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9. ABSTRACT
This working note results from a survey and research project to investigate the influence of certain economic and institutional factors on couples' fertility behavior in Peninsular Malaysia. The purpose of the project was to identify factors within the range of direct public policy influence which directly or indirectly affect birthspacing and family size and to estimate the magnitude of statistical relationships between these factors and the outcomes of interest. Breastfeeding currently provides about one-third more protection against pregnancy than do family planning program contraceptives. This protection is rapidly diminishing in Malaysia and in most other LDCs due to the decline in breastfeeding. This paper reports empirical evidence concerning these issues. The initial results are from a survey and research project designed to estimate the responsiveness of couples' contraceptive use, breastfeeding, and birthspacing to changes in specific factors under policy influence. The survey was conducted in 52 primary sampling units throughout the country, with a sample of over 1200 households. The characteristics of the sample are described and trends in the demographic variables or principal interests since World War II are discussed. Section III summarizes a model of couples' breastfeeding, contraceptive use, and birthspacing that characterizes behavior in these areas as the result of an optimization process subject to biological and behavioral constraints. This model is the structure for the regression analyses that follow in Section IV. Separate regression analyses are discussed for length of post-partum amenorrhea, length of full and partial breast-feeding, length of closed menstruating interval, use of contraceptives, length of closed birth interval, infant mortality, and birthweight. The last section reviews the findings and discusses some implica-

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CONTRACEPTING, BREASTFEEDING AND BIRTHSPACING IN MALAYSIA: A MODEL OF DECISIONMAKING SUBJECT TO ECONOMIC AND BIOLOGICAL CONSTRAINTS

William P. Butz and Julie DaVanzo

A WORKING NOTE
prepared for the
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PREFACE

This Working Note is one of a series of publications resulting from a survey and research project to investigate the influence of certain economic and institutional factors on couples' fertility behavior in Peninsular Malaysia. This project is funded by the U.S. Agency for International Development and has been conducted by The Rand Corporation in collaboration with, initially, The Department of Statistics of the Government of Malaysia, and subsequently, Survey Research Malaysia, Sdn. Bhd. The project's purposes are to identify factors within the range of direct public policy influence which directly or indirectly affect birthspacing and family size and to estimate the magnitude of statistical relationships between these factors and the outcomes of interest.

The project has involved development and field testing of survey instruments; training of field personnel; collection, coding and cleaning of data; and statistical investigation of research hypotheses. Project outputs include the resulting data set, reports on initial research findings, and materials of methodological and operational interest to investigators who use the data set or are involved in similar or related projects. These written outputs are as follows:

William P. Butz and Julie DaVanzo, *Economic and Demographic Family Behavior in Malaysia: A Conceptual Framework for Analysis*, The Rand Corporation, R-1834-AID, September 1975.

William P. Butz, Julie DaVanzo, Dorothy Z. Fernandez, Robert Jones, and Nyle Spoelstra, *The Malaysian Family Life Survey: Questionnaires and Interviewer Instructions*, The Rand Corporation. WN-10147-AID. March 1978.

Terry Fain and Tan Poh Kheong, *The Malaysian Family Life Survey: Round One Codebook*, The Rand Corporation, WN-10148-AID, March 1978.

Fahmi Omar, *The Malaysian Family Life Survey: Descriptions of Sample Communities*, The Rand Corporation, WN-10151-AID, March 1978.

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Robert Jones and Nyle Spoelstra, *The Malaysian Family Life Survey: Field Report*, The Rand Corporation, WN-10150-AID, March 1978.

Iva Maclennan, *RETRO: A Computer Program for Processing Life History Data*, The Rand Corporation, WN-10149-AID/RF, March 1978.

William P. Butz and Julie DaVanzo, *Contracepting, Breastfeeding and Birthspacing in Malaysia: A Model of Decisionmaking Subject to Economic and Biological Constraints*, The Rand Corporation, WN-10146-AID, March 1978

Julie DaVanzo and Donald L.P. Lee, *The Compatibility of Work and Child Care: Preliminary Evidence from Malaysian Time Budget Data*, The Rand Corporation, P-6126, May 1978.

William P. Butz and Julie DaVanzo, *The Malaysian Family Life Survey: Summary Report*, The Rand Corporation, WN-10173- AID, March 1978.

This Working Note contains initial research findings from the survey. It should be useful to persons interested in the demography and household economy of Malaysia, to persons interested in empirical modeling of household behavior in less developed countries, and to persons concerned with the research potentials of retrospective life history data.

We are indebted to a great many people for collaboration and assistance in the survey and data preparation phases of this project. Their contributions are acknowledged in Working Note WN-10147, cited above. We are also indebted to Terry Fain and David Harrison for able programming and research assistance on the research reported here, and to Frank Berger, Wendy Cooper, Donald Negri, Katherine Rydell and Andrea Spatz for helpful assistance. We also thank staff members of the Agency for International Development for helpful comments during seminar presentations of an earlier draft of this paper. All remaining errors are the responsibility of the authors. Order of authorship was determined alphabetically.

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I. INTRODUCTION

Reproductive behavior has changed dramatically in Malaysia since World War II. Breastfeeding declines preceded, then accompanied, a rapid increase since the middle 1960s in use of modern contraceptives. Many couples found themselves without contraceptive protection during this transition and experienced short birthspacing.

