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Fertility and Mortality Changes in Thailand, 1950–1975

Panel on Thailand
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 mid-1979, 106 population specialists around the world were members of one or more panels or working groups. This number includes 66 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 Thailand, is No. 2 in a series produced by the Committee. The work leading to this report was carried out by the Panel on Thailand, which was established in September 1977 to conduct the required study. The work of the Panel culminated in a workshop held in Pattaya, Thailand, on June 19–23, 1978, and attended by all Panel members plus representatives of interested organizations within Thailand. A number of background papers, some prepared specially for the workshop and others published or intended for publication elsewhere, were distributed to the participants. At the completion of the workshop, the Panel assessed the evidence available and arrived at the conclusions presented in this report.

It should be stressed that this report is not a report on the workshop itself, but is rather a summary of those results regarded by the Panel as being of particular importance or of acceptable reliability. A number of background papers are cited as support for the estimates given, but are not reproduced as a part of the report itself. Complete sets of these papers are being kept at the Institute of Population Studies, Chulalongkorn University, Bangkok; at the Population Survey Division, National Statistical Office, Bangkok; at the Institute of Population and Social Research, Mahidol University, Bangkok; at the Population Division of the Economic and Social Commission for Asia and the Pacific, Bangkok; at the Office of Population Research, Princeton University, U.S.A.; and at the National Academy of Sciences, Washington, D.C., U.S.A.

The Committee's thanks for this study are clearly due to the Panel members, who labored hard and long on the organization and analysis involved in the study. 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, editor for the Assembly, for their support, assistance, and advice. 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 secretary; to Mary Anne Fitzgerald, research assistant, for carrying out many tedious and repetitive calculations; and to Solveig Padilla, secretary, for coping with the tables.

Our thanks are also due to Arjun Adlakha, International Program of Laboratories for Population Studies; John Fulton, Brown University;

James Spitler, Census Bureau, U.S. Department of Commerce; Vijay Verma, World Fertility Survey; and to all the participants in the workshop held by the Panel, in Thailand in June 1977, for useful comments on the data and methods of analysis used in this report. We are also grateful to the reviewers of early drafts of this report for helpful comments and suggestions, in particular to Judith Blake, University of California, and to Warren Robinson, Pennsylvania State University.

Finally, thanks are also due to the Thailand Ministry of Public Health and National Statistical Office for providing us with previously unpublished data that proved to be of great value to our analysis.

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

Summary

The application of appropriate analytical techniques to the range of demographic data available for Thailand produces rather consistent estimates of fertility and mortality for various time periods. The estimates of the time trend of fertility are especially consistent, as is shown by Figure 1. In terms of the total fertility rate, the level in the early 1960s was in the range of 6.3–6.6. The level began to decline fairly sharply in the mid-1960s, reaching a level of 5.4–5.8 in 1970. The decline continued through the early 1970s, reaching a level in 1975 of 4.5–4.9. Two sources of estimates, the Survey of Fertility in Thailand (SOFT) and the reverse survival of the 1975 Survey of Population Change (SPC) single-year age distribution, indicate an acceleration of fertility decline in the early 1970s; it is possible, however, that these results are influenced by typical data errors in these sources, and it cannot be concluded with confidence that the rate of decline accelerated in the early 1970s.

The overall fertility decline is largely accounted for by rapid change in the Central and North regions of Thailand, with much slower change in the Northeast and South regions. Urban fertility was probably already declining by 1960 and continued to decline throughout the period; rural fertility, on the other hand, remained constant until the second half of the 1960s, and then began a rapid decline.

The available estimates of mortality, and particularly the estimates of adult mortality, are somewhat less consistent. The estimates of child mortality, using the probability of dying by age 5, ${}_5q_0$, as the index, show reasonable consistency between the direct sources, the Surveys of

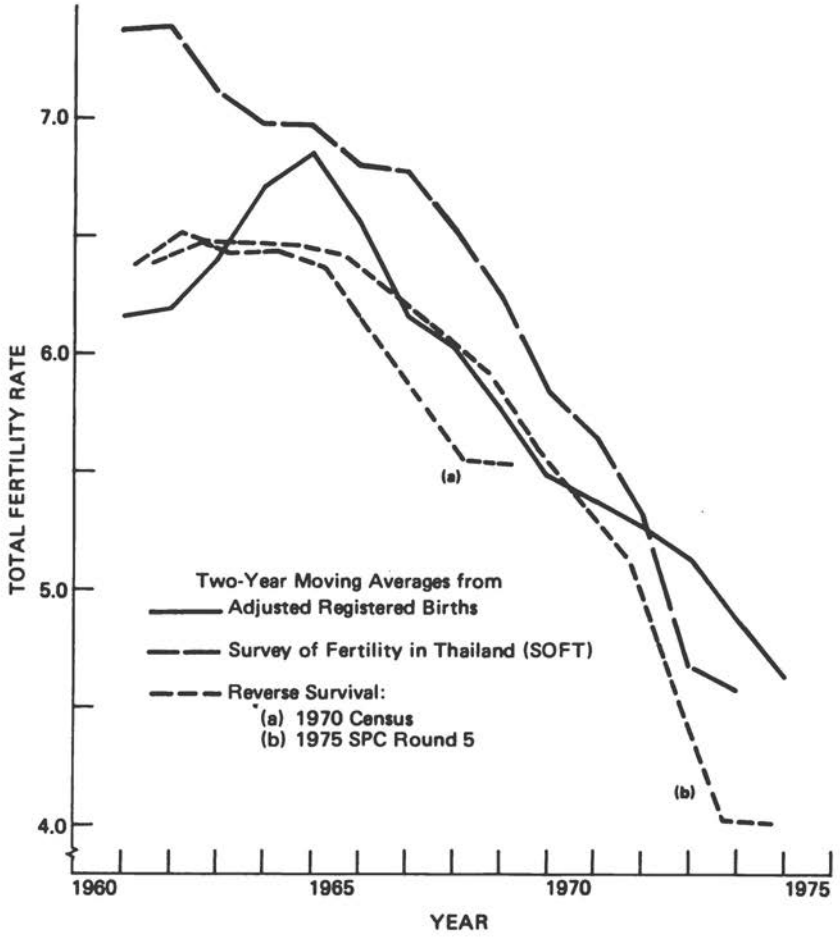

FIGURE 1 Total fertility rates by single calendar years and source of estimate, 1960–1975: Thailand.

Population Change, and the indirect sources, the analysis of data on children ever born and children surviving by age of mother, although the indirect sources indicate in general somewhat lower mortality. All these estimates show a downward mortality trend from the mid-1960s to the mid-1970s, the probability of dying by age 5 declining by some 15 percent over the period. The infant mortality estimates also show a clear but not rapid decline over the period, the infant mortality rate being below 70 per

1,000 by 1975, although these estimates are less reliable than those of ${}_5q_0$. The available estimates of adult mortality are probably the weakest: expectation of life at age 10 from the SPC data shows little change for males and a slight improvement for females between the mid-1960s and the mid-1970s; estimates based on attempts to adjust the death registration figures for the effects of omission show a much higher mortality level, although they also show the level to be declining slowly with time.

In terms of overall mortality, expectation of life at birth probably increased by some two or three years between the mid-1960s and the mid-1970s, reaching about 58 years for males and 64 years for females by the end of the period. The normal female advantage of lower mortality at most ages seems to be particularly marked in Thailand. Regional variations of mortality are fairly pronounced, with the Central region having the lowest mortality, followed by the South, followed by the Northeast and the North, the last having a slightly heavier mortality, at least in childhood. Urban areas seem to have lower mortality than rural areas, as is to be expected.

The estimates of total fertility and child and adult mortality presented above can be used to derive the natural rate of population increase through the calculation of crude birth and death rates. The ranges of total fertility can be converted into ranges of crude birth rates, the results being 43–46 births per 1,000 population for the early 1960s, 36–38 by 1970, and 32–36 by 1975. The decline in the crude death rate is much more gradual, from about 10–11 in the mid-1960s to about 8–9 in the mid-1970s. The derived growth rates range from 3.2 to 3.4 percent in the early 1960s, falling to between 2.6 and 2.9 percent by 1970, and continuing to fall to between 2.3 and 2.6 percent by 1975.

The Panel recognizes that for many purposes a single figure is preferable to a range. However, in view of the uncertainties that remain despite the considerable consistency shown by the various estimates available to the Panel, it is felt that the only responsible procedure is to give the ranges within which the Panel believes the true values lie.

Fertility and Mortality Changes in Thailand, 1950–1975

INTRODUCTION

Thailand meets all the criteria set by the Committee on Population and Demography for inclusion among those countries to be studied in detail. The population recorded by the 1970 population census was over 34 million, several surveys have indicated a fertility decline in recent years, though the extent of this decline has been the subject of dispute, and demographic statistics from a variety of sources are available covering a considerable period of time. The charge of the Panel was to estimate levels and recent trends of fertility and mortality in Thailand, taking into consideration all the available sources of information relevant to the estimation of these demographic parameters, and to investigate regional or socioeconomic differentials insofar as these have a bearing on the plausibility of the findings of the study. The work of the Panel therefore consisted of a critical examination of existing studies and further analysis of existing data where recently developed or improved analytical methodologies would justify it.

