	89,485	70,272	4,715	1.2639	.0671
20-24	76,066	63,391	4,783	1.1910	.0755
25-29	62,212	56,109	4,711	1.1005	.0840
30-34	54,684	45,175	4,496	1.2015	.0995
35-39	46,526	36,658	4,214	1.2597	.1150
40-44	37,236	28,011	4,242	1.3194	.1157
45-49	30,687	23,416	4,600	1.3007	.1964
50-54	25,112	17,818	5,209	1.3988	.2923
55-59	18,035	10,646	5,597	1.6814	.5258
60-64	17,624	8,359	5,620	2.0925	.6724
Females					
5-9	150,867	129,559	4,089	1.1558	.0316
10-14	114,[illegible]8	102,198	3,295	1.1092	.0322
15-19	94,688	75,957	3,282	1.2373	.0432
20-24	81,701	66,228	3,489	1.2244	.0527
25-29	68,125	59,164	3,834	1.1429	.0648
30-34	56,107	46,363	3,916	1.2011	.0845
35-39	48,872	38,311	3,597	1.2661	.0939
40-44	37,207	28,163	3,702	1.3113	.1315
45-49	30,845	23,797	3,984	1.2865	.1674
50-54	25,671	17,128	4,649	1.4876	.2714
55-59	18,202	11,434	5,291	1.5800	.4628
60-64	17,846	8,305	5,255	2.1328	.6328

[a] The populations have been moved back to the beginning of each year by using observed growth rates.

sex, male deaths are rather more completely registered than female deaths, the adjustment of the 1974 population gives more plausible intercensal growth rates (3.4 percent for males, 3.5 percent for females), and adjusted registered deaths give reasonable mortality levels (discussed in the section on vital registration). The 1961 census has therefore been adopted as the benchmark for this study, the 1950 enumerated population has not been adjusted for want of a reliable adjustment factor, and the 1974 population has been inflated by 11 percent, equally for each sex.

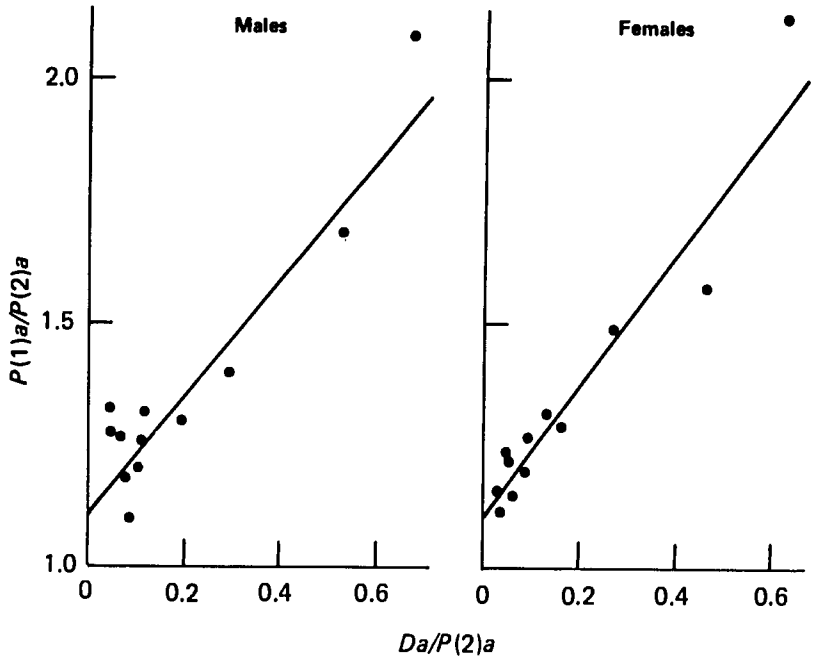

FIGURE 2 Cohort deaths as proportion of final cohort size plotted against initial cohort size as proportion of final cohort size, 1961–1974: Honduras.

An alternative explanation of the apparent population deficit in 1974 is net migration, since the technique used assumes a closed population. The effect of steady emigration from a cohort will be to reduce the size of the cohort by the amount of the emigration and also to reduce the cohort deaths by about half the proportionate amount of the net emigration.

TABLE 9 Estimates of Completeness of Enumeration and Death Registration, 1950-1961 and 1961-1974: Honduras

	Completeness in Relation to 1961 Census Enumeration of				
Sex	1950 Census	1951-1960 Registered Deaths	1961 Census	1961-1973 Registered Deaths	1974 Census
Males	0.92	0.30	1.00	0.83	0.90
Females	0.87	0.24	1.00	0.76	0.90

These effects will result in an underestimate of enumeration completeness of the second census relative to the first and an overestimate of registration completeness. However, these simple conclusions are confounded by the age pattern of migration and its heavy concentration among young adults; only those cohorts substantially affected by migration would be strongly distorted, and inspection of the points for those cohorts only would be expected to reveal whether migration had been an important factor or not.

Birthplace information from the 1974 census is not available, but in 1961 the foreign-born population was nearly 63,000, having increased from 33,000 in 1950. Information on those born in Honduras but enumerated in censuses elsewhere is rather difficult to obtain, since birthplace data are often not tabulated in sufficient detail or not published at all. Of those countries with data available, however, the United States had the largest number of people born in Honduras, about 19,000 in 1970; El Salvador had about 14,000 in 1971, and Guatemala nearly 10,000 in 1964. No figures are available for the other country bordering Honduras, Nicaragua, but the total number of foreign born enumerated in Nicaragua in 1963 was only about 5,000. Putting these scraps together and doubling them to allow for countries not included suggests that the number of people born in Honduras but living elsewhere in 1970 probably did not exceed 90,000; extrapolating forward from the foreign-born population of Honduras in 1961 (63,000), it seems reasonable to suppose that the number of foreign born in 1970 might also have been about 90,000. (Arrival and departure statistics, which cannot be considered reliable evidence for 1963–1967, showed a net loss of nearly 8,000 people, insufficient to account for the apparent population deficit in 1974.) Further, an examination, cohort by cohort, of intercensal survival rates does not show the pattern that would be expected from emigration. In general, then, the majority of the evidence does not support the possibility of substantial emigration between 1961 and 1974, although one piece of evidence that does support it comes from the 1970–1972 multiround survey: emigrants outnumbered immigrants by 2 to 1, giving a net emigration rate of 3 per 1000, enough to account for about half of the population deficit observed in 1974. One reason for not putting too much reliance on this finding is the fact that the number of people leaving the sample areas for other parts of Honduras also outnumbered those arriving from other parts of Honduras by a substantial margin (Somoza and Packer, 1975).

One special event that ought to be mentioned, since it is relevant to the question of migration between 1961 and 1974, is the so-called soccer war that took place between Honduras and El Salvador in July 1969. Population pressure in El Salvador is alleged to have resulted in

substantial migration to Honduras, causing tensions that culminated in a five-day war between the two countries. Some journalistic sources have claimed that as many as 300,000 Salvadorians had migrated to Honduras in the decade or two before 1969, though there is no confirmation for this estimate in the available statistics. It has also been claimed that as many as 200,000 of these immigrants left Honduras just before or after the war, though again there is no firm evidence to support that claim. Indeed, the registered births and deaths, which might be expected to show a sharp drop if 10 percent of the population suddenly left, show no sudden break in their trend in 1968, 1969, and 1970. One of the cease-fire provisions was that Salvadorians in Honduras were to be adequately treated; so again there is no reason to suppose that a large number were forced to return to El Salvador.

If the journalistic estimates of Salvadorian immigration are correct, the above estimates of underenumeration in 1974 may be too low. It seems unlikely that many of those immigrants returned to El Salvador after the 1969 war, but even if they did, only those who arrived in Honduras before the 1961 census would affect the estimates of relative census enumeration given above. The effect of the remaining migrants, arriving after one census but leaving before the next, would be to overestimate the completeness of death registration, since some of the deaths among them would probably be registered; the estimates of relative enumeration completeness would be little affected. Given the data available, there is no way of estimating the flow of Salvadorians to Honduras, though it seems unlikely that a large number returned suddenly to El Salvador around the time of the war. The estimates of relative underestimation of the 1974 census should be regarded as minimums since they assume a net immigration of zero.

COMPLETENESS OF VITAL REGISTRATION

Comparison of Registered Births with Average Number of Children Ever Born

Registered births by age of mother are available for Honduras from 1951 to 1974; information on average number of children ever born by age of mother is available from the retrospective sample survey of 1972 and from a 10-percent sample drawn from the 1974 census.