Short birthspacing increases the rate of population growth under conditions common in many less developed countries. It also appears to harm the health and survival probabilities of mothers and children. In spite of these serious consequences, the behavioral causes of short birthspacing are not well understood. Of the three principal determinants of birthspacing--breastfeeding patterns, use of traditional contraceptive methods, and use of modern methods--only the last has been widely studied. Yet, Franz Rosa (n.d.) has estimated that in the less developed countries, breastfeeding currently provides about one-third more protection against pregnancy than do family planning program contraceptives. This protection provided by breastfeeding is rapidly diminishing in Malaysia and in most other less developed countries. Because scientific evidence concerning the causes of the phenomenon and its interaction with use of other contraceptive methods is nearly nonexistent, appropriate public policy reactions are difficult to formulate.

This paper reports empirical evidence concerning these issues. These initial results are from a survey and research project designed to estimate the responsiveness of couples' contraceptive use, breastfeeding, and birthspacing to changes in specific factors under policy influence in Peninsular Malaysia. The three-round survey was conducted in 1976 and 1977 in 52 primary sampling units throughout the country, with a sample of over 1200 households.

Following a discussion of limitations and characteristics of the data used herein, this introduction concludes by describing some characteristics of the sample. Section II then makes use of the

retrospective nature of our data to discuss trends since World War II in the demographic variables of principal interest in the study. The next section summarizes a model of couples' breastfeeding, contraceptive use, and birthspacing that characterizes behavior in these areas as the result of an optimization process subject to biological and behavioral constraints. This model is the structure for the regression analyses that follow in Section IV.

There we discuss separate regression analyses for length of post-partum amenorrhea, length of full and partial (supplemented) breast-feeding, length of closed menstruating interval, use of contraceptives, length of closed birth interval, infant mortality, and birthweight.[1] The unit of observation is a live birth, with multiple observations for mothers who had more than one live birth. Most explanatory variables are constructed in such a way that they refer to the time of the birth under consideration, rather than the time of the interview. We find that the estimated biological and behavioral relationships correspond closely with other evidence where it is available. For many of the findings, there is no literature for comparison, but most of these accord with our hypotheses.

The last section reviews these findings and discusses some implications for public policies, particularly those that influence the supplies of contraceptives, infant food, and health care.

Characteristics and Limitations of the Data

In the three rounds of this survey, detailed data were collected on a number of family activities bearing on reproductive behavior. The questionnaires cover retrospective life histories of male and female respondents, time budgets for all family members, detailed income and wealth information, attitudes and expectations of male and female respondents in areas of the study's interest, and characteristics of

[1] A *closed* interval is defined as one that ends with a pregnancy; an *open* interval ends with the respondent's interview.

communities and local programs. The analyses in this paper use only a subset of these data--first-round data from the two retrospective questionnaires and the community survey. These analyses make considerably greater demands on a retrospective data set, than have, to our knowledge, been made previously.

Since retrospective data are time-ordered observations on the same individuals, they are similar to prospective panel data. But there are important differences. The most obvious is that demographic and economic information about a 20-year-old woman is bound to be more reliable and complete if collected from the woman when she is 20 or 21 than years later when she is 40. Respondents tend to report less accurately about events that occurred further in the past. This "retrospective reporting bias" can mean failure to report events, such as pregnancies and child deaths, that happened years earlier. A result is estimated trends in, say, fertility rates and child mortality rates that are biased upward. Also, respondents may shift the timing of events in their life history so that, even if all events are remembered, their dates are systematically compressed or extended.[1]

Another difference between retrospective and prospective surveys is that a retrospective sample for some year prior to the year of interview will of course contain only respondents still alive in the interview year. However, a survey actually conducted in that earlier year would have sampled some women who have since died or left the country. If the survivors had systematically different experiences, say different fertility or contraceptive use histories, than their deceased contemporaries, then vital rates or sample means from the two sources will differ for the earlier year.

Because of these potential biases, careful interviewing, checking and cleaning procedures are especially important in a retrospective survey. Our retrospective instruments are direct descendents of others that were developed and administered in Guatemala.[2] These underwent lengthy field development and testing as did the subsequent Malaysian

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[1]See Potter (1977) for an analysis of the ramifications of particular assumptions concerning patterns of respondents' forgetfulness.

[2]Rand and the Institute for Nutrition in Central America and Panama (INCAP) collaborated in the Guatemala survey.

instruments. The Malaysian survey involved lengthy interviewer training and extensive field checking and editing, and the survey technique involved much cross-referencing and checking across events in different life areas. Such cross-checking during the interview was greatly aided by the accurate birth registration records kept by virtually all mothers in Malaysia.[1] Respondent cooperation was unusually high for a lengthy survey. The questionnaires were formatted for direct punching, so that there was no risk of transcription errors, after which the data were cleaned and then checked for logical consistency across ages and life areas of the respondents and between spouses.[2]

The resulting data used in this paper are unusual in several respects. One is that spouses' life histories have been matched in our working data files, so that characteristics and activities of either spouse can be accessed at specific ages or events in the partner's life. Another is that these surveys cover an unusually wide range of life areas, and, for each, we can construct a variety of types of variables, all of which take values at assigned ages, dates, or events in respondents' lives.[3] This enables us to assemble data files that can be used much as one uses prospective panel data. Further, the unit of observation in working data files can be a variety of events, such as each life birth, first job after marriage, or each migration. Hence, sample sizes for analysis can easily exceed the number of respondents. Finally, our retrospective data are part of a much larger data set on the same respondents, including information on public programs and community characteristics relevant to the respondents in the year of interview.

Characteristics of the Sample[4]

The first-round sample, used in this paper, contains 1262 households in Peninsular Malaysia that each contained at least one ever-married

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[1] See Appendix C.

