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ANALYSIS OF DEMOGRAPHIC CHANGE IN EAST PAKISTAN: A STUDY OF RETROSPECTIVE SURVEY DATA

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PREFACE

The research on which this study is based was supported by the Agency for International Development, Department of State, contract CSD-2151. This is the third of four "country studies" undertaken at Rand under AID sponsorship investigating particular aspects of fertility patterns.[1]

The Demographic Survey of East Pakistan, 1961-1962 is the primary data source used in this Memorandum. The Statistical Survey Research Unit of the University of Dacca in collaboration with the Institute of Statistical Research and Training collected the survey materials and published four reports dealing with the survey methodology, demographic characteristics of the population, and field problems.[2] The Population Council of New York sponsored the Survey. The retrospective reproductive histories for about 4000 married women interviewed in the Survey were not analyzed extensively, though vital rates were computed for the current year and age at marriage was tabulated.

Dr. M. Hossain of the Dacca Institute of Statistical Research and Training encouraged the authors to analyze the retrospective data from the Institute's survey. He had these data copied and permitted the authors to proceed with the analysis of the data at Rand. The authors are indebted for the help and guidance received from Dr. Wiley H. Mosley and Mr. A. K. M. Alauddin Chowdhury of the Pakistan-SEATO Cholera Research Laboratory in Dacca, and for helpful comments on this study, Arthur Alexander and Peter Morrison of Rand.

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[1] See Marc Nerlove and T. Paul Schultz, Love and Life Between the Censuses: A Model of Family Decision Making in Puerto Rico, 1950-1960, RM-6322-AID, September 1970, Alvin J. Harman, Fertility and Economic Behavior of Families in the Philippines, RM-6385-AID, October 1970, and T. Paul Schultz, The Evaluation of Family Planning in Taiwan (forthcoming).

[2] A. N. M. Muniruzzaman, Part I, Survey Methodology and Operational Procedures, December 1965; A. N. M. Muniruzzaman, Part II, Chapter I, Basic Demographic Characteristics, April 1966; M. Obaidullah, Part II, Chapter II, On Marriage, Fertility and Mortality, June 1966; A. N. M. Muniruzzaman, Part III, Chapters I and II, Field Problems: The Interview and the Response, June 1966, Statistical Survey Research Unit in collaboration with Institute of Statistical Research and Training, University of Dacca, Dacca, East Pakistan.

SUMMARY

Despite the inadequacies frequently attributed to retrospective information on birth and death rates, this detailed analysis of survey data collected in 1961-1962 for a sample of 4200 women in central East Pakistan yields reasonable estimates of vital rates for the preceding decade. Age-specific marital birth rates declined by about one-fifth during the 1950s, according to these estimates. Nonetheless, birth rates in central East Pakistan remain high. There is reason to anticipate that they declined further during the 1960s, particularly among older women.

The average total number of children born to women over age 34 is about six in this population; yet because of the exceptionally high death rates, the median number of children alive is about three. By 1962 three-fourths of the women age 30 or over had three living offspring, and continued high fertility among these older women would lead them to have more living children than previous generations had. This impending "excess fertility," by traditional past standards, should motivate these older women to reduce their birth rates further and increase demands in this population for improved means of birth control.

Estimating a simplified model of fertility determination from the individual data from this sample survey, evidence is presented for the postpartum sterility (amennorrhea) effect of a birth in the previous year, reducing the likelihood that a married woman bears a child in the current year. A direct relationship is also confirmed between the death of a child and the subsequent probability of birth of another child to the mother. The magnitude of this reproductive response to the recent loss of a child implies a 50 percent replacement, on average, for mothers 15 to 19 and 30 to 39 over a five-year adjustment period, and a smaller 30 percent replacement response for mothers 20 to 29 years old. The reproductive response of a mother to her child's death is more pronounced if she loses a boy than if she loses a girl, but the difference is less than cultural factors had led us to expect.

A better understanding of the behavioral and biological determinants of reproductive behavior is needed to improve policy to cope with predicted trends in fertility and to influence these crucial trends. Longitudinal data for families are promising sources of information for policy oriented research in the population field; these data can be collected by prospective panel surveys or by retrospective inquiries. The greater cost and difficulty associated with the collection of data prospectively are usually justified by the alleged unreliability of the alternative retrospective sources. It may be time to reappraise this rationale.

We are not certain why the apparent quality of the retrospective histories collected in the Pakistan survey and analyzed in this study is clearly superior to those commonly cited. However, it is our judgment that improved sampling methodology, careful training and supervision of interviewers (possibly on a permanent staff basis), and repeated checks and reinterview techniques to verify the completeness and consistency of pregnancy rosters and other historical data can contribute to a substantial reduction in recall error in this and future surveys.

We conclude that more resources could be productively used to collect and analyze retrospective survey information. Though many past surveys have routinely collected, but not analyzed, pregnancy rosters, new surveys are also needed to emphasize retrospective data on more than demographic events; data are needed on family economic status, child schooling and work experience, and job opportunities and employment experience of women within and outside of the home. Such characteristics of the family as these have been useful in predicting reproductive patterns among individuals and communities and should be considered increasingly in policy oriented research as possible causes for variation in desired family size. These new combined sources of demographic and economic longitudinal data on representative samples of families provide an essential empirical foundation to test, refine, and add to our limited understanding of the structural dynamics linking reproductive behavior with demographic and economic development in the Third World.

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I. INTRODUCTION

A major objective of demographic research is to develop analytical and empirical foundations for predicting future demographic trends in a reliable manner, thereby providing time for implementing policy to cope with the repercussions of these trends. An even more important role for research is to estimate the responsiveness of demographic trends to policy instruments, allowing governments to modify future trends effectively. This study first explores the policy making needs for demographic information and research. It attempts, then, to estimate some of this information for East Pakistan from a survey of retrospective histories collected from a sample of married women. The results of this analysis have some implications for a redirection of resources toward increasing reliance on retrospective longitudinal surveys and their analysis for policy making in the Third World.

Retrospective estimates are first computed for vital rates during the 1950s and early 1960s. These estimates are found to be consistent with other sources of demographic information, although they indicate unexpectedly large declines in child death rates and age-specific marital birth rates. To determine whether these trends were likely to have continued in the 1960s and to formulate policy to influence these demographic trends in the 1970s, an analytical approach is developed that distills from the sample of individual histories what factors appear to be responsible for observed variation in the frequency of births among individuals and over time. Multivariate statistical models are estimated to fit the retrospective histories that were constructed from the sample survey. Several simple hypotheses regarding the behavioral and biological determinants of birth rates are confirmed, although many implications of this approach remain to be investigated with other surveys that contain more socio-economic information.

II. INFORMATION AND ANALYSIS FOR POLICY MAKING

AN INFORMATION AND RESEARCH STRATEGY

In low income countries where rapid population growth appears to constitute the most immediate hardship, the least is generally known about the problem, its causes, and its consequences. Even defining the magnitude of the problem is difficult: Registration statistics on birth, death, and marriage are particularly unreliable in these countries. Since the inadequacies of registered vital statistics cannot be remedied at a reasonable cost in the short run, other sources of demographic information should be considered that can be promptly assembled and whose costs are commensurate with their immediate value. Surveys may randomly sample a population where a prior census is available and collect information on the incidence of birth and death within the responding unit, typically the household or family. These sample surveys can collect information currently, retrospectively and prospectively, building up fertility-mortality-migration histories for the individual interview unit that permit one to study the interrelationships within families over time. Statistical, sociological, and psychological shortcomings of retrospective versus prospective evidence are well known.[1] Prospective or repeated panel surveys may narrow the margin of error due to failure to recall events but are vulnerable to bias from the inevitable attrition of the original sample over time because of migration. The optimal strategy for acquiring demographic information in low income countries hinges on whether the policy maker is interested primarily in levels or trends in vital rates, or in understanding the mechanisms whereby his policy options influence future demographic events.

WHAT INFORMATION IS NEEDED?

It is clearly valuable to know where one currently stands. The contemporary level of birth and death rates provides a benchmark and,

[1] See for example Mauldin [1966]; Potter *et al.* [1965].

indeed, a naive basis for population projection. Without reliable registration figures on birth or deaths, vital rates may be estimated by indirect techniques of demographic inference such as those associated with the work of Coale, Demeny, Brass, and others.[1] Population growth surveys have also been used to estimate vital rates more directly.[2] Prospective or repeated household panel surveys or model registration areas also can provide reliable evidence on the frequency of vital events or the margin of their under-registration.[3]

Information about past levels of birth and death rates is also important for predictive purposes, for evidence of regularities in year-to-year changes should enable one, on the average, to predict future vital rates with greater accuracy. Demographic analysis and indirect techniques of inference may again aid in identifying and measuring past trends by linking together historical bodies of data and thereby reducing the inadequacies in any single data source.

Nonetheless, the range of future projected birth rates that various demographic experts regard as plausible remains substantial.[4] The abrupt economic, political, and demographic changes underway in most low income countries preclude confident extrapolation of any social trends, and the record of predictions of demographic trends is far from admirable, even by the standards of the social sciences.

To improve our capability to predict population growth requires first that we learn what social and economic conditions are related to variation in fertility. This information -- analytical rather than merely descriptive -- can point the way to developments and policies

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[1] United Nations [1968].

[2] Mauldin [1966]; Seltzer [1969].

[3] See discussion on this point in United Nations [1969], and the classic proposal by Chandra Sekar and Deming [1949].

[4] The classic contrast is between the two famous demographers from the University of Chicago, Donald Bogue and Philip Hauser. The former predicts a zero population growth rate for the world by the year 2000, whereas the latter envisages little retardation in the rate of world population growth by that date.

that might contribute to a reduction in fertility. Moreover, it will provide an empirical foundation for tentative generalizations about the dynamics of population change and will help to refine working hypotheses regarding the interrelationships between family demographic and economic conditions and its subsequent reproductive behavior. Analyses of micro longitudinal data may eventually permit us then to estimate the sensitivity of fertility to the opportunities and constraints imposed on families by changing environments and to predict the efficacy of policy measures to reduce birth rates.

THE DETERMINANTS OF FERTILITY

In our judgment, direct inquiry has not elicited from parents a satisfactory set of subjective reasons for preferring particular reproductive patterns. Moreover, even if this research strategy yielded a method for improving predictions of birth rates among a particular group of parents, it would then be necessary to show that policy instruments or predictable social forces affect these subjective attitudes in predictable fashion. Otherwise, this information would have little practical use to the policy maker or planner.

Another mode of research assumes certain regularities in the preferences of parents for children, and tries to discover why people behave as they do in terms of their objective resources and experiences and the opportunities they have to improve their welfare.[1] This "objective" interpretation of behavior, although often used in economics, should have applicability to situations where economic factors may be of secondary importance. The study of reproductive behavior, from this point of view, should include social institutions, the state of productive art, and the stock of available resources, all of which subtly constrain the population's behavior with regard to reproduction.

Trends in vital rates at the national level do not generally provide sufficient evidence for us to infer confidently that one

[1] For a formal statement of this approach see Willis [1970] or Schultz [1969a].

policy or one program has affected these rates. Any single time series of a vital rate, or more appropriately in this case age-standardized birth rates, cannot provide enough information for us to conclude that a single policy or set of conditions has influenced fertility. Many things change over time with the glacial speed that characterizes most demographic variables. Analysis and interpretation must dig deeper; in technical terms, more degrees of freedom and greater variation in vital rates are needed as inputs to a more comprehensive model of the determinants of fertility if one is to conclude with statistical confidence that a concurrence of trends is more than accidental.

Beneath the aggregate trends, regional evidence may begin to confirm what factors are associated with the accelerated decline in birth rates in some areas and what factors are apparently supporting high levels of fertility observed elsewhere. The most promising research strategy is to observe fertility at the family or small community level across many units and trace the substantial variation in reproductive behavior to the differences in individual units and their environments, among which local family planning activities may differ.

Multivariate statistical procedures are required for this task, and the complexity of this problem precludes the standard convention of partitioning the population until groups are derived that are homogeneous with regard to all influential factors except program inputs. Similarly, indirect standardization is inappropriate in most cases, for the determinants of fertility are themselves intercorrelated and some are determined jointly and simultaneously with fertility. As a practical matter multivariate statistical analysis of the determinants of fertility must also specify the functional forms that relate the various factors to each other and to fertility.

Since registration of births and deaths is not adequate for this mode of analysis in most low income countries, household surveys appear to be the logical source of data to proceed with research along these lines. Moreover, longitudinal information on the family is required for this analytical approach. Given the cost and difficulty of obtaining

prospective data and the time this requires, it was decided to reconsider retrospective survey data to determine their reliability and usefulness for policy making purposes.

This information and research strategy is not likely to improve estimates of birth rates, because smaller samples will be required owing to the lengthier and more complex interview schedules. On the other hand, one anticipates that these data may indicate the direction birth rates are moving, at what rate, and, most important, why. Evidence accumulated in this fashion on the local determinants (or correlates) of birth rates provides a crude basis for selecting more cost-effective policies to hasten the reduction in birth rates. As an increasing body of evidence points to specific environmental factors that best predict variation in fertility, pilot efforts to change particular features of the environment can be undertaken and precisely monitored. These tests, under more nearly controlled circumstances than history provides, will enable one to determine whether the observed statistical associations are actually cause-and-effect relationships upon which public policy has effective leverage.[1]

The remainder of this study is devoted to an analysis of retrospective histories for a sample of married women in central East Pakistan. Demographic information on this country is scarce, and population growth is a recognized policy problem. It was therefore hoped that in evaluating the demographic survey as a source of information there would emerge a useful outline of aggregate demographic characteristics of the East Pakistan population. An approach to the analysis of the determinants of fertility is then proposed that relies for verification and refinement on longitudinal observations of births

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[1]Assuming we can isolate the effectiveness under different circumstances of various population programs and policies to reduce birth rates, and can further estimate the resources required to accomplish a specific reduction in fertility, it will become crucial that we have reliable quantitative evidence of the consequences or net social and private costs of high fertility. Without information on the costs of population growth, the policy maker will not be able to assign population programs their appropriate priority and defend their claims on social resources.

and deaths to individual families. These data from the retrospective histories are used to estimate the parameters of the fertility model. Interpretation of these parameter estimates not only confirms the usefulness of the analytical approach but provides a rough basis for projecting future birth rates in East Pakistan.

