ON PROBLEMS OF ACCURACY AND COMPARABILITY OF INTERNATIONAL FERTILITY DATA

Arjun Adlakha, Food Research Institute, Stanford University

Introduction

When one consults the United Nations Demographic Yearbook, the major source of international population data, he finds a large supply of data on human fertility. One will find birth rates given for a large majority of the countries of the world. However, after going through the footnotes to tables, which often run to several hundreds for a single table, one finds that the apparent existence of reliable fertility data is an illusion. To anyone more than a casual observer, it becomes clear that for a majority of the world's population, data from vital registration statistics are so deficient that they cannot be used for statistical purposes.

For many countries parameters of fertility are estimates from sources other than vital registration systems. Most often these are derived from censuses or surveys with the aid of demographic techniques developed in recent years. In a few instances information on fertility is available from dual systems, i.e., data are collected through two independent sources and corrected for events missed in both sources.

This article briefly evaluates the current availability of fertility data and discusses some major problems of data comparability and adequacy. A complete analysis of the present availability of data should be based on a tabulation showing for each country of the world the kind of information available and how it is obtained. This would be a monumental task and is not undertaken here. Further, problems of comparability of data of less developed countries differ in nature from those of more advanced countries. In general, satisfactory basic data on fertility for more advanced countries are available, though a skilled demographer may not find for all countries the detailed classification he needs for sophisticated analysis. On the other hand, data on fertility for less developed countries are usually estimates derived indirectly and suffer from numerous deficiencies. The present paper gives more attention to the latter.

The paper is divided into two sections, one dealing with vital registration systems and the other with information on fertility obtained for several countries from sources other than the vital registration system. Discussion in this paper is confined to availability of data on the national level.

Vital or Civil Registration Systems

In the latest United Nations Demographic Yearbook, 1970, which lists more than 250 countries and territories, there are some data on births for a great majority of the areas, and for certain years. However, for a large number of countries, under-registration of births is on the order of 30 per cent or more. In 1970, with the admittedly lenient criterion of completeness of birth reporting (90 per cent or better is considered satisfactory), 66 per cent of the estimated world population lacks reliable birth registration. This is shown in Table 1. Around 1947 usable vital statistics were available for about 30 per cent of the world's population.[1] There has been only a little improvement in availability of birth data during the last two decades.

Deficiency in vital registration statistics is by no means randomly distributed among different geographical regions. As might be expected, availability of birth statistics and social and material development are correlated. In Table 1 data are presented by major divisions of the world. Almost 100 per cent of the population of Europe (including the USSR) and Northern America have reliable statistics on live births while only a small fraction of the population in other regions are so classified. Even such rudimentary information as total number of births is missing for about 2.4 billion people living in developing areas.

The availability of fertility data of satisfactory quality from civil registration systems by type of tabulation is given in Table 2. The table lists the types of tabulation and the aggregate population as well as per cent of total population for which each type of tabulation is available in various regions of the world. The contrast between the more developed and the less developed regions is startling with respect to the availability of satisfactory data for birth tabulations. While satisfactory data on total births are available for only a small percentage of the populations of developing nations, more detailed tabulations are even less widely available. In Africa, while about 6 per cent of the population is classified as having virtually complete birth statistics, only one-half of one per cent has a classification of births by age of mother. The situation in Asia,excluding Japan, is not very different from that of Africa. In Latin America the situation is only slightly better than in Asia and Africa.

This general lack of reliable data on births from vital registration systems for a large portion of the world population, however, is not the only problem. Even in countries classified as having virtually complete data there are problems of comparability. These arise from differences in procedure for evaluation of birth data and differences in recording procedure.

As stated above, the United Nations classifies data virtually complete for a country if coverage of births is at least 90 per cent complete. The basis for the evaluation is information accumulated from questionnaires, from direct correspondence, and from relevant official publications. However, there is considerable subjectivity involved, as in several instances the basis for a country's own evalua-

tion is not provided. Even if one takes the evaluation results at face value, countries classified as having virtually complete data may vary in coverage between 90 and 100 per cent among themselves, as well as in the same country over time.