[2] For details of this process with round I data, see Fain and Tan (1978)

[3] The computer program that constructs such variables from these life history data is described in Maclennan (1978).

[4] The tables on which this section's discussion is based appear in Appendix B.

woman less than 50 years of age at the time of the initial visit in 1976.[1] One-fifth of the sample lives in the three main cities of Kuala Lumpur (the capital), Ipoh, and Penang; 22 percent live in smaller towns (population more than 10,000 or less than 10,000 with more than half of the working population in nonagricultural employment); while the majority (58 percent) live in rural areas.

Reflecting their relative prevalence in the population of Peninsular Malaysia, nearly half (48 percent) of the sample households are Malay, 40 percent Chinese, 12 percent Indian, and 1 percent are of other ethnicities. Ethnicity and type of area are not independent in Malaysia. Chinese make up only 40 percent of the total sample, but 60 percent of those living in the three main cities, while Malays who make up less than one-half of the total sample account for 60 percent of rural residents. Nearly three-fourths of all Malay households in our sample live in rural areas. The distributions of our sample by ethnic groups and type of area are very similar to the distributions reported in recent Government of Malaysia statistics.

The average household in the sample consists of 6.3 persons (an average of 2.0 persons under 10 years of age, 0.9 aged 10-14, and 3.4 aged 15 or over). Household size varies little with type of area, being slightly smaller than average in metropolitan areas (6.2 persons) and slightly above average in towns (6.4 persons).

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[1] The 1262 households interviewed in Round I resided in 52 Primary Sampling Units (PSUs). 1179 of these households are in a national probability sample of 49 primary sampling units (PSUs), each chosen at random with probability proportional to the number of households in the PSU. (All private dwelling units in each of the chosen PSUs were listed before the sample was drawn; hence, the sample frame reflects the current population of the PSUs at the beginning of the survey.) This national probability sample of 1179 is supplemented with an additional purposive sample of 103 households in three PSUs, chosen such that the total sample contains minimum numbers of certain ethnic and occupational groups for analytical purposes. More than 95 percent of first-round households are also represented in the subsequent two rounds. The analyses described in this paper are based on 1262 households. (Twenty cases were incomplete and are not included in any of our analyses).

94.5 percent of the women in the sample were married at the time of the survey.[1] Consequently, we have survey data on over 1,100 male heads of household (husbands).[2] The median age of female respondents is around 34, while that of their husbands is nearly 40.

The average schooling level of female respondents in the sample is 3.7 years, but there is considerable variation around this mean. Over one-third of female household heads never attended school, while nearly 15 percent have completed more than six years of schooling. Less than 13 percent of the male household heads have never attended school, and nearly one-quarter have completed more than six years. The average male educational attainment is 5.6 years. For both males and females, average educational attainment decreases as age increases. The decline is especially marked for females.[3]

Forty-six percent of sampled female heads of households were not engaged in an income-producing activity (for cash or kind) at the time of the survey. The vast majority of those who did were either full-time paid employees or workers in family businesses. Part-time work appears to be relatively rare (3.9 percent of female heads), as does cottage industry (home products/services for sale) as a main occupation (4.9 percent). Over half (52 percent) of women who work have agricultural occupations.

The majority (59 percent) of male household heads were paid employees. Over one-third of all male household heads engage in agricultural activities for their main occupation.

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[1] Of those not reporting to be currently married at the time of the survey, 60 percent were widowed (most of these were over age 40), 22 percent were divorced (all of these were Malays), and 18 percent were separated.

[2] Not all women who reported to be currently married had husbands available to be interviewed.

[3] Female heads aged 20-29 at the time of the survey averaged over three times more schooling than their 40-49-year-old counterparts, while 20-29-year-old males had less than twice the average education of men 40 or over (a group which contains a substantial number of men over 50). The data clearly indicate that the gap between the educational attainments of males and females is narrowing over time.

II. TRENDS IN DEMOGRAPHIC VARIABLES

Moving closer to the focus of this paper, we now examine the levels and trends of some demographic indicators.

Age-Specific Fertility Rates and Children Ever Born

Table 1 shows how fertility rates have varied over time and with age. Prior to 1964 women's peak fertility was generally occurring at age 25-29; since 1965 it has occurred in the earlier age interval, 20-24. Accordingly, fertility at age 25-29 has shown dramatic and consistent decline between 1950 and 1974, much of it prior to the first public family planning effort in the early 1960s. Fertility rates have generally declined at all ages; except at ages 15-19, the fertility rate for each age was lower in 1970-1974 than in any earlier period.

TABLE 1

TRENDS IN AGE-SPECIFIC FERTILITY RATES
(LIVEBIRTHS PER WOMAN YEAR x 1000)

Date	15-19	20-24	25-29	30-34	35-39	40-44	45-49
1940-1944	123.36	-	-	-	-	-	-
1945-1949	164.36	364.49	-	-	-	-	-
1950-1954	159.30	345.17	364.49	-	-	-	-
1955-1959	173.22	338.24	331.47	257.94	-	-	-
1960-1964	146.79	307.76	328.42	295.86	179.44	-	-
1965-1969	100.16	313.14	302.48	249.86	184.91	72.90	-
1970-1974	134.73	306.05	290.01	233.02	139.66	68.49	5.61

Note: Diagonals trace cohorts over time. Smallest denominator is 178.
- = not available

Considering the rates along the diagonal of Table 1, we see that women who were 15-19 in 1940-44 had given live birth on average to 6.8 children by the time they were aged 45-49 in 1970-74.