III. EVIDENCE OF DEMOGRAPHIC CHANGE IN EAST PAKISTAN

Our investigation of a sample of retrospective reproductive histories was undertaken on the optimistic premise that although retrospective data might be inadequate for estimating vital rates, they might shed some light on the dynamics of fertility and child mortality and their interaction at the family level. It is widely believed that "single retrospective surveys cannot be depended upon to provide valid or reliable estimates of births and deaths." Mauldin supports this conclusion with evidence of many surveys and much analysis.[1] The purpose of this section is to describe briefly the source of data and report the aggregate demographic trends it reveals. A related objective of this section will be, so far as possible, to check the consistency of these findings against other demographic evidence and analysis of East Pakistan.

THE DATA

The source of the survey data and how it was processed for this analysis are discussed in Appendix A. In brief, a stratified random sample of about 2000 rural and 1000 urban households was selected from 48 primary sampling units (1961 Census of housing circles). Its primary purpose was to measure demographic characteristics of the population. Each household was visited five times at approximately three-month intervals in an effort to obtain prospective coverage of vital events in the household during the year (1961-1962) and to check repeatedly the accuracy of a pregnancy history for each of the some 4000 "at least once married women" living in the sampled households. Approximately 2.5 percent of the original rural sample and 10 percent of the urban sample were dropped, mostly because their movement precluded completing the full number of visits. In processing these data an additional

[1] Mauldin [1966, p. 652]. The particular survey we investigated for East Pakistan did in fact yield plausible estimates of vital rates with regard to both level and trend (rate of change); and, on the whole, the survey data exhibited a persuasive degree of internal and external consistency.

one percent of the respondents was eliminated from our working sample because the timing of pregnancies, length of birth intervals, current age, and age at marriage appeared to be internally inconsistent (see Appendix A).

Reproductive histories and the surviving age and composition of each woman's family were reconstructed for each year since marriage in much the same way a longitudinal study of Monterrey, Mexico was processed,[1] permitting great flexibility in tabulations and regression analysis. Because of the assumed problem of "recall error," only the ten-year period preceding the survey, 1952-1961, is analyzed directly.[2] The regression analysis is based only on the most recent five-year period. Since the rural and urban subsamples are not self-weighting, tabulations are generally reported for both subpopulations.[3]

The survey is not representative of all of East Pakistan, but only of a central region of East Pakistan containing three districts -- Faridpur, Dacca, and Comilla -- and a southern portion of Mymensingh. As shown in Figure 1, this area is at the confluence of the major rivers of East Pakistan, the Ganges, Jamuna, Brahmaputra, and Meghna. In 1961 the surveyed region contained more than one-fourth of the East Pakistan population, but has only about one-sixth of the land area. Literacy is slightly higher than for the rest of East Pakistan, but incomes appear to be lower. Population density per sown and gross cropped area is greater in this region than in the rest of East Pakistan. Estimates by Revelle and Thomas [1970] suggest further that the region is a net importer of basic foodstuffs and sustains lower consumption standards of cereals and all sources of food energy combined than does

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[1] Belan et al. [1969].

[2] Years referred to in tables and figures are only approximate and relate to twelve month periods for each respondent which began between June and November of the year in question. For example, 1961 refers to a period from about September 1961 to September 1962.

[3] Only one out of twenty persons in East Pakistan lives in an urban area, although one out of three in the surveyed households is urban. Within the urban and rural regions, the survey sample was drawn on an equal probability basis, and the two subsamples are therefore self-weighting. See Appendix A.

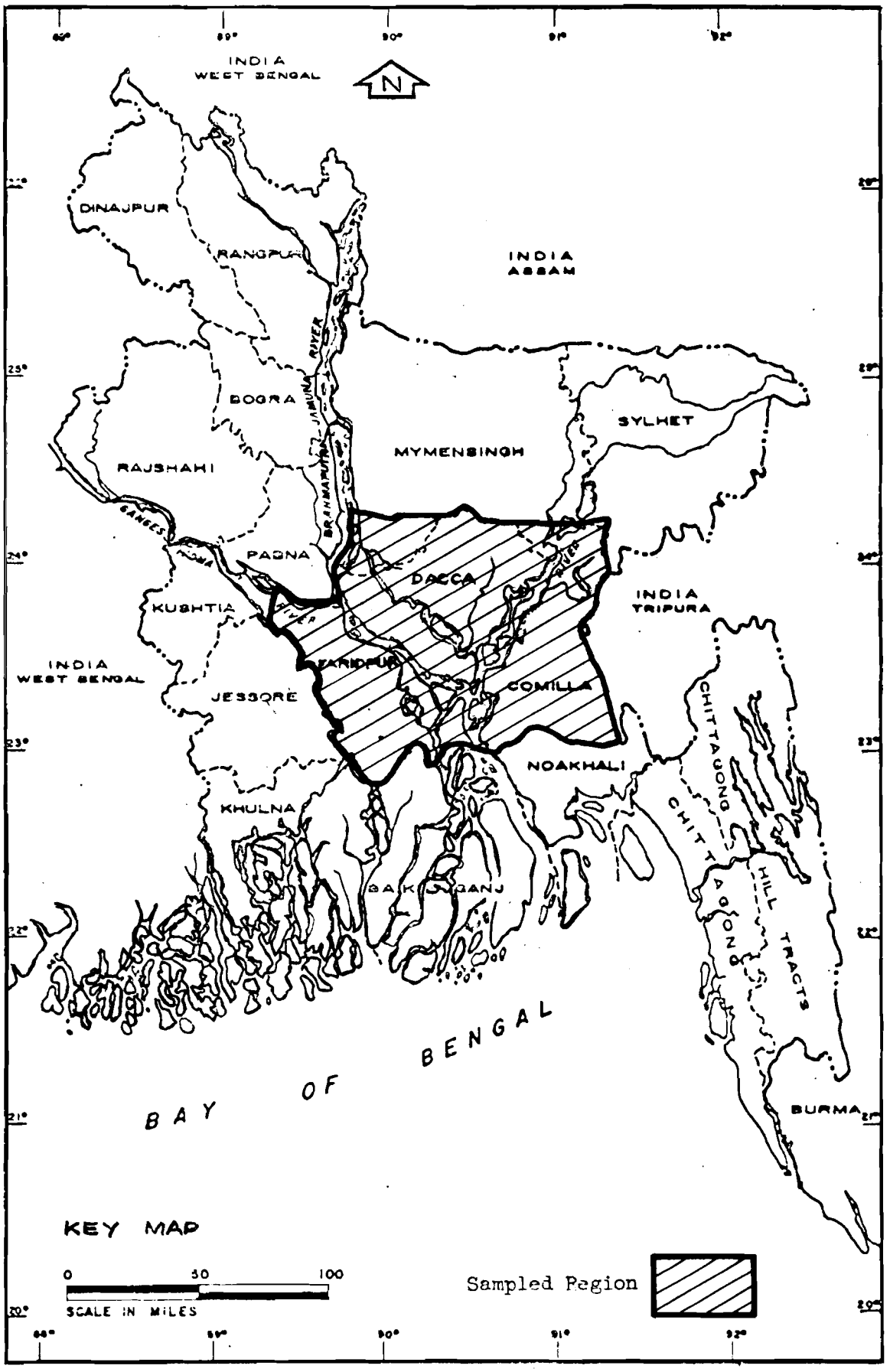

Fig. 1 -- East Pakistan

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the remainder of East Pakistan. Only 5 percent of the surveyed population (as well as the population of East Pakistan) were classified in the 1961 Census as living in an urban area, though past censuses document the rapid growth of the urban compared with the rural population.

MARRIAGE

Among the married women enumerated in the survey the average age of marriage was 12.9 years for the rural population and 14.2 years for the urban. Table 1 shows the average age of marriage by cohort, that is, age at the time of the survey. There is little evidence of secular change in the age of marriage, though if one excludes women over 59 as unreliable on matters regarding the distant past, there are weak indications that the average age of marriage may have increased a year in the urban areas and four months in the rural areas from the 1920s to the 1950s. These results parallel those reported by Obaidullah [1966] based on the same survey population.

Other estimates of the age of marriage for East Pakistan by Afzal [1967], and Sadiq [1965] fall within the range of 13 and 15, suggesting somewhat later marriage in urban than rural settings. We could not detect the sharp increase in age at marriage over the last three or four decades that Afzal computed on the basis of a sample of the 1961 Census.

MORTALITY

The level of infant and child mortality implied by the survey is high and increases conspicuously as we probe deeper into the past. (See Figures 2 and 3 and Table B-8.) Deaths during the first year of life are about 180 per thousand rural births in the early 1950s and fall irregularly to about 150 for children born in 1960. In urban areas the infant death rate is more erratic (note urban sample size is half the rural) but systematically lower, declining from about 130 to 100 per thousand births. Death rates for children surviving the first through fifth year also trend downward, and are distinctly higher in

Table 1

AVERAGE AGE OF MARRIAGE IN RURAL AND URBAN SAMPLES BY CURRENT AGE GROUP

Age Groups	Rural	Urban	Total
20-29	13.01 (829)	14.32 (407)	13.44 (1236)
30-39	12.89 (534)	14.26 (276)	13.36 (810)
40-49	12.78 (422)	14.29 (162)	13.20 (584)
50-59	12.67 (257)	13.32 (95)	12.85 (352)
60-69	12.87 (134)	13.69 (54)	13.11 (188)
70+	13.27 (77)	13.50 (20)	13.32 (97)
Total	12.89 (2833)	14.15 (1186)	13.26 (4019)

Note:
Numbers in parentheses are sample sizes. According to the 1961 Census of East Pakistan [1962, Table 1], about 99 percent of the women age 20 to 24 have been married at least once in the regions sampled in the survey.