Thailand has a number of sources of demographic data, and it has therefore been possible to apply a wide range of techniques of demographic analysis. Following a brief section describing the data sources available, the main body of this report consists of a description of the results obtained by applying the full range of analytical techniques regarded as relevant to those data sources. The presentation of these analytical results is organized by type of data source, so that, for example, all methods based

primarily upon age distributions are presented in one section. In the final section, estimates of fertility and mortality based on different data sources are brought together and compared for consistency and the conclusions are presented.

DATA SOURCES

The situation of Thailand is particularly satisfactory with respect to the availability of demographic data; these are generally of high quality, of a wide variety of types, and cover a reasonably long time period. Registration of births and deaths, though incomplete, provides a continuous series of data from early in the century to 1975, though no use is made here of information for periods earlier than 1937. Population censuses, of varying demographic content, have been held since 1911, although only the censuses of 1937, 1947, 1960, and 1970 are considered in this study. Two surveys of a dual-record type, the Surveys of Population Change (SPC), have been conducted to estimate fertility and mortality parameters and the completeness of registration, the first between 1964 and 1967 and the second between 1974 and 1976. Two rounds of a panel-type survey, the Longitudinal Study of Economic, Social, and Demographic Change (LS), collecting information on recent fertility and related factors, were conducted in 1969–1970 and 1972–1973. In 1975 the Survey of Fertility in Thailand (SOFT) was conducted as part of the World Fertility Survey; it collected complete birth histories and other relevant information from a sample of ever-married women. Table 1 summarizes these data sources by the evidence available from them relevant to this study.

Additional evidence of an indirect nature relevant to the estimation of fertility is available from the statistics of new acceptors of contraceptive methods compiled by the National Family Planning Program, as well as from local studies such as the Northern Thailand Fertility Study; these local studies are not taken into consideration in this report.

RESULTS

POPULATION AGE DISTRIBUTIONS

Problems Associated with Age Reporting in Thailand

Age reporting in Thailand is good in relation to that in most other countries in the world. Single-year age distributions show only minimal age heaping (Arnold et al. 1977). Even the rural and less-educated segments of the population appear to know both their age and their year or

TABLE 1 Data Sources by Evidence Available: Thailand

Type of Evidence	Censuses			Surveys of Population Change		Longitudinal Surveys		Survey of Fertility in Thailand, 1975	Vital Registration	
	1947	1960	1970	1964-1967	1974-1976	1969-1970	1972-1973		1937-1959	1960-1975
Age/sex distribution										
Five-year groups	X	X	X	X	X	X	X	X		
Single years		X	X		X			X		
Own-children tabulation			X							
Registered births										
By age group of mother									X	X
By birth order										X
Registered deaths										
By sex and age									X	X
Children ever born										
By age of mother		X	X		X	X	X	X		
Children surviving										
By age of mother			X		X			X		
Fertility histories						X	X[a]	X		
Contraceptive-use data						X	X	X		

[a]Full fertility histories available for new respondents only; former respondents asked only about births during last three years.

date of birth since the latter is important for astrological reasons. However, as reported in some detail in the paper by Chamratrithirong et al. (1978), there is substantial evidence of a tendency to state age at next birthday in preference to age at last birthday in response to a direct question about age. Although the extent to which this practice occurs has not yet been determined, it seems clear that at any given single age, a substantial proportion of respondents state their age at next birthday as opposed to age at last birthday; there is some evidence that the tendency is to round age to that at the nearest birthday.

In the absence of more definitive evidence, most adjustments of age data to allow for this tendency in the papers presented in the Panel's workshop assume that in stating age directly, half of the respondents round age up to the next birthday whereas half report age at last birthday. The problem is particularly important for analyses that use sources that tabulate age on different bases. Persons who give age directly will, according to our assumption, be reported as being on average about half a year older than if their age had been computed from birth dates. The sources used in the analyses presented to the workshop can be divided according to the way age was determined:

Sources Based on Age as Reported	Sources Based on Age Calculated from Birth Date
1947 and 1960 censuses	1970 census
Vital registration	SOFT
Family planning acceptor statistics	LS rounds one and two
	Baseline surveys and surveyed events in SPC

It should be noted that some previously published results for the rural round one of the Longitudinal Survey were tabulated on the basis of stated age.

A special problem regarding age reporting for infants and young children exists because their ages are often stated by respondents in terms of weeks or months instead of years. In such cases, one can expect rounding to occur in terms of weeks or months; this rounding will have a different and smaller effect in terms of years of age than will rounding for adults, for whom age is reported in units of years. The available evidence is unfortunately even less adequate for arriving at a definite judgment about how much of an adjustment is required to allow for this effect on age reporting for infants and young children. Several formulas were used in

the analyses presented to the workshop for adjusting distributions of five-year age groups to allow for the tendency to state age at next birthday (see Chamratrithirong et al. 1978, Hill 1978).

Stable Population Analysis

A population exposed for a long period to constant fertility and mortality rates establishes a constant age structure typical of the rates; a population with such an unchanging age structure is referred to as a stable population. The constant age structure contains information about the underlying fertility and mortality rates, and it can be used to estimate them given some additional information such as the rate of natural increase or the level of childhood mortality.

Leoprapai and Wanglee (1978) analyzed the male age structures from the 1960 and the 1970 censuses, using rates of population growth computed for the 1947–1960 and 1960–1970 intercensal periods. In justifying the application of the method, they note that Thailand experienced very low levels of net international migration for a long period prior to the two censuses, that mortality had been declining for a considerable period prior to 1960, the decline continuing to 1970, and that fertility had probably started to decline prior to 1970. A steady, gradual mortality decline has a rather modest impact on population age structure, though it would tend to imply spuriously lower fertility for proportions over higher and higher ages. Fertility decline, on the other hand, has a more immediate and substantial impact on the population age structure, requiring that the results be interpreted with caution. A further problem is encountered with the 1960 and 1970 age distributions, because the former was distorted by the form of the age question, and the 1970 census seems to have been more seriously affected by underenumeration than the 1960 census. The age distributions used in the Leoprapai and Wanglee analysis were the adjusted ones developed for both years (Arnold and Phananiramai 1975), the results therefore being to some small extent dependent on the adjustment procedure.

Table 2 shows the estimates obtained, in terms of crude birth rate and crude death rate. Table 2 also shows estimates of the total fertility rate implied by the birth rate for both sexes combined: this derived total fertility rate was obtained by using the age pattern of fertility of registered births in the years prior to the censuses and scaling the registered rates to agree with the estimated birth rate. The results show a relatively high birth rate of 46 prior to 1960 and a somewhat lower rate of 42 prior to 1970, though the latter estimate needs to be interpreted with caution in view of the fertility decline then under way. A sharp decline in the crude death

TABLE 2 Stable Population Analysis, 1960 and 1970 Censuses: Thailand

	Estimates		
Census	CBR	TFR[a]	CDR
1960	45.9	6.50	15.2
1970	42.3	6.26	10.3

[a]Estimated equivalent derived from CBR.

SOURCE: Leoprapai and Wanglee (1978).

rate, from 15 to 10 per 1,000, is shown; the latter figure is satisfactorily consistent with the mid-decade estimate from the 1964–1965 SPC.

Reverse Survival

If independent estimates of child mortality are available, the age distribution of children can be used to obtain estimates of aggregate fertility not dependent on the assumption of stability. Reverse survival is applied to the enumerated population in an age group, using the child mortality estimates, to obtain the number of births in a period for which the enumerated population represents the survivors; the period depends on the age group used, being, for example, the five years prior to the census in the case of the census age group 0–4. The birth rate can then be obtained by dividing the estimated number of births by an estimate of the total person-years lived by the population during the period, this in turn being obtained as the mid-period population by applying an observed rate of natural increase or, more laboriously, by applying reverse survival to the entire population. The method can be applied to five-year age groups, dampening the effects of age heaping, or to single-year groups, showing wider variations but being more revealing of both errors and recent trends.

Leoprapai (1978) applied this method to the population of each sex under age 5 in the adjusted age distributions from the 1960 and 1970 censuses (Arnold and Phananiramai 1975), using mortality figures from the 1964–1965 and 1974–1976 Surveys of Population Change. The results depend to some extent on the adjustments made to the census age distributions. Additional calculations were circulated at the Panel's workshop, applying the reverse survival technique to the enumerated populations aged 0–4 and 5–9 in 1960, 1964–1965, 1970, and 1974, and also to the 1960 population adjusted for half a year by subtracting half those aged 5 from the age group 5–9, adding them to the age group 0–4,

TABLE 3 Fertility Estimation from Reverse Survival to Recorded and Adjusted Age Distributions, 1960-1975: Thailand

Source of Age Information	Period to Which Estimate Refers				
	1950-1954	1955-1959	1960-1964	1965-1969	1970-1974
1960 census, unadjusted	44.2	40.0			
1960 census					
Adjusted[a]		43.3			
Adjusted[b]	43.3	44.1			
1964-1965 SPC, midyear		42.8	43.3		
1970 census, unadjusted			44.8	40.7	
1970 census, adjusted[a]				41.5	
1974-1975 SPC, round one				41.5	33.2

[a] Adjustments as shown in Arnold and Phananiramai (1975).
[b] Adjusted for half-year age error.