Despite the recommendation of the United Nations to adopt a uniform statistical definition of births and procedures for tabulation of births there exist differences among countries.[2] In many countries infants who are born alive but die before registration are not included in the live-birth registers, e.g. Algeria, Belgium, and France. In other countries the law specifies that an infant must survive for at least 24 hours before it can be considered for inclusion in the live-birth register, e.g. Ecuador and Spain. The effect of these factors is to underestimate total births.

In addition, many countries, due not to obduracy but to necessity, report data on births by date of registration,[3] rather than date of occurrence, as recommended by the United Nations. A lag between date of occurrence and date of registration of 20-25 years is not uncommon, though the majority of births are recorded within two to four years. Unless registration is prompt, such data are neither comparable internationally nor in the same country over time. For example, in Costa Rica, where data are tabulated by date of registration, it was observed that in recent years when registration improved the difference between births classified by date of occurrence and date of registration could be as high as 10 per cent. It is estimated that about 62,000 births occurred during 1961, while registered births in 1961 were 68,377.[4] The official birth rate, published in the United Nations' compilations for the same year, was derived from the latter figure and was therefore substantially exaggerated.

In brief, while vital registration systems provide satisfactory fertility data for most advanced countries, such data are missing for a majority of developing populations where problems of population are most salient and where fertility plays a prominent role in the population problems.

Other sources of Data on Fertility

In the absence of usable data from vital registration systems, the basic information used to estimate fertility parameters for most developing countries comes from censuses or surveys. The estimation of fertility from census or survey data has been feasible due to development of ingenious demographic techniques in recent years. There are a large variety of techniques, among them those known as the stable population technique, the survival ratio technique, the Brass technique, etc. On the basis of these techniques the Economic Commission for Africa and the Demographic Center for Latin America have provided estimates of fertility for most African and Latin American countries. Even more recently the use of such techniques has made it possible for the United Nations to provide plausible estimates of birth rates for countries having no usable official data on births.

The latest United Nations Population and Vital Statistics Report, which contains data available as of April 1, 1972, provides estimates of the birth rate for some 90 countries with no reliable registration data on births. For most of these countries the estimates are made by the United Nations. Details of computation for each country are not available; however, as explained in the Report these rates have been estimated from retrospective information obtained from sample surveys and censuses, by application of the "reverse survival" method and by other methods of analysis.[5] Earlier, the Population Division of the United Nations provided data on birth rates for 1950-55, 1955-60, and 1960-65 for a large number of countries, mainly using data from censuses and surveys with the aid of the reverse survival method and the stable population technique.[6]

Though these techniques have been useful tools in providing information which otherwise would not have been available, the information obtained in this manner is of limited utility. Several of the deficiencies in estimates obtained by the use of these techniques are illustrated below by detailing the two commonly-used techniques, stable population and survival ratio. The purpose of the discussion is merely to point out some problems in the application of the techniques and some limitations in the parameters obtained, not to describe the various techniques in use.[7]

Stable Population Technique

The stable population technique has been useful for obtaining estimates of the crude birth rates and--less often of other parameters of fertility for several countries without satisfactory vital statistics. For the proper application of the technique, the conditions required are that fertility and mortality in the population have remained unchanged in the long past and the population did not experience migration. If these conditions are met, estimates of fertility parameters for such a population can be obtained by comparing the age distribution of the population with a stable population which has a growth rate or mortality level identical to that of the population under consideration. Such comparison has been facilitated by the work of Coale and Demeny, who have constructed a series of stable population models[8] and also extended their use in situations of changing mortality but constant fertility in a population.[9]

There are several limitations of the estimates obtained in this manner. These are as follows:

First, as stated above, the technique is valid only if fertility in the long past has remained unchanged in the population under

consideration. In several instances where the technique is used, it is difficult to ascertain directly whether this requirement is met since satisfactory information on fertility levels is not available. It is, therefore, generally assumed, rather than ascertained, that fertility in the population has been constant in the past.

Second, because of the problems of age misreporting and of age-selective coverage in the census or survey enumeration, the technique often yields a wide range of birth rate estimates within which the true value for the population probably lies. This can be seen from the data in Table 3, taken from the work of Zachariah on estimation of birth rates of Arab countries using the stable population technique.[10] The birth rate corresponding to the cumulative proportion of population at different ages and growth rates differs widely within each country shown in Table 3. A difference of more than 10 points between the lowest and highest value of birth rate for a country is not uncommon, while in several instances it is more than 15 points and in a few instances even greater than 20 points. When such large difference in estimates of the birth rate for a given country exist, any averaging procedure is likely to provide an estimate which could be far from the true value. Estimates obtained in this manner, therefore, provide only a crude picture of the level of fertility of a country as well as of differences in levels of fertility among countries.