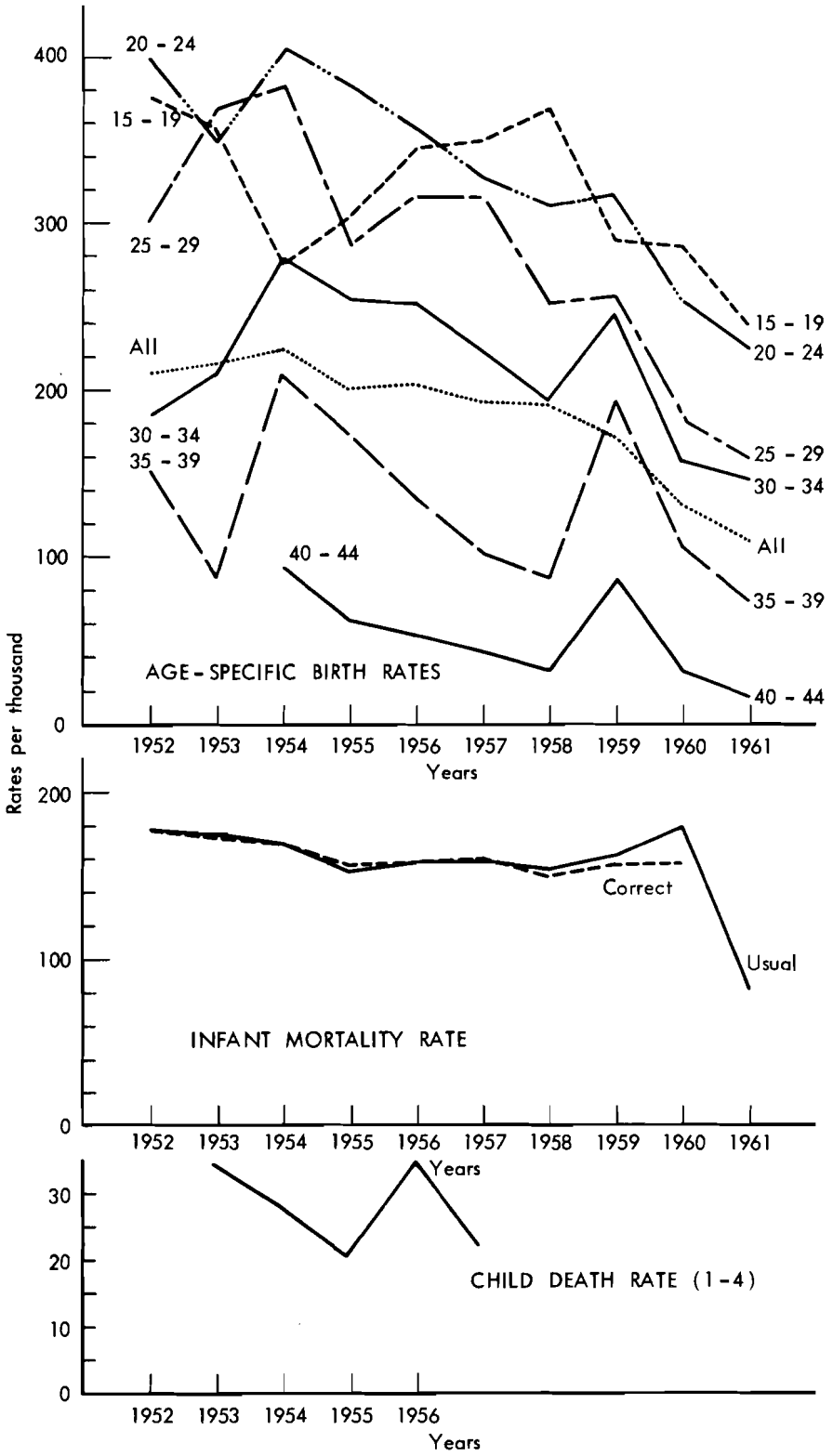

Fig. 2—Rural vital rates

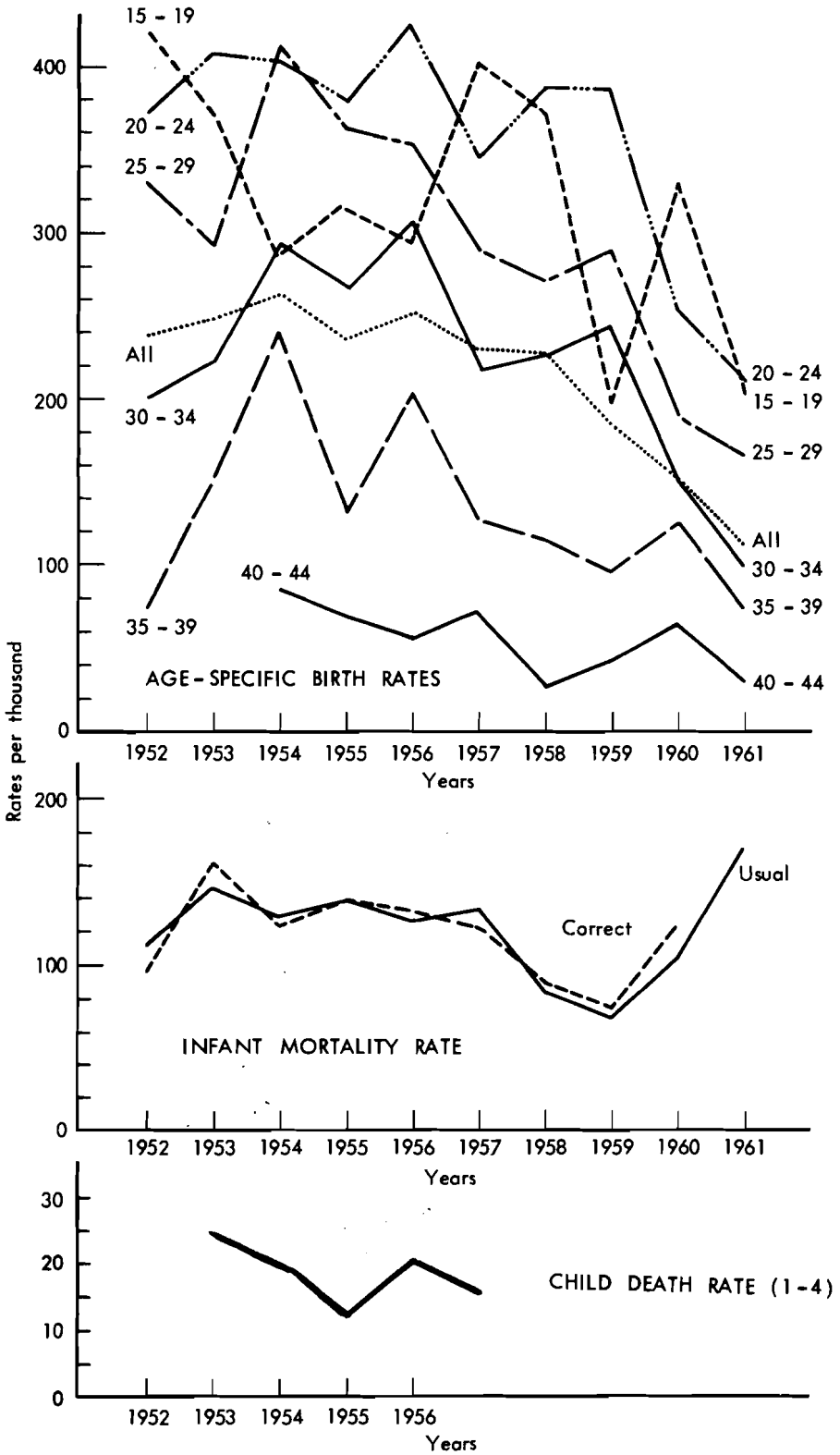

Fig. 3—Urban vital rates

rural than in urban areas. Each year 25 rural and 18 urban children in these ages died per thousand. Because these infant and child death rates are based on cohort survival calculations, the years referred to in Figures 2 and 3 are the years when the child was born or reached his first birthday, respectively. Infant death rates are also computed in the "usual" although incorrect manner of the number of infants who died in a year divided by the number born in the same year.

Using the same survey population, Obaidullah [1966] has estimated on the basis of 1961-1962 data infant death rate of 150 and 138 for rural and urban subpopulations, and a death rate of 21 and 20 for the rural and urban populations of children aged one to four. The rural and urban crude death rates are estimated by Obaidullah as 20.0 and 18.7. These estimates of child mortality fall within the plausible range, although some understatement of deaths is of course likely from retrospective data sources.[1]

FERTILITY: RATE

Age-specific birth rates for married women are estimated from the survey for the decade preceding 1961-1962. These estimates for the rural and urban samples are reported in Appendix Tables B-2 and

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[1]The population growth experiment (PGE) of 1962 and 1963 estimated crude death rates as 20 and 19 based on the Chandra Sekar and Deming [1949] method of adjusting longitudinal registration evidence. PGE estimates based on direct cross-sectional evidence were only 13 and 15 in 1962 and 1963. Feroz Ahmed [1970] regards even the PGE Chandra Sekar and Deming estimates of crude death rate as too low, but he is more inclined to accept their estimates of infant death rates that fall between 135 and 145 for East Pakistan. Demographic surveillance of a population of about a hundred thousand in Comilla district in 1966/67 to 1968/69 by the Pakistan-SEATO Cholera Research Laboratory led to estimates of crude death rates between 15 and 17 and infant death rates between 111 and 129 per thousand concurrent live births (Mosley et al. [1968]; Alauddin Chowdhury et al. [1969]). Stoeckel [1970] in a retrospective survey of a rural population in Comilla District that did not have the benefit of the Cholera Laboratory's emergency medical facilities reports infant death rates of 176 per thousand births in 1958-1959, 148 in 1963-1964, 156 in 1964-1965 and 139 in 1966-1967. For extensive discussion of mortality trends in Pakistan see Robinson (ed.) [1967].

B-3 and shown in Figures 2 and 3. For comparative purposes Table 2 presents the survey estimates of age-specific birth rates for 1953-1956 and 1957-1960 and those for all East Pakistan based on the PGE for 1963 and the 1961 Census. The PGE estimates of total fertility are about 5 percent greater than the 1956-1960 survey estimates, but the excess is largely due to the higher birth rates attributed by the PGE to women between the ages of 25 and 39. The survey suggests higher birth rates prevailed in the central region in the early 1950s than the PGE estimated in 1963, with significantly higher birth rates for women between the ages of 15 and 24.

In conjunction with the 1961 Census age composition of the entire population of East Pakistan, the 1957-1960 age-specific birth rates estimated retrospectively from our survey imply a crude birth rate for Pakistan of 47.7 per thousand. Although this estimate is low in comparison with those finally estimated from the PGE for 1962 and 1963 (Seltzer [1968]), there is growing evidence to suggest that the PGE figure is high (Ahmed [1970], Shaw [1970]). Moreover our sample survey is drawn from the central portion of East Pakistan, which may be subject to slower rates of natural population increase and lower fertility as reflected in 1961 Census child-woman ratios (Duza [1967], Census [1962]). In combination with the estimated crude death rate of 20 per thousand, the implied natural rate of population increase is about 2.8 percent per year. We again feel that the implied level and downward trends in birth rates derived from our retrospective survey data cannot be rejected out of hand as implausible.[1]

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[1]Other evidence of birth rates can be cited, such as those from the Cholera Laboratory surveillance project, which indicate a total fertility rate of 6.82 in 1967/1968 (Alauddin Chowdhury [1969]). Stoeckel and Choudhury [1969b] estimate for their rural portion of Comilla district in 1958-1959 a total fertility rate of 8.51, which had fallen to 6.21 by 1966-1967. Ahmed [1970] argues that the PGE estimates of birth rates are probably too high, and Shaw [1970] in an effort to reconcile a large body of data on the structure and growth of the Pakistan population presents convincing reasons for adjusting PGE estimates of the East Pakistan crude birth rate from 56 (for 1963/1964) to 48.6 per thousand in 1961.

Examination of the sex ratios of reported births provides another check on retrospective errors of recall (See Appendix tables B-4 and

Table 2

ESTIMATES OF AGE-SPECIFIC BIRTH RATES, EAST PAKISTAN
(per thousand women)

Age of Woman	Survey Central East Pakistan[a] 1953-1956	1957-1960	Population Growth Experiment 1963	1961 Census based Calculation by Afzal 1956-1961
	(1)	(2)	(3)	(4)
10-14	b	36	c	c
15-19	292	305	228	154
20-24	372	301	308	266
25-29	337	250	344	242
30-34	246	206	264	196
35-39	152	123	148	160
40-44	70	48	48	100
45-49[d]	b	17	12	88
Total Fertility	7.35	6.43	6.76	6.03

Notes:

[a]Ever married proportion of total female population assumed to be for rural and urban populations respectively: age 10-14, 29 and 20 percent; age 15-19, 80 and 91 percent; age 20-24, 99 and 96 percent; age 25+, 100 percent. Rural population assumed to be 96 percent of total in 1953-1956 and 95 percent in 1957-1960.

[b]Not computed in this study.

[c]Not reported.

[d]If 10-14 and 45-49 birth rates had not changed from 1953-1956 to 1957-1960, comparable total fertility for the early period would have been 7.61.

Source:

Columns (3) and (4), Afzal [1967, Table 2.11, p. 74].

Several discontinuities temper our confidence in the survey vital rate estimates for the year of the survey, 1961: the numbers of births and rural infant deaths appear to be unusually low. First, the sex ratio of live births is very low in the urban sample and somewhat low in the rural sample in 1961.[1] Second, age-specific birth rates are below trend in 1961, particularly in urban areas. Third, the reduction in births in 1961 contributes to the rise in the urban infant death rate computed in the "usual" way, but the plunge in the rural infant death rate remains a mystery unless some sort of response bias led to a systematic understatement of rural births and infant deaths in the year of the survey.

Excluding the first and last year of the retrospective estimates of birth rates, Table 3 shows the percentage change in age-specific marital birth rates from 1953-1956 to 1957-1960 in the rural and urban samples.[2] It is noteworthy that the total marital fertility for both populations (measured from 15 to 44) declined more than one-fifth in this four-year averaged period. Among married women between the ages of 15 and 19 there was an increase in the birth rate, particularly in the urban areas. A compensating rise in the age of marriage may also have reduced the proportion married in this age group, but this cannot be measured in the survey. The large declines in fertility generally occur to women over the age of 24. For a sample of rural women in the Comilla District Stoeckel and Choudhury [1969b] find a similar 27 percent reduction in total fertility rates from 1958-1959 and 1966-1967,

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B-5). Presumably in the distant past, parents are more likely to recall births of sons than births of daughters. If this is true, the sex ratios should increase in the past. For the period 1952 to 1961 the sex ratio of live births is 106.8 males per hundred females in the rural sample and 100.1 in the urban. There is no statistically significant evidence of a linear time trend in the sex ratios estimates from the survey, that is, the urban and rural sex ratios were regressed on a linear time trend and a constant, and in neither case was the t statistic for the coefficient of the time variable greater than one.

[1] See Appendix Tables B-4 and B-5.

[2] 1952 is excluded to obtain equal time periods for comparisons, and moreover the retrospective bias is presumably greater the earlier the year.

Table 3

PERCENTAGE REDUCTION IN ESTIMATED AGE-SPECIFIC BIRTH RATES AMONG MARRIED WOMEN (between 1953-1956 and 1957-1960)

Age of Woman	Rural	Urban
15-19	+ 4	+ 8
20-24	-25	-17
25-29	-34	-39
30-34	-20	-27
35-39	-23	-58
40-44	-46	-35
All Married Women	-22	-24

Source:
Dervied from Tables B-2 and B-3.

which is most pronounced among women over the age of 24; however, they do not find evidence of an increase in marital fertility among the youngest women.

FERTILITY: STOCK

Another dimension of fertility estimated from the survey is the number of children ever born (CEB) to each married woman. Table 4 shows average CEB by age of woman in 1961 for the rural and urban samples. For comparative purposes over time the average of 1952-1956 and 1957-1961 estimates are also reported. Several patterns are consistent with other demographic studies of East Pakistan. Urban and rural CEB are approximately equal for women under 40, but beyond that age, rural CEB increases and urban CEB decreases.[1] From 1952-1956 to 1961, CEB generally increased in both rural and urban populations for women under 40, but generally decreased for women 40 and over. This evidence is consistent with trends in birth rates, in which the major declines in age-specific fertility occur among the older women, except for 1959 and 1960 when birth rates for women in their twenties also fell.

Conversely, the evidence suggests that younger women are having their children at a somewhat more rapid rate in the last two decades than prior to that period. This could occur because of increased fecundity due to improved diet and health, or because of reduced widowhood and the consequent increased possibility of pregnancy.[2]

The frequency distribution of married women by their number of children ever born and number of children living draws attention to the low level of childlessness and the high level of child mortality in East Pakistan. See Table 5 and Figure 4. Only about 3 percent

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[1]This is confirmed by Afzal [1967] between urban and rural areas of East Pakistan in a sample of the 1961 Census.

[2]Some evidence on this latter point is provided by Appendix Tables B-6 and B-7 where age-specific birth rates are reported for both ever-married women and women whose first marriage is still continuing.

Table 4

CHILDREN EVER BORN PER WOMAN, URBAN AND RURAL EVER-MARRIED WOMEN, 1952-1961

Age of Woman	1952-1956			1957-1961			1961		
	Rural	Urban	Rural and Urban	Rural	Urban	Rural and Urban	Rural	Urban	Rural and Urban
15-19	0.88	0.85	0.87	0.96	0.96	0.96	0.63	0.63	0.63
	(1957)	(840)	(2797)	(1753)	(663)	(2416)	(409)	(152)	(561)
20-24	2.37	2.25	2.33	2.49	2.44	2.48	2.39	2.22	2.34
	(1876)	(898)	(2774)	(2149)	(991)	(3140)	(452)	(210)	(662)
25-29	3.83	3.75	3.81	3.97	3.98	3.97	3.89	3.89	3.89
	(1465)	(707)	(2172)	(1907)	(917)	(2824)	(416)	(205)	(621)
30-34	4.98	4.91	4.96	5.22	5.16	5.20	5.19	4.96	5.12
	(1128)	(526)	(1654)	(1475)	(718)	(2193)	(343)	(168)	(511)
35-39	5.80	5.48	5.72	5.93	5.90	5.92	5.83	5.84	5.83
	(1095)	(421)	(1516)	(1138)	(534)	(1672)	(234)	(120)	(354)
40-44	6.29	5.99	6.22	6.27	6.06	6.21	6.11	6.00	6.08
	(630)	(213)	(843)	(1101)	(422)	(1523)	(231)	(94)	(325)
45-49	6.68	6.36	6.60	6.45	6.15	6.37	6.36	6.00	6.27
	(1100)	(372)	(1472)	(635)	(216)	(851)	(215)	(74)	(289)
50-59	6.60	5.94	6.42	6.68	6.28	6.58	6.53	5.80	6.33
	(827)	(297)	(1124)	(1383)	(475)	(1858)	(283)	(103)	(386)
60-69	6.74	5.60	6.49	6.52	5.61	6.27	6.41	5.14	6.05
	(386)	(111)	(497)	(693)	(261)	(954)	(141)	(57)	(198)
70+	6.90	6.14	6.70	6.81	5.57	6.55	6.61	5.57	6.40
	(147)	(53)	(200)	(398)	(105)	(503)	(82)	(21)	(103)
All Ages	3.88	3.57	3.79	4.29	4.15	4.25	4.09	4.01	4.06
	(11,425)	(4671)	(16,096)	(13,183)	(5423)	(18,606)	(2979)	(1225)	(4204)

Note:
Sample sizes are given in parentheses in number of woman-years.