SOURCE: Leoprapai (1978).

and adding half those aged 10 to the age group 5–9. The birth rates obtained for all these alternatives, for periods from 1950–1954 to 1970–1974, are shown in Table 3.

In general, there are two or more aggregate fertility measures for each five-year period, and the agreement between the estimates, based upon independently collected age distributions, is encouraging. The most obvious disagreement is for the period 1955–1959, for which the unadjusted 1960 census age distribution gives a substantially lower estimate of fertility than either the adjusted age distribution or the 1964–1965 SPC age distribution. This discrepancy is consistent with the problem discussed above concerning the form of the 1960 age question. The picture that emerges from this analysis is of approximately constant fertility up to the 1960–1964 period, a drop of 5 percent or so in the 1965–1969 period, and a fall of about 20 percent in the 1970–1974 period.

Single-year age distributions are available from the 1960 census, the 1970 census, and round five (1975) of the second SPC. The latter two sources are of particular interest, since they can provide overlapping year-by-year estimates of aggregate fertility throughout the 1960s. The mortality rates required for application of reverse survival of the two populations were obtained by interpolating between the life tables from the two Surveys of Population Change and by extrapolating to 1960 the observed mortality trend between them. The crude birth rates (by sex) and derived total fertility rates are shown for each year in Table 4.

TABLE 4 Birth Rates and Total Fertility Rates for Single Years, 1960-1975, Obtained by Reverse Survival: Thailand

	Male Birth Rate		Female Birth Rate		Derived Total Fertility Rate	
Year[a]	1975 SPC	1970 Census	1975 SPC	1970 Census	1975 SPC	1970 Census
1975	30.5		28.6		4.11	
1974	29.0		26.2		3.90	
1973	30.3		27.8		4.16	
1972	35.1		33.0		4.96	
1971	36.4		35.2		5.30	
1970	38.8		34.9		5.45	
1969	41.1	38.8	36.5	37.3	5.76	5.63
1968	42.0	37.9	40.0	35.6	6.08	5.45
1967	41.4	39.1	41.0	37.0	6.12	5.64
1966	44.3	41.3	41.4	39.2	6.37	5.97
1965	45.0	42.8	42.6	40.3	6.46	6.18
1964	44.8	45.8	43.6	43.3	6.45	6.56
1963	46.3	44.6	43.6	41.9	6.49	6.31
1962	45.9	46.7	44.5	43.6	6.47	6.52
1961	45.0	47.2	43.9	44.1	6.30	6.52
1960		45.6		42.5		6.23

[a]The date of round five of the SPC can be taken as August 1975 and that of the 1970 census as April 1, 1970. Estimates for 1975 (and other years) from the SPC are thus really for the period August 1974 to August 1975; estimates for 1969 (and other years) from the census are really for the period April 1969 to March 1970.

SOURCE: Hill (1978).

For the years for which the two series overlap, the agreement is impressive between 1960 and 1964, but after 1964, the estimates based on the 1970 age distribution are lower than those based on the 1975 age distribution, probably as a result of age misreporting or omission of young children. Similar biases probably affect the estimates from the 1975 age distribution based on children aged 0, 1, 2, and 3, all of which are suspiciously low. This analysis confirms that aggregate fertility was more or less constant to 1965, after which an accelerating decline began. Though estimates based on young children cannot be relied upon, the estimates from the 1975 age distribution based on children aged 4 and older (those born in 1971 and earlier) look reasonable and agree closely with other series.

Own Children

The own-children estimation technique is a form of reverse survival procedure in which children living in the same household as their mother are matched with the mother by the use of relationship to head of household codes and other information (Cho 1973). Measures of aggregate

fertility obtained from the own-children estimation procedure depend on the age distribution of the children and on the mortality assumptions employed; they are thus neither more nor less accurate than those obtained by the conventional reverse survival technique. However, the relation of children by age to their mothers by age yields additional information, not available from the conventional reverse survival technique, about the age pattern of fertility.

The method has been applied to the 1970 census (Retherford and Cho 1978) by using a special own-children tabulation from the census to relate children to their mothers and adjusting the enumerated population for the underenumeration levels estimated by Arnold and Phananiramai (1975). It should be noted that with the own-children method, the age patterns of fertility depend almost entirely on the own-children tabulation, which links mothers to children, whereas the measures of aggregate fertility depend almost entirely on the number of children of each age, that is, on the age distribution under 10. In the case of Thailand in 1970, the adjusted age distribution used in the own-children analysis was obtained from annual registered births and child deaths between 1960 and 1969, combined with the 1964–1965 SPC estimate of the completeness of birth and death registration. The age pattern estimates are therefore dependent almost entirely on 1970 census information, whereas the estimates of aggregate levels depend on vital registration data and evidence concerning their completeness.

Table 5 shows age-specific and total fertility rates estimated by the own-children method for 1960–1964 and 1965–1969. The age patterns of fertility agree rather well with those obtained from other sources; the level of fertility is approximately 5 percent lower in the second half of the decade than in the first, in close agreement with the results of both the stable population and the reverse survival methods.

Completeness of Census Enumeration

Table 6 shows the total population by sex enumerated by the censuses of 1947, 1960, and 1970, together with the average growth rates implied for the intercensal periods. The growth rate for the period between 1960 and 1970 is substantially lower, at 2.7 percent, than that for the period between 1947 and 1960, 3.2 percent. Since mortality fell between the earlier and later periods (see below), the only factors that could account for the lower growth rate in the later period are a sharp decline in fertility, changes in net migration, or differential completeness of census enumeration.

Net international migration seems to have been negligible in the case of

TABLE 5 Estimates of Age-Specific and Aggregate Fertility Obtained from Own-Children Analysis of 1970 Census: Thailand

	Period	
Age Group	1960-1964	1965-1969
15-19	.086	.089
20-24	.274	.267
25-29	.313	.299
30-34	.281	.260
35-39	.215	.206
40-44	.106	.100
45-49	.020	.019
Total Fertility	6.48	6.19

SOURCE: Retherford and Cho (1978).

Thailand for the period under consideration, and although fertility will be shown to have been falling by the end of the later intercensal period, the fall would have been too small and too late to have caused such a major decline in the growth rate. The rate of natural increase estimated by the SPC for 1964–1965 was 3.1 percent. The low growth rate implied between 1960 and 1970 was probably largely the result of relative underenumeration in 1970. A comparison of cohort intercensal survival and cohort registered deaths (Preston and Hill 1980) leads to estimates of the extent of this relative underenumeration of 5.1 percent for males and 4.0 percent for females (Hill 1978). Estimates of similar magnitude given by Arnold and Wanglee (1975) and Fulton (1975), though obtained by different methodology, confirm the general level of these results. Population figures for 1970 have been adjusted to allow for these estimates of underenumeration in all subsequent methods of analysis requiring population denominators.

TABLE 6 Enumerated Population by Sex, 1948, 1960, and 1970, and Implied Intercensal Growth Rates: Thailand

Population and Growth Rate	Males	Females	Total
1947 population (thousands)	8,722	8,721	17,443
Intercensal growth rate (percent)	3.17	3.14	3.16
1960 population (thousands)	13,154	13,104	26,258
Intercensal growth rate (percent)	2.66	2.78	2.72
1970 population (thousands)	17,124	17,274	34,397

COMPLETENESS OF VITAL REGISTRATION

A problem exists with the use of vital registration data in Thailand, and it needs to be described before methods for estimating the completeness of registration are considered. In the vital registration system (described in Thailand Ministry of Public Health 1978b), the Ministry of the Interior is responsible for the registration system, but detailed tabulations of, for instance, births by age of mother or birth order, are prepared by the Health Information Centre of the Ministry of Public Health. These tabulations are based on event summaries prepared by the provincial health centers from summaries prepared at the district level. The Ministry of the Interior also receives information about the number of births and deaths, transmitted from the district administration to the provincial administration and then to the Ministry. Since 1967 the number of events recorded annually by each Ministry has been different, and the published statistics have been obtained by applying Ministry of the Interior totals to Ministry of Public Health classifications of events by characteristics. In the following analysis of the completeness of birth registration, totals obtained by Tieng Pardthaisong from Ministry of Public Health records have been used to maintain consistency with the totals obtained prior to 1967; these totals, shown by Hill (1978), are typically around 10 percent lower than published totals. Since the completeness of registration is estimated by comparison with independently gathered information, the overall level is not of great importance, though discontinuities in the series may distort the results.