Finally, the technique is useful for measuring levels but not for trends. If the objective is to study the change in the level of fertility of a population the technique cannot be used since such a population is not, by definition, stable.

To illustrate these problems explicitly, stable population estimates of birth rates for Pakistan as obtained by various scholars are shown in Table 4.[11] The data in Table 4 show that using the same technique and even the same data different persons arrive at different results. For example, using 1951 census data, Krotki estimates a birth rate of 55 for Pakistan. Using the same data, Ahmed's estimates of the birth rate for East Pakistan (now Bangladesh) and West Pakistan are 59 and 62 respectively, both higher than Krotki's estimate. When 1951 census results are used the estimated birth rate is higher in East Pakistan than in West Pakistan. Results from 1961 census data are in just the opposite direction. The only conclusion one can derive from these data is that fertility in Pakistan is high. The data fail to provide any precise information on how high it is or on the direction and magnitude of differences in level of fertility between East Pakistan (now Bangladesh) and West Pakistan.

Use of Census Survival Ratios in the Estimation of Fertility

When a country has had two censuses the birth rates can be obtained from the census survival ratios, that is the proportion of age-group cohorts surviving from one census to the next, plus additional information from censuses. Details may vary, but the commonly-used techniques involve obtaining a life table representative of observed survival ratios. A birth rate can be obtained by two alternative procedures. The one commonly used by the United Nations is the "reverse survival" method, i.e. increasing the number of children of a given age group, usually 0-4 years, recorded in a census, by the life table survival coefficient, in order to estimate the number of births from which these children are survivors. An alternative procedure applies the age-specific death rate from the life table to the observed population by age to get a crude death rate. The birth rate is obtained by adding this death rate to the rate of natural increase usually determined as the rate of population growth between the two censuses.

The use of survival ratios in obtaining birth rates has an advantage over the stable population technique because it is applicable even if fertility is changing. However, estimates of fertility obtained by this technique have limitations of a similar nature to those already described. Some of these are detailed below by illustrative data from Turkish and Brazilian populations which have had regular censuses and are representative of several Asian and Latin American populations.

The construction of life tables, or even the estimation of some level of overall mortality, by this procedure requires that two censuses should be accurate, or at least that errors in the two censuses are of the same magnitude, and that ages are correctly reported. Generally, data from developing countries do not satisfy either of these requirements. Coverage probably varies from census to census,and there are certainly problems of age misreporting. Survival ratios obtained from census data are usually deficient and require some adjustment or smoothing. For example, census survival ratios obtained from the Turkish censuses conducted in 1960 and 1965, shown in Table 5, provide results which are improbable. In certain ages the survival ratios are greater than unity, while at other ages they are surely too low. This pattern is not only common in Turkish populations but also is found in other Asian populations, notably India, Pakistan, and Indonesia. Improbable results are also noted in the case of females in Brazil; however, survival ratios based on data for males in Brazil are much more regular in pattern. Similar results are observed in other Latin American countries, i.e. problems of age-reporting are much less serious in the case of males than females.

Recently Demeny and Shorter and Coale and Demeny have suggested a new procedure which minimizes the effect of age misreporting. They suggest the use of cumulative survival ratios instead of survival ratios for single cohorts, i.e. computing the proportion of the population surviving from age "x and over" in one census to age "x + 10 and over" in a census taken 5 or

10 years later. This should be done for each age x from 0 to 40. Computations involve projecting the initial population by various model life tables to conform to the population enumerated in the succeeding census and locating a model life table corresponding to each age "x and over" where x takes values from 0 to 40. Various life tables so selected provide a range of mortality estimates which is considered as the range of errors introduced by age misreporting. The median life table, it is suggested, should be selected and considered as the best estimate of the mortality level, relatively free of age misreporting.[12]

Through the use of the procedure outlined above, values of e_0^o have been obtained for males and females from the Turkish census conducted in 1960 and 1965 and the Brazilian census conducted between 1960 and 1970 and are shown in Table 6. In spite of the fact that this method is better than using individual cohort survival ratios, the range of mortality level is still too wide to provide an unbiased estimate of the true level of mortality. When values of e_0^o show variations of about 15 years, as in Turkey and for females in Brazil, the median may not be representative of the true value.