Table 5

FREQUENCY DISTRIBUTIONS OF NUMBER OF CHILDREN EVER BORN AND OF NUMBER OF CHILDREN NOW ALIVE BY AGE OF MARRIED WOMEN
(percent)

Age of Woman	Median	0	1	2	3	4	5	6	7	8	9	10 or more	Total Number of Women
15-19													
ever born	0.94	53.12	33.69	10.70	2.32	0.18	0.0	0.0	0.0	0.0	0.0	0.0	(561)
now alive	0.87	57.40	34.22	7.66	0.71	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
20-24													
ever born	1.75	7.70	18.43	31.72	23.87	12.39	4.98	0.60	0.15	0.15	0.0	0.0	(662)
now alive	1.27	10.57	30.21	34.44	17.82	5.14	1.51	0.15	0.15	0.0	0.0	0.0	
25-29													
ever born	3.49	3.86	6.76	11.92	15.94	23.67	20.77	11.43	2.90	1.93	0.48	0.32	(621)
now alive	2.48	5.48	12.72	20.61	23.35	20.93	11.43	4.83	0.48	0.0	0.0	0.16	
30-34													
ever born	4.74	3.13	3.13	4.50	10.76	14.48	18.98	19.77	13.50	7.63	2.15	1.96	(511)
now alive	3.31	4.50	8.22	13.70	15.66	25.83	15.07	12.33	3.52	0.98	0.0	0.20	
35-39													
ever born	5.76	5.08	3.39	5.93	6.50	7.63	10.17	14.97	17.51	13.84	9.32	5.65	(354)
now alive	3.56	8.19	5.08	10.45	16.95	16.67	14.97	14.12	7.91	3.95	11.13	0.56	
40-44													
ever born	5.67	2.46	3.69	6.15	8.62	9.85	10.15	13.54	14.46	10.46	8.62	12.00	(325)
now alive	3.34	3.69	12.00	13.54	16.92	11.38	16.00	12.00	6.15	4.00	2.15	2.15	
45-49													
ever born	5.76	3.11	3.81	5.19	6.92	9.34	13.49	10.73	11.42	14.19	7.61	14.19	(289)
now alive	3.06	4.84	10.38	18.69	15.22	15.57	11.76	11.76	7.27	2.77	1.04	0.69	
50-59													
ever born	6.16	4.92	3.63	6.74	4.15	8.03	10.10	10.36	13.21	16.58	9.33	12.95	(386)
now alive	2.87	9.59	9.84	13.47	19.69	15.80	11.92	9.07	5.70	2.33	0.78	1.81	
60 or more													
ever born	5.98	3.99	6.31	6.98	7.31	8.31	9.30	7.97	12.62	11.63	10.96	14.62	(301)
now alive	2.35	11.30	15.95	16.94	16.61	12.29	9.97	7.97	4.32	2.99	0.66	1.00	

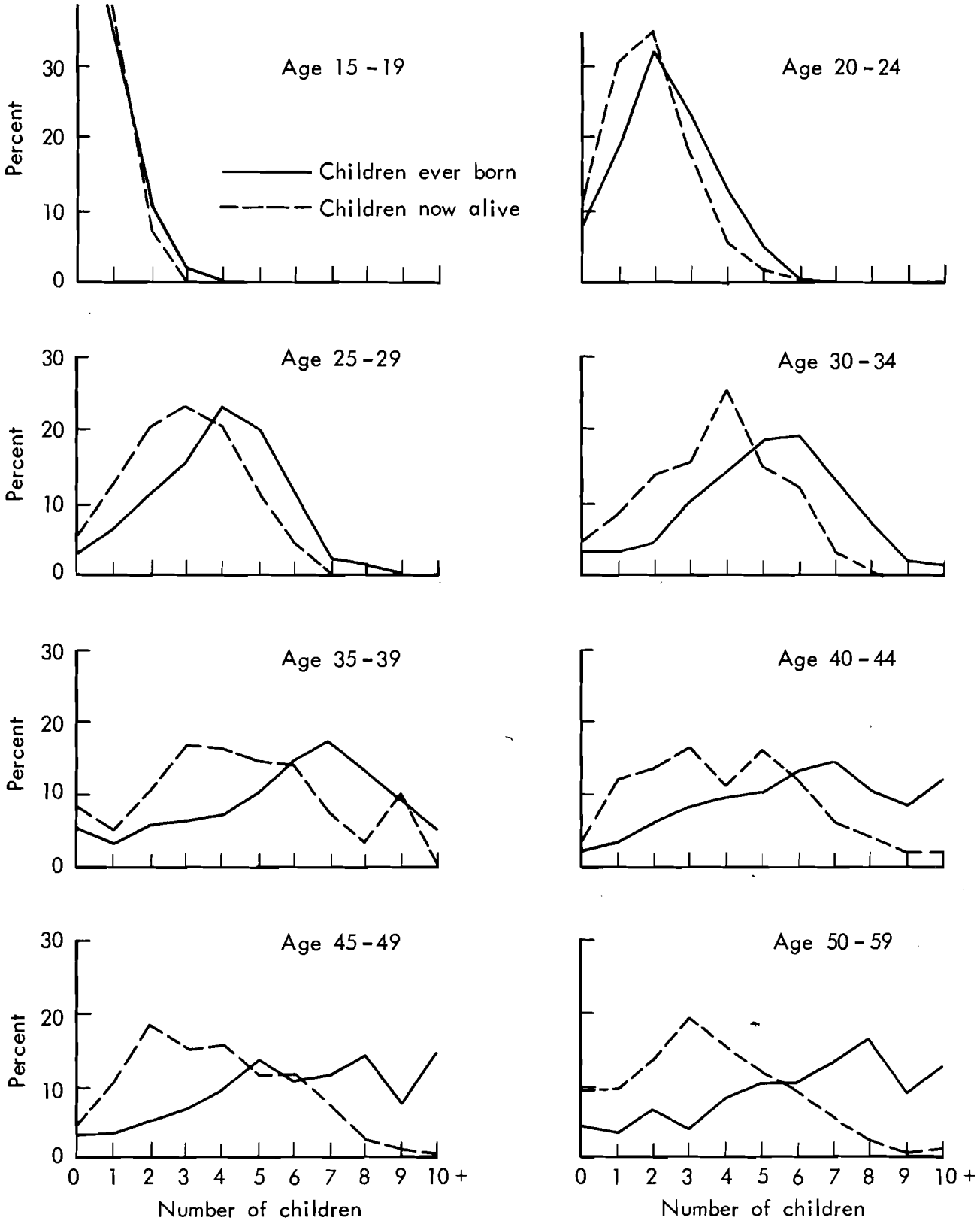

Fig. 4—Frequency distributions of number of children ever born and of number of children now alive by age of woman

of the ever-married women age 40 and over were childless.[1] This compares approximately to the American Hutterites.[2] Although women 35 years and over have had on the average six births, the median number of their children alive at the time of the survey is between three and four. If the surviving number of children obtained by the older women, about three, continues to be the goal sought by younger women, there will be increasing demand in the future for means to reduce birth rates among women over the age of 25.

According to the survey, six-tenths of the women aged 25-29 have three or more living offspring and three-fourths of the women aged 30-34 have three or more. If the child death rate continues to fall and the traditional size of surviving family sought by parents remains constant, women over 25 will be increasingly motivated to reduce their birth rates. The effect of this pressure will be more pronounced in the long run, of course, if the age at marriage does not increase.

SUMMARY

The demographic characteristics of the surveyed population are very similar to those documented by other analysts of East Pakistan surveys and Censuses. Death and birth rates are very high; marriage is early and childlessness uncommon. All the well-known biases of retrospective data, including the failure to recall more distant births and deaths and the tendency for the more fertile women to be removed from the sampled population by maternal mortality, lead one to expect that the retrospectively estimated level of birth and death rates would be subject to an increasing downward bias as one extends estimates into the past. The retrospective evidence reviewed here, nonetheless, portrayed generally falling birth and death rates for the 1950s and early 1960s. It seems probable that the rate of decline in vital rates,

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[1] In the 1961 Census of East Pakistan only one percent of women aged 40-44 were not married at least once.

[2] See Afzal [1967, p. 64]. He finds from a sample of the 1961 Census for East Pakistan somewhat higher figure of 5 percent childless. For Hutterites see Eaton and Mayer [1954, Table 10, p. 20].

particularly child death rates, are understated by these retrospective estimates, but the plausible magnitude and direction of change justifies further more refined analysis of these data for evidence of the determinants of fertility.[1] The next section, therefore, develops a simple model of fertility determination, and the subsequent section uses the Pakistan retrospective histories to test and quantify several of the interrelationships implied by the model between mortality and fertility at the family level.

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[1]We have resisted the temptation to suggest explanations for the large year-to-year variations in the birth and death rate series shown in Figures 2 and 3. Time series on floods, harvests, and death rates have some suggestive parallel movements during this period, and when a lag of one or two years is allowed, one can imagine relationships with fertility, particularly among the youngest and oldest women. We are doubtful of the value of interpreting such evidence until we have found data on flood and harvest figures for several of the districts of central East Pakistan from which the survey collected stratified samples.

IV. TOWARD A MODEL OF FERTILITY DETERMINATION

The purpose of formal models is to provide a framework in which information can be viewed statistically to confirm or to reject stated hypotheses designed to account for systematic components of the variation in parent and group reproductive behavior. Moreover, this process of model formulation and estimation should contribute to a more precise description of the determinants of fertility for each social setting where there are empirical materials to study. Particular emphasis is given here to the need for information and analysis of individual longitudinal histories that combine demographic and socio-economic factors.

The probability that a woman will bear a child in a particular year is a function of both biological and behavioral factors. Her ability to conceive and bear a child (fecundity) is conveniently viewed as a stochastic process for which the expected value is a function of the woman's age, health, interval since last birth, lactation pattern, and other factors. The woman's behavior also impinges, consciously and unconsciously, on the reproductive process and changes the likelihood of her bearing a child, given her fecundity. Behavior may influence the timing, mode, and frequency of coitus, alter the effectiveness of contraception, and affect fetal mortality. The objective is to express how these two sets of forces might be observed to influence the likelihood of birth.

For our purposes, fecundity will be assumed to vary systematically with age and with the recent occurrence of a birth, which induces an uncertain period of postpartum sterility. Given these controls for differences in fecundity, the conditional probability that a married woman will bear a child (or multiple birth) in a specified period will be assumed to be a function of the difference between the number of children she wants to have at that time, and the number of offspring she actually has living. Her access to and understanding of birth control measures may well influence her ability to avert "unwanted" births, which might be a function of socio-economic variables such

as her education, and policy variables such as whether she resides in a region served by a family planning program. The East Pakistan population considered here has not benefited from any major organized effort to disseminate information or services in the family planning field, and moreover we have no information from the survey on birth control knowledge or use.[1]

It is further assumed that a woman's behavioral and, at times, biological response to the death of her child will increase her likelihood of birth in subsequent periods. The behavioral response stems from the mother's desires to replace the child and also possibly to insure or "hedge" against further anticipated child losses in her family. Biologically there may also be a feedback mechanism linking child mortality to fecundity if the child is breast feeding and dies while his mother is still subject to postpartum sterility. In this case, after the infant's death the mother ceases to breast feed and her period of postpartum sterility is probably shortened. Thus, the loss of a child may biologically increase the probability that the mother will bear another child in immediately following periods.

Since the probability that a woman will have at least one live birth in a year[2] is a number between zero and one, there are obvious difficulties with assuming this probability to be a <u>linear</u> function of any determining variables. We assume, nonetheless, linearity in the relevant range in our approximation of this function.[3] This set of propositions and hypotheses can then be represented in the following form, for each age group of married women.

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[1]Harman [1970] finds no evidence in the Philippines that reported knowledge or use of contraceptive methods is associated with lower fertility after controlling for various socio-economic determinants of desired fertility and stratifying by age. This study is based on individual family records for some 7000 Philippine households in 1968.

[2]The infrequent occurence of two independent (not multiple) births in one year is treated as though only one birth occurred in the current year and the second birth occurred in the subsequent year.

[3]For a more extensive discussion of the difficulties of the linear probability model as formulated here and later estimated, see footnote 1, p. 31.

$$B_{t,j} = \alpha + \sum_{i=1}^{n} \beta_{t-i} B_{t-i,j} + \sum_{i=\tau}^{m} \gamma_{t-i} D_{t-i,j} \tag{1}$$

$$+ \sum_{i=\tau}^{m} \delta_{t-i} f(Z^*_{t-i,j} - C_{t-i,j}) + \varepsilon_j$$

where

$B_{t,j}$ is the conditional probability of birth for the jth woman in time period t,

$D_{t-i,j}$ is the number of children of the jth woman dying in time period t-i,

$Z^*_{t-i,j}$ is the number of surviving children the jth woman wants at time t-i,

$C_{t-i,j}$ is the number of surviving children the jth woman has at time t-i,

f is the adjustment function for women of a particular age that relates the difference in Z^* and C to its behavioral impact on the probability of birth,

α, β_{t-i}, γ_{t-i} and δ_{t-i} for all i are parameters of the biological and behavioral model,

ε_j is a random disturbance that has zero mean and assumed constant variance for the age group of women, and

τ is the minimum period of gestation.

A difficult task is to identify and observe those factors that systematically affect desired family size or Z^*. The rationale for the choice of possible environmental and individual determinants of desired family size is discussed elsewhere (Schultz [1969a]), but it is clear in the present formulation that τ must exceed the minimum period of gestation.

The biological lag parameters β_{t-i} should diminish sharply with increasing i, as the postpartum sterility effect of a prior birth wears off. There is no reason to expect n to exceed three years, and we anticipate that only β_{t-1} and β_{t-2} will be statistically significantly less than zero. In terms of the magnitude of these estimates of the biological postpartum sterility effect, we expect that β_{t-1} will

approximately equal in absolute size the constant term α, and that the ratio of β to α may be conveniently interpreted as a relative sterility effect of a prior birth on the conditional probability of birth, adjusted for the absense of prior births and child deaths.