Two methods of analysis are available for estimating the completeness of registration of births by comparison with data on children ever born by age group of mother. The first method (Brass, 1964) cumulates age-specific registered birth rates and, after interpolation, compares the totals (denoted

TABLE 10 Estimates of Completeness of Birth Registration Based on Comparisons with Lifetime Fertility: Honduras

Part A Period Estimates, 1972 and 1974

Age	Registered Births	Estimated Female Midyear Population	Observed Fertility Rate f	Reported Average Parity P^a	Comparable Cumulated Current Fertility F	Estimated Completeness of Registration F/P
1972						
15-19	23,371	153,642	.1521	0.288	0.328	1.140
20-24	34,594	124,966	.2768	1.671	1.449	0.867
25-29	26,519	93,349	.2841	3.382	2.871	0.849
30-34	18,412	75,050	.2453	4.971	4.201	0.845
35-39	13,143	69,271	.1897	6.242	5.306	0.850
40-44	5,114	55,461	.0922	7.202	5.999	0.833
45-49	1,090	46,257	.0236	7.296	6.289	0.862
1974						
15-19	24,268	167,504	.1449	0.288	0.309	1.073
20-24	36,781	134,813	.2728	1.600	1.406	0.879
25-29	27,125	98,747	.2747	3.227	2.790	0.865
30-34	18,857	79,049	.2385	4.888	4.084	0.836
35-39	12,961	73,720	.1758	6.132	5.131	0.837
40-44	5,137	59,556	.0863	6.918	5.777	0.835
45-49	1,037	49,726	.0209	7.163	6.045	0.844

Part B Cohort Cumulation to 1974

Age of Cohort in 1974	Cumulated Cohort Fertility	Average Children Ever Born	Estimated Completeness of Registration for Cohort
15-19	0.253	0.288	0.931
20-24	1.342	1.600	0.861
25-29	2.740	3.227	0.848
30-34	4.135	4.888	0.841

[a] The data for 1972 are from the 1972 survey, after adjustment by the El Badry technique for false "not stateds." The data for 1974 are from a 10-percent sample; no adjustment for false "not stateds."

by *F*) by age group with the average number of children ever borne (denoted by *P*) by the women in the corresponding age groups. Assuming that younger women correctly report their children ever born and that the failure to register births does not vary with age, the age pattern of fertility obtained from registered births is accepted, but the level of fertility is adjusted to give the observed average parities for the younger women. One assumption of this method is that fertility is not changing, and a marked trend by age group of women in the estimates of registration completeness obtained would be a warning that the assumptions of the method may not have been met.

The second method of analysis does not require the assumption of constant fertility, but it does require more data. Age-specific fertility rates are calculated from registered births for 20 years or so before the census or survey providing information on children ever born. The fertility rates for each calendar year are split up to estimate single-year rates, which are then cumulated by cohort, selecting cohorts to coincide with conventional five-year age groups at the time of the census or survey. Completeness of registration for the period is then estimated by the ratio of the cumulated registered birth rates to the average number of children ever born per woman in each five-year age group reported by the census or survey. In practice, the cumulation is carried out only up to the 30–34 age group, since the registration data needed for women older than that extend an excessive length of time into the past. The method is not affected by changing fertility since cohorts of women are followed through their reproductive lives, but it is affected by changing completeness of birth registration: if registration is improving over time, the estimates of completeness based on the reports of older women will be of average completeness over their reproductive lives, thus being below the level of completeness at the time of the census or survey.

The first of the two methods, generally called the *P/F* ratio method, has been applied to the data for both 1972 and 1974, the two years for which data on children ever born are available. The second method has been applied only to 1974 because the observed average parities for 1972 and 1974 are so similar. The population denominators used were calculated using the inflated 1974 population, after allowing for relative underenumeration. The applications are shown in Table 10.

Excluding the estimates based on the generally unreliable 15–19 age group, the estimates of registration completeness are rather consistent, all falling within the range of 83–87 percent (see Table 10). The average completeness estimated by the *P/F* ratio method for both 1972 and 1974 is 85 percent, as is the average completeness for cohorts to 1974; all these

completeness estimates are relative to the completeness of enumeration of the 1961 census. A best estimate of 85 percent, the median of all the estimates except those for the 15–19 age group, is accepted, implying that registered births should be adjusted by a factor of 1.18 to allow for underregistration. The cohort cumulation procedure does not suggest that birth registration has improved much (improving registration would show up in the form of declining estimates of completeness as cohort age increases); the average level of completeness estimated for 1974 is the same as that for 1972, but the 1972 average parities come from a very much smaller sample and also incorporate an adjustment for nonresponse. It is therefore concluded that the completeness of birth registration has remained more or less constant during the recent past. Table 11 shows age-specific fertility rates for selected years obtained by adjusting registered births by a factor of 1.18 and calculating denominators for intercensal years by assuming a constant intercensal growth rate for each age group.

The very high fertility rates estimated for the early 1960s may in part result from a bunching of delayed registrations in that period, since births are recorded by year of registration rather than occurrence. A piece of circumstantial evidence that supports this idea is provided by the mean age of the fertility schedule: it increases steadily to the mid-1960s and then declines somewhat. It is possible that registration among older women improved or that the age pattern of fertility changed, actually got somewhat older, but it is also possible that delayed registrations, recording age of mother at the time of registration rather than at the time of the birth of the child, created higher recorded ages of mother. Evidence from the 1970–1972 multiround survey, not affected at all by delayed registration, gives an estimate of 29.3 years for the mean age of the fertility schedule, virtually the same as that obtained from registered births in the same period. This finding is consistent with, though of course it does not prove, the theory that the fertility rates for the early 1960s were somewhat inflated by delayed registration, whereas the more recent ones were little affected.

The sequence of total fertility rates obtained by inflating registered births by 1.18, shown in Figure 1, suggests that fertility may have been slightly lower in 1973 and 1974 than in 1972, since either the registration of births was somewhat less complete in the latter two years than earlier, for which we have found no evidence, or fertility rates averaged some 4 percent lower in these two years than in 1972. However, the recent total fertility rates show some fluctuations, and the level for 1970 is in fact lower than that for 1973 or 1974, so it would be unwise to conclude that a fertility decline has recently started, though it is a possibility.

TABLE 11 Age-Specific Fertility Rates Based on Adjusted Registered Births, Selected Years: Honduras

	Age-Specific Fertility Rates[a]						
	1951	1956	1961	1965	1969	1972	1974
Age Grour							
15-19	.1611	.1412	.1642	.1590	.1644	.1794	.1710
20-24	.3274	.3313	.3458	.3215	.3172	.3266	.3219
25-29	.3487	.3510	.3611	.3481	.3363	.3352	.3241
30-34	.2734	.2779	.3108	.3214	.3041	.2895	.2814
35-39	.1449	.1947	.2329	.2380	.2211	.2238	.2074
40-44	.0773	.0761	.1005	.1064	.1031	.1088	.1018
45-49	.0154	.0181	.0350	.0455	.0231	.0278	.0247
TFR	6.74	6.95	7.75	7.70	7.35	7.46	7.16
Mean age at childbearing	28.3	28.8	29.3	29.6	29.2	29.1	29.0
Birth rate (census years)	50.9[b]		54.1				49.9

[a] Births registered in year shown inflated by 1.18 for underregistration; 1974 population inflated by 1.11.
[b] One year after the 1950 census; population estimated by interpolation between 1950 and 1961 populations.

Estimates of the Completeness of Death Registration

Brass (1975) and Preston (Preston and Hill, 1980) have devised methods of estimating the completeness of registration of deaths that occur after childhood. Both methods are based on the assumption that the population under study is stable: the Brass method uses information on the age structure of deaths and the age structure of the population, whereas the Preston method uses information on the age structure of deaths and an estimate of the stable rate of natural increase.

Registered deaths by five-year age group and sex are available from 1951 to 1974, but census age distributions are available only for 1950, 1961, and 1974. For the application of the Brass technique, the 1950 census age distribution was moved forward to mid-1951 using the observed intercensal growth rate. The 1961 enumerated population was also moved forward to midyear, and the 1974 population was both moved to midyear and inflated by a factor of 1.11. The Preston method has been applied to the same three years.

Estimates of completeness of registration, with a stable rate of population growth, are shown in Table 12. For the Brass method, the rates of growth are estimated as a part of the method; for the Preston method, the growth rates are assumed. The variant of the Brass technique applied uses successive age groups rather than successive point ages to provide "birth" rates of the population over given ages, as recommended by Rachad (1977); straight lines were fitted to observed points using a trimmed mean procedure by which the three lowest and the three highest points were increasingly underweighted. The graphs obtained by applying the Brass techniques are shown in Figure 3.

Consistency is not a notable feature of the estimates shown in Table 12. The estimates of completeness vary by at least 25 percent, and it is clear that the Preston results depend critically on the estimates of the growth rate; when the growth rates estimated by the Brass technique are used in applying the Preston method, the completeness estimates are almost identical, except in 1974. The Brass estimates show low completeness and rather slow growth around 1951, improved registration (especially for females) and doubled growth rates by 1961, and 80 percent or higher completeness for both sexes with high growth rates in 1974, consistent with the intercensal rates obtained by inflating the 1974 population totals. The 1951 estimates, of course, depend on the 1950 age distribution, which has been shown to be suspect. The Preston estimates of completeness of registration rise in some cases and decline in others between 1961 and 1974, depending on the rate of growth. In view of the variations by sex, by method, and by period, it is difficult to reach any firm conclusions about

TABLE 12 Estimates of Completeness of Death Registration, by Sex, 1951, 1961, and 1974: Honduras

Method	1951		1961		1974	
	Completeness	Rate of Growth[a] (percent)	Completeness	Rate of Growth[a] (percent)	Completeness	Rate of Growth[a] (percent)
Males						
Brass	0.424	1.4	0.701	2.9	0.795	3.3
Preston[b]	0.684	(2.8)	0.678	(2.9)	0.564	(2.6)
Preston[c]	n.a.	n.a.	0.778	(3.2)	0.785	(3.4)
Preston[d]	0.425	(1.4)	0.678	(2.9)	0.752	(3.3)
Females						
Brass	0.459	1.5	0.782	3.2	0.844	3.6
Preston[b]	0.722	(2.8)	0.642	(2.8)	0.536	(2.7)
Preston[c]	n.a.	n.a.	0.805	(3.3)	0.758	(3.5)
Preston[d]	0.456	(1.5)	0.771	(3.2)	0.791	(3.6)

Note: n.a. means not available.

[a] Growth rates in parentheses are assumed; growth rates not in parentheses are estimated by the method.
[b] Using average of growth rates observed on either side of year shown, except for 1974, which used the observed intercensal growth rate for 1961-1974.
[c] As in footnote *b*, but after adjusting 1974 total by 1.11 for underenumeration.
[d] Taking the rate of growth from the Brass estimate.