Registered Births Compared with Average Number of Children Ever Born

The completeness of birth registration may be estimated through comparison for successive age groups of women of registered fertility rates with the average number of children ever born, obtained from a census or survey. In the original Brass procedure (Brass et al. 1968), suitable only for situations of constant fertility, age-specific fertility rates obtained from registered births in a given year are cumulated and interpolated for comparison, age group by age group, with information on average parity obtained by a census or survey for the same year. Assuming that the proportion of births that are registered is constant by age group and that younger women report their lifetime fertility accurately, the ratios of average parity to cumulated current fertility, often called P/F ratios, for women aged 20–24 and 25–29 provide indicators of the completeness of registration. Fertility must be constant for the method to work, for

otherwise cumulated current fertility and retrospective lifetime fertility would not be theoretically equal. The only source of information on children ever born that meets this condition is the 1960 census, so only one application of the original technique has been made. The completeness of registration estimated for 1960, shown in Table 7, is 76 percent; when the observed age-specific fertility rates are adjusted for this level of completeness, the total fertility rate estimated for 1960 is 6.5.

Two developments of the original technique are suitable for use under conditions of changing fertility. If information is available on average parity from two surveys five or ten years apart, synthetic parity distributions can be calculated from the parity increments of successive cohorts over the intersurvey period (Hill 1978). This synthetic parity distribution can then be compared with cumulated age-specific fertility rates obtained from registered births and person-years lived over the same period.

This method was applied to two periods: 1960–1969, using information on children ever born from the two censuses; and 1970–1974, using information on children ever born from the 1970 census and an average of the children ever born reported by the 1974 and 1975 SPC's. The 1970 and 1975 parity distributions were adjusted to represent age groups half a year younger than reported, to be on a common age basis with the 1960 census and vital registration data, and the 1974 and 1975 parity distributions from the SPC were averaged in order to approximate the parity distribution applicable exactly five years after the census date. The estimates of birth registration completeness, shown in Table 7, are 81 percent for 1960–1969 and 82 percent for 1970–1974. Adjusting the observed fertility rates by these amounts gives estimates of average total fertility for the two periods of 6.2 and 4.9, respectively.

The second development of the original Brass procedure is more complicated, at least in application. Age-specific fertility rates for five-year age groups are calculated from registered births for each calendar year, and the rates are then split up into rates for single-year age groups (Hill 1978). Given that average parity by five-year groups is available for some point from a census or a survey, the single-year rates experienced in all previous years by each cohort are cumulated from the start of childbearing to the time of the census or survey, and the sum is compared with the recorded parity to provide a measure of average completeness of registration. If information is available for two points five or ten years apart, the cumulation may add on to the parities reported at the earlier point, in which case the ratio of the cumulated rates to the recorded cohort parity increment provides an indication of the completeness of registration during the period between the two surveys. The lifetime cumulation can be

TABLE 7 Estimates of Completeness of Vital Registration: Thailand

	Estimate of Completeness of Registration of Births				Estimate of Completeness of Registration of Deaths			
			P/F Ratios[b]		SPC[a]			
Period	SPC[a]	Cohort Cumulation[b]	1960 Parity	Intersurvey Synthetic Parity	All Ages	Over Age 10	Cohort Attenuation[b]	Growth Balance[c]
1960 or before		.701	.759					.656[d]
1960-1969		.784		.809			.810[e]	.656[d]
1964-1965	.844				.625	.708		
1964-1967	.715				.500	.574		
1970-1974		.797		.818				
1974-1976	.711				.592	.719		

[a]Thailand National Statistical Office, *Reports on Surveys of Population Change.*
[b]Hill (1978).
[c]Rungpitarangsi (1974).
[d]Completeness of adult death registration (over age 10).
[e]Completeness of death registration over age 5 on average.

applied up to 1960, 1970, and 1975, and the intersurvey cumulation can be applied between 1960 and 1970 and between 1970 and 1975. Summarized results, shown in column 3 of Table 7, give an estimate of completeness of 70 percent for the period up to 1960, 78 percent for 1960–1969, and 80 percent for 1970–1974, suggesting that although registration was improving in the 1950s and early 1960s, the improvement did not continue into the late 1960s and early 1970s.

Dual Record System Estimates of Completeness of Birth Registration

Other estimates of the completeness of registration are available from the two Surveys of Population Change. The matching of events recorded by the vital registration system with those recorded by a regular multiround survey provides a method for estimating the number of events missed by both systems and hence the total number of events. The ratio of registered events to total events provides a measure of registration completeness. Such estimates are available from the first year of the first SPC (1964–1965), all three years of the first SPC (1964–1967) and both years of the second SPC (1974–1976).

The estimates, shown in Table 7, show a rather large difference in completeness between the first year and the three years of the first SPC (the three-year figures are thought to be less reliable and are generally not used), and a substantial decline in completeness from the first year of the first SPC to the two years of the second SPC. None of the estimates of completeness agree well with those obtained by comparisons with parity data, the first year of the first SPC giving higher completeness and the other two periods showing lower completeness.

Completeness of Adult Death Registration Using the Growth Balance Method and Intercensal Survival

Rungpitarangsi (1974) describes an ingenious method for estimating the completeness of adult death registration. Finding that intercensal survival between the censuses of 1937, 1947, 1960, and 1970 gave implausible mortality estimates, probably for reasons of varying enumeration completeness, Rungpitarangsi applied the Brass growth balance method (Brass 1975) to registered deaths in each census year in order to estimate the completeness of adult death registration. The estimates obtained were then averaged, by sex, and applied as a correction factor to registered deaths of those aged 5 and over in each intercensal interval to estimate the correct number of deaths. Taking the 1960 census enumeration as the most complete, the adjusted intercensal deaths were used to estimate the relative

completenesses of enumeration of the other censuses, the adjusted populations of which were then used to provide denominators for the calculation of intercensal life tables from age 5 using adjusted intercensal deaths as numerators. The life tables were completed by splicing on suitable model life tables to represent mortality up to age 5. However, since the method essentially estimates completeness of registration of deaths after childhood, it is estimates of completeness of registration of these deaths that are shown in Table 7. With reference to this method, it should be noted that if mortality is declining, completeness of registration will tend to be underestimated. The registration of adult deaths is estimated to be about 66 percent complete, both for the period prior to 1960 and for the period from 1960 to 1970.

Dual Record System Estimates of Completeness of Death Registration

As in the case of birth registration, the Surveys of Population Change provide estimates of the completeness of death registration for 1964–1965, 1964–1967, and 1974–1976. These completeness estimates can be calculated by age group, and for comparison purposes, Table 7 shows the estimates of completeness of registration of all deaths and of deaths over age 10. The estimates of completeness, both overall and over age 5 or 10, are reasonably consistent, with the exception of that obtained from the cohort attenuation method (Hill 1978). It is difficult, however, to draw firm conclusions concerning the completeness of death registration from these estimates, beyond saying that completeness is probably around 60 percent, that it is higher for adult than child deaths, and that there is no evidence of any continuing trend in completeness over time.

CHILDREN EVER BORN DATA FROM TWO SURVEYS

If information on children ever born is available from two censuses or surveys five or ten years apart, the age-specific fertility schedule for the intersurvey period may be estimated from the parity increments of successive cohorts (National Research Council 1980). Table 8 shows the age-specific fertility rates for 1960–1969 and 1970–1974 estimated in this way, after adjustment of the 1960 parity figures for the half-year age shift (Hill 1978). The results are affected if children are omitted from the reports of older women, and there is some reason to suppose that this may have happened in 1960, and to a lesser extent in 1970, although the overall effect is probably small. The total fertility rate estimated by this method is 6.2 for 1960–1969, close to the adjusted registration estimates and very close to the SPC mid-decade estimates. For 1970–1974 the estimate of total

TABLE 8 Age-Specific Fertility Rates Estimated from Intersurvey Cohort Parity Increment: Thailand

	Period	
Age Group	1960-1970	1970-1975[a]
15-19	.080	.076
20-24	.253	.213
25-29	.301	.235
30-34	.272	.202
35-39	.208	.149
40-44	.101	.109
45-49	.019	.025
Total Fertility	6.17	5.04

[a]Average number of children ever born by age group of mother in 1975 was obtained as a weighted average of results from rounds one and five of the second SPC, to approximate a date of April 1, 1975.

SOURCE: Hill (1978).

fertility from this method is 5.0, almost exactly the same as the adjusted registration figure. The agreement is not surprising, since the estimates of completeness of birth registration depend on the same parity data as the cohort parity increment method.

INDIRECT ESTIMATES OF INFANT AND CHILD MORTALITY

Both infant mortality and child mortality have been estimated directly by the Surveys of Population Change, and the results are included in the summary table of mortality estimates in the final summary section of this report. A series of indirect estimates of child mortality is also available, based on proportions dead among children ever born as reported in the 1970 census, the 1974–1976 SPC, and the SOFT (see Knodel and Chamratrithirong 1978 and additional tabulations prepared for the workshop).

The proportion dead among children ever born to women of a given age depends on the age pattern of childbearing, which determines the age distribution of the children ever born, and the mortality risks to which they were exposed. If the age pattern of childbearing can be estimated and an age pattern of child mortality can be assumed, proportions dead among children ever born may be converted into estimates of probabilities of dying by exact ages of childhood (Brass 1964).