Since we know the mother's age and calendar year for all pregnancies in our sample, we are able to compare estimates of average numbers of children every born by a particular date to those from other surveys in Peninsular Malaysia. This enables us to check the reasonableness of our

retrospective data against those from contemporary surveys. In Table 2 we compare our estimates of numbers of children ever born by December 1966 July 1970, and July 1974 to those in the West Malaysian Family Survey (1966-67), Post-Enumeration Survey (1970), and Malaysian Fertility and Family Survey (World Fertility Survey) (1974).

Table 2

MEAN NUMBER OF CHILDREN EVER BORN BY CURRENT AGE FOR CURRENTLY MARRIED WOMEN IN 1974, 1970 and 1966/67: COMPARISONS OF OUR RETROSPECTIVELY REPORTED DATA WITH INDEPENDENT SURVEYS[a]

	1974		1970		1966/67	
Current Age:	Malaysian Fertility and Family Survey (World Fertility Survey)	MFLS as of July 1, 1974	Post Enumeration Survey	MFLS as of July 1, 1970	West Malaysian Family Survey 1966/67	MFLS as of Dec. 31, 1966
15-24	1.5	1.4	1.6	1.5	1.9	1.6
25-34	3.6	3.7	4.1	3.9	4.3	4.2
35-44[b]	5.9	6.2	6.0	6.5[b]	5.8	6.3[b]
All Women 15-44	4.2	4.1	4.1	4.2[b]	4.1	3.9[b]

Sources: The figures from independent surveys are taken from R. Chander and V.T. Palan, Malaysian Fertility and Family Survey - 1974: First Country Report, Department of Statistics, Kuala Lumpur, Malaysia, April 1977, Table 6: 2, page 75.

The figures from the MFLS are calculated from retrospectively reported pregnancy histories collected in 1976 and 1977.

[a]Smallest sample size for MFLS numbers if 183.

[b]The MFLS samples for 1970 and 1966/67 contained only women aged 35-43 and 35-39, respectively. See the text for implications.

In making these comparisons, it is important to keep in mind that the underlying samples in our survey (MFLS) are different from corresponding samples in the other surveys. In the first place, women older than 49 at the date of our first interview visit in 1976 were ineligible for the MFLS sample. Hence, our survey contains no women older than 43 in 1970 and none older than 39 in 1966. The result is that our sample of women "aged 35-44" in 1970 and 1966/67 contains only women aged 35-43 and 35-39, respectively.

Another result of this retrospective sample base is that our samples for earlier years obviously contain only women still alive in 1976/1977,

whereas surveys conducted in those earlier years sampled some women who have since died (or left the country). As noted earlier, if the survivors had systematically different fertility histories than their deceased contemporaries, the comparisons in Table 2 will reflect these differences.

Table 2 shows mean number of children ever born to women currently married in the year in question. For each age group, columns 1, 3 and 5 show estimates from the contemporaneous surveys, while columns 2, 4 and 6 contain MFLS estimates calculated for women currently married in the same years. The MFLS estimates are based on our national probability sample, i.e. we exclude women living in the purposely selected PSU's.

Both sets of estimates show similar trends over time, with fertility of the two younger groups falling and fertility of the oldest group rising in the late 1960s and then falling. However, comparison of the numbers for any age group and year indicates systematic differences. For one thing, the MFLS estimates of children ever born are generally lower than the other estimates for the two younger groups and decline less rapidly from 1966/67 to 1974. The first difference may arise from the fact discussed above that our sample includes only women still alive in 1976 or 1977. To the extent that rapid fertility induces high maternal mortality and that poor women have both more children and higher mortality, we would expect our figures for children ever born to lie below those from contemporary surveys.

The second difference probably occurs because of the tendency of respondents to underreport births far in the past. Although all these surveys rely on respondents' retrospective reporting of births, our estimates for women aged 15-24 in 1966-67 are calculated from information given when these women were 25-34 years old (in 1976) rather than when they were ten years younger. This has the effect of reducing our estimates for 1966-67 and to a lesser extent for 1970, causing an underestimate of the extent of decline in mean number of children ever born.

Also note that our sample of older women is actually younger than 35-44 in 1966-67 and 1970. Since this sample of younger women should have a smaller mean number of children ever born than an older sample in the same year, the difference of a half-birth shown in Table 2 for older women in the earlier two years is understated. If the age groups were comparable, our figures would be even higher.

Birth Spacing

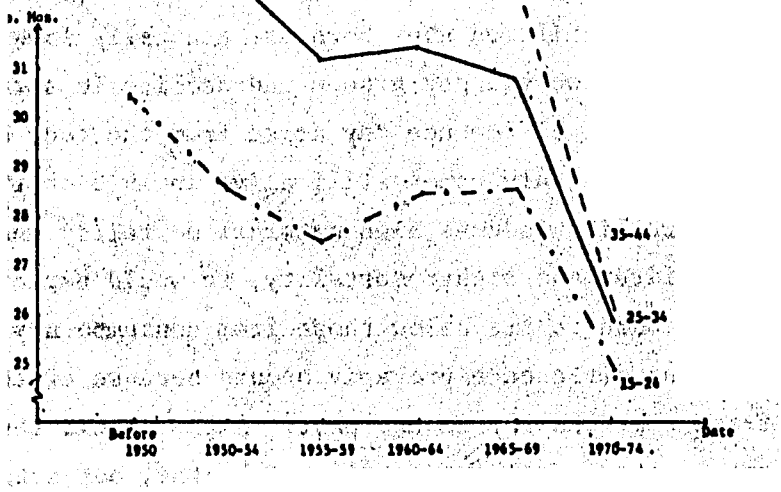
Data in Figure 1 show trends in mean lengths of closed intervals[1] by mother's age. For each time period, the mean length of pregnancy intervals is positively related to mothers' age. For all age groups it has decreased over time. An unknown part of this decrease in probably due to respondents' systematic underreporting of births that occurred far in the past. However, Table 1 shows that calculated fertility rates have fallen over time, in spite of any such underreporting.