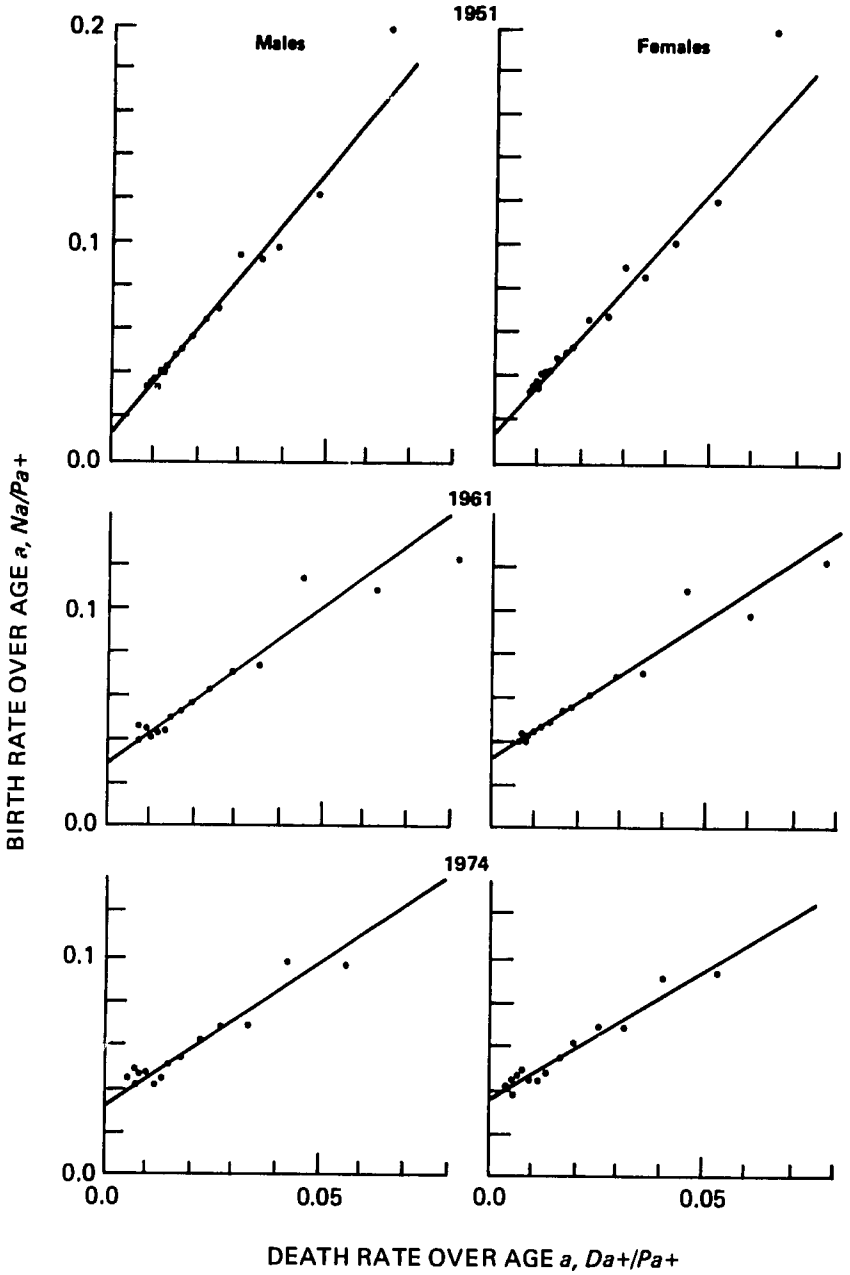

FIGURE 3 Applications of the Brass growth balance method, 1951, 1961, and 1974: Honduras.

the level of completeness of registration of deaths after childhood beyond saying that registration is incomplete, that it was more incomplete in 1951 than in 1961 or 1974, that in 1974 completeness was probably within the range of 75–85 percent, and that it may have been in the range of 70–80 percent in 1961. It is interesting to bear in mind that the intercensal cohort survival method (covered in the previous section) gave estimates of completeness of registration of deaths after childhood for the 1961–1974 intercensal period of 83 percent for males and 76 percent for females. The intercensal method does not, of course, make any assumptions about stability.

It should be emphasized that the estimates being discussed here are of completeness of registration of deaths after early childhood; registration of infant deaths in Honduras is much less complete (as is discussed below).

Registered deaths provide information not only about the level of mortality but also about its age pattern. If it can be assumed that completeness of registration is approximately constant by age, deaths recorded by age and sex can be adjusted by the reciprocal of the estimated level of completeness, age-specific mortality rates can be calculated for each sex, and these estimated rates can be compared with those from model life table systems of similar mortality levels in order to select for subsequent use a model life table system with a suitable age pattern of mortality. The necessary information, namely deaths by age group and sex, and population denominators are available for Honduras for 1961 and 1974. Deaths were inflated to allow for estimated completeness of adult death registration of 83 percent for males and 76 percent for females; the 1974 population was increased by a factor of 1.11 for both sexes to allow for relative underenumeration in 1974. Age-specific mortality rates were then calculated, separately by sex. Corresponding death rates from a standard level life table from each Coale-Demeny regional family were found, and differences were calculated for each age group. Relative differences, expressed as a proportion of the model values, are shown graphically by age (for age groups after infancy) in Figure 4. The standard level used was chosen to give mortality rates approximately equal to the observed values for the central age range: level 14 was chosen for 1961 and level 17 for 1974.

Figure 4 calls attention to several important points. Perhaps the most obvious feature is the similarity between the deviations for 1961 and those for 1974; the observed mortality rates are thus consistent for the two years, though of course the reason for this consistency may be similar data errors for both years. Further, the deviations from the model mortality patterns are rather large, particularly in late childhood and middle age. The variation in the deviations by family also indicates that in order to

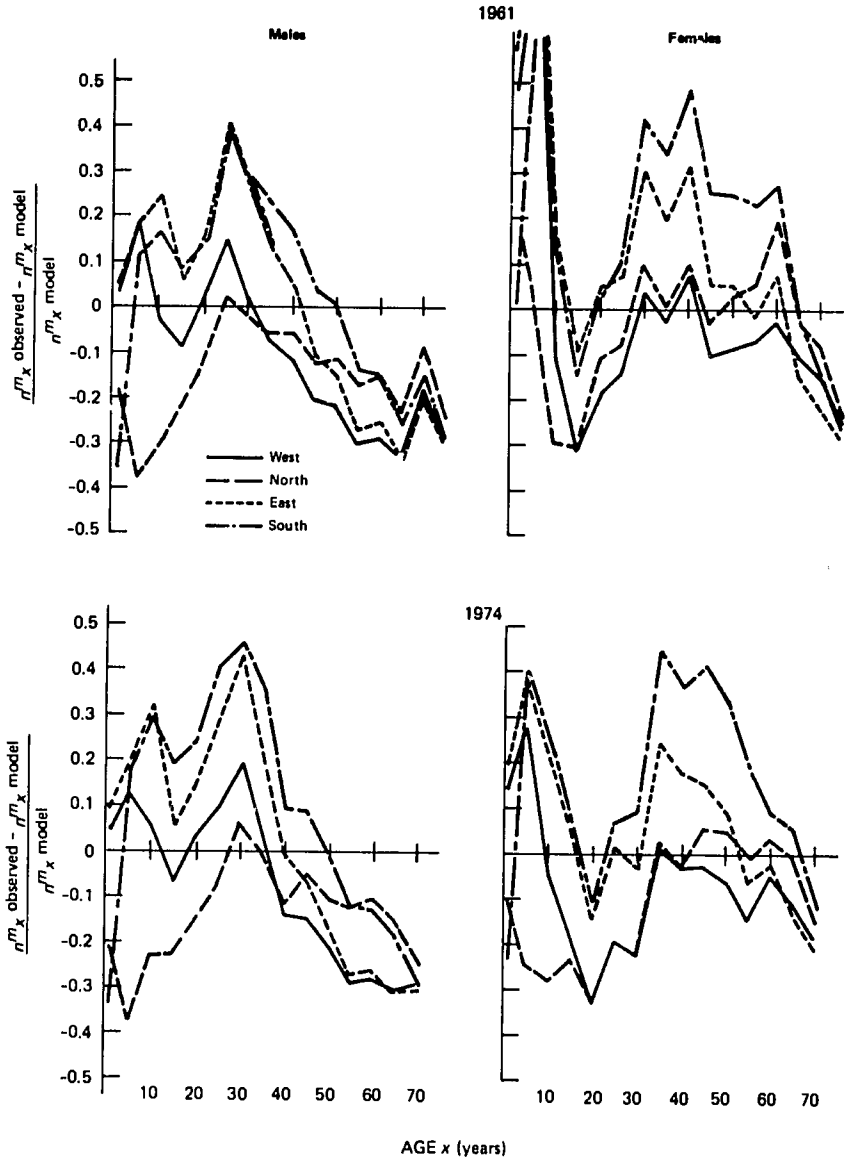

FIGURE 4 Relative deviations of observed age-specific mortality rates from model values, 1961 and 1974: Honduras.