The behavioral and biological lag parameters, γ_{t-i} and δ_{t-i}, are likely to conform to a unimodal distribution, which would probably increase for two or three years and then diminish as i increases (Schultz [1969b]; Nerlove and Schultz [1970]). If the lag parameters for child deaths, γ_{t-i}, peak in the prior year for i=1, then it may be concluded that the biological feedback mechanism outweighs the postulated behavioral response. We assume here that the maximum lag, m, is five years, or in other words, events occurring today that influence desires to have an additional child have their major impact on the probability of birth during the next five years and are not responsible for statistically distinguishable effects on birth probabilities thereafter. To interpret the magnitude of these parameters, their sum over the time horizon (five years) should be compared with the potential biological fecundity of the woman's age group. Since fecundity is an unobserved variable, the relative response is defined here as the sum of the lag parameters divided by the average (unadjusted) birth rate (probability) for the woman's age cohort. It thus represents in the case of γ the proportionate increase in the average cohort probability of birth associated over the five-year period with the death of a child.

This model could be estimated using data for B, D, C, and determinants of Z^* applicable to groups of women of the same or similar age. Because of the high positive serial correlation among Bs for the same population over time, the biological postpartum sterility effect cannot, practically speaking, be estimated from group observations. The problem of serial correlation is solved to some extent by estimating the model for individual family data, but other problems arise with estimating the conditional expectation model with a dichotomous dependent variable.

In the East Pakistan survey, no socio-economic data are available on married women or their households.[1] Without a basis for predicting Z^* from environmental and individual characteristics of the woman, the hypothesized relationship between the conditional probability of birth and the difference $(Z^* - C)$ cannot be explored with these data. The model, therefore, collapses to a relationship among current births, past births, and past child deaths, as follows:[2]

$$B_{t,j} = \alpha + \sum_{i=1}^{3} \beta_{t-i} B_{t-i,j} + \sum_{i=1}^{5} \gamma_{t-i} D_{t-i,j} + \varepsilon_j, \qquad (2)$$

where again j refers to individual women in five-year age groups, and B and D are discontinuous variables; B may be zero or one and D may be zero or a positive integer. Because the dependent variable is a dichotomous variable, the ordinary least squares estimates of the standard errors of α, βs, and γs do not have well established

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[1] In the combined samples, urban-rural and Moslem-Hindu dummy variables were introduced, but they did not appear to bear a systematic relationship to the birth probabilities. The survey did collect some limited socio-economic information, but it was apparently destroyed or lost.

[2] It would be inappropriate to analyze C alone in the model, for the hypothesis is that the difference between Z^* and C should contribute to increasing the birth probability, and since C and Z^* are undoubtedly positively correlated in the population the simple association between C and B is likely to be positive until appropriate controls for Z^* are added to the model. Omitting the determinants of Z^* and C from the analysis should not seriously bias the other parameter estimates if the difference between them is not highly correlated with the Bs and Ds. Because the Bs and Ds are dichotomous event variables and $Z^* - C$ is a stock disequilibrium variable, the two should not be highly correlated.

statistical properties, although the regression estimates of the parameters themselves are unbiased.[1]

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[1]Two difficulties are well documented with applying classical least squares regression techniques to predict conditional expectations when the dependent variable is dichotomous, assuming the value of either 0 or 1: heteroscedastic properties of the disturbance term and the lack of restriction on the predicted probability to the zero-one interval (Goldberger [1964, pp. 248-251]). Ordinary least squares (OLS) estimates of the parameters of a model with disturbances of unequal variance (heteroscedastic) are unbiased but not best (minimum variance) linear unbiased estimates. Weighting the observations by an unbiased estimate of the variance-covariance matrix of the disturbances yields more efficient generalized least squares (GLS) estimates. The second difficulty of the linear probability function formulation is that the expected value of the event may fall outside the interval between 0 and 1 for observed values of the independent variables. Probit and logit analyses are means to circumvent this problem with grouped observations and constrain the dependent variable to the zero-one interval. A third problem arises because the disturbance term with individual observations is not distributed normally. We have not seen an investigation of the implications for the properties of the conventional tests of significance when the classical linear regression assumption of normally distributed disturbances is distorted by the dichotomous nature of the dependent variable.

V. EVIDENCE OF INTERRELATIONSHIPS BETWEEN MORTALITY AND FERTILITY

AGGREGATE ANALYSIS

The survey of East Pakistan permits us to consider only the implications of the fertility model with respect to possible interaction between fertility and child mortality. The conventional procedure of partitioning the population until groups are derived that are homogeneous with regard to all influential factors except one is practically impossible as our understanding of fertility grows and the number of potentially influential factors increases. If we assumed that parents were equally fecund, married at the same time, wanted the same number of living offspring, and were equally efficient (or inefficient) at controlling their fertility, one would anticipate that for women of the same age, birth rates would be a decreasing function of their number of living children. Table 6 reports age-specific birth rates from the survey for women by number of children living. Birth rates are generally lower as predicted among women with larger numbers of living children. For example, among women 25 to 29, higher birth rates are reported by women with two or three children alive than by those with four to five or six to seven children alive. Similarly, for women 30 to 34, birth rates are higher for those with four or five living children than for those with six or more. This supporting evidence is marred by exceptions and is difficult to interpret, for our initial assumptions are clearly unrealistic -- women do in fact marry at different ages, are of different fecundity, and may want different numbers of children. These factors will not be unrelated either to the number of children living or to their current birth rates.

The same difficulties blur interpretation of another arrangement of aggregate birth rate data in Table 7 that again seek to explore the hypothesis of a link between child mortality and subsequent birth rates; age-specific birth rates are tabulated by number of children who have died and number born (parity). The table only reports the calculations for women 30 to 39. For these women who have had any number of children from two to nine, birth rates are higher if they have lost two or three

Table 6

AGE SPECIFIC BIRTH RATES BY NUMBER OF CHILDREN NOW LIVING, 1957-1961[a]

Age of Women	Number of Children Now Living					All Women
	0-1	2-3	4-5	6-7	8+	
15-19	320.4 (2026) >	279.3 (383)	b	b	b	313.7 (2416)
20-24	321.6 (1247) >	273.7 (1589)	286.7 (293)	b	b	295.2 (3140)
25-29	203.3 (477) >	249.2 (1332) >	229.1 (886) >	195.1 (123)	b	233.0 (2824)
30-34	156.8 (236)	187.3 (742)	214.2 (873) >	162.9 (313) >	137.9 (29)	190.6 (2193)
35-39	35.2 (119)	89.7 (502)	138.6 (563)	144.7 (311) >	113.4 (97)	111.2 (1672)
40-44	14.1 (213)	16.2 (495)	61.8 (437)	53.8 (279)	131.3 (99)	43.3 (1523)
45+	0.0 (781)	0.7 (1437)	1.8 (1109)	15.6 (639)	5.0 (200)	3.4 (4166)
All ages	218.8 (5847)	164.7 (6484)	139.9 (4168)	89.6 (1674)	76.2 (433)	162.7 (18,606)

Note:

[a]Sample sizes are given in parentheses in number of woman-years.

[b]Cell size less than ten woman-years.

Table 7

BIRTH RATES FOR EVER-MARRIED WOMEN AGE 30-39 BY PARITY AND NUMBER OF CHILDREN WHO HAVE DIED: 1957-1961[a]

Parity	Number of Children Who Have Died				
	0-1	2-3	4-5	6 or More	All
0-1	55.9 (179)	b	b	b	55.9 (179)
2-3	108.8 (524)	< 131.9 (91)	b	b	112.2 (615)
4-5	179.8 (873)	< 181.8 (198)	c	b	179.2 (1077)
6-7	159.5 (721)	< 183.9 (435)	147.1 (102)	c	166.9 (1258)
8-9	144.5 (173)	< 180.8 (260)	141.7 (120)	< 152.2 (46)	160.3 (599)
10 or more	162.2 (37)	60.6 (33)	292.7 (41)	230.8 (26)	189.78 (137)
All	147.6 (2507)	174.0 (1017)	163.6 (269)	180.6 (72)	156.3 (3865)

Notes:

[a]Numbers in parentheses are sample sizes in number of woman-years.

[b]Not applicable.

[c]Cell size less than ten woman-years.

children than if they have lost at most one child. Nonetheless, unless one can control for differences in desired family size, which must parallel to some extent the number of children women have had, a clear test of the behavioral-biological hypothesis linking child deaths with birth rates is not possible using these aggregate data. Individual data and regression techniques permit a better test of this hypothesis.

REGRESSION ANALYSIS

Ordinary least squares estimates of the parameters of the collapsed fertility model are reported in Tables 8 through 11 for the rural and urban subsamples separately and combined for the period 1957-1961 and for the combined sample for the earlier period 1953-1956. Although only a small fraction of the variance of these dichotomous events (birth or no birth) is explained across individuals in the sample (R^2 equals .04 to .12), this is common for analyses of individual behavior. It is indeed somewhat surprising that without allowing for any of the environmental determinants of the number of surviving children parents want, the regression model nonetheless accounts for an apparently significant fraction of the variation in reproductive behavior among women 15 to 39, as tested by the F ratio. Prior births and child deaths are not strongly associated with the infrequent births among women 40 to 44.

Only the first parameters for prior year's birth, β_1, are strongly associated with the current probability of birth, and thus n in Equation (2) is effectively found to be 1. Independently estimated values of $\gamma_{t-i,j}$ vary systematically in their pattern from one to five years across age groups. Constraining the pattern for each age group to a plausible positive unimodal lag structure, the best fits were obtained with the weights reported in Part III of Table 12. These weights for lagged child deaths were estimated from the combined 1957-1961 sample and used in this form for all of the regression estimates reported in Tables 8 through 15. The lag weights conform to patterns of fecundity for women of various age groups. The implied mean child death-birth intervals for the five year cohorts from age 15 to 39 are 1.7, 1.9, 2.1, 3.0 and 3.25 years, respectively. The distribution of the length

Table 8

REGRESSIONS ON BIRTHS FOR SAMPLE OF RURAL AND URBAN MARRIED WOMEN, EAST PAKISTAN, 1957-1961[a]

Age of Cohort	Mean Probability of Live Birth	Sample Size	Constant Term	Birth in Previous Year	Child Death in Previous Years[b]	F[c]	R^2
15-19	.303	805	.349 (19.0)	-.301 (-8.21)	.605 (5.73)	39.74	.090
20-24	.320	785	.384 (19.2)	-.325 (-9.21)	.377 (4.03)	45.52	.104
25-29	.244	941	.297 (17.8)	-.253 (-8.24)	.203 (2.54)	35.67	.071
30-34	.183	731	.188 (11.0)	-.187 (-5.74)	.540 (5.44)	27.20	.070
35-39	.106	836	.0982 (8.1)	-.0883 (-3.03)	.397 (4.92)	15.86	.038
40-44	.0407	761	.0415 (5.39)	.0097 (.31)	-.0431 (-.54)	.17	.001

Notes:

[a]Beneath each regression coefficient is its "t" statistic. Values of this statistic in excess of 2.33 suggest the coefficient is different from zero at the 1 percent level, using the one-tailed test.

[b]Lag structures are defined for each age cohort in Table 12.

[c]The multivariate relationship is statistically significant at the 1 percent confidence level if the F statistic exceeds 3.95.

Table 9

REGRESSIONS ON BIRTHS FOR SAMPLE OF
RURAL MARRIED WOMEN, EAST PAKISTAN, 1957-1961[a]

Age of Cohort	Mean Probability of Live Birth	Sample Size	Constant Term	Birth in Previous Year	Child Death in Previous Years[b]	F[c]	R^2
15-19	.308	585	.358 (16.6	-.310 (-7.20)	.558 (4.52)	29.06	.091
20-24	.309	537	.378 (16.3)	-.354 (-8.36)	.361 (3.36)	36.69	.121
25-29	.251	634	.297 (14.5)	-.260 (-6.72)	.213 (2.25)	24.26	.071
30-34	.181	492	.177 (8.55)	-.191 (-4.68)	.565 (4.87)	19.23	.073
35-39	.111	568	.108 (7.18)	-.096 (-2.56)	.273 (2.84)	6.77	.023

Notes:

[a]Beneath each regression coefficient is its "t" statistic. Values of this statistic in excess of 2.33 suggest the coefficient is different from zero at the 1 percent level, using the one-tailed test.

[b]Lag structures are defined for each age cohort in Table 12.

[c]The multivariate relationship is statistically significant at the 1 percent confidence level if the F statistic exceeds 3.95.

Table 10

REGRESSIONS ON BIRTHS FOR SAMPLE OF
URBAN MARRIED WOMEN, EAST PAKISTAN, 1957-1961[a]

Age of Cohort	Mean Probability of Live Birth	Sample Size	Constant Term	Birth in Previous Year	Child Death in Previous Years[b]	F[c]	R^2
15-19	.291	220	.325 (9.40)	-.278 (-3.96)	.733 (3.59)	11.02	.092
20-24	.343	248	.397 (11.0)	-.272 (-4.26)	.466 (2.48)	10.78	.081
25-29	.231	307	.296 (10.2)	-.240 (-4.70)	.174 (1.15)	11.13	.068
30-34	.188	239	.211 (6.89)	-.188 (-3.41)	.509 (2.59)	8.49	.067
35-39	.097	268	.076 (3.79)	-.070 (-1.52)	.761 (5.10)	13.99	.096

Notes:

[a]Beneath each regression coefficient is its "t" statistic. Values of this statistic in excess of 2.33 suggest the coefficient is different from zero at the 1 percent level, using the one-tailed test.

[b]Lag structures are defined for each age cohort in Table 12.

[c]The multivariate relationship is statistically significant at the 1 percent confidence level if the F statistic exceeds 3.95.

Table 11

REGRESSIONS ON BIRTHS FOR SAMPLE OF MARRIED WOMEN, EAST PAKISTAN, 1953-1956[a]

Age of Cohort	Mean Probability of Live Birth	Sample Size	Constant Term	Birth in Previous Year	Child Death in Previous Years[b]	F[c]	R^2
15-19	.341	742	.407 (20.5)	-.330 (-8.66)	.536 (4.30)	39.84	.097
20-24	.373	761	.484 (21.7)	-.345 (-10.2)	.243 (2.78)	53.52	.124
25-29	.339	914	.441 (22.7)	-.330 (-10.6)	.168 (2.13)	57.45	.112
30-34	.259	667	.287 (13.8)	-.208 (-5.35)	.290 (2.50)	15.72	.045
35-39	.169	615	.159 (9.01)	-.117 (-2.90)	.383 (3.80)	9.73	.031

Notes:

[a]Beneath each regression coefficient is its "t" statistic. Values of this statistic in excess of 2.33 suggest the coefficient is different from zero at the 1 percent level, using the one-tailed test.

[b]Lag structures are defined for each age cohort in Table 12.