Figure 1 and all subsequent ones in this section (except figures 8 and 9) are based on the same data we use in our regression analyses in Section IV. The restrictions used to define this working sample are discussed in Appendix A.

Figure 1

MEAN LENGTH OF CLOSED BIRTH INTERVALS, BY AGE AND DATE

(BIRTH TO NEXT PREGNANCY OUTCOME)



Post-Partum Amenorrhea

Figure 2 shows that the average length of post-partum amenorrhea, the infertile period following a birth, has fallen over the survey reference period for women under age 35,[2] while there has been a slight

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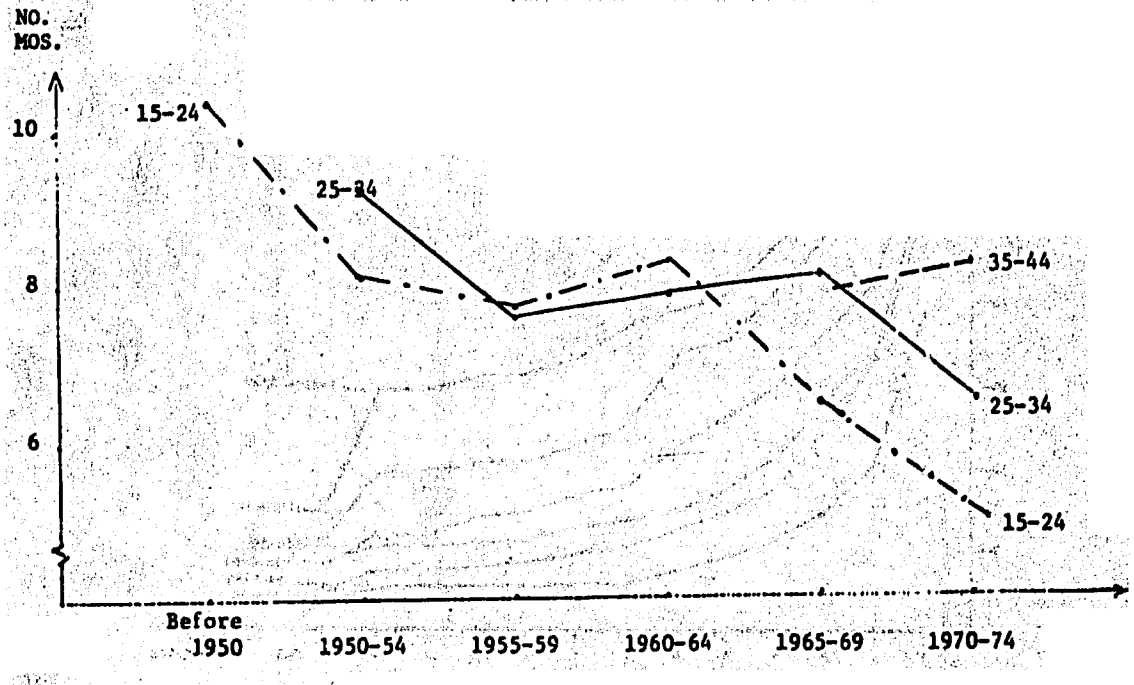
[1] Actually number of months from one live birth to the next pregnancy outcome.

[2] Data on five-year age groups show substantial decreases in the earliest and latest time periods for women under 30 and little variation over time for those aged 30-34.

increase for those over 35. Data on five year age groups show that the drop is largest in the prime childbearing age group, 20-24, where post-partum amenorrhea has decreased from nearly 11 months before 1950 to just over 5 months in 1970-74.

Figure 2

LENGTH OF POST-PARTUM AMENORRHEA BY MOTHER'S AGE AND DATE

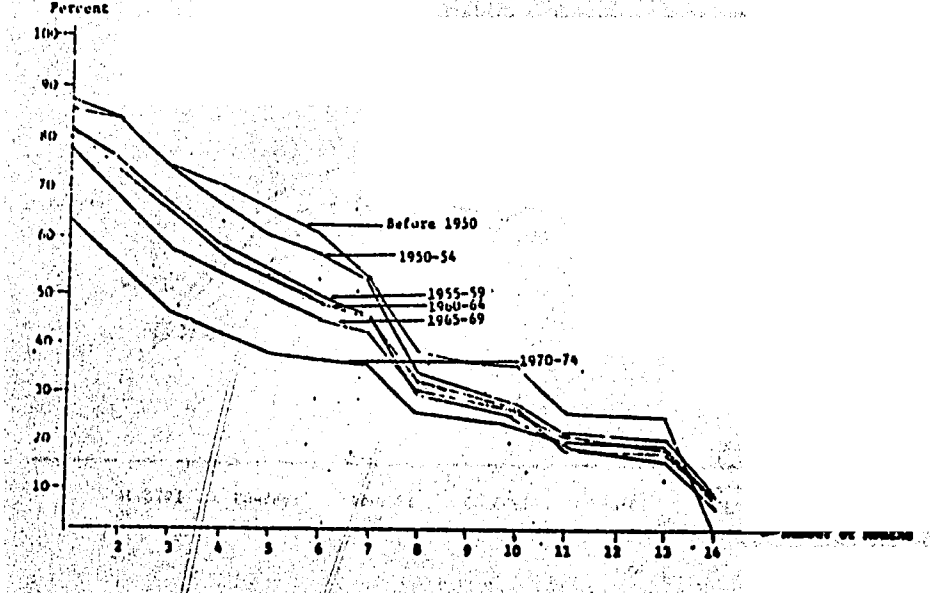


Breastfeeding

Figures 3 and 4 show proportions of children still breastfeeding, and still full-breastfeeding (without supplementation), at successive months of age for six calendar year periods. A long-term decline in