TABLE 13 Comparison of Current and Retrospective Fertility, 1972 Survey: Honduras

Age Group of Women	Female Population	Recorded Births	Children Ever Born[a]	Observed Fertility Rate	Average Parity[b]	Cumulated Current Fertility	Adjustment Factor *P/F*
All Births							
15-19	1586	234	455	.1475	0.288	0.381	0.756
20-24	1292	394	2153	.3050	1.671	1.645	1.016
25-29	979	318	3302	.3248	3.382	3.251	1.040
30-34	790	229	3916	.2899	4.971	4.780	1.040
35-39	757	174	4712	.2299	6.242	6.067	1.029
40-44	585	73	4201	.1248	7.202	6.900	1.044
45-49	501	11	3645	.0220	7.296	7.216	1.011
First Births Only							
15-19	1586	134	323	.0845	0.204	0.257	0.792
20-24	1292	96	917	.0743	0.710	0.667	1.065
25-29	979	19	868	.0194	0.887	0.857	1.035
30-34	790	5	732	.0063	0.927	0.912	1.016
35-39	757	—	714	—	0.943	0.923	1.022
40-44	585	—	555	—	0.949	0.923	1.028
45-49	501	—	471	—	0.940	0.923	1.018

[a] Reported.
[b] After application of the El Badry technique to estimate true "not stateds" (0.28 percent of all women).

represent the true age-specific mortality rates properly, it is important to select the right model; at most ages, some deviations are positive and some negative. All observed male rates are below model ones after age 50, suggesting that either the numerators, registered deaths, are too small, or the denominators, male population, are too large, or, of course, a combination of both. Female rates are not consistently too low until after age 60 in 1961 or age 70 in 1974. It is interesting to note that although the male and female patterns are broadly similar, there do seem to be systematic differences by sex. For example, the female observed rates are relatively low around age 20, have a peak in the age group 5–9, and reach another peak around age 40; for males, the first peak is less marked and later, the subsequent trough is less marked, the main peak comes around 30, and the shortfall after age 50 is much more marked. Once again it should be stressed that there is no reason to suppose that these patterns reflect real differences in the age pattern of mortality by sex rather than consistent age patterns of error that are different by sex.

The final choice of a family cannot be made with much confidence from Figure 4, though the choice seems to lie between "North" and "West." When relative errors are summed for all ages, the "North" family gives a somewhat lower sum than the "West" family in all four cases, and so "North" has been selected.

RETROSPECTIVE SURVEY INFORMATION ON FERTILITY

The 1972 retrospective survey collected information on children ever born by age of mother and on the date of each woman's most recent live birth. Tabulations are available (Hill et al., 1977) that make it possible to compare current fertility, that is, births by age of mother in the year before the survey, with lifetime fertility, that is, children ever born by age of mother, both for all births, regardless of order, and for first births only. These survey data for 1972 thus provide fertility information that is entirely independent of the vital registration system. Table 13 shows the internal comparison of the survey data for all births and for first births.

Excluding the 15–19 age group, for which the interpolation procedure used is too crude to give reliable results, the ratios of current to retrospective fertility experience are very consistent, show no trend with age, and give an average adjustment factor for current fertility of 1.03. This adjustment factor is close to what one would expect if all births were reported with no timing error, given the form of the question, which was date of most recent birth. A subsequent tabulation of births in the last year would count multiple births or a woman with two single births in the year only once, the combined effect of which might be to reduce the number of

TABLE 14 Age-Specific Fertility Rates, 1972, from Adjusted Registration and Adjusted Survey Data: Honduras

Source	Age Group of Women							TFR
	15-19	20-24	25-29	30-34	35-39	40-44	45-49	
Adjusted registered births	.1794	.3266	.3352	.2895	.2238	.1088	.0278	7.46
Adjusted survey data	.1833	.3162	.3309	.2942	.2260	.1180	.0204	7.44

births recorded by some 2 or 3 percent. The ratios of current to retrospective fertility for first births only are somewhat more erratic, though the average, once again excluding the 15–19 age group, is also 1.03. Given the general consistency of the adjustment factors with age and birth order, considerable confidence can be placed in a set of fertility rates obtained by inflating the observed rates by 1.03 and adjusting the rates by half a year to coincide with conventional age groups, the women having been half a year younger, on average, at the time of a reported birth than at the time of the survey. Adjusted rates are shown in Table 14, together with the rates calculated for 1972 from adjusted registered births. The two sets of rates are compared graphically in Figure 5. The two distributions are very similar and give total fertility rates that are practically identical. This close agreement provides powerful confirmation for the general level of fertility in 1972.

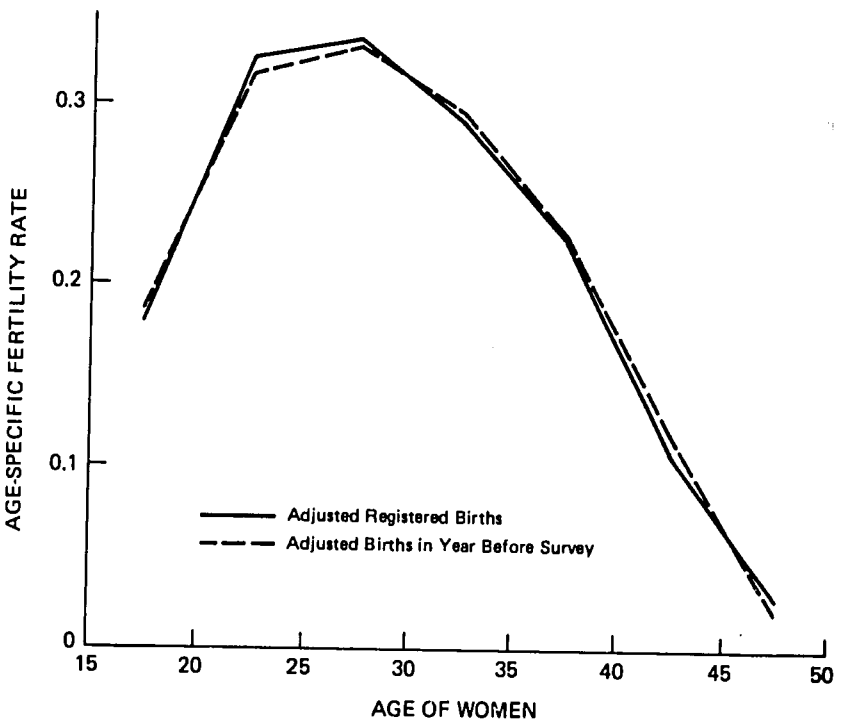

FIGURE 5 Age-specific fertility rates from adjusted registered births and adjusted survey data: Honduras.

INDIRECT METHODS FOR MORTALITY ESTIMATION

Estimates of Child Mortality

Child mortality can be estimated from information on the proportion dead among children ever borne by women in given age groups (Brass, 1964; Trussell, 1975). Such information is available for Honduras from two sources, the 1972 retrospective sample survey, and a 10-percent sample tabulation of the 1974 census. Several methods have been proposed for converting the proportions dead among children ever born to women of given age groups into probabilities of dying by exact ages of childhood, but the results given by the various methods do not in general differ greatly. A method proposed by Trussell, who used regression analysis to study the relationships between proportions dead and mortality risks in model situations, described in a technical manual (National Research Council, 1981), has been used here. In accordance with the evidence about the age pattern of mortality discussed above, the version of the Trussell method based on the "North" family of regional model life tables (Coale and Demeny, 1966) was used. Reported proportions dead by age group of mother, and derived child mortality estimates, are shown in Table 15. The probabilities of dying by exact ages of childhood have also been converted into estimates of mortality level in the "North" family of the Coale-Demeny model life tables.

TABLE 15 Child Mortality Estimates from Data on Children Dead Among Children Ever Born, 1972 and 1974: Honduras

Age Group of Women	Proportion of Children Dead	x	${}_xq_0$	Equivalent Mortality Level ("North" Models)	Years Prior to Survey (t^*)
1972 Survey					
20-24	.1602	2	.1579	12.4	2.4
25-29	.1914	3	.1801	12.3	4.4
30-34	.1956	5	.1912	13.1	6.5
1974 Census					
20-24	.1399	2	.1370	13.7	2.5
25-29	.1446	3	.1359	14.7	4.4
30-34	.1724	5	.1687	14.1	6.3

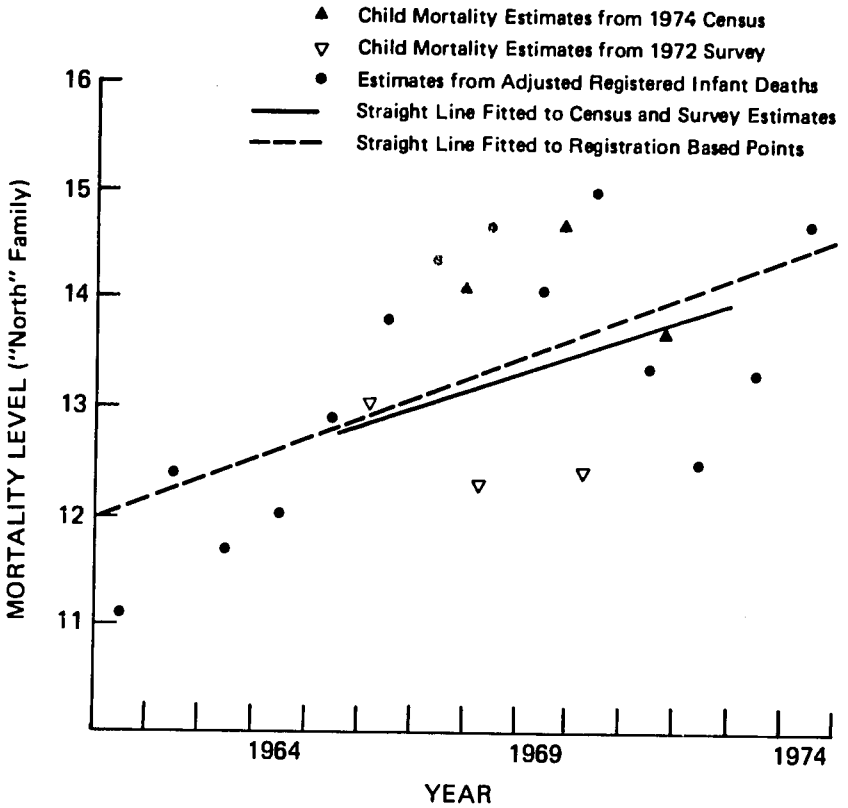

FIGURE 6 Levels of child mortality estimates in "North" family of model life tables by time period, 1961–1974: Honduras.