The procedure used here was developed by Trussell (National Research Council 1980), who studied the relationship between ratios of probabilities of dying to proportions dead among children ever born and indicators, in this case average parity ratios, of the age pattern of childbearing, using linear regression on a large number of computer-generated cases based on demographic models. The relationships used here were based on the subset of model cases generated by using the Coale and Demeny (1966) "North" age pattern of child mortality. (A full discussion of this technique will be found in National Research Council 1980.) Indirect estimates derived from the reported proportion dead among children ever born will underestimate child mortality to some extent if women underreport children who died to a greater extent than children who survived. In general, the results from applying the indirect estimation technique to data from Thailand are in reasonable agreement with the direct estimates of child mortality obtained by the dual record system approach of the SPC's, although the indirect estimates are slightly lower in most cases.

Table 9 shows the indirect estimates of the probability of dying by exact ages 2, 3, and 5 based on data from the 1970 census, rounds one and five of the 1974–1976 SPC, and the SOFT. The table also shows estimates of the time to which each estimate refers: t^* is the number of years prior to the date of the census or survey to which the estimates refer. The indirect estimates of child mortality are reasonably consistent with one another. Round one and round five of the second SPC give very similar estimates, though round five shows slightly higher average mortality. The estimates from the 1970 census, referring roughly to a period five years earlier, show a substantially higher mortality level. The results from the SOFT, taken between the two rounds of the second SPC and therefore referring to a similar time period, are consistently higher, perhaps indicating lower omission of dead children using the pregnancy history question. The general picture, however, is of moderate child mortality for a developing country and of a gradual decline in the level of mortality from the mid-1960s to the early 1970s.

The estimates of child mortality in the form of estimates of ${}_2q_0$, ${}_3q_0$, and ${}_5q_0$ are derived from the proportions dead among children ever born to women aged 20–24, 25–29, and 30–34, respectively; each refers to a different number of years prior to the date on which the information was collected. It is possible to combine these three estimates into a single summary measure of child mortality by averaging the levels of mortality implied by each in some system of model life tables; any single index of child mortality corresponding to the average level can then be derived from the same model life tables. This procedure was followed using the "North" family from the Coale and Demeny (1966) regional model life

TABLE 9 Indirect Estimates of Child Mortality from Proportions Dead Among Children Ever Born, Using the Trussell Technique: Thailand

Source of Estimate	$_2q_0$	t^*	$_3q_0$	t^*	$_5q_0$	t^*
1970 census	.0753	2.2	.0967	3.8	.1223	6.0
1974 SPC (round one)	.0667	2.3	.0791	3.8	.1064	5.7
1975 SPC (round five)	.0716	2.3	.0769	3.9	.1043	5.8
1975 SOFT	.0786	2.3	.0883	4.0	.1169	5.8

Note: t^* indicates the estimated number of years before the census or survey to which the child mortality estimate refers.

SOURCE: 1970 and 1974 results from Knodel and Chamratrighirong (1978) and additional calculations for 1975 results.

tables, and the summary value of $_5q_0$ was found for each case (see Table 10). The time before the survey to which each average estimate referred was calculated as the average of the three times found for the separate estimates of mortality derived from each age group of women.

In addition to the estimates of child mortality obtained from the indirect methods, time trends in infant mortality ($_1q_0$) can also be derived. The Trussell technique does not directly give estimates of $_1q_0$, but each estimate of the probability of dying by age n, $_nq_0$, corresponds to a mortality level in the "North" model life table system, and the infant mortality rate for that level can be found. The accuracy of these estimates of infant mortality can be affected not only by biases in reporting of children ever born and children surviving, which affect all the indirect estimates, but also by the appropriateness of the fit between the actual age pattern of child mortality and the age pattern built into the "North" model life tables that were used in the determination of infant mortality. The time series of these indirect estimates of infant mortality are presented in the summary table on mortality included in the final summary section of this report.

FERTILITY ESTIMATES FROM BIRTH HISTORIES

Estimates of recent levels and trends in Thai fertility are available from birth histories collected by several national sample surveys. Two approaches have been used. In the first approach, marital fertility rates for the year or two years prior to the time of the survey have been calculated on the basis of the births recorded during those periods in the birth history. It is possible to determine trends in marital fertility in this way by comparing the results obtained from the various rounds of the LS and the SOFT. The second approach uses a single set of birth histories from a

TABLE 10 Mortality Indicators by Period: Thailand

Indicator/Source	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
Child Mortality														
${}_5q_0$ (probability of dying by exact age 5)														
SPC life tables		.1226											.0969	
Indirect:[a]														
1970 census				.1097										
1974 SPC								.0938						
1975 SPC									.0944					
1975 SOFT									.1057					
Infant mortality rate														
SPC life tables		86											68	
Indirect:[b]														
1970 census	77		71		63									
1974 SPC						68		59	56					
1975 SPC							67		58	60				
1975 SOFT							74		66	65				

Indicator/Source	1935	1940	1945	1950	1955	1960	1965	1970	1975
Adult Mortality									
Expectation of life at age 10, ${}_{10}\mathring{e}_0$									
SPC life tables, males							55.7		55.7
Growth balance,[c] males	42.2		42.5			52.1		53.1	
SPC life tables, females							59.2		60.7
Growth balance,[c] females	44.6		45.3			55.4		56.7	
All Mortality									
Expectation of life at birth, $\mathring{e}_0$									
SPC life tables, males							56.3		58.0
SPC life tables, females							60.6		63.8

[a] ${}_5q_0$ of "North" model life table level with average level of results shown in Table 9.
[b] ${}_1q_0$ of "North" model life table of level determined by each estimate in Table 9.
[c] From Rungpitarangsi (1974).

particular survey and calculates retrospectively annual age-specific fertility rates based on these data. This has been done for the SOFT, fertility rates having been calculated retrospectively to 1960.

Marital fertility rates based on births occurring one year or two years prior to each survey are shown in Table 11. Since the age distributions of currently married women were substantially different in the surveys involved, it is necessary to standardize the summary measure of marital fertility for age. Both unstandardized and standardized rates are shown. Comparison of the rates based on a one-year and a two-year period prior to the survey reveals a consistent difference. When the age-specific marital fertility rates are converted into age-specific fertility rates and total fertility rates are calculated from the latter rates (results not shown), the two-year rates are too low in comparison with other available estimates of fertility. It seems clear that the different results obtained when calculating fertility rates for a one-year rather than a two-year period prior to the survey arise from complicated distortions of the time scale on which women report the birth of their children, a problem observed not infrequently when using data obtained from fertility histories in developing countries.

Regardless of whether one- or two-year rates are used, however, a clear trend towards declining marital fertility is evident from the standardized marital fertility rates. The one-year rates for the whole country indicate that marital fertility declined by 21 percent from the time shortly before the first rounds of the Longitudinal Survey in 1969 and 1970 to the time shortly before the SOFT in 1975. The equivalent decline for the two-year rates is 16 percent. It should be noted that the one- and two-year rates were not calculated in precisely the same manner; however, the differences should have only trivial effects.

Retrospective estimates of the total fertility rate based on birth histories have been published in *SOFT: Country Report, Volume 1* (Institute of Population Studies and National Statistical Office 1977). Since the publication of these results, several revisions have been made. A comparison of the previously published results with the revised results is shown in Table 12. Two types of revisions or adjustments account for the differences. A new way of calculating the fertility rates for five-year age groups for which only incomplete data were available was used to obtain the first set of revised estimates, shown in the second column in Table 12. It was noticed, however, that the proportions of women ever married by age indicated from the household schedules collected in the SOFT were substantially lower than the proportions of women ever married by age indicated by either the 1970 census or the 1975 SPC. The latter two sources agree quite closely with each other, suggesting that the SOFT results are probably not representative. The age-specific fertility rates derived from

TABLE 11 Births During One Year and During Two Years Prior to Interview per 1,000 Married Women 15-49, Unstandardized and Standardized for Age Based on Sample Surveys: Thailand

Place of Residence of Respondent and Year of Interview and Survey Source	Rates Based on Births Occurring During One Year Prior to Survey		Rates Based on Births Occurring During Two Years Prior to Survey		Ratio of One-Year to Two-Year Rates, Unstandardized
	Unstandardized	Standardized	Unstandardized	Standardized	
Rural					
1969 LSI	277	298	234	258	1.18
1972 LSII	239	260	207	224	1.15
1975 SOFT	223	227	210	211	1.06
Urban					
1970 LSI	192	209	175	185	1.10
1973 LSII	180	193	164	179	1.10
1975 SOFT	188	193	175	179	1.07
Kingdom					
1969-1970 LSI	262	282	224	245	1.17
1972-1973 LSII	230	250	201	217	1.14
1975 SOFT	218	223	205	206	1.06

Note: The one-year rates for the LS assume one year of exposure for all currently married women at the time of interview, whereas all other rates are based on the actual number of married women years of experience. Standardization for age was based on the age distribution of currently married women from the 1970 census.