[c]The multivariate relationship is statistically significant at the 1 percent confidence level if the F statistic exceeds 3.95.

Table 12

IMPLIED RELATIONSHIPS FROM REGRESSION ANALYSES

Age of Cohort	I: Contraceptive Effect of Birth Last Year on Current Year Fertility[a]				II: Change in Cohort Average Fertility Associated with the Loss of an Existing Child[b]				III: Death Rate Lag Structure[c] (in years)				
	1957-1961			1953-1956	1957-1961			1953-1956	t-1	t-2	t-3	t-4	t-5
	Rural	Urban	Combined	Combined	Rural	Urban	Combined	Combined					
15-19	.87	.86	.86	.81	1.81	2.52	2.00	1.57	.5	.3	.2	.0	.0
20-24	.94	.69	.85	.71	1.17	1.36	1.18	.65	.4	.4	.1	.1	.0
25-29	.88	.81	.85	.75	.85	.75	.83	.50	.2	.5	.3	.0	.0
30-34	1.08	.89	.99	.73	3.12	2.71	2.95	1.12	.1	.2	.4	.2	.1
35-39	.89	.92	.90	.74	2.46	7.85	3.75	2.27	.1	.15	.3	.3	.15

Notes:

[a]Extent to which a birth in a previous year reduces the likelihood of a birth in the current year. It is derived by dividing the regression coefficient for prior year's birth by the constant term in Tables 8, 9, 10 and 11.

[b]Extent to which the likelihood of birth changes due to a death of a child during the lag period, e.g., in three to four years for mothers aged 15-29 and in five years for mothers aged 30-39. It is derived by dividing the regression coefficient for the lagged death variable by the cohort mean probability of live birth in Tables 8, 9, 10 and 11.

[c]These death rate lag structures were estimated directly with the imposed assumption that they should conform to a unimodal positive distribution of weights from one to five years in duration. For example, if a woman age 20-24 lost a child in 1955 and none before or after that, the effect on her probability of birth would be distributed relatively .4 in 1956, .4 in 1957, .1 in 1958 and .1 in 1959 and would have no distinguishable effect on her probability of birth in 1960. The regression coefficient as reported in the tables should be multiplied times the lag weight to obtain the effect of a child death in one year on the conditional probability of birth in another subsequent year. The regression coefficient itself represents the entire (summed) effect over the three-five year effectiveness horizon.

of the mean lag across age groups confirms the existence of behavioral components in the link between the death of children and the subsequent probability of birth to their mothers. To facilitate direct comparisons among parameter estimates and their t statistics for different age groups, independent subsamples of approximately equal size were drawn from very different sized age groups in the survey population.

Rural sample estimates of the effect of a birth in the previous year, β_{t-1}, on the conditional probability of birth in the current year are slightly greater than those for the urban sample. Since the constant terms, αs, in the regressions are similar in magnitude between the rural and urban subsamples, the implied postpartum sterility effect of a birth last year on the chance of having a birth this year is greater in the rural than in urban sample for women between the age of 15 and 34 (part I, Table 12). On average, the postpartum sterility influence is 85 to 90 percent effective for the period 1957-1961 and about 75 percent effective in the earlier period, 1953-1956. All t ratios are substantial.

The implied reproductive response to child deaths within the family is strong, as reflected in our estimates of γ, given the relative lag structure shown in part III, Table 12. To interpret the magnitude of γs this coefficient is divided by the average birth rate for the respective age cohort of women; this ratio is viewed as a relative reproductive response to the death of a child over the lag period of three of five years. In most samples the lowest response ratios are estimated for women 20 to 29. Ratios are higher for both the youngest cohort, 15 to 19, and very much higher for women 35 to 39. The ratios are somewhat higher for women 15 to 24 in the urban than in the rural subsample (1957-1961), and this difference is more striking still for women 35 to 39.

Between 1953-1956 and 1957-1961, estimates of the response ratio to child deaths increased by 30 to 160 percent. Part of this increase may be attributable to the increasing proportion of women, particularly in the older groups, who have the number of children alive that they want. As this proportion grows and they exercise some control over their fertility, the response of this cohort to child deaths will

become more readily distinguishable and statistically significant.[1] This explanation may also account for the unusually high estimate of γ for urban women aged 35 to 39, and the large t ratio associated with this regression coefficient. The higher rates of child survival observed in the urban population than in the rural would have increased the proportion of women in these ages with the traditional number of children living, and thus increased the proportion seeking to control their fertility.

The higher response ratio to child deaths for women over 30 is consistent with earlier studies of family limitation, but the high values for the youngest cohort deserves further mention for it is also observed in studies of Taiwan (Schultz [1969b]) and the Philippines (Harman [1970]). It may reflect the fact that a young mother is particularly eager to replace her first child if it dies to fulfill herself and her family function, and to reconsummate her marriage with offspring. We saw no way of testing this and alternative hypotheses concerning this relationship.

There are two difficulties in attaching a behavioral interpretation to the magnitude of the estimates reported for γ. The Pakistan survey does not specify exactly when child deaths occurred but only the age of the child at death by intervals: less than one, one to four, and five or more years. To construct the historical records analyzed, an arbitrary average age at death for the older child deaths is assumed: ages two and seven, respectively (see Appendix A). This convention permits a two-year error for individuals in the timing of child deaths (age 1 to 4), and an even larger error is possible for the older group of children (5 and over), particularly for older women who have older children. This source of error in measurement should bias down the regression coefficients for aggregate prior child deaths that include other than infant deaths.

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[1]Also, because of the retrospective survey bias of mothers to forget child deaths in earlier periods, the apparent response relationship might be weakened in the earlier period.

There are also biological as well as behavioral reasons for expecting the reproductive response to a child's death to be greater the younger the child who died. This biological feedback mechanism is sharply diminished with the death of an older child, who is less likely to be breast feeding and whose mother is less likely to be subject to postpartum subfecundity.

Both of these arguments suggest child deaths in the three distinguished age groups should be associated differently with the conditional probability of birth. Introducing these three age-specific death variables, the same fixed weighting structure for deaths in prior years is used as before. Because the number of deaths of children is smaller than the number of infant deaths, the comparison of significance (t ratios tests) of regression coefficients is difficult. Combining urban and rural samples and using all possible subsamples from the survey for the period 1957-1961, Table 13 reports the regression findings for the age-specific death variables, and Table 14 summarizes these results across subsamples.

The expected number of children a mother is likely to bear in a five-year period increases by about half a child after she loses an infant if she is 15 to 19 or 30 to 39 years of age (Table 14). The expected birth probabilities for a mother age 20 to 29 increases by about a third of a child subsequent to her loss of an infant. The indistinguishable combination of errors in measurement and the diminished role of the biological-lactation effect accounts for the estimated lower response coefficients to the death of older children. The response coefficient to the death of children five years old and over is still half the magnitude of the response coefficients to infant deaths for mothers age 20 to 29. Since the older child death variable is probably subject to fewer errors in measurement for this group of mothers than for the older women, we regard this as confirmation that compensatory behavioral activity is quantitatively important in understanding the observed association between child deaths and subsequent reproductive behavior.

Table 13

REGRESSIONS OF BIRTH DUMMY VARIABLE ON AGE

SPECIFIC CHILD DEATH VARIABLE

		Coefficients of Independent Variables					
				Age of Child at Death (in years)			
Woman's Age	Subsample	Constant	Birth in Prior Year	Less than 1	1-4	5 or older	R^2
15-19	I	0.349	-0.302	0.622	0.546	-	.090
(805)[a]		(19.1)[b]	(-8.20)	(5.13)	(2.45)		
	II	0.358	-0.268	0.384	0.187	-	.061
		(19.3)	(-7.15)	(2.97)	(0.79)		
	III	0.391	-0.337	0.555	0.604	-	.098
		(20.9)	(-8.97)	(4.54)	(2.05)		
20-24	I	0.384	-0.325	0.433	0.303	-0.466	.106
(785)		(19.6)	(-9.12)	(3.70)	(1.63)	(-0.62)	
	II	0.348	-0.289	0.220	0.204	0.702	.097
		(18.0)	(-8.83)	(1.83)	(1.28)	(1.78)	
	III	0.373	-0.306	0.268	0.104	-0.095	.106
		(18.8)	(-9.55)	(2.13)	(0.66)	(-0.16)	
	IV	0.394	-0.329	0.385	0.016	0.468	.112
		(19.9)	(-9.81)	(3.23)	(0.09)	(0.97)	
25-29	I	0.296	-0.252	0.133	0.241	0.454	.072
(941)		(17.8)	(-8.18)	(1.20)	(1.84)	(1.77)	
	II	0.268	-0.208	0.360	0.271	0.081	.059
		(16.1)	(-6.95)	(3.19)	(1.82)	(0.31)	
	III	0.276	-0.254	0.415	0.128	-0.083	.087
		(17.0)	(-8.82)	(3.91)	(0.94)	(-0.35)	
30-34	I	0.188	-0.189	0.719	0.333	0.465	.075
(731)		(11.0)	(-5.80)	(5.32)	(2.04)	(1.63)	
	II	0.219	-0.202	0.331	0.445	-0.097	.050
		(12.6)	(-5.68)	(2.08)	(2.38)	(-0.34)	
	III	0.203	-0.172	0.395	0.289	-0.113	.041
		(11.8)	(-4.97)	(2.81)	(1.61)	(0.41)	
35-39	I	0.099	-0.097	0.741	0.164	-0.206	.057
(836)		(8.26)	(3.33)	(6.10)	(0.99)	(-0.88)	
	II	0.113	-0.087	0.296	0.148	0.300	.017
		(9.05)	(-2.72)	(2.27)	(0.91)	(1.26)	

Notes:

[a]The number given in parentheses under each age group is the size of each subsample.

[b]Numbers given in parentheses under coefficients are asymptotic t statistics.

Table 14

AVERAGE SIZE OF REGRESSION COEFFICIENTS FROM SUBSAMPLES

Age of Woman	Constant	Birth in Prior Year	Age of Child at Death (in Years)		
			Less than 1	1-4	5 or Older
15-19	0.366	-0.302	0.520	0.446	a
20-24	0.375	-0.312	0.327	0.157	0.152
25-29	0.280	-0.238	0.303	0.213	0.151
30-34	0.203	-0.188	0.482	0.356	0.085
35-39	0.106	-0.092	0.519	0.156	0.047

Note:

[a]No observations.

Source:

Derived from Table 13.

One further issue can be explored with retrospective data of this type: the differential response to the deaths of male and female children. It is widely believed that a male child is valued in East Pakistan more highly than a female child, and thus the loss of a boy is a stronger incentive to seek an additional birth than would be the loss of a girl. Table 15 presents the results of regressions where child deaths have been distinguished by sex. In nine cases out of the 14 the response coefficients for boys is greater than for girls.[1] Using the t test to determine whether the male and female coefficients differ in magnitude significantly, a 15 percent confidence level can be sustained in five cases out of the 14 ($t > 1$). Though it is possible to conclude with some confidence that the reproductive response to a boy's death exceeds that to a girl's death, the difference is not as great as cultural factors might have led us to expect if the response were entirely due to behavioral factors. This analysis supports the conclusion that part of the observed relationship between child death and subsequent reproductive behavior is due to non-behavioral factors such as the biological-lactation mechanism proposed earlier.

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[1]There is again a problem with regard to differential sample size, for the child death rate is about 20 percent higher for boys than girls, and thus the greater effective sample size for the male than for the female dummy variable slightly biases the above test of coefficient differences.

Table 15

REGRESSIONS OF BIRTH DUMMY VARIABLE

ON SEX SPECIFIC CHILD DEATH VARIABLES

Age of Woman	Subsample	Coefficients of Independent Variables: Constant	Birth in Prior Year	Male Child Death Rate	Female Child Death Rate	R^2	t Test of Difference Between Coefficients of the Sex-Specific Death Rates[a]	Mean Male Child Death Rate	Mean Female Child Death Rate
15-19	I	0.349	-0.302	0.653	0.504	.091	0.7[illegible]	0.037	0.019
(805)[b]		(19.1)[c]	(-8.22)	(5.17)	(2.82)			(0.127)[d]	(0.088)[d]
	II	0.358	-0.266	0.360	0 298	.060	0.26	0.032	0.018
		(19.2)	(-7.12)	(2.56)	(1.60)			(0.116)	(0.086)
	III	0.391	-0.338	0.557	0.571	.098	-0.06	0.033	0.019
		(21.0)	(-8.99)	(3.89)	(3.10)			(0.115)	(0.087)
20-24	I	0.385	-0.328	0.461	0.251	.106	1.13	0.047	0.031
(785)		(19.7)	(-9.26)	(3.87)	(1.72)			(0.134)	(0.109)
	II	0.348	-0.294	0.282	0.203	.095	0.45	0.041	0.038
		(18.1)	(-9.03)	(2.13)	(1.63)			(0.115)	(0.122)
	III	0.372	-0.304	0.249	0.127	.106	0.62	0.043	0.031
		(18.8)	(-9.49)	(1.94)	(0.85)			(0.119)	(0.102)
	IV	0.393	-0.324	0.285	0.263	.109	0.11	0.047	0.030
		(19.8)	(-9.68)	(2.37)	(1.73)			(0.131)	(0.102)
25-29	I	0.297	-0.253	0.369	0.057	.075	2.03	0.035	0.040
(941)		(17.8)	(-8.24)	(3.22)	(0.54)			(0.118)	(0.126)
	II	0.268	-0.205	0.231	0.348	.058	-0.69	0.030	0.039
		(16.1)	(-6.90)	(1.77)	(3.15)			(0.103)	(0.121)
	III	0.276	-0.256	0.264	0.278	.083	-0.09	0.038	0.038
		(17.0)	(-8.87)	(2.38)	(2.56)			(0.118)	(0.120)
30-34	I	0.188	-0.188	0.470	0.603	.070	-0.68	0.036	0.039
(731)		(11.0)	(-5.76)	(3.28)	(4.45)			(0.097)	(0.103)
	II	0.218	-0.200	0.237	0.413	.047	-0.77	0.038	0.030
		(12.5)	(-5.61)	(1.62)	(2.38)			(0.099)	(0.083)
	III	0.202	-0.169	0.413	0.192	.038	1.10	0.034	0.038
		(11.8)	(-4.88)	(2.68)	(1.45)			(0.093)	(0.106)
35-39	I	0.098	-0.088	0.476	0.312	.038	1.02	0.027	0.028
(836)		(8.11)	(-3.03)	(3.99)	(2.49)			(0.089)	(0.085)
	II	0.112	-0.085	0.146	0.366	.017	1.26	0.029	0.025
		(9.01)	(-2.68)	(1.23)	(2.69)			(0.093)	(0.081)

Notes:

[a]The t test is used here to test the null hypothesis that the coefficients of the two sex-epecific child death variables are equal against the alternative hypothesis that the coefficient of the male death variable is greater than that of the female death variable (a one-tail test):

$$t = \frac{(B_M - B_F)}{\sqrt{\mathrm{Var}\ (B_M) + \mathrm{Var}\ (B_F) - 2\ \mathrm{Cov}\ (B_M, B_F)}}$$

It should be noted, however, that when the dependent variable is not normally distributed but is rather a binary variable (birth or no birth), the appropriateness of the t test has not been demonstrated.