These estimates of child mortality are derived from retrospective reports of women about all their children, whose births were distributed over a period prior to the survey, the length of the period increasing with the average age of the women. The mortality experience represented by the proportion dead is an average of mortality over a period, and the mortality estimates obtained refer to some time in the past. If mortality has been constant, the time reference of the estimates does not matter, but if mortality has been changing, it is useful to be able to pinpoint the period to which the various mortality estimates refer. By assuming that mortality risks have been changing linearly over the period prior to the survey, it is possible to estimate the point to which each estimate refers, and a procedure for doing this has been devised by Coale and Trussell (National

Research Council, 1981). The estimated time location of each estimate, in terms of years before the survey, is shown in Table 15; the estimates are plotted as triangles in Figure 6.

The results obtained from the census and the survey seem to be inconsistent. The estimates of mortality levels in the "North" family of model life tables obtained from the survey are at least one level lower than those obtained from the census, the average difference being 1.6 mortality levels, equivalent to a difference in expectation of life at birth of nearly four years. As Figure 6 shows, although the reference periods of the estimates overlap, the levels obtained from the census are clearly above the levels obtained from the survey, so declining mortality cannot explain the difference. In both cases the data come from samples, and sampling error may explain much of the difference; if so, the census sample should be preferred since it is 10 times the size of the survey sample. Neither source, however, gives estimates that show a clear trend in child mortality with time; in fact, if anything, the estimates from each source seem to show increasing mortality, so it seems likely that some sort of reporting error is involved.

In an attempt to estimate a trend in child mortality, the six points were divided by period into two groups of three and a line drawn through the midpoints of the two clusters; this trend line, shown as a solid line in Figure 6, has a slope indicating an improvement in child mortality of 0.13 of a level per year. In view of the dispersion of the results, however, one cannot have much confidence in this trend estimate, but there is an additional piece of information. Infant mortality rates can be calculated from registered births and infant deaths, and although the level of such estimates will be grossly distorted by omission, both of births but more importantly of deaths, the trend will not be distorted unless completeness of registration changes. Infant mortality rates were calculated using registered events for each year from 1961 to 1974, and the average rate over the period was then calculated. The adjustment factor necessary to equate this rate with the estimate of infant mortality obtained for the beginning of 1968 from the mortality level trend line based on the indirect techniques was calculated. This factor, 2.81, was then applied to the registered infant mortality rates, and the implied levels in the "North" model life tables of the adjusted rates were found. These calculations are summarized in Table 16, and the levels are plotted as solid circles in Figure 6. The fluctuations are wild, but the levels do seem to show an upward trend; a straight line fitted by least-squares regression gives an annual improvement of 0.19 of a level per year, as shown by the dashed line in Figure 6. Only 41 percent of the variance of the points is explained by this line, however, so the confirmation is not very powerful, but the rate

TABLE 16 Births, Deaths, Observed and Adjusted Infant Mortality Rates, 1961-1974: Honduras

Year	Registered		Infant Mortality Rate		Mortality Level[b] Adjusted Rate ("North" Family)
	Births	Infant Deaths	Observed (per thousand)	Adjusted[a] (per thousand)	
1961	85,842	4,283	50	140	11.1
1962	92,128	4,020	44	123	12.4
1963	93,649	4,400	47	132	11.7
1964	100,315	4,564	45	128	12.0
1965	99,871	4,116	41	116	12.9
1966	100,266	3,790	38	106	13.8
1967	102,606	3,644	36	100	14.4
1968	107,302	3,650	34	96	14.7
1969	108,306	3,951	36	103	14.1
1970	107,121	3,559	33	93	15.0
1971	117,430	4,637	39	111	13.4
1972	122,267	5,260	43	121	12.5
1973	121,246	4,827	40	112	13.3
1974	126,166	4,301	34	96	14.7

[a] Observed rate times 2.81.
[b] Assuming sex ratio at birth of 105 males per 100 females.

of improvement agrees reasonably with that found from the indirect estimation procedure.

Infant mortality rates estimated from incomplete registration data will vary with changes in completeness of registration of either births or deaths. If birth registration improves while infant death registration remains constant, infant mortality will appear to fall, while if birth registration gets worse, infant mortality will apparently rise. However, if birth registration gets worse, it may be precisely those infants who die whose births are not registered and whose deaths will not be registered either; in this case, the registration of infant deaths will get worse, and infant mortality will apparently fall. In Honduras, however, there is no reason to suppose that completeness of birth registration has changed much since the early 1960s, so changes in infant death registration completeness are the most likely source of error. The decline in infant mortality discussed above could result from a decline in infant death registration or from more rapidly declining infant mortality being partially masked by improving infant death registration. The weak agreement of the trends obtained directly and indirectly suggests that the observed pattern may approximate the true one.

TABLE 17 Proportions with Surviving Mother by Age Group and Derived Estimates of Adult Survivorship, 1972 and 1974: Honduras

		1972 Survey		1974 Census	
Age Group of Respondents	Age N	Proportion with Mother Surviving	Female Survivorship Probability $l(25+N)/l(25)$	Proportion with Mother Surviving	Female Survivorship Probability $l(25+N)/l(25)$
15-19	20	0.929	0.925	0.930	0.927
20-24	25	0.877	0.875	0.882	0.879
25-29	30	0.809	0.813	0.814	0.818
30-34	35	0.713	0.723	0.721	0.731
35-39	40	0.596	0.604	0.610	0.620
40-44	45	0.504	0.506	0.498	0.500
45-49	50	0.389	0.371	0.387	0.369

Note: Mean age of childbearing: 26.92 years.

It is concluded, therefore, that child mortality has been declining in the recent past, the probability of dying by age 5 decreasing from about 0.247 in 1961 to about 0.186 in 1974. It is clear that infant deaths are very heavily underregistered; if these estimates of child mortality are correct, the completeness of infant death registration relative to birth registration is only 36 percent, and since birth registration is only estimated to be some 84 percent complete, the overall completeness of infant death registration is only 30 percent, three times worse than the completeness of adult death registration. Reasonable confidence can be placed in the general level of these child mortality rates, but the estimates of trends are much less soundly based, given the possible biases in the infant mortality rates obtained from registration data and the lack of consistency of the indirect estimates.

Adult Female Mortality

Techniques have been developed for obtaining estimates of adult survivorship from information on survival of mother or father (Brass and Hill, 1973; Hill and Trussell, 1977). The basic method is based on the fact that the parents of a particular respondent are known to have been alive at the time of conception (in the case of the father) or birth (for the mother) of the respondent. The parents were then exposed to the risk of dying for a period equal to the respondent's age (mothers) or age plus gestation period (fathers). The proportion of respondents of a particular age (or, usually, in a particular age group) with a surviving parent is therefore an indicator of adult survival probabilities. Models have been used to study the relationship between survival probabilities and proportions with surviving parents by age group, and methods for converting the latter into the former have been devised.

In Honduras, information on survival of mother is available from the 1972 retrospective survey and from a 10-percent sample of the 1974 census. Adult survivorship probabilities were calculated from the proportions with surviving mother using regression constants calculated by Hill (National Research Council, 1981). One of the independent variables used in the regression technique is the mean age of childbearing in the population; in both applications, this mean was calculated using information on the age pattern of births in the year before the 1972 survey, the 1974 registered births by age not being used for this purpose because of suspicions about their age pattern. Table 17 shows the proportions not maternally orphaned in the age range 15–49 and estimates of female survivorship from age 25 for both the 1972 survey and the 1974 census. The proportions with surviving mother are very consistent between the

TABLE 18 Logit Life Table Constants α and β Calculated from Survivorship Probabilities Shown in Table 17: Honduras

	1972			1974		
	$l(25+N)/l(25)$	α	β	$l(25+N)/l(25)$	α	β
Age N						
20	0.925	−0.170	0.673	0.927	−0.187	0.678
25	0.875	−0.041	0.787	0.879	−0.065	0.785
30	0.813	0.047	0.865	0.818	0.025	0.865
35	0.723	0.140	0.947	0.731	0.114	0.944
40	0.604	0.215	1.013	0.620	0.177	0.999
45	0.506	0.187	0.988	0.500	0.190	1.010
50	0.371	0.181	0.983	0.369	0.176	0.998
Female $l(2)$		0.866			0.871	
Mean		0.080	0.89		0.061	0.90
Median		0.140	0.95		0.114	0.94

two sources, as are the survivorship estimates, these being in most cases slightly higher from the 1974 data than from the 1972 data, consistent with the possibility of declining adult mortality.