Since estimation of birth rates depends upon the selected life table, errors in the latter are introduced in the former. In Table 7 we give estimated birth rates for Turkey and Brazil using the lowest, median, and highest levels of mortality in these countries as obtained in Table 6 by two different methods outlined at the beginning of this section. The detailed interpretation of this table is left to the reader; however, a few points are worth noting. When basic data are of poor quality, as in the case of Turkey, the possible range for the birth rate is very wide and estimated values differ widely when one uses different procedures. Even when basic census data are of reasonably good quality, as in Brazil, estimated values are quite different when one uses different assumptions.

It should be further noted that birth rates estimated by the reverse survival technique, with a few exceptions, are lower than birth rates obtained by growth rate and death rate. This finding is not unexpected. The estimated value of birth rate by the reverse survival method depends upon the accuracy of the census count of children. Serious underreporting of children in censuses is a common feature of less as well as more developed populations. Thus not only is comparability limited by the grossness of the estimates: it is also systematically biased by the methods used, some of which by this inherent weakness produce lower estimates than others.

The limitations of the techniques we have cited are known to demographers who use these data; however, they are explicitly brought out here. We have described only two of the many techniques, but other techniques have similar limitations. We have also limited our discussion to estimation of birth rate, though techniques have been and are used to extract more detailed information on fertility. This requires additional assumptions, which may introduce additional biases.

Concluding Remarks

Reliable data on fertility are available for only a small per cent of the world's population, mainly living in the more developed countries of the world. A source of non-comparability for this group of countries arises from differences in the availability of detailed data. But in so far as basic data on births and births by age of mother are concerned, these are available for most of these countries and can be considered as of reasonable quality for statistical purposes.

For a large per cent of the populations of developing countries reliable information on fertility is non-existent. The available information for these countries for the most part comes from retrospective data with the use of demographic techniques. The burden of this paper has been that information obtained in this manner is suspect and should be used with care for cross-cultural comparison or studying changes in fertility over time in one country. The techniques used have several limitations:

First, the techniques usually provide a range rather than a unique value of parameters to be estimated. Obtaining a precise figure requires some sort of averaging, dependent upon the choice of the researcher and sometimes on his preconceived notion of the plausible level of characteristics for the population under study. In fact, different scholars do arrive at different results nominally using the same data and the same methods for a population.

Second, the use of the techniques often requires making some general assumptions, e.g., population is stable, censuses have identical coverage, which may or may not be true for the population under study. The techniques also make use of models derived mainly from the experience of Western nations, which may or may not be valid for populations of developing countries.

Third, though techniques do provide some plausible estimates of levels they often fail to provide information on trends.

The Population Division of the United Nations has been doing an excellent job in publishing data for a large number of countries in a single volume. Yet there is a need for some modifications in the presentation of data so that they are not misused. First,the criterion for classification of data as "virtually complete" should be more rigorous than presently used. It is suggested that for countries where strong evidence exists that data are reasonably accurate the data should be given in a separate table. For the remaining countries data should

be published without any code for completeness. This should include those countries for which there is evidence that data are probably accurate but evidence is either fragmentary or of dubious nature. These limitations may be explained in footnotes to the table. Second, estimated rates as published in the United Nations' volumes give an impression of false precision as they are given in decimal points. In addition to the average, the range of estimated value should be included so that the user of the volume becomes aware of the approximate nature of the estimates and uses them with care.

Demographers are usually aware of deficiencies in available data and have been careful in using them and arriving at conclusions from such data. However, on occasion the data are used indiscriminately. In the case of less developed countries users of the data should recognize (a) that for most countries birth rates are obtained indirectly from census data; (b) that the methods employed may build in systematic biases; and (c) that model life tables and stable population models are elegant methodologies that may substitute a spurious plausibility and regularity for the more complex reality that careful analyses can reveal. In addition the user should carefully go through the footnotes to tables to become acquainted with the deficiencies of the data.