[b]The number given in parentheses under each age group is the size of each of the subsamples.

[c]Numbers given in parentheses under coefficients are asymptotic t statistics.

[d]Numbers given in parentheses under means are standard deviations.

VI. CONCLUSIONS

TRENDS

Despite the inadequacies frequently attributed to retrospective information on vital rates, a detailed analysis of survey data collected in 1961-1962 for a sample of 4200 families in central East Pakistan produced internally consistent and reasonable estimates of birth and death rates for the preceding decade. Extremely high levels of infant and child mortality declined noticeably in the period 1952-1961. In the rural areas, where 95 percent of the people of East Pakistan live, the retrospective estimate of the infant death rate fell from about 180 to 160 per thousand live births in this decade. Age-specific birth rates to married women also decreased in the decade for women over the age of 19, while a small increase was recorded for married women 15 to 19. During the 1950s total marital fertility, which is the sum of the cross-sectional age-specific marital birth rates, declined about one-fifth. Birth rates in central East Pakistan remained high in 1960 according to our estimates but there is reason to anticipate further reductions in birth rates, particularly among older women.

The average total number of children born to all cohorts of women over the age of 34 is about six; yet because of the exceptionally high death rates, the median number of children still alive to these women in 1960 is about three. By 1962 three-fourths of the women age 30 to 34 and older already had three living offspring. Continued high fertility among these older women will lead them to have more living children than previous generations had. This impending excess fertility, by traditional standards, should motivate these older women to reduce their birth rates further, and increase demands in this population for improved means of birth control.

DETERMINANTS OF FERTILITY

A simplified model was developed to interpret the expected probability of birth for a married woman as a function of her age,

recent births, and own child deaths. The lack of socio-economic information in the survey precluded examination of hypotheses on how environmental and policy factors influence the number of surviving children parents want. Evidence from individual records indicate that a woman having borne a child last year has 85 percent less chance of bearing a child in the current year than other women of the same age. This postpartum sterility effect is statistically significant for only one prior year, although some weak effect is seen in the second postpartum year. This inverse relationship is interpreted as evidence of the strength and duration of postpartum sterility among the population of central East Pakistan.

The direct relationship between the death of the woman's existing children and her subsequent probability of birth is interpreted as due to a behavioral response mechanism and a biological-lactation feedback mechanism. The biological mechanism could not account for the observed link between the death of older children and subsequent fertility of the mother, or the structure of the lagged effect of child deaths on the mother's conditional probability of birth. The behavioral response mechanism, therefore, is thought to be responsible for the major part of the observed relationship between the birth rate of mothers and their recent loss of children. The magnitude of this replacement response is about 50 percent for women 15 to 19 and over 29, whereas for women in their twenties the replacement response to a child's death is closer to 30 percent within the five-year time horizon analyzed. The reproductive response of a mother to the death of her child is somewhat more pronounced is she loses a boy than if she loses a girl, but the difference is less than cultural factors might have led us to expect.

INFORMATION STRATEGY FOR POPULATION POLICY MAKING

To examine the determinants of reproductive behavior and to formulate policy both to cope with predicted trends in fertility and to influence these trends, the demographic analyst requires historical information on the socio-economic and demographic circumstances of

families. Longitudinal data for families can be collected by prospective repeated surveys or by retrospective inquiries. The greater cost and difficulty associated with the collection of data prospectively are usually justified by the alleged unreliability of the alternative retrospective sources. It may be time to reappraise this rationale.

Why is the apparent quality of the reproductive histories collected in the Pakistan survey superior to those commonly cited? First we are not alone; other researchers have also found pregnancy rosters imply plausible retrospective vital rates.[1] Second, the Pakistan survey had several special features. Much attention was given to methodological problems associated with the sampling procedures and the problems of interview.[2] Trained and closely supervised interviewers returned to each family repeatedly to check and verify the completeness and consistency of the pregnancy roster and to record recent vital events. This process, although costly, may reduce recall error.

It is our conclusion that more resources could be productively allocated to the collection and analysis of retrospective survey information. Many surveys of Knowledge, Attitudes and Practices (KAP) of family planning routinely collect, but do not analyze, pregnancy rosters. If these surveys contain some socio-economic detail on the family and the exact time of child deaths, research of the sort pursued here could be fruitfully undertaken. New surveys may also be required that place emphasis on obtaining reliable and complete retrospective information. These newly designed demographic surveys must broaden their scope of inquiry to also collect information on the family's economic status, child schooling, and work experience, and the job opportunities and employment experience of women within and outside of the some. Such characteristics of the family frequently

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[1]Using retrospective survey data from a sample of women in the Comilla district of East Pakistan, Stoeckel and Choudhury found consistent evidence of high but declining levels of infant mortality and age-specific fertility for the period 1958-1968 (Stoeckel [1970] and Stoeckel and Choudhury [1969]).

[2]Two out of the four survey reports discuss the survey interview response problems and sampling methodology.

help predict reproductive patterns among individuals and communities and should be considered in future analyses as probable determinants of desired family size (Z^* in our model). These combined sources of demographic and economic longitudinal data on representative samples of families will provide an essential empirical foundation to test, revise, and add to our limited understanding of the structural dynamics linking reproductive behavior with demographic and economic development. Improvement in our policies to influence future trends in birth rates depends upon our improved knowledge of the biological and behavioral determinants of existing variation in fertility.

Appendix A

DATA SOURCE AND PROCESSING

The original data for this study are from the University of Dacca (East Pakistan) Statistical Survey Research Unit's "Demographic Survey in East Pakistan." This survey was conducted in the period from April 1961 through November 1962 under the direction of Mr. A. N. M. Muniruzzaman.[1] We would like to thank Dr. M. Hossain of the Dacca Institute of Statistical Research and Training for permitting us to copy their survey materials and analyze them for this study. We also owe a substantial debt to Mr. A. K. M. Alauddin Choudhury and Dr. Wiley H. Mosley of the Pakistan-SEATO Cholera Research Laboratory, who facilitated our research in many ways.

The survey sampled a 9,000 square mile area of central East Pakistan (approximately one-sixth the area of Each Pakistan). See Table A-1. Sampling was done separately in urban and rural areas. The urban sample was confined to the cities of Dacca and Narayanganj. A two-stage stratified sampling procedure was used, with census "circles" as the primary sampling units. In all, 16 (of a possible 1,333) rural and 32 (of a possible 358) urban census circles were sampled. "At least once married" women in 2,016 rural households and in 1,024 urban households were questioned in the First Round of the Survey. Each household was then visited in the Second Round of the Survey at three-month intervals over the period of one year.[2] These frequent visits were designed to minimize the probability of "recall lapse" for vital events affecting the composition of the household, and to provide a check on the consistency and accuracy of previously given information. In all, 1,967 rural and 923 urban households were sampled all five times; these 2,890 households constitute the final sample. Approximately

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[1] For further information on survey techniques and field problems see A. N. M. Muniruzzaman [1966a, 1966b].

[2] The First Round was begun in April 1961 and the Second Round was concluded in November 1962.

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Table A-1

POPULATION OF EAST PAKISTAN AND SAMPLED REGIONS
(thousands of persons)

	1961	1951
Rural Area		
Faridpur District	3,179	2,717
Dacca District	4,377	3,671
Comilla District	4,389	3,676
Mymensingh District[a]	1,107	811
Total Rural:	13,052	10,875
Urban Area		
Dacca City	577	339
Narayanganj City	162	73
Total Urban:	719	412
All East Pakistan:	50,840	41,932
Rural	48,199	40,113
Urban	2,641	1,820

Note:
[a]Only Subdivision, Mymensingh Sadar South.

2.5 percent of the original rural sample and 10.0 percent of the original urban sample were dropped, mostly because of movements of households.[1] The final sample included 4,242 ever-married woman -- 2,974 in the rural area and 1,268 in the urban area.

The following information is available for each ever-married woman questioned:

A. General information

1. Current age of woman at time of survey (in age group).[2]
2. Religion (Islamic, Hindu, or other).

B. Marriage information

1. Age of woman at first marriage (in age group)
2. Age of husband at wife's first marriage (in age group)
3. Whether first marriage still continuing (yes-no dummy variable)
   a) If not, how first marriage discontinued (widowed, divorced, or separated)
   b) If not, what was the woman's age when the first marriage ended (in age group)
   c) If not, number of times married.
   d) If not, number of times widowed.
   e) If not, number of times divorced.
   f) If not, present marital status (married, widowed, divorced, separated, "away," or registered prostitute)
4. For women over 43 years of age:
   a) Duration (in years) of married life after last birth.
   b) Whether or not married life continued up to age 49 without a break (yes-no dummy)
      (1)-(7) For each age 43-49 inclusive, whether or not under wedlock at that age (yes, no, or partly).

C. Summary pregnancy information

1. For all marriages

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[1] Incidentally, this implies that the migration rate is much higher for urban households than for rural.

[2] The possible age groups are: 0-1, 1-4, 5-9, 10-14, . . ., 45-49, 50-59, 60-69, . . ., 90-99, 100 and older.

a) Total number of pregnancies.

b) Total number of live births.

c) Total number of male live births.

d) Total number of female live births.

e) Total number of still births.

f) Total number of miscarriages or abortions.

2. For first marriages.

(a)-(f) as directly above.

3. Age of woman at termination of last pregnancy (actual age)

D. Individual pregnancy history information (the following information was given for each of the woman's pregnancies).

1. Result of pregnancy. Code for one of the following:

a) Live birth male

b) Live birth female

c) Miscarriage

d) Still birth

2. Survival status. Code for one of the following:

a) Miscarriage or still birth

b) Still living

c) Died within one month of age

d) Died between one month and one year of age

e) Died between one year and five years of age

f) Died after five years of age

3. Interval (in months) between termination of this pregnancy and the one immediately before it (for first pregnancy the interval between marriage and first pregnancy).

4. Age of woman at termination of pregnancy (in age group)

5. Age of husband at termination of pregnancy (in age group)

The data were first checked for consistency. Summary pregnancy information was checked within itself and also against dates for individual pregnancies.[1] At this stage 25 observations were dropped from the sample because they were incomplete.

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[1]During this procedure it was discovered that the survey had special codes for twin births, including the sex distribution, that were not mentioned in the write-up of the survey.

Age at pregnancy termination and pregnancy interval data were then checked for consistency. Since age of woman at termination of last pregnancy was the only age given as an exact number, rather than in an age group, this was used as the reference point. The interval between the last and the next to the last pregnancy was converted from months into years and was subtracted from the age at termination of last pregnancy to derive the exact age of the woman at the termination of the next to last pregnancy. It was then checked to see if this derived age fell into the age group reported for the next to last pregnancy. This procedure was repeated for all pregnancies up to the first. The interval between marriage and termination of first pregnancy was then subtracted from the derived age of the woman at the termination of her first pregnancy to derive her exact age at first marriage.

Incorrectly reported or recorded birth intervals or age group data could be recognized and were corrected if the mistake seemed unambiguous. Often by changing one interval length, all of the other data were consistent (i.e., derived exact ages fell into reported intervals).[1] Often all derived exact ages of a woman at termination of a pregnancy were consistent with the reported age groups, but the derived age at first marriage was not. If the derived age at first marriage did not fall into the reported interval, allowing for a possible two-year error, a notation of this was made, and these observations were eliminated from calculations of average age at marriage. This occurred for 185 observations.

The current age of the woman (at the time of the survey) was only reported in a group and since there was no way of deriving it exactly from the data, it was assumed to be equal to the mid-point of the reported age group, or the age at termination of last pregnancy if the latter was greater.

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[1]Thirteen more observations were dropped from the sample at this stage owing to inconsistency of the data, leaving a sample of 4204 women -- 2979 rural and 1225 urban women. According to our computations, our final rural sample contains five more women than are reported in published survey methodology. This may be because an error was made in this survey report or in the classification of the total sample in Dacca into rural and urban decks on which we based our analysis.

The following assumptions were made about the average age of a child at death (another variable that was reported only in an age group rather than exactly):

Reported Age Group	Assumed Average Age
0-1 month	.08 year
1 month to 1 year	0.3 year
1 year to 5 years	2.0 years
greater than 5 years	7.0 years

These averages are based on the assumption that the distribution of age at death is positively skewed for the first ten years. Since the exact age of the mother at the birth of each child was now estimated, the age of the mother at the death of a child was calculated by adding to her estimated age at birth the number of years the child had lived. Information on the age of the mother at all births and deaths, and the number of children ever born and number of children currently alive were thus derived for each year of her married life.

FINAL FORM OF DATA FOR THIS STUDY

Beginning with the most current year (year in which the survey was conducted), going backward year by year for ten years (t = 1, . . ., 10), for each woman the following information was calculated:

1. Age of woman in year t.
2. (a) How many live births to this woman in year t (0, 1, 2)
   (b) How long these children lived (if now dead)
3. (a) Number of births in year t-1
   (b) Number of births in year t-2
   (c) Number of births in year t-3
   (d) Number of births in year t-4
   (e) Number of births in year t-5
4. Parity of woman in year t (how many children born before year t)
5. (a) (1) Number of children who died in year t
      (2) Number of these who were boys
      (3) How long each child lived (if now dead)
   (b) (1) - (3) immediately above for year t-1

(c) (1)-(3) for year t-2

.

.

(k) (1)-(3) for the year t-10

6. Percent of children ever born (not counting births in year t) now alive
7. Percent of pregnancies (not counting those in year t) ending in miscarriage, abortion, or stillbirth
8. Percent of currently living children (not counting any born in year t) who are males
9. Is first marriage still continuing? (yes-no dummy variable)
10. Age of woman at first marriage
11. Rural-urban dummy variable
12. Religion (Islamic-non-Islamic dummy variable)
13. Dummy variable telling whether or not age at first marriage variable is of questionable accuracy (see above)
14. How many years before the survey is year t?