There are several ways in which adult and child mortality estimates can be linked together to provide a complete life table, and one of the most convenient is the logit system (Brass, 1975). This system proposes that a life table can be defined in terms of some standard life table in such a way that

$$Y(a) = \alpha + \beta YS(a),$$

where α and β are constants, $Y(a)$ is the logit of $l(a)$, the probability of surviving to age a, and $YS(a)$ is the logit of the probability of surviving to age a in the standard life table. The logit of a probability p is defined as $1/2 \log [(1 - p)/p]$. The constant α can be interpreted as a measure of the level of mortality relative to the standard, and β can be interpeted as a shape parameter, determining the relationship between child and adult mortality relative to that of the standard. The logit system provides a useful way of looking at the consistency of adult mortality estimates obtained from orphanhood data. Given an estimate of survivorship to age 2, $l(2)$, each adult survivorship ratio $l(25 + N)/l(25)$ defines a unique pair of α and β values for any given standard and, although the values of α and β cannot be determined explicitly, iteration techniques can be used to obtain values of any required precision. In the case of Honduras, the standard used is a Coale-Demeny "North" family model life table, level 16, for females. An estimate of $l(2)$ for females, referring to a period five years before the date of the survey, was obtained by finding the mortality level for the required date from the trend line in Figure 6 and finding the female $l(2)$ corresponding to that level. An estimate for five years before the survey was used because of the fact that orphanhood data reflect deaths throughout a lengthy exposure period (data for young children, reflecting short exposure periods, are normally not usable because the reported incidence of orphanhood is implausibly low, perhaps because young orphans are adopted by relatives who are then recorded as the true, and of course surviving, parents). Estimates of α and β for each value of $l(25 + N)/l(25)$ are shown in Table 18; although they are extremely consistent between surveys, the internal consistency is not impressive, the values of β showing a marked tendency to increase with age of respondent. In general terms, the level of mortality, as measured by α, falls from 1972 to 1974, though this measure is largely determined by the assumed $l(2)$; the age pattern of mortality, however, as measured by β, has not changed measurably, adult mortality being shown to be somewhat lower, in relation to child mortality, than in the "North" level 16 standard. Declining

TABLE 19 Estimation of Adult Male Survivorship from Proportions of Ever-Married Women with Surviving First Husband, 1972: Honduras

	Proportion of Ever-Married Women with Surviving First Husband	N	Male Probability of Surviving $l(N)/l(20)$	Logit Life Table Constants ($l(2)$ Male = .846)	
				α	β
Age Group of Women					
25-29	.9498	25	.9650	0.181	0.990
30-34	.9303	30	.9426	0.052	0.866
35-39	.8601	35	.8905	0.207	1.015
40-44	.8496	40	.8805	0.060	0.874
45-49	.7785	45	.8316	0.109	0.921
50-54	.7237	50	.7969	0.076	0.890
55-59	.6900	55	.7845	−0.031	0.787
Mean				0.094	0.91
Median				0.076	0.89

Note: Singulate mean age at marriage is 24.3 for males and 20.1 years for females.

mortality and the time reference of orphanhood estimates may be responsible for the general trend of β with age shown in Table 18.

For the sake of completeness, it should be noted that the 1972 survey included an additional question related to orphanhood that was intended to identify those respondents who were the eldest surviving child of their mothers, with a view to removing the possible bias arising from multiple reporting of the same mother. An analysis of these data resulted in higher estimates of female mortality (Hill et al., 1977). However, the proportion of all respondents who claimed to be eldest surviving children was higher than would be expected, and the inclusion of other survival orders would tend to bias upwards mortality estimates based on such data. Experience elsewhere with similar questions has tended to confirm their unreliability, so no further use of these data is made in this study.

Adult Male Mortality

Attempts have been made to estimate adult male mortality from information on survival of fathers, but all the possible objections concerning the maternal orphanhood procedure, such as its reliance on models and vague time reference period, apply even more strongly to paternal orphanhood. As an alternative, a procedure based on the survival of a first husband has been developed (Hill and Trussell, 1977) to estimate adult male mortality. In this case, exposure to risk begins at the first marriage of the respondent and is equal to the time since this first marriage took place; in practice, since data are generally tabulated by age, the average exposure to risk is estimated from age using an estimate of average female age at first marriage. Survivorship probabilities for males from age 20 are estimated from proportions of female respondents with a surviving first husband, using regression equations obtained from model cases and using as additional independent variables the singulate mean age at marriage of males (locating the approximate starting point of exposure) and of females (providing in conjunction with age the average length of the exposure period).

The 1972 retrospective survey collected information on survival of first husband. Table 19 shows the proportions of women with surviving first husband, and the estimated male survivorship probabilities obtained from them, by age group of women. Once again, using the logit life table system described above, it is possible to estimate the parameters α and β of a logit system, using as the standard a Coale-Demeny "North" level 16 male model life table, for each adult male survivorship probability in combination with a male probability of survival to age 2, $l(2)$. The values of α and β for each estimate are shown in Table 19 and make it possible to compare

estimates of adult survivorship obtained from orphanhood with those obtained from widowhood. The estimated life table constants show considerable variation from one age group to another, though the overall range is somewhat narrower than in the case of orphanhood, and the estimates show no clearly marked trend. The average values of the constants, however, are very similar to those obtained from orphanhood, the mean values of β being 0.91 from widowhood and 0.89 from orphanhood and the mean values of α being 0.094 and 0.080, respectively. It is no surprise that the estimates of α should match, since they are largely determined by the assumed values of $l(2)$ by sex; in this case, the split by sex was adopted from the "North" family of model life tables. The close agreement of the mortality pattern variable, β, however, is an encouraging indication of consistency in the data. Of course, if the age patterns of mortality for males and females were not related in a way similar to that of the standards being used, the values of β obtained from orphanhood and widowhood would not be expected to be the same.

Male and female life tables can be constructed using the logit system, after developing estimates of α and β for a particular standard. The combination of adult and child mortality estimation procedures provides the required estimates, and male and female life tables have been constructed using "North" level 16 model life tables as standards. For both sexes, β was taken as 0.90, and α was taken as 0.061 for females and 0.069 for males; these latter values were obtained from the mortality levels estimated for a period five years before the 1974 census, given the trends shown in Figure 6. Table 20 shows abridged life tables obtained from the use of the logit system; it also shows, for purposes of comparison, the age-specific mortality rates obtained by cumulating intercensal deaths for 1961–1973, inflated to allow for estimated underregistration, and dividing by estimated exposure to risk, obtained from adjusted census age distributions. Male deaths were inflated by 1.20, female deaths by 1.32; the 1961 census population was adjusted by a factor of 0.9912, to move the population back to the beginning of the year; the 1974 population was adjusted up by a factor of 1.1017, this being an adjustment of 1.11 for underenumeration and of 0.9925 to move the population back to the beginning of the year.

The comparison of the two columns of age-specific mortality rates in Table 20 is interesting. For males, the registered rates are lower than those of the life table obtained by indirect techniques up to age 25 and over age 70, but from ages 25 to 70 the agreement is remarkable. For females, the registered rates are below those from the life table up to age 30, somewhat above them from ages 30 to 70, and somewhat below them over age 70. In general, however, the age-specific mortality rates from the two sources,

TABLE 20 Abridged Life Table Obtained from Indirect Techniques: Honduras

x	l_x	L_x	${}_nq_x$	${}_nm_x$	Adjusted Death Registration ${}_nm_x$ 1961-1973[a]
Males					
0	10,000	9,165	.1246	.13599	.02328 (.04291)[b]
1	8,754	33,579	.0671	.01750	
5	8,166	40,235	.0291	.00591	.00440
10	7,928	39,322	.0161	.00325	.00216
15	7,800	38,592	.0210	.00425	.00301
20	7,636	37,616	.0296	.00601	.00498
25	7,410	36,487	.0304	.00618	.00621
30	7,185	35,347	.0321	.00652	.00670
35	6,954	34,1[illegible]	[illegible]56	.00725	.00727
40	6,707	32,822	.0424	.00866	.00868
45	6,422	31,288	.0512	.01052	.00983
50	6,093	29,435	.0677	.01401	.01321
55	5,681	27,175	.0865	.01809	.01941
60	5,189	24,366	.1218	.02593	.02584
65	4,557	20,807	.1737	.03805	.04117
70	3,766	16,450	.2525	.05780	.08713 (.10269)[b]
75	2,815	11,531	.3613	.08818	
80	1,798	8,691	1.0000	.20687	
e_0	50.71				
e_{10}	53.49				
Females					
0	10,000	9,314	.1055	.11327	.02362 (.03695)[b]
1	8,945	34,417	.0627	.01630	
5	8,384	41,370	.0262	.00532	.00478
10	8,164	40,508	.0153	.00309	.00207
15	8,039	39,843	.0175	.00354	.00275
20	7,898	39,073	.0211	.00427	.00328
25	7,731	38,188	.0242	.00490	.00433
30	7,544	37,205	.0273	.00554	.00570
35	7,338	36,125	.0308	.00626	.00639
40	7,112	34,920	.0360	.00733	.00811
45	6,856	33,588	.0404	.00825	.00912
50	6,579	32,033	.0524	.01077	.01221
55	6,234	30,095	.0690	.01429	.01847
60	5,804	27,565	.1003	.02111	.02690
65	5,222	24,143	.1507	.03260	.04346
70	4,435	19,678	.2253	.05077	.08885 (.09640)[b]
75	3,436	14,370	.3271	.07822	
80	2,312	11,958	1.0000	.19334	
e_0	54.44				
e_{10}	56.26				

Note: standard is "North" level 16; α = 0.061; β = 0.90.

[a] See text for method of adjustment.
[b] Comparable grouped value from life table.

which are effectively completely independent, are rather similar, the most marked deviations occurring where they would be expected, at the beginning and at the end of the age range, at which extremes the registration data are most suspect. The results of the indirect techniques, and the adjustments made both to numbers of people and to numbers of deaths for underenumeration and underregistration, respectively, are mutually supported by the close similarity of the mortality rates obtained.