Techniques, no matter how sophisticated, cannot substitute for good data. There is a need for improving basic sources of data as the existing information on fertility is inadequate for identifying changes in fertility in developing countries and for making valid projections of future changes in fertility--and hence for evaluating the achievement of family planning programs now under way in several countries. Responsibility for improving the vital registration system to make it capable of providing comparable and reliable information on fertility lies mainly with the governments. Progress in recent years has been disappointing, understandably due to real problems of organization and funds. But these difficulties can be minimized by proper organization of the system and by financial and technical assistance.

In the meantime, for several developing countries we will have to rely on data obtained from sources other than vital registration. Well-designed sample surveys, closely supervised with a skilled staff, can provide indispensable data on current levels and current trends in fertility. Finally, there is need to improve the analytical methods, perhaps most important, methods of estimating mortality for developing countries. Currently the procedure for estimating mortality in less advanced countries uses a model based mainly on the experience of European and more advanced countries. There is evidence that such models may not be applicable to currently developing countries[13] and a new model based on the experience of these countries should be constructed.

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FOOTNOTES

[1] Dudley Kirk, "Problems of Collection and Comparability of International Population Statistics," in book of same name, Milbank Memorial Fund, 1949, pp. 20-39.

[2] For recommendation of the United Nations, reference is made to United Nations, Principles for Vital Statistics Systems, Statistical Papers Series M, No. 19, New York, 1953. For greater detail on deficiencies in registration data see United Nations, Report of the Seminar on Civil Registration and Vital Statistics for Asia and the Far East, Statistical Papers, Series M, No. 50, New York, 1970, and Demographic Yearbook 1969.

[3] Tunisia, Antigua, Barbados, British Honduras, British Virgin Islands, Costa Rica, Dominica, Grenada, Jamaica, Mexico, Montserrat, St. Kitt's-Nevis-Anguila, St. Vincent, Guyana, Ceylon, China (Taiwan), Hong Kong, Jordan, Ireland, Isle of Man, Northern Ireland, Scotland, Australia, Cook Islands, Fiji, New Zealand, Norfolk Island. All these territories are characterized as having "virtually complete" data.

[4] Direccion General de Estadistica y Censos, Principales, Hechos, Vitales Occurridos en Costa Rica, Depto. de Estadisticas Sociales, Seccion de Estadistica Vital, No. 28, 1963, p. 18.

[5] United Nations, Population and Vital Statistics Reports, Data available as of 1 April 1972, ST/STAT/Ser.A/100, V. XXIV, N. 2, 1972.

[6] United Nations, Estimates of Crude Birth Rates, Crude Death Rates, and Expectation of Life at Birth, Regions and Countries, 1950-1965, ESA/P/WP/38, Feb. 22, 1971.

[7] A succinct summary of the techniques in use is provided by Ansley Coale, "The Determination of Vital Rates in the Absence of Registration Data," The Milbank Memorial Fund Quarterly, XLIX, 4:2, Oct. 1971; for detailed description and application of technique refer to Ansley Coale and Paul Demeny, Methods of Estimating Basic Demographic Measures from Incomplete Data, United Nations, Manual IV, New York, 1967.

[8] Ansley J. Coale and Paul Demeny, Regional Model Life Tables and Stable Populations, Princeton, New Jersey, Princeton University Press, 1966.

[9]Ansley J. Coale and Paul Demeny, "Estimating Vital Rates for Populations in Process of Destabilization," Demography 2, 1965, 516-530.

[10]K.C. Zachariah, "The Demographic Measures of Arab Countries, A Comparative Analysis," in Demographic Measures and Population Growth in Arab Countries, Cairo Demographic Center, Research Monograph Series, No. 1, Cairo, 1970, pp. 279-326.

[11]These are cited in Sultan S. Hashmi, "Fertility Studies in the Pakistan Institute of Development Economics, Karachi," in Minoru Tachi and Minoru Muramatsu (eds.), Population Problems in the Pacific: New Dimensions in Pacific Demography, 1971 (Proceedings of the Congress Symposium No. 1 and Divisional Meeting of Section VIII, No. 5, 11th Pacific Science Congress, Tokyo, August 22-September 10, 1966).

[12]Paul Demeny and Frederic Shorter, Estimating Turkish Mortality, Fertility, and Age Structure: Application of Some New Techniques, Istanbul Faculty of Economics, University of Istanbul, Publication No. 218, 1968.