Comments on Accuracy of Data

The Pakistani investigators, all males, who collected these data were carefully screened and then specially trained to conduct interviews for this survey. The fact that each household was visited five times further reduced the probability of recording errors.

Directors of the survey feared that because the interviewers were men they might not obtain accurate information:

1. Pakistani social customs do not, as a rule, allow a woman to talk with an unknown man.
2. A woman may be reluctant or embarrassed to give pregnancy history information to a man.

In nearly half of the households surveyed the male head of the household gave all the information for all members of the family. However, many women were successfully interviewed by the male investigators.

As with any survey there are possibilities of misreporting by respondents and misrecording by investigators. Misreporting may be unintentional -- out of ignorance or inability to remember (which was probably the case for the age at first marriage information since most girls marry at a very early age in Pakistan) -- or intentional.

The consistency checks mentioned above showed that the data was nearly always internally consistent. Age-specific birth rates and infant mortality rates calculated from the sample as a whole were of reasonable magnitude as discussed in the text. All evidence we have contributes to our confidence that the data are trustworthy and reliable by standards typically applied to survey data.

Appendix B

SUPPLEMENTARY SURVEY TABULATIONS

Table B-1

FREQUENCY DISTRIBUTION OF AGE OF WOMAN AT FIRST MARRIAGE
(urban and rural sample combined)

Age of Woman at First Marriage	Number of Women First Married at This Age	Percent of Women First Married at This Age
0-9	409	10.18
10	286	7.12
11	281	6.99
12	456	11.35
13	877	21.82
14	452	11.25
15	457	11.37
16	310	7.71
17	132	3.28
18	196	4.88
19	51	1.27
20-24	102	2.54
25-29	7	0.17
30-34	1	0.02
35+	2	0.05
Total	4019[a]	100.00

Median Age at First Marriage	13.66
Average Age - All Women	13.26
Average Age - Rural Women	12.89
Average Age - Urban Women	14.15

Note:

[a]Some women are not included in this calculation because data on age at first marriage were not internally consistent. See discussion p. 57.

Table B-2

RURAL AGE-SPECIFIC BIRTH RATES, 1952-1961

Age of Women	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1953-1956	1957-1960	1952-1961
15-19	375.3	359.3	267.1	302.8	346.0	352.9	370.0	290.5	286.9	242.1	322.8	334.8	323.7
	(389)	(398)	(355)	(393)	(422)	(425)	(427)	(241)	(251)	(409)	(1568)	(1344)	(3710)
20-24	394.6	349.1	409.5	382.1	358.0	326.0	310.3	318.0	354.6	225.7	375.6	201.7	329.2
	(332)	(338)	(398)	(403)	(405)	(408)	(419)	(434)	(436)	(452)	(1544)	(1697)	(4025)
25-29	300.0	367.5	381.4	285.3	319.4	318.3	254.4	256.1	185.4	161.1	336.1	250.1	274.0
	(230)	(234)	(333)	(333)	(335)	(333)	(338)	(410)	(410)	(416)	(1235)	(1491)	(3372)
30-34	181.4	208.7	267.9	254.5	250.0	220.8	195.7	246.2	159.2	148.7	245.1	205.0	209.4
	(226)	(230)	(224)	(224)	(224)	(231)	(235)	(333)	(333)	(343)	(902)	(1132)	(2603)
35-39	152.4	85.7	208.9	173.3	133.3	101.8	87.0	196.4	107.1	76.9	151.4	122.8	132.1
	(210)	(210)	(225)	(225)	(225)	(226)	(230)	(224)	(224)	(234)	(885)	(904)	(2233)
40-44	NA	NA	95.2	61.9	52.4	42.9	33.3	84.4	31.1	17.3	69.8	48.3	52.0
			(210)	(210)	(210)	(210)	(210)	(225)	(225)	(231)	(630)	(870)	(1731)
All Rural Ever-Married Women	213.8	217.8	227.2	203.1	205.7	195.4	192.1	178.5	134.7	115.8	213.2	161.6	185.6
	(2138)	(2204)	(2284)	(2359)	(2440)	(2503)	(2546)	(2571)	(2584)	(2979)	(9287)	(10,204)	(24,608)

Notes:
NA: Not available.
Sample sizes are given in parentheses under each birth rate in number of woman-years.

Table B-3

URBAN AGE-SPECIFIC BIRTH RATES, 1952-1961

Age of Women	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1953-1956	1957-1960	1952-1961
15-19	422.2	371.0	286.8	316.8	299.4	401.1	369.9	197.4	329.4	203.9	321.3	348.3	330.7
	(180)	(186)	(136)	(161)	(177)	(177)	(173)	(76)	(85)	(152)	(660)	(511)	(1503)
20-24	373.4	408.5	404.3	378.2	425.6	346.7	387.3	386.2	254.0	209.5	404.1	344.4	355.2
	(158)	(164)	(188)	(193)	(195)	(199)	(204)	(189)	(189)	(210)	(740)	(781)	(1889)
25-29	327.4	289.5	406.3	362.5	356.2	289.3	272.7	288.7	190.7	165.9	358.6	258.4	288.2
	(113)	(114)	(160)	(160)	(160)	(159)	(165)	(194)	(194)	(205)	(594)	(712)	(1624)
30-34	202.1	221.1	292.0	267.9	303.6	219.3	228.1	242.2	173.9	101.2	273.2	214.5	218.6
	(94)	(95)	(113)	(112)	(112)	(114)	(114)	(161)	(161)	(168)	(432)	(550)	(1244)
35-39	70.4	152.8	239.1	129.0	204.3	127.7	115.8	97.3	125.0	75.0	182.9	115.9	131.9
	(71)	(72)	(92)	(93)	(93)	(94)	(95)	(113)	(112)	(120)	(350)	(414)	(955)
40-44	NA	NA	84.5	70.4	56.3	70.4	27.8	43.5	64.5	31.9	70.4	51.8	55.1
			(71)	(71)	(71)	(71)	(72)	(92)	(93)	(94)	(213)	(328)	(635)
All Urban Ever-Married Women	237.5	246.1	261.0	237.7	252.2	232.9	230.3	189.3	152.1	115.1	249.3	200.6	211.7
	(863)	(894)	(935)	(976)	(1003)	(1022)	(1042)	(1062)	(1072)	(1225)	(3808)	(4198)	(10,094)

Notes:

NA: Not available.

Sample sizes are given in parentheses under each birth rate in number of woman-years.

Table B-4

RURAL BIRTH SEX RATIOS[a]

Age of Mother	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1952-1961
15-19	100.0 (73.)	101.4 (70.)	140.0 (40.)	77.6 (67.)	131.7 (63.)	111.3 (71.)	140.6 (64.)	125.8 (31.)	132.3 (31.)	95.9 (49.)	112.9 (559)
20-24	81.7 (71.)	169.8 (43.)	105.0 (80.)	111.1 (72.)	114.1 (64.)	89.9 (69.)	106.3 (63.)	100.0 (69.)	113.7 (51.)	92.3 (52.)	106.0 (63.4)
25-29	86.1 (36.)	100.0 (42.)	101.7 (60.)	138.5 (39.)	119.1 (47.)	82.8 (58.)	120.5 (39.)	90.9 (55.)	100.0 (38.)	75.7 (37.)	100.9 (451)
30-34	141.2 (17.)	92.0 (25.)	71.4 (35.)	83.9 (31.)	74.2 (31.)	96.0 (25.)	155.6 (18.)	134.3 (35.)	147.6 (21.)	104.2 (24.)	10544 (262)
35-39	77.8 (18.)	125.0 (8.)	115.0 (20.)	116.7 (18.)	130.8 (13.)	228.6 (7.)	53.8 (13.)	75.0 (24.)	118.2 (11.)	157.1 (7.)	107.9 (139)
40-44	NA	NA	200.0 (6.)	44.4 (9.)	175.0 (4.)	350.0 (2.)	75.0 (4.)	58.3 (12.)	75.0 (4.)	300.0 (1.)	109.5 (42)
15-44	93.0 (215)	116.5 (188)	108.3 (241)	100.4 (236)	116.7 (222)	101.8 (232)	120.4 (201)	101.8 (226)	116.2 (156)	95.3 (170)	106.8 (2087)

Notes:

NA: Not available.

[a]Number of male births per 100 female births.
Numbers in parentheses are number of female births.

Table B-5

URBAN BIRTH SEX RATIOS[a]

Age of Mother	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1952-1961
15-19	130.3 (33.)	146.4 (28.)	85.7 (21.)	96.2 (26.)	89.3 (28.)	105.7 (35.)	120.7 (29.)	150.0 (6.)	100.0 (14.)	63.2 (19.)	108.4 (239)
20-24	118.5 (27.)	91.4 (35.)	123.5 (34.)	102.8 (36.)	92.7 (41.)	71.8 (39.)	82.9 (41.)	87.2 (39.)	100.0 (24.)	76.0 (25.)	93.8 (341)
25-29	133.3 (15.)	65.0 (20.)	96.9 (32.)	81.3 (32.)	119.2 (26.)	119.0 (21.)	104.5 (22.)	75.0 (32.)	164.3 (14.)	113.3 (15.)	101.7 (229)
30-34	111.1 (9.)	133.3 (9.)	83.3 (18.)	114.3 (14.)	126.7 (15.)	31.6 (19.)	200.0 (8.)	129.4 (17.)	136.4 (11.)	88.9 (9.)	107.8 (129)
35-39	66.7 (3.)	175.0 (4.)	46.7 (15.)	71.4 (7.)	90.0 (10.)	100.0 (6.)	57.1 (7.)	120.0 (5.)	50.0 (8.)	80.0 (5.)	77.1 (70)
40-44	NA	NA	500.0 (1.)	150.0 (2.)	33.3 (3.)	0.0 (0.)	100.0 (1.)	300.0 (1.)	100.0 (3.)	50.0 (2.)	130.8 (13)
15-44	123.0 (87)	109.4 (96)	97.5 (121)	93.4 (117)	100.0 (123)	85.0 (120)	104.6 (108)	98.0 (100)	112.2 (74)	81.3 (75)	100.1 (1021)

Notes:

NA: Not available.

[a]Number of male births per 100 female births.
Numbers in parentheses are number of female births.

Table B-6

AGE-SPECIFIC BIRTH RATES FOR ALL RURAL EVER-MARRIED WOMEN AND ALL WOMEN WHOSE FIRST MARRIAGE IS STILL CONTINUING

Age of Women	1961		1957-1961		1952-1961	
	All Ever-Married Women	All Women Whose First Marriage Still Continuing	All Ever-Married Women	All Women Whose First Marriage Still Continuing	All Ever-Married Women	All Women Whose First Marriage Still Continuing
15-19	242.1 (409)	234.1 (393)	313.2 (1753)	311.1 (1607)	323.7 (3710)	323.4 (3364)
20-24	225.7 (452)	221.6 (379)	285.7 (2149)	285.7 (1771)	329.2 (4025)	333.9 (3318)
25-29	161.1 (416)	167.7 (328)	230.7 (1907)	239.4 (1483)	274.0 (3372)	285.1 (2596)
30-34	148.7 (343)	151.2 (258)	191.9 (1475)	206.0 (1073)	209.4 (2603)	230.2 (1833)
35-39	76.9 (234)	101.4 (148)	113.4 (1138)	138.7 (714)	132.1 (2233)	172.2 (1394)
40-44	17.3 (231)	22.1 (136)	41.8 (1101)	54.9 (638)	52.0 (1731)	76.2 (1010)
All Ages	115.8 (2979)	139.5 (2086)	161.6 (13,183)	199.5 (8932)	185.6 (24,608)	229.9 (16,726)

Note:
Sample sizes given in parentheses in number of woman-years.

Table B-7

AGE-SPECIFIC BIRTH RATES FOR ALL URBAN EVER-MARRIED WOMEN AND ALL WOMEN WHOSE FIRST MARRIAGE IS STILL CONTINUING

Age of Women	1961		1957-1961		1952-1961	
	All Ever-Married Women	All Women Whose First Marriage Still Continuing	All Ever-Married Women	All Women Whose First Marriage Still Continuing	All Ever-Married Women	All Women Whose First Marriage Still Continuing
15-19	203.9 (152)	208.1 (149)	315.2 (663)	315.2 (625)	330.7 (1503)	331.9 (1416)
20-24	209.5 (210)	228.0 (193)	315.8 (991)	328.1 (884)	355.2 (1889)	363.2 (1685)
25-29	165.9 (205)	186.0 (172)	237.7 (917)	258.8 (765)	288.2 (1624)	310.3 (1363)
30-34	101.2 (168)	104.5 (134)	188.0 (718)	212.9 (559)	218.6 (1244)	256.8 (958)
35-39	75.0 (120)	92.0 (87)	106.7 (534)	136.4 (374)	131.9 (955)	171.2 (666)
40-44	31.9 (94)	47.6 (63)	47.4 (422)	65.9 (273)	55.1 (635)	74.9 (414)
All Ages	115.1 (1225)	147.9 (913)	181.3 (5423)	227.5 (3965)	211.7 (10,094)	262.6 (7459)

Note:
Sample sizes given in parentheses in number of woman-years.

Table B-8

NEO-NATAL, INFANT, AND CHILD DEATH RATES

Year	Neo-Natal Death Rates[a]		Infant Mortality Rates				Child Death Rates[d]	
			Correct Method[b]		Usual Method[c]			
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
1952	53.7	83.2	97.6	177.2	112.2	177.2	24.8	33.1
1953	90.9	91.7	159.1	172.9	145.5	177.1	20.2	27.5
1954	73.8	105.8	123.0	169.2	131.1	169.2	13.4	20.6
1955	69.0	89.8	137.9	156.6	137.9	154.2	19.9	34.3
1956	79.1	89.6	130.4	157.4	126.5	157.4	15.6	23.1
1957	87.9	79.8	121.3	159.5	133.9	157.5	NA	NA
1958	50.0	75.7	87.5	153.4	83.3	155.4	NA	NA
1959	49.8	93.7	74.6	159.0	69.7	161.2	NA	NA
1960	55.2	86.2	122.7	158.0	104.3	178.2	NA	NA
1961	99.3	54.9	NA	NA	170.2	83.8	NA	NA

Notes:

NA: Not available.

[a]Number of deaths in year t of infants less than one month old per 1,000 live births in year t.

[b]Number of infants born in year t who died before age 1 per 1,000 live births in year t.

[c]Number of infants less than one year old who died in year t per 1,000 live births in year t.

[d]Number of children born in year t who died between the age of 1 and 5 per 1,000 child years period (approximated by the number who died plus four times the number who lived to be five).

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