ESTIMATES OF FERTILITY AND MORTALITY FROM A MULTIROUND SURVEY

Between 1970 and 1972, a four-round follow-up sample survey of Honduras was conducted by the Statistics and Census Office of Honduras in collaboration with the Latin American Demographic Centre (CELADE). Changes in the sample population that occurred between rounds, as a result of births, deaths, or movements in or out of the sample areas, were recorded. Conventional rates were then calculated using the observed events as numerators and person-years lived by relevant population subgroups as denominators. Total exposure of the whole sample slightly exceeded 51,000 person-years.

TABLE 21 Fertility Estimates from Multiround Survey, 1971-1972, with Comparable Estimates from Other Sources: Honduras

	Age-Specific Fertility Rates		
	Multiround Survey 1971-1972[a]	Adjusted Registration 1971[b]	Retrospective Survey 1972
Age group of women			
15-19	.1707	.1695	.1833
20-24	.3165	.3148	.3162
25-29	.3392	.3298	.3309
30-34	.3070	.2896	.2924
35-39	.2213	.2244	.2260
40-44	.1267	.1071	.1180
45-49	.0177	.0272	.0204
Total fertility	7.50	7.31	7.44
Mean age of childbearing	29.3	29.3	29.2

[a] Camisa (1975).
[b] Registered births inflated by 1.18, estimated female population allowing for underenumeration in 1974.

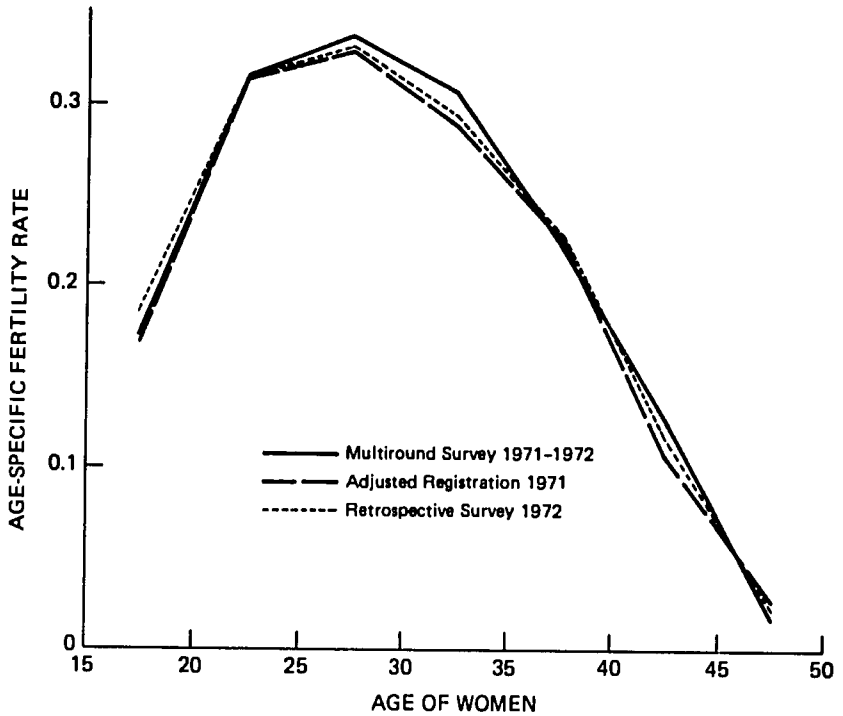

FIGURE 7 Estimated age-specific fertility rates from selected sources, 1971 and 1972: Honduras.

Table 21 shows age-specific fertility rates, total fertility, and the mean age at childbearing for the period covered by the survey, roughly the whole of 1971 and the first half of 1972, together with rates based on adjusted birth registration data for 1971 and on the results of the retrospective survey for 1972. Figure 7 graphically shows the rates by sources. The age-specific rates, total fertility rates, and mean ages of the fertility schedule are all very similar, and the multiround survey results confirm an estimate of total fertility in the 7.3–7.5 range for 1971 and 1972. A detailed analysis of the fertility data from the multiround survey is provided by Camisa (1975).

Age-specific mortality rates by sex have also been calculated from the survey results, and life tables have been constructed from them (Ortega and Rincon, 1975). When comparing age-specific rates with those from other sources, it must be remembered that the results are affected by small numbers of events in many cells, as few as four or five deaths being recorded for several sex and age-specific categories. Certain adjustments

TABLE 22 Age-Specific Mortality Rates, Observed and Adjusted, from Multiround Survey, 1971-1972, with Comparable Rates from Indirect Estimation Procedures: Honduras

Age Group	Males			Females		
	Multiround Survey		Retrospective Survey	Multiround Survey		Retrospective Survey
	Observed	Adjusted[a]		Observed	Adjusted[a]	
0-4	.05496	.05007	.04291	.03717	.03458	.03695
5-9	.00433	.00486	.00591	.00405	.00470	.00532
10-14	.00254	.00225	.00325	.00349	.00215	.00309
15-19	.00184	.00285	.00425	.00302	.00275	.00354
20-24	.00263	.00376	.00601	.00291	.00345	.00427
25-29	.00699	.00471	.00618	.00420	.00430	.00490
30-34	.00341	.00543	.00652	.00515	.00500	.00554
35-39	.00663	.00631	.00725	.00617	.00590	.00626
40-44	.00516	.00813	.00866	.00387	.00730	.00733
45-49	.00626	.01084	.01052	.01062	.00960	.00825
50-54	.01379	.01458	.01401	.01675	.01280	.01077
55-59	.02431	.02016	.01809	.00894	.01750	.01429
60-64	.02670	.02804	.02593	.02393	.02500	.02111
65-69	.01509	.04026	.03805	.0357[illegible]	.03700	.03260
70-74	.03917	.05711	.05780	.04972	.05300	.05077
75+	.12158	.11630	.13920	.06169	.11522	.13051
e_0	—	50.91	50.71	—	55.53	54.44
e_{10}	—	55.41	53.49	—	56.68	56.26
${}_5q_0$	—	.2079	.1834	—	.1521	.1616

[a] Ortega and Rincon (1975).

were made to the mortality rates before calculating the life tables: to move the minimum mortality rate from the 15–19 age group to the 10–14 age group; to smooth the rates from age 5 to age 50; and to increase somewhat the observed mortality rates over age 50. Table 22 shows the mortality rates by sex and five-year age group both before and after smoothing; also shown are the rates obtained from the life tables constucted from indirect estimation procedures. Overall, the agreement between the two life tables, in terms of expectation of life at birth, is very close, but the details are rather different. For both sexes, adjusted rates from the multiround survey indicate lower mortality from age 5 to age 45 and rather lower mortality above age 75. Under age 5, male mortality from the multiround survey exceeds that from the life table based on the indirect methods, while female mortality from the multiround survey is below that from the indirect life table. The systematic nature of these differences arises largely from the smoothing applied to the multiround survey rates; the unsmoothed rates show substantial fluctuations, though after age 40 the fluctuations are around the rates obtained from the indirect methods. However, the deficit of deaths in the multiround survey between age 5 and age 40 relative to the deaths expected on the basis of the indirect life tables remains.

It is possible to check the completeness of the death recording of the multiround survey by applying both the Brass and the Preston method outlined in the section on vital registration. Results of these methods (obtained in the same way as described above) are shown in Table 23. As before, the estimates vary considerably, those obtained from the Preston method depending critically on the rate of growth used. However, the

TABLE 23 Estimates of Completeness of Death Recording by Sex, 1971-1972 Multiround Survey: Honduras

	Males		Females	
Method	Completeness	Rate of Growth	Completeness	Rate of Growth
Brass	0.912	3.2	0.763	2.9
Preston[a]	0.989	(3.4)	0.915	(3.5)
Preston[b]	0.908	(3.2)	0.718	(2.9)

[a] Based on intercensal growth rate, 1961-1974, after adjusting the 1974 population for an estimated undercount of 10 percent.
[b] Based on growth rate obtained from Brass method.

TABLE 24 Comparison of Age-Specific Mortality Rates Under Age 10 from the Multiround Survey with Model Values: Honduras

		Age-Specific Mortality Rates ($_nm_x$)			Relative Deviation from Model	
x	n	Survey	"North" Level 15	"South" Level 15	"North"	"South"
Males						
0	1	.15773	.10803	.13616	.4601	.1584
1	1	.03884	.02785	.04133	.3946	−.0602
2	1	.02527	.01732	.01966	.4590	.2854
3	1	.01383	.01307	.01070	.0581	.2925
4	1	.00441	.01005	.00596	−.5612	−.2601
5	5	.00433	.00593	.00329	−.2698	.3161
Females						
0	1	.09904	.08984	.12096	.1024	−.1812
1	1	.03386	.02506	.04042	.3512	−.1623
2	1	.01844	.01620	.01917	.1383	−.0381
3	1	.01176	.01259	.01027	−.0659	.1451
4	1	.00550	.00985	.00589	−.4416	−.0662
5	5	.00405	.00543	.00316	−.2541	.2816

evidence suggests that male deaths were more completely recorded than female deaths, but that both sexes suffered some omission. The comparisons in Table 22 suggest that female deaths were differentially omitted only over age 75 and lend little support to the large differences in completeness shown in Table 23. The adjusted female mortality rates from the multiround survey agree very closely with the mortality rates shown in Table 20 obtained by inflating intercensal registered deaths by a factor of 1.32 and do not agree well with the rates from the life table based on indirect techniques. For male mortality, however, the mortality rates based on adjusted intercensal registered deaths agree with those from the indirectly obtained life table, and neither set agrees closely with the rates from the multiround survey. The differences, of course, are of the age pattern of mortality rather than of the overall level, as is clear from the similarity of the expectations of life at birth in Table 22.