[13]Arjun Adlakha, "Model Life Tables: An Empirical Test of their Applicability to Less Developed Countries," to be published in Demography, November 1972 issue.

Table 1.--Estimated Total Population, Population With and Without Reliable[a/] Birth Date, and Per Cent of Population Without Reliable Birth Data as of 1970 by the Major Regions of the World

Population in Millions

	Total	With reliable birth data	Without reliable birth data	Percentage without reliable birth data
World	3638	1230	2408	66.3
Africa	344	21	323	93.9
Western	101	0.3	100	99.7
Eastern	98	1.6	96.4	98.4
Northern	87	19.3	67.7	77.8
Middle	36	0.6	35.4	98.3
Southern	23	0	23	100.0
Northern America	227	227	0	0.0
Latin America	285	105.4	180	63.1
Tropical	153	1.2	151.5	99.2
Middle	67	62.5	4.7	7.0
Temperate	39	34.1	5.3	13.5
Caribbean	25	7.8	17.6	69.2
Asia	2056	152	1904	92.6
East Asia	930	1221	817.9	88.0
South Asia	1126	303	1095.7	97.3
Europe	462	462	0	0.0
Oceania	19.4	18.6	0.8	4.1
USSR	243	243	0	0.1

Source: United Nations, Demographic Yearbooks, 1969 and 1970.

a/ Complete or virtually complete data as reported to the Statistical Agency of the United Nations. Some countries in Africa have complete data for certain ethnic groups. In these calculations such countries are considered as lacking complete data. Inclusion of these countries, however, does not make any substantial difference in the overall situation.

Table 2.--Aggregate Population and Per Cent of Total Population for which Different Types of "Virtually Complete" Data from Vital Registration Systems are Available, by Major Regions of the World

Population in Millions

Type of information	Africa		Asia		Latin America		North America		Europe	
	Population	%	Population	%	Population	%	Population	%	Population	%
Number of live births	21	6.1	152	7.4	105	36.9	227	100.0	462	100.0
Birth rate[a/]	21	6.1	152	7.4	105	36.9	227	100.0	462	100.0
Live births by age of mother	2	0.5	151	7.3	104	36.7	227	100.0	460	99.6
Live birth rates by age of mother[b/]	2	0.5	151	7.3	74	26.1	227	100.0	427	92.4
Live births by age of mother & birth order	2	0.5	119	5.8	29	10.2	227	100.0	426	92.2
Live birth rates by age of mother & birth order[c/]	2	0.5	110	5.4	23	5.1	227	100.0	164	35.5

Source: United Nations, Demographic Yearbooks 1969 and 1970

a/ Birth rate is the number of live births reported for a calendar year per 1,000 persons in the same area at the midpoint of the year.

b/ Rates specific for age of mother are the number of live births in each age group per 1,000 female population in specified age group.

c/ Rates are the number of live births in each birth order and age group per 1,000 total female or married female population in the specific age group.

Table 3.--Estimates of Crude Birth Rate by Stable Population Method Using Cumulative Age Distribution and Growth Rate*

		Growth Rate	Age 5	10	15	20	25	30	35	40	Range	Difference
Morocco	M	27	48	59	54	42	40	41	42	43	40-59	19
	F	27	52	58	45	36	37	43	47	48	36-58	22
Algeria	M	26.9	55	57	65	61	54	51	51	49	49-65	16
	F	27.2	52	53	55	53	50	49	51	50	49-55	6
Tunisia	M	27	48	53	58	52	45	43	43	43	43-58	15
	F	27	48	51	54	49	46	46	48	50	46-54	8
Libya	M	27[a/]	45	48	47	39	39	41	42	42	39-48	9
	F	27	49	54	48	43	43	48	48	50	43-54	11
UAR	M	24.7	38	45	50	46	43	41	42	44	38-50	12
	F	22.5	38	43	45	41	40	41	42	46	38-46	8
Syria	M	27	57	63	66	55	50	50	51	50	50-63	13
	F	27	52	53	51	47	47	49	48	49	47-53	6
Jordan	M	27	48	50	60	64	61	60	56	52	48-64	16
	F	27	43	43	46	52	52	54	53	54	43-54	11
Iraq	M	27.5	54	60	54	46	42	40	39	39	39-60	21
	F	26.2	51	53	47	44	41	42	43	42	41-53	12

* K.C. Zachariah, "The Demographic Measures of Arab Countries: A Comparative Analysis," in Demographic Measures and Population Growth in Arab Countries, Cairo Demographic Center, 1970, p. 302.

a/ Assumed growth rate.