Figure 3

Percent of All Children Still Breastfeeding at Successive Months of Age, by Year of Birth



length of breastfeeding is evident in both Figs., with the largest decline coming since 1970 in Fig. 3. The points at which the curves in Fig. 3 intersect the vertical axis show the proportions of infants who were breastfed at all. This proportion has dropped precipitously--from about 88% in 1950-54 to less than 65% two decades later, with most of the decline occurring in the latter part of the period.

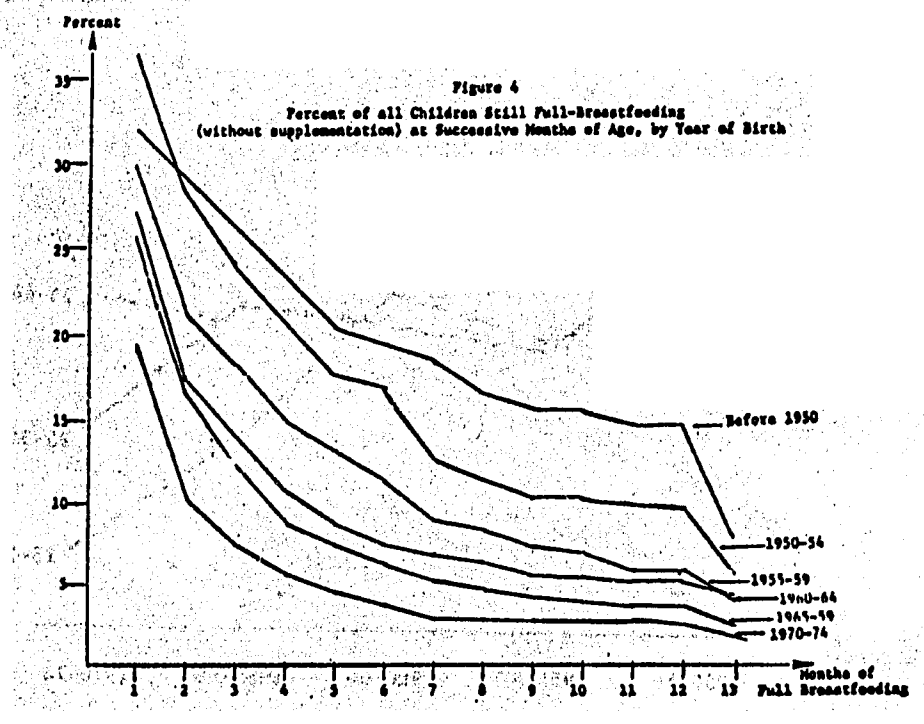
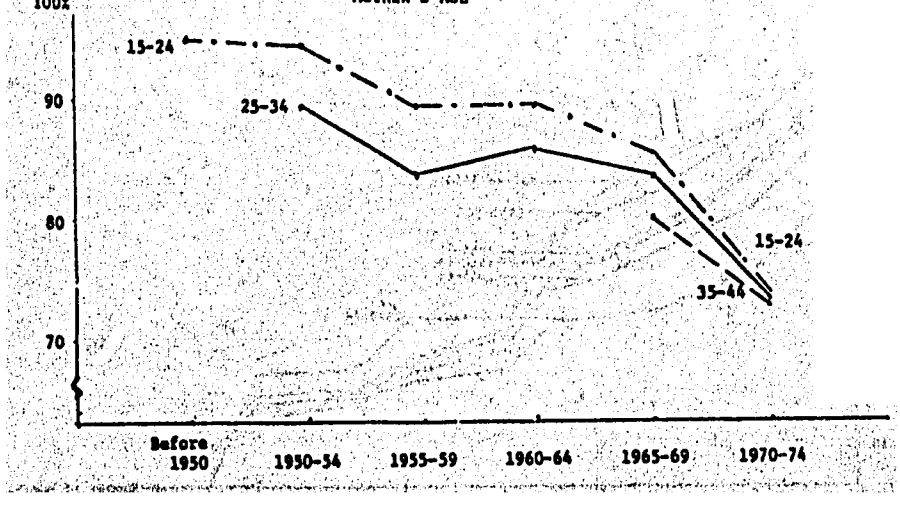


Figure 4
Percent of all Children Still Full-Breastfeeding (without supplementation) at Successive Months of Age, by Year of Birth

Figure 5 shows that the percent of babies breastfed has fallen at all mothers' ages. In each time period, young women are more likely to breastfeed than older ones, though the age differences have become smaller over time. In data not shown here, length of breastfeeding shows the