TABLE 12 Comparison of Previously Published Retrospective Estimates of Total Fertility Rates from the Survey of Fertility in Thailand (SOFT) with Revised and Adjusted Estimates (adjusted for differences in the proportion ever married in the SOFT and the 1970 census): Thailand

Period	Previously Published[a]	Revised[b]	Revised and Adjusted[b]
1965-1969	6.25	6.20	6.46
1970-1974	4.85	4.86	5.09

[a]Institute of Population Studies and National Statistical Office (1977), p. 56.
[b]Revised by Sauvaluck Piampiti and John Knodel, July 1978.

the SOFT were therefore adjusted by applying the 1970 census proportions of ever-married women, by age, to the SOFT marital fertility rates. The results of this adjustment combined with the revision discussed above are shown in the last column of Table 12; together they raise slightly the total fertility rates obtained from the birth histories. In both the previously published and the newly revised results, a substantial decline in total fertility is evident from the 1965–1969 period to the 1970–1974 period.

Estimates of the total fertility rate for each calendar year based on the retrospective analysis of the birth histories collected in SOFT are shown in Table 13; two-year moving averages, taken to smooth out irregularities, are also shown. Both sets of results are shown unadjusted and adjusted for the differences in the proportion of women ever married observed between the results of the 1970 census and the SOFT. Total fertility declines fairly slowly from 1960 to about 1967, when a more rapid decline begins: from 1967 to 1974, the estimated total fertility fell by about one third. As with all retrospective fertility estimates based on birth histories, caution is required in interpreting the results since they are sensitive to the failure of respondents to mention all births and to possible misplacement in time of the dates of particular births.

SUPPLEMENTAL EVIDENCE OF FERTILITY DECLINE

Birth-Order Statistics

Data on the distribution of registered births by birth order help to confirm the existence of a recent decline in fertility (Pardthaisong et al. 1978). It has commonly been observed that during the transition from high to low levels of fertility, the proportion of higher-order births declines while the

TABLE 13 Retrospective Estimates of Total Fertility Rates from the Survey of Fertility in Thailand (SOFT), Unadjusted and Adjusted for Differences in the Proportion of Ever-Married Women in the SOFT and in the 1970 Census: Thailand

	Single-Year Estimates		Two-Year Moving Averages[a]	
	Unadjusted	Adjusted	Unadjusted	Adjusted
1960	7.32	7.58	–	–
1961	6.89	7.17	7.10	7.37
1962	7.32	7.61	7.10	7.39
1963	6.35	6.61	6.83	7.11
1964	7.06	7.34	6.71	6.97
1965	6.35	6.60	6.71	6.97
1966	6.71	7.00	6.53	6.80
1967	6.30	6.56	6.50	6.78
1968	6.24	6.50	6.27	6.53
1969	5.76	6.01	6.00	6.25
1970	5.46	5.70	5.60	5.85
1971	5.38	5.62	5.42	5.66
1972	4.80	5.04	5.09	5.33
1973	4.12	4.32	4.46	4.68
1974	4.64	4.85	4.38	4.58

Note: Previously unpublished rates were revised by Sauvaluck Piampiti and John Knodel, July 1978.

[a]The two-year moving averages refer to the average of the year shown and the previous year.

proportion of lower-order births increases. This is of course a result of a shift from larger to smaller family sizes. Although birth registration is incomplete, changes in the distribution of registered births by birth order may be expected to reflect real changes in the actual distribution of all births unless changes in completeness are parity specific.

Table 14 summarizes the birth-order composition of registered births for Thailand from 1961 to 1975. The birth-order distribution was relatively stable during the early years of the 1960s, but from mid-decade onward it changed systematically, the change continuing into the 1970s. The proportion of all births that were either first order or first and second order increased annually almost without exception from 1965 on, whereas the proportion of births that were fourth and higher order declined. These findings are quite consistent with the observed trends in fertility over the same period. Caution in interpreting the sharp changes during the 1970s is in order since the proportion of births of unknown order increased sharply during this period.

TABLE 14 Distribution of Registered Births by Birth Order: Thailand

	Percent of All Births of Known Order[a]			
	First Births	First and Second Births	Fourth or Higher Births	Percent of All Births of Unknown Order[b]
1961	21.8	40.3	44.0	5.0
1962	21.4	39.6	44.7	5.4
1963	21.8	39.8	44.8	6.1
1964	21.1	38.9	45.8	6.9
1965	21.2	38.8	45.9	7.5
1966	21.8	39.6	45.4	7.8
1967	22.0	39.9	45.3	7.7
1968	22.7	40.6	44.6	8.0
1969	23.0	41.4	43.7	7.9
1970	23.0	41.6	43.4	7.9
1971	23.8	42.4	42.5	8.4
1972	25.7	45.2	40.0	9.3
1973	27.1	46.7	38.5	15.6
1974	28.8	48.7	36.6	16.1
1975	31.0	52.4	32.9	20.4
1961-1965[c]	21.5	39.5	45.0	6.2
1966-1970[c]	22.5	40.6	44.5	7.9
1971-1975[c]	27.3	47.1	38.1	14.0

[a]Excluding births of unknown order from denominator.
[b]Including births of unknown order in denominator.
[c]Unweighted five-year averages.

SOURCES: Calculations by Pardthaisong (1978) and additional calculations from data provided by the Ministry of Public Health.

Contraceptive Use Data

Additional supplemental evidence comes from survey data on the extent of contraceptive practice among married women of reproductive age and data on family planning acceptor statistics collected by the National Family Planning Program. The survey data show that contraceptive use increased dramatically between 1969 and 1975, coincident with the period of rapid fertility decline (Table 15). The increase is particularly marked in rural areas where the National Family Planning Program concentrated its efforts. The low level of use found for rural women in 1969 and the substantially higher use found for urban women in 1970 are consistent with the evidence indicating lower urban fertility and a more substantial urban fertility decline during the preceding decade. There is no direct

TABLE 15 Percent Who Are Currently Using and Percent Who Have Ever Used Contraception Among Currently Married Women Aged 15-44 as Reported in National Sample Surveys: Thailand

	Current Use	Ever Use
Rural		
1969 LS 1	10.9	14.4
1972 LS 2	22.8	29.4
1975 SOFT	34.8	49.0
Urban		
1970 LS 1	32.6	39.7
1973 LS 2	45.1	56.5
1975 SOFT	49.4	65.7
Kingdom		
1969-1970 LS 1	14.8	18.9
1972-1973 LS 2	26.3	33.6
1975 SOFT	36.7	51.2

SOURCE: Debavalya and Knodel (1978).

study for Thailand to indicate whether contraceptive use is likely to be overreported or underreported in surveys. There are no obvious grounds to suspect large biases in either direction, and even if such biases existed their effect should be minimal on the trends of contraceptive use derived from successive surveys, all of which followed a broadly similar methodology.

Data on new acceptors from the National Family Planning Program acceptor statistics are also consistent with a substantial fertility decline since the end of the 1960s. The number of new acceptors has continued to increase for most years during the 1970s, as shown in Table 16. It should be noted that there is some double counting and possible overregistration of new acceptors. The largest share of acceptors is attributed to the pill, which accounts for more than half of all acceptors for each year shown. An analysis of family planning acceptor statistics based on both private and public sources indicates that the expected trend in total fertility rates derived from estimating births averted is roughly consistent with the observed trend in those rates (Thailand Ministry of Public Health 1978a).

Data on Marital Status

In a country where most fertility is legitimate, changes in marital status can have a considerable impact on overall fertility without any change occurring in marital fertility, and in trying to account for changes in the overall level of fertility, marital status is an important factor to take into

TABLE 16 New Acceptors in the National Family Planning Program: Thailand

Year	Total[a]	Pill	IUD	Injectable Hormonal	Female Sterilizations	Vasectomy
1965-1971	946,738	505,314	336,392	–[a]	← 105,032 →	
1972	450,378	327,582	90,128	–[a]	← 32,668 →	
1973	411,729	268,674	93,449	–[a]	← 49,606 →	
1974	475,465	305,244	89,739	–[a]	73,702	6,780
1975	535,023	345,117	75,163	24,559	82,650	7,534
1976	627,239	376,707	71,894	73,357	95,131	10,150
1977	758,212	488,765	74,794	68,714	106,816	19,123
1978[b]	199,614	119,050	19,808	21,042	29,515	10,199

[a]Does not include other methods not listed, such as condoms. Also, totals for injectable acceptors prior to 1975 were combined with acceptors of other methods such as condoms and foam.
[b]First three months of 1978.

SOURCE: Thailand Ministry of Public Health (1978a).

TABLE 17 Proportions of Females Single by Age Group from Selected Sources: Thailand

	1960 Census				
Age Group	Reported Ages	Half-Year Adjusted Ages	1970 Census	1975 SOFT	1975 SPC
15-19	.862	.830	.810	.846	.786
20-24	.387	.352	.379	.415	.359
25-29	.141	.126	.156	.192	.156
30-34	.067	.062	.081	.101	.081
35-39	.042	.040	.053	.064	.048
40-44	.031	.030	.039	.039	.032
45-49	.026	.026	.030	.033	.015
Singulate mean age at marriage	22.10	21.64	21.97	22.46	21.96

account. The censuses of 1960 and 1970, the 1975 fifth round of the second SPC, and the SOFT all collected data on marriage, the last in considerable detail. The proportions of single females by age group from these sources are shown in Table 17. Two sets of proportions are given for 1960, one based on reported age and one obtained by regarding reported age as half a year older than true age to reflect the problem of age reporting discussed above.