Table 4.--Estimate of Crude Birth Rate for Pakistan Using Stable Population Technique

Source	Data used	East Pakistan	West Pakistan	Total
Krotki	1951 census			55
Ahmed	1951 census	59	62	
Krotki	1961 census	58	51	
Planning Commission	--	57	52	
Khan	1962 PGE			49
Zelnik and Khan	1962 PGE	38-68	37-51	
Robinson	1962 PGE	54	53	

Source: Sultan S. Hashmi, "Fertility Studies in the Pakistan Institute of Development Economics, Karachi," in Minoru Tachi and Minoru Muramatsu (eds.), Population Problems in the Pacific, New Dimensons in Pacific Demography, Proceedings of the Congress Symposium No. 1 and Divisional Meeting of Section VIII, No. 5, 11th Pacific Science Congress, Tokyo, August 22-September 10, 1966, 1971, pp. 113-114.

Table 5.--Survival Ratios of Males and Females in Turkey from 1960 and 1965 Censuses and in Brazil from 1960 and 1970 Censuses

	Turkey 1960-65[a/]		Brazil 1960-70[b/]	
Age	Males	Females	Males	Females
0-4	1.109	1.086	1.024	1.061
5-9	0.993	0.941	0.957	1.054
10-14	0.916	0.919	0.948	1.017
15-19	0.984	1.079	0.930	0.905
20-24	0.938	1.040	0.964	0.927
25-29	1.027	0.970	0.976	0.931
30-34	0.994	0.952	0.978	0.934
35-39	0.954	0.978	0.963	0.932
40-44	0.889	0.785	0.906	0.922
45-49	1.006	1.183	0.862	0.900
50-54	0.820	0.714	0.822	0.848
55-59	1.067	1.358	0.759	0.801
60-64	0.700	0.677	0.477	0.545

a/ Five years survival ratios
b/ Ten years survival ratios

Table 6.--Estimated Value of Expectation of Life (e_0^o) for Turkey 1960-65 and for Brazil 1960-70 by the Use of Census Survival Ratio

Age (x & over)	Turkey 1960-65		Brazil 1960-70	
	Males	Females	Males	Females
0	64.3	64.3	61.0	68.0
5	47.2	50.0	56.5	62.5
10	45.9	55.2	58.0	57.5
15	51.6	63.3	59.6	54.3
20	51.6	55.5	62.0	57.5
25	58.4	50.0	62.4	59.6
30	53.4	50.3	62.0	61.2
35	51.0	52.5	60.9	62.5
40	52.3	51.8	59.5	63.5
Median	51.6	52.5	60.9	61.2
Range	45.9-64.3	50.0-64.3	56.5-62.4	54.3-68.0

Estimates of e_0^o are obtained from the census data by the use of the Demeny and Shorter techniques discussed in the text: South and West Regional Model Life Tables of Coale and Demeny were used in Turkey and Brazil respectively.

Table 7.--Birth Rates in Turkey 1960-65 and Brazil 1960-70 Obtained from Census Survival Ratios Using Lowest, Median, and Highest Estimates of Mortality, Intercensal Growth Rate and Reverse Survival Method

Mortality Estimates	Turkey 1960-65: Birth rate based on estimates of mortality derived from data of			Brazil 1960-70: Birth rate based on estimates of mortality derived from data of		
	Males[a/]	Females[a/]	Both sexes	Males[b/]	Females[b/]	Both sexes
	With the Use of Intercensal Growth Rate					
Lowest	33.8	34.8	34.2	35.0	35.8	35.4
Median	39.4	41.2	40.3	36.1	38.8	37.5
Highest	44.2	42.6	43.4	37.9	42.4	40.2
	Reverse Survival Technique					
Lowest	34.0	34.8	34.3	35.4	35.5	35.5
Median	36.2	37.3	36.8	36.0	37.1	36.5
Highest	38.5	38.0	38.2	37.0	39.0	38.0

a/ Assumes a sex ratio at birth of 106.

b/ Assumes a sex ratio at birth of 105.