Figure 5
TRENDS IN PROPORTION OF INFANTS WHO WERE BREASTFED, BY MOTHER'S AGE



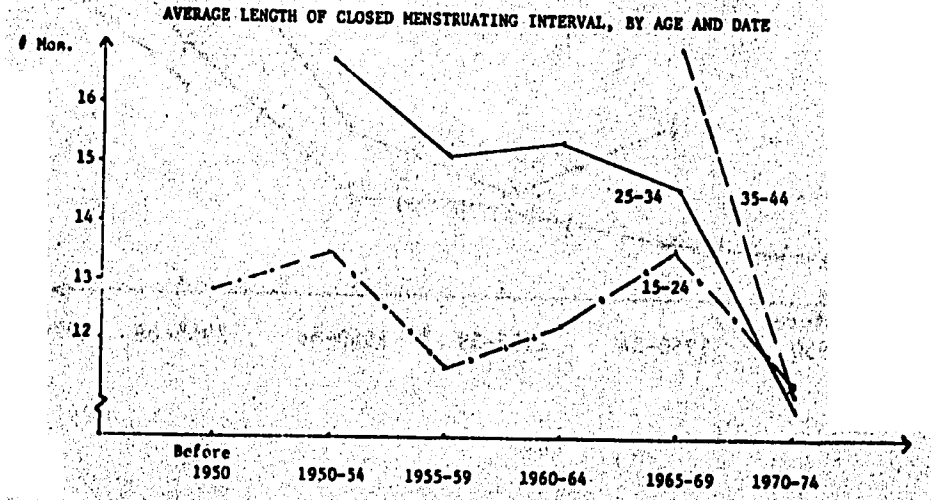
opposite relationship with age: Although fewer older women breastfeed, those who do do so longer than younger women. The differences among age groups have become greater over time. In 1970, women aged 35-44 who breastfed, breastfed 60% longer than women aged 15-24. For women under 25, the group most likely to breastfeed, not only has the percent who breastfed decreased substantially over time, but among the increasingly smaller subset of women who do breastfeed, the average length of lactation has fallen consistently from just over 15 months before 1950 to just over 10 months in 1970-74. The 24-34 age group also shows a marked decline over the survey reference period. Although fewer older women breastfed in the 1970s than in the 1960s, those who do did so for a substantially longer period of time. This may be why average length of post-partum amenorrhea has risen somewhat for this group.

Menstruating Interval

Figure 6 shows trends over time in the length of the other part of the inter-pregnancy interval -- the fertile period, or menstruating interval, during which the woman is at risk to conceive. The patterns shown in Figure 6 very much resemble those in Figure 2 and may arise in part from systematic underreporting of early births. Considering Figures 1, 2 and 6 together, recent declines in average lengths of pregnancy intervals are, at young ages, due to decreases in the lengths of both component parts, post-partum amenorrhea and menstruating intervals, but due only to decreases in the latter at older ages.

Figure 6

AVERAGE LENGTH OF CLOSED MENSTRUATING INTERVAL, BY AGE AND DATE



Contraceptive Use

An important determinant of the length of the at-risk interval is whether the couple did anything to reduce the chance the woman would become pregnant.

Figure 7 indicates that contraceptive usage rates have generally increased over time for all age groups. In all time periods before 1970, 25-34-year-old women, who are beginning to stop childbearing, exhibit higher usage rates than younger or older women. Similar patterns occur for usage rates of modern contraceptives. Data on 5-year age groups show that 25-29-year-old women are the most frequent users of contraceptives, and since 1965 the most frequent users of modern contraceptives. This is consistent with the evidence in Table 1 that 25-29 year-old fertility rates exhibited the greatest decrease over the survey reference period.