A further element of confusion is introduced by the age pattern of mortality from the multiround survey. Deaths and person-years lived are classified by single years of age up to age 5, and the age pattern of child mortality can therefore be compared with models in great detail. Unfortunately, such a comparison suggests that the "South" family is more satisfactory than the "North," as shown in Table 24, though it should be noted that over age 5, "North" is more satisfactory than "South." Neither family is very satisfactory, of course, but the "North" pattern results in a definite trend of relative deviations with age, while the "South" pattern gives a fairly random scatter. With mortality rates from the vital registration system and lacking any breakdown under age 5, the "North" family provided easily the best fit taking all ages into account, and the "South" family provided the worst fit. The most likely conclusion may be that the age pattern of mortality up to age 5 is not well represented by the "North" mortality pattern, though it provides the best available approximation thereafter.

Glossary

AGE HEAPING A tendency for enumerators or respondents to report certain ages instead of others; also called age preference or digit preference. Preference for ages ending in 0 or 5 is widespread.

AGE PATTERN OF FERTILITY The relative distribution of a set of *age-specific fertility rates*. It expresses the relative contribution of each age group to *total fertility*.

AGE-SPECIFIC FERTILITY RATE The number of births occurring during a specified period to women of a specified age or age group, divided by the number of person-years-lived during that period by women of that age or age group. When an age-specific fertility rate is calculated for a calendar year, the number of births to women of the specified age is usually divided by the midyear population of women of that age.

AGE-SPECIFIC MORTALITY RATE The number of deaths occurring during a specified period to persons (usually specified by sex) of a specified age or age group, divided by the number of person-years-lived during that period by the persons of that age or age group. When an age-specific mortality rate is calculated for a calendar year, the number of deaths to persons of the specified age is usually divided by the midyear population of persons of that age.

AGE STANDARDIZATION A procedure of adjustment of crude rates (birth, death, or other rates) designed to reduce the effect of differences in age structure when comparing rates for different populations.

BIRTH HISTORY A report of the number and dates of all live births experienced by a particular woman; see also *pregnancy history*. The sex of each child, the survival of each child to the date of the interview and, where pertinent, the date of death are also generally recorded.

BIRTH ORDER The ordinal number of a given live birth in relation to all previous live births of the same woman (e.g., 5 is the birth order of the fifth live birth occurring to the same woman).

BIRTH RATE See *crude birth rate.*

CHILDBEARING AGES The span within which women are capable of bearing children, generally taken to be from age 15 to age 49 or, sometimes, to age 44.

CHILDREN EVER BORN(E) The number of children ever borne alive by a particular woman; synonymous with *parity.* In demographic usage, stillbirths are specifically excluded.

COHORT A group of individuals who experienced the same class of events in the same period. Thus an age cohort is a group of people born during a particular period, and a marriage cohort is a group of people who married during a particular period. The effects of a given set of mortality or fertility rates are often illustrated by applying them to hypothetical cohorts.

COHORT FERTILITY The fertility experienced over time by a group of women or men who form a birth or a marriage cohort. The analysis of cohort fertility is contrasted with that of *period fertility.*

CRUDE BIRTH RATE The number of births in a population during a specified period divided by the number of person-years-lived by the population during the same period. It is frequently expressed as births per thousand population. The crude birth rate for a single year is usually calculated as the number of births during the year divided by the midyear population.

CRUDE DEATH RATE The number of deaths in a population during a specified period divided by the number of person-years-lived by the population during the same period. It is frequently expressed as deaths per thousand population. The crude death rate for a single year is usually calculated as the number of deaths during the year divided by the midyear population.

CUMULATED FERTILITY An estimate of the average number of children ever borne by women of some age x, obtained by cumulating *age-specific fertility rates* up to age x; also often calculated for age groups.

DEATH RATE See *crude death rate.*

EXPECTATION OF LIFE AT BIRTH The average number of years that a member of a *cohort* of births would be expected to live if the cohort were subject to the mortality conditions expressed by a particular set of *age-specific mortality rates.*

FERTILITY HISTORY Either a *birth history* or a *pregnancy history.*

FORWARD SURVIVAL A procedure for estimating the age distribution at some later date by projecting forward an observed age distribution. The procedure uses *survival ratios,* often obtained from model *life tables.* The procedure is basically a form of population projection without the introduction of new entrants (births) to the population.

GENERAL FERTILITY RATE The ratio of the number of live births in a period to the number of person-years-lived by women of *childbearing ages* during the period. The general fertility rate for a year is usually calculated as the number of births divided by the number of women of childbearing ages at midyear.

GROSS REPRODUCTION RATE The average number of female children a woman would have if she survived to the end of her childbearing years and if, throughout, she were subject to a given set of *age-specific fertility rates* and a given *sex ratio at birth*. This number provides a measure of replacement fertility in the absence of mortality.

GROWTH RATE The increase or decrease of a population in a period divided by the number of person-years-lived by the population during the same period. The increase in a population is the result of a surplus (or deficit) of births over deaths and a surplus (or deficit) of immigrants over emigrants. (The annual increase is often expressed as a fraction of the total population at the beginning of the year, but this convention has the inconvenient characteristic of not being readily defined for a five-year interval and of being unequal to the difference between the birth rate and the death rate even in the absence of migration.) See also *rate of natural increase*.

INFANT MORTALITY RATE The number of deaths of children under 1 year of age occurring in a year per 1,000 live births occurring in the same year; also used in a more rigorous sense to mean the number of deaths that would occur under 1 year of age in a *life table* with a *radix* of 1,000.

LIFE TABLE A listing of the number of survivors at different ages (up to the highest age attained) in a hypothetical cohort subject from birth to a particular set of age-specific mortality rates. The rates are usually those observed in a given population during a particular period of time. The tabulations accompanying a life table include other features of the cohort's experience: its expectation of life at different ages, the probability of surviving from the beginning of each age interval to the end of that interval, etc.

MARITAL FERTILITY Any measure of fertility in which the births (in the numerator) are births to married women and in which the number of person-years-lived (in the denominator) also pertains to married women. In some instances, the designation "married" includes persons in consensual unions.

MEDIAN The value associated with the central member of a set that is ordered by size or some other characteristic expressed in numbers.

MEAN AGE OF CHILDBEARING The average age at which a mortality-free *cohort* of women bear their children according to a set of *age-specific fertility rates*.

MEAN AGE OF CHILDBEARING IN THE POPULATION The average age of the mothers of the children born in a population during a year. This measure incorporates the effects of both mortality and the age distribution.

MODEL LIFE TABLE An expression of typical mortality experience derived from a group of observed *life tables*.

MOVING AVERAGES The successive averaging of two or more adjacent values of a series in order to remove sharp fluctuations.

NATURAL FERTILITY The age pattern of *marital fertility* observed in non-contraceptive populations where reproductive behavior is not affected by the number of children already born.

NET MIGRATION The difference between gross immigration and gross emigration.

NET REPRODUCTION RATE The average number of female children born per woman in a *cohort* subject to a given set of *age-specific fertility rates*, a given set of age-specific mortality rates, and a given *sex ratio at birth*. This rate measures replacement fertility under given conditions of fertility and mortality: it is the ratio of daughters to mothers assuming continuation of the specified conditions of fertility and mortality.

OWN-CHILDREN METHOD A refinement of the *reverse survival* procedure for fertility estimation, whereby estimates of *age-specific fertility rates* for the recent past are obtained by relating mothers to their own children, using information on relationship and other characteristics available from a census or survey.

PARITY See *children ever born*.

PERIOD FERTILITY The fertility experienced during a particular period of time by women from all relevant birth or marriage *cohorts*; see also *cohort fertility*.

PREGNANCY HISTORY A report of the number and the dates of occurrence of all the pregnancies experienced by a particular woman. The outcome of the pregnancy—live birth, stillbirth, fetal death—is also recorded.

${}_xq_0$ The probability of dying between birth and some exact age x, sometimes also written $q(x)$: q is the probability of dying, 0 is birth, and x is the exact age up to which the probability of dying refers.

RADIX The hypothetical birth cohort of a *life table*. Common values are 1, 1,000, and 100,000.

RATE OF NATURAL INCREASE The difference between the births and deaths occurring during a given period divided by the number of person-years-lived by the population during the same period. This rate, which specifically excludes changes resulting from migration, is the difference between the *crude birth rate* and the *crude death rate*.

RETROSPECTIVE SURVEY A survey that obtains information about demographic events that occurred in a given past period, generally terminating at the time of the survey.

REVERSE SURVIVAL A technique to estimate an earlier population from an observed population, allowing for those members of the population who would have died according to observed or assumed mortality conditions. It is used as a method of estimating fertility by calculating from the observed number of survivors of a given age a the expected number of births that occurred a years earlier. (In situations for which mortality is known or can be reliably estimated, reverse survival can be used to estimate migration.)

ROBUSTNESS A characteristic of estimates that are not greatly affected by deviations from the assumptions on which the estimation procedure is based.

SEX RATIO AT BIRTH The number of male births for each female birth, or male births per 100 female births.

SINGULATE MEAN AGE AT MARRIAGE (SMAM) A measure of the mean age at first marriage, derived from a set of proportions of people single at different ages or in different age groups, usually calculated separately for males and females.

SURVIVAL RATIO The probability of dying between one age and another; often computed for age groups, in which case the ratios correspond to those of the person-years-lived function, ${}_nL_x$, of a *life table.*

SYNTHETIC PARITY The average parity calculated for a hypothetical cohort exposed indefinitely to a set of period *age-specific fertility rates.*

TOTAL FERTILITY RATE (TFR) The average number of children that would be born per woman if all women lived to the end of their childbearing years and bore children according to a given set of *age-specific fertility rates*; also referred to as total fertility. It is frequently used to compute the consequence of childbearing at the rates currently observed.

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