The proportions marrying and the singulate mean age at marriage are broadly similar for the 1960 census (after adjustment), the 1970 census, and the 1975 SPC. The SOFT sample, however, shows substantially lower proportions ever married than the other sources and later marriage on

TABLE 18 Fertility and Mortality Indicators by Region and Period: Thailand

Parameter Estimated	Source	Time Period	Regional Estimates					Index Values, Kingdom = 1.00			
			Kingdom	North	Northeast	Central	South	North	Northeast	Central	South
Total fertility rate	P/F, registered births	1960	6.54	6.23	6.98	5.64	5.71	.95	1.07	.86	.87
	Own children	1960-1964	6.48	6.36	6.97	6.06	6.52	.98	1.08	.94	1.01
	Cohort parity	1960-1970	6.17	6.03	7.15	5.34	6.13	.98	1.16	.87	.99
	Adjusted registered births	1960-1969	6.44	5.92	7.25	5.44	6.09	.92	1.13	.84	.95
	SPC	1964-1965	6.30[a]	6.47	6.61	5.90[a]	6.02	1.03	1.05	.94	.96
	Own children	1965-1969	6.19	5.71	7.20	5.32	6.48	.92	1.16	.86	1.05
	Cohort parity	1970-1975	5.04	4.34	6.52	3.48	6.64	.86	1.29	.69	1.32
	Adjusted registered births	1970-1974	5.13	4.39	6.32	3.63	6.17	.86	1.23	.71	1.20
	SPC	1974-1976	4.90	3.74	6.25	3.93[b]	6.12	.76	1.28	.80[b]	1.25
Birth order-proportion not first births	Registration[c]	1960	.782	.782	.785	.786	.761	1.00	1.00	1.01	.97
		1965	.788	.791	.790	.783	.789	1.00	1.00	.99	1.00
		1970	.770	.754	.795	.747	.782	.98	1.03	.97	1.02
		1974	.712	.698	.766	.640	.744	.98	1.08	.90	1.04
Marital fertility[d]	SOFT	1973-1974	210	152	267	182	231	.72	1.27	.87	1.10
Infant mortality	SPC	1964-1965	84.3[a]	96.5	83.4	94.0[a]	48.5	1.14	.99	1.12	.58
	Indirect[e]										
	1970 census	1966	70.1	81.4	78.9	55.4	54.7	1.16	1.13	.79	.78
	1974 SPC	1970	61.1	77.4	68.8	35.4	60.0	1.27	1.13	.58	.98
	1975 SPC	1971	61.5	79.7	70.6	38.5	53.6	1.30	1.15	.63	.87
	SPC	1974-1976	51.9	74.0	52.3	40.0[b]	52.4	1.43	1.01	.77[b]	1.01

[a] Excludes Bangkok-Thonburi.

[b] Weighted average of central (excluding Bangkok-Thonburi) and Bangkok-Thonburi.

[c] Data from Thailand Ministry of Public Health.

[d] Age standardized 20-24.

[e] Infant mortality rates obtained from Coale and Demeny (1966) "North" family life tables corresponding to indirect estimates of ${}_2q_0$, ${}_3q_0$, and ${}_5q_0$.

average. Given the consistency of the other data sets, we conclude that the SOFT marriage data are not representative. Considering the other distributions only, there seems to have been no significant change in marriage patterns between 1960 and 1975, and fertility changes cannot be explained in this way.

REGIONAL VARIATION

Regional variation is an important factor in understanding levels and trends of fertility and, to a lesser extent, mortality in Thailand. Some of the methods of analysis presented above are more suitable than others for application to regions. Own-children analysis has been applied at the regional level; the completeness of birth registration can be estimated at the regional level by comparison with reported average parity in 1960 and by comparing cumulated cohort fertility with parity in 1970 and 1975; cohort parity increment methods can also be applied for the periods 1960–1970 and 1970–1975; and the Surveys of Population Change provide regional estimates of fertility.

The estimates are summarized in Table 18, by source and time period, in terms of the total fertility rate. The regional estimates are also shown as index values, taking the national estimate as 100; these index values thus provide an indication of regional variation independent of level. Table 18 also shows age-standardized marital fertility rates by region from the SOFT; regional estimates of the infant mortality rate from the Surveys of Population Change and from 1970 census information on children ever born and surviving, the 1974 first round of the second SPC, and the 1975 SOFT; and proportions of births other than first births among all registered births of known order by region for selected years from 1960 to 1974.

The fertility estimates show impressive consistency even at the regional level. The index numbers show the North having fertility slightly below the national average prior to 1970, after which it falls rapidly; the Northeast starts somewhat above average in the early 1960s and becomes increasingly above average thereafter; the Central region starts below average and declines further; the South starts close to average in the early 1960s and becomes above average by the early 1970s. The marital fertility rates from the SOFT for 1973–1974 show a similar pattern, although they indicate substantially lower fertility in the North than in the Central region. The birth-order composition of registered births provides additional confirmation of the changes that have taken place, showing nearly perfect homogeneity for 1960 and 1965 followed by declines in higher-order births, fastest in the Central and North regions and slowest in the Northeast and South regions.

TABLE 19 Age Patterns of Fertility by Period and Source of Estimate: Thailand

Source	Period	Standardized Rates by Age Groups							Observed TFR
		15-19	20-24	25-29	30-34	35-39	40-44	45-49	
Birth registration[a]	1960	.0129	.0435	.0510	.0446	.0353	.0100	.0029	4.704
SOFT[b]	1960-1964	.0161	.0456	.0456	.0370	.0340	.0165	.0051	7.170
Own children[c]	1960-1964	.0133	.0423	.0483	.0434	.0332	.0164	.0031	6.480
SPC[d]	1964-1965	.0109	.0423	.0495	.0387	.0363	.0184	.0039	6.119
SOFT[b]	1965-1969	.0138	.0406	.0469	.0406	.0319	.0212	.0051	6.460
Own children[c]	1965-1969	.0144	.0431	.0483	.0420	.0333	.0162	.0031	6.190
CPI[e]	1960-1970	.0130	.0410	.0488	.0441	.0337	.0164	.0031	6.170
Birth registration[a]	1970	.0148	.0452	.0477	.0405	.0317	.0157	.0046	4.374
SOFT[b]	1970-1974	.0114	.0378	.0451	.0409	.0385	.0212	.0052	5.085
CPI[e]	1970-1975	.0151	.0423	.0466	.0401	.0296	.0216	.0050	5.040
SPC[d]	1974-1976	.0165	.0487	.0504	.0372	.0292	.0144	.0037	4.899
Birth registration[a]	1975	.0162	.0433	.0476	.0398	.0303	.0163	.0067	3.699

[a]Rates calculated from birth registration data adjusted for age but not level.
[b]From Survey of Fertility in Thailand, revised and adjusted.
[c]From own-children analysis of 1970 census.
[d]From Survey of Population Change.
[e]From intersurvey cohort parity increment.

The infant mortality estimates are not quite so consistent, and it must be borne in mind that the indirect estimates come from estimates of survivorship to ages 2, 3, and 5, converted into infant mortality rates through the "North" family of regional model life tables. In general, however, it appears that the North region has the highest infant mortality, followed by the Northeast, the South, and, finally, the Central region. Over time, the North's disadvantage seems to have been getting worse, and the South's advantage seems to have been eroded, but the trends are neither entirely clear nor consistent.

AGE PATTERNS OF FERTILITY

Many of the methods presented in this report have estimated both the aggregate level and the age pattern of fertility. The different levels of these estimates makes it difficult to observe the variations in age pattern of fertility. Table 19 presents all the fertility schedules, estimated on a normalized basis with a total fertility rate of 1.0, and orders them by approximate time period. The distributions are reasonably consistent, but they show no clear trend in the age pattern of fertility over time. This is somewhat surprising, since fertility declines often start, or are concentrated, among older women; in the case of Thailand, fertility seems to have declined at all ages. However, a comparison of marital fertility rates from the Longitudinal Surveys and the Survey of Fertility in Thailand does show a more rapid decline of marital fertility for older women than for younger women (Debavalya and Knodel 1978). Contraceptive use data from the SOFT, on the other hand, show fairly high levels of use among younger women, consistent with the apparently rather minor changes over time in the age pattern of fertility.

COMPARISON OF FERTILITY AND MORTALITY ESTIMATES FROM DIFFERENT SOURCES

It is convenient for purposes of comparison to summarize the various national estimates of fertility and mortality presented above, which were obtained by a range of methodologies and which refer to different time periods, in terms of simple aggregate indicators.

For fertility, the indicator chosen is the total fertility rate; where necessary, crude birth rates and marital fertility rates have been converted into corresponding levels of total fertility, using observed age patterns of fertility and observed proportions of women married, respectively. Table 20 shows the total fertility rates by time and source; Figure 1 (above) shows estimates of total fertility for calendar years, smoothed by taking

TABLE 20 Estimates of Total Fertility by Period and Method: Thailand

Method/Source	1955	1957	1959	1961		1963		1965		1967		1969		1971		1973		1975	1977
SOFT[a,b]				7.4	7.4	7.1	7.0	7.0	6.8	6.8	6.5	6.3	5.9	5.7	5.3	4.7	4.6		
Adjusted registered births[b]				6.2	6.2	6.4	6.7	6.9	6.6	6.2	6.0	5.8	5.5	5.4	5.3	5.1	4.8	4.6	
Reverse survival																			
1975[c]				6.3	6.5	6.5	6.5	6.5	6.4	6.1	6.1	5.8	5.5	5.3	5.0	4.2	3.9	4.1	
1970[c]			6.2	6.5	6.5	6.3	6.6	6.9	6.0	5.6	5.5	5.6							
SPC								6.3									4.9		
LS																			
births, 1 year before[c]												6.1			5.3				
births, 2 years before[c]										5.3				4.6					
Cohort parity increment								6.2								5.0			
Stable population analysis[c]		6.5								6.3									
Own children						6.5		6.5			6.0								
Reverse survival using reported age distribution[c]		5.7				6.5				6.0									
Reverse survival from SPC's (reported midyear populations)[c]		6.1				6.3				6.2						4.8			
Reverse survival using adjusted distribution[c]		6.1								6.2									

[a] Revised and adjusted rates.
[b] Two-year moving average.
[c] TFR's obtained by conversion from other indicator.

two-year moving averages, from four sources—adjusted registered births, the SOFT, and two single-year age distributions obtained by reverse survival. The agreement between the estimates obtained, by independent methodologies, for comparable time periods is impressive.

The estimates shown in Figure 1 are particularly interesting. The downward bias of the estimates obtained from reverse survival for the four years before the survey shows up clearly for both the census and the SPC age distributions; in both cases the bias appears to be less marked for the point nearest the survey (based on an average of children aged 0 and 1) than for the second point (based on an average of children aged 1 and 2). The SOFT estimates show a rather similar pattern, the last three points showing an apparent acceleration of the fertility decline; it is tempting to assume that the same sort of dating error may be affecting both the age distributions and the fertility history. The overall level of the SOFT estimates, to 1970, is consistently and suspiciously higher than those obtained from the other three methods, possibly reflecting a tendency to bunch events into the period 5–15 years before the survey. The adjusted birth registration rates show a dubious pattern of rise and fall to 1966, but follow a fairly constant trend thereafter; the early rise and subsequent decline may be due to improving registration in the early 1960s, with an increase in delayed registration in the mid–1960s. All four sources show, however, that fertility has declined rapidly, the decline having started around 1965; the minimum decline in the total fertility rate by 1975 is 28 percent.

In the case of mortality, it is less easy to select one single indicator, since the methods applied are often estimating mortality for different periods of life. It is also more difficult to convert one measure of mortality into another, given the uncertainty surrounding the underlying age pattern of mortality. Therefore, four different indicators are shown in Table 10: child mortality estimates, from the SPC and from indirect methods, are shown in the form of probabilities of dying by age 5 and of the infant mortality rate; adult mortality estimates, from the SPC's and from adjusted registered deaths, are presented in the form of expectation of life at age 10, and in the case of the SPC, expectation of life at birth. It must be remembered that the infant mortality rates estimated by indirect methods were obtained by using an assumed age pattern of childhood mortality; a different pattern would give different estimates. It is clear, however, that child mortality has declined in the recent past.

The Surveys of Population Change show a decline of 21 percent in the probability of dying by exact age 5 between the mid-1960s and the mid-1970s, although this figure exaggerates the true change, since Bangkok was excluded from the earlier survey. The indirect child mortality estimates,

when considered internally, indicate a decline over approximately a five-year interval of one level in the Coale and Demeny (1966) life tables, equivalent to a decline in ${}_5q_0$ of close to 15 percent. When differences between the surveys are considered, a similar decline may be observed from the 1970 census to the 1974–1975 SPC results. The estimates derived from the SOFT, however, show virtually no decline after 1970, though for reasons noted earlier these estimates are not really comparable with the rest despite the fact that they may be more reliable.

The decline of adult mortality seems to have been less marked, with expectation of life at age 10 remaining constant for males from the first SPC to the second, although improving by about a year and a half for females.

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 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 record of the number and dates of all live births experienced by a particular woman; see also *pregnancy history*. 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 event 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 central value 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 record 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 up to some specific time, generally 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.

References

Arnold, F., and M. Phananiramai (1975) Revised Estimates of the 1970 Population of Thailand. Research paper No. 1, National Statistical Office, Bangkok.

Arnold, F., and A. Wanglee (1975) Demographic Evaluation of the 1970 Census of Population and Housing in Thailand. Paper presented at the Fourth Population Census Conference, East-West Population Institute, East-West Center, Honolulu, Hawaii.

Arnold, F., R. Retherford, and A. Wanglee (1977) The Demographic Situation in Thailand. No. 45, Papers of the East-West Population Institute, East-West Center, Honolulu, Hawaii.

Brass, W. (1964) Uses of Census and Survey Data for the Estimation of Vital Rates. Addis Ababa: United Nations Economic Commission for Africa.

Brass, W. (1975) Methods for Estimating Fertility and Mortality from Limited and Defective Data. An occasional publication, Laboratories for Population Statistics, University of North Carolina, Chapel Hill.

Brass, W., A. Coale, P. Demeny, D. Heisel, F. Lorimer, A. Romaniuk, and E. van de Walle (1968) The Demography of Tropical Africa. Princeton, N.J.: Princeton University Press.

Chamratrithirong, A., N. Debavalya, and J. Knodel (1978) Age Reporting in Thailand: Age at Last Birthday Versus Age at Next Birthday. Paper No. 25, Institute of Population Studies, Chulalongkorn University, Bangkok. Paper presented at the Pattaya workshop.

Cho, L.-J. (1973) The own-children approach to fertility estimation: An elaboration. Pages 263–278, International Population Conference, Liège, 1973. Vol. 2. Liège, Belgium: International Union for the Scientific Study of Population.

Coale, A., and P. Demeny (1966) Regional Model Life Tables and Stable Populations. Princeton, N.J.: Princeton University Press.

Debavalya, N., and J. Knodel (1978) Fertility Transition in Thailand: A Comparative Analysis of Survey Data. Report No. 3, World Fertility Survey, Survey of Fertility in Thailand, Bangkok.

Fulton, J. (1975) Evaluation of selected aspects of the 1970 census of Thailand. Unpublished master's degree thesis, Department of Sociology, Brown University, Providence, R.I.

Hill, K. (1978) Estimating Fertility in Thailand from Information on Children Ever Born. Paper presented at the Pattaya workshop. (Published as pages 1–48 in The Survey of Population Change, 1974–76 (1979). Bangkok: Thailand National Statistical Office.)

Institute of Population Studies and National Statistical Office (1977) The Survey of Fertility in Thailand: Country Report. Vol. 1. Bangkok: Allied Printers.

Knodel, J., and A. Chamratrithirong (1978) Infant and Child Mortality in Thailand: Levels, Trends and Differentials as Derived Through Indirect Estimation Techniques. No. 57, Papers of the East-West Population Institute, East-West Center, Honolulu, Hawaii. Paper presented at the Pattaya workshop.

Leoprapai, B. (1978) Fertility Estimation by Reverse Survival Method for Thailand: 1960 and 1970. Paper presented at the Pattaya workshop.

Leoprapai, B., and A. Wanglee (1978) Estimates of Vital Rates by Stable Population Analysis of the Age Distribution for Thailand 1960 and 1970. Paper presented at the Pattaya workshop.

National Research Council (1980) Draft chapters of a manual of demographic estimation techniques for countries with incomplete data.

Pardthaisong, T., et al. (1978) Emerging Areas of Fertility Decline in Thailand, 1961 to 1974; Preliminary Results. Paper presented at the Pattaya workshop.

Preston, S., and K. Hill (1980) Estimating the completeness of death registration. Population Studies (in press).

Retherford, R., and L.-J. Cho (1978) Comparative Analysis of Own-Children Fertility Estimates in Pakistan, the Philippines, and Thailand. Paper presented at the Tokyo Conference on Comparative Fertility Transition in Asia, March 27–31, 1978.

Rungpitarangsi, B. (1974) Mortality Trends in Thailand: Estimates for the Period 1937–1970. Paper No. 10, Institute of Population Studies, Chulalongkorn University, Bangkok.

Thailand Ministry of Public Health (1978a) Application of Reverse Projection Technique to Estimate Births Averted Attributable to Acceptors of Contraception. Tables presented at the Pattaya workshop.

Thailand Ministry of Public Health (1978b) The Vital Registration System in Thailand: Legal and Administrative Procedures of the Vital Registration System. Paper presented at the Pattaya workshop.

Thailand National Statistical Office (no date) Report of the Survey of Population Change, 1964 to 1965. Bangkok.

Thailand National Statistical Office (1970) Report of the Survey of Population Change, 1964 to 1967. Bangkok.

Thailand National Statistical Office (1978) Fertility and Mortality Estimates from the Survey of Population Change, 1974 to 1976 (Preliminary). Paper presented at the Pattaya workshop.