Figure 7

PERCENT OF BIRTH INTERVALS IN WHICH SOME CONTRACEPTIVE (OTHER THAN BREASTFEEDING) WAS USED, BY AGE AND DATE

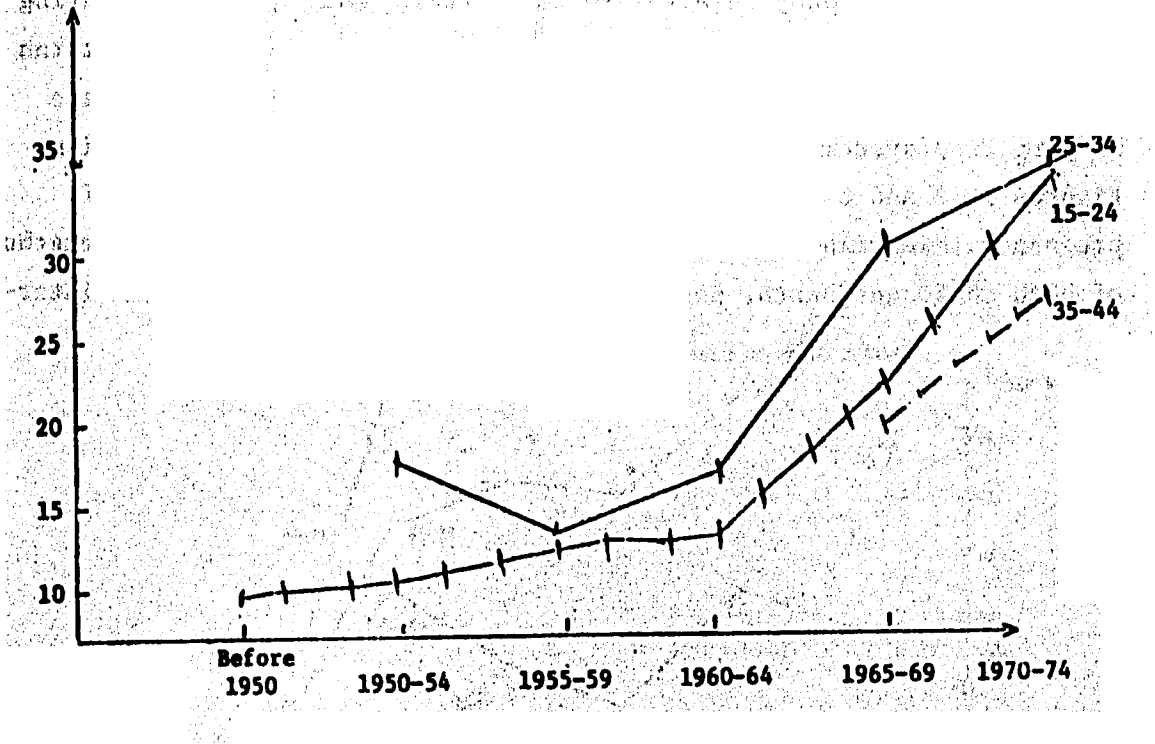
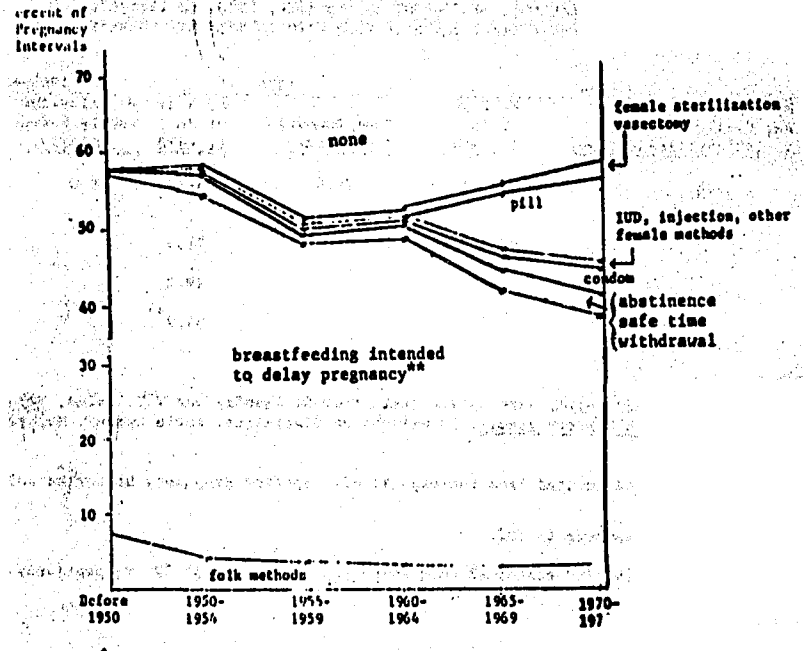


Figure 8 shows that all the increase in contraceptive usage since the early 1960s has been in use of modern methods, especially the pill. Use of folk methods and intentional use of breastfeeding to delay a birth have steadily declined.[1] The net result is a decreasing proportion of birth intervals that were intentionally protected until the late 1950s, and a steady increase thereafter.

Figure 8

Types of Contraceptives Used, By Year*

(Proportion of pregnancy intervals in which a contraceptive method was used)



*The sample for this figure includes intervals in which contraceptives are being used at the time of the interview, and hence, unlike our working sample (see Appendix B), includes vasectomies and hysterectomies.

**Breastfeeding is included in this figure only if the mother reported using it in the interval in order to delay the next pregnancy.

Table 3 gives the percent of currently married women in our MFLS sample who had ever used contraceptives (excluding breastfeeding) by 1966, 1970 and 1974. As in Table 2, we compare our estimates from retrospective data with numbers from three other surveys. Our estimates show a far less dramatic, though still substantial, rise over time in the percent of women who had ever used a contraceptive. Although we have not yet compared the four survey instruments, we suspect

[1] There is reason to suspect that some survey respondents reported breastfeeding to delay the next pregnancy when they had breastfed for any reason. Future analysis will investigate this possibility. Since, we have no reason to think that the extent of such mis-reporting changed over time, the trends pictured in Figure 8 are probably unaffected. Instead, only the height of the breastfeeding line and the lines above it may be too high in all periods.

that this difference occurs because the three other surveys underrecorded use of traditional contraceptive methods. Later in this paper we show that some such methods have been widely used and have been effective in delaying pregnancy. If the other surveys underrecorded their use, they would show a larger increase in use of any contraceptive during this period when modern contraceptive use spread rapidly.

Table 3

PERCENTAGE OF CURRENTLY MARRIED WOMEN WHO HAD EVER USED CONTRACEPTION (EXCLUDING BREASTFEEDING), BY CURRENT AGE IN 1974, 1970 and 1966/67: COMPARISON OF RETROSPECTIVELY REPORTED DATA WITH INDEPENDENT SURVEYS*

	1974		1970		1966-67	
Current Age:	Malaysian Fertility and Family Survey (World Fertility Survey)	MFLS as of July 1, 1974	Post Enumeration Survey	MFLS as of July 1, 1970	W. Malaysian Family Survey 1966/67	MFLS as of Dec. 31, 1966
All Women 15-44	39.8	43.1	26.9	34.0**	14.0	24.4**
15-24		28.6		21.3		14.6
25-34		50.7		39.2		29.3
35-44		41.7		34.9**		26.7**

Sources: The figures from independent surveys are taken from R. Chander and V.T. Palan, Malaysian Fertility and Family Survey - 1974: First Country Report, Department of Statistics, Kuala Lumpur, Malaysia, April 1977, Table 6: 2, page 75.

The figures from the MFLS are calculated from retrospectively reported pregnancy histories collected in 1976 and 1977.

*Smallest sample size for MFLS numbers is 183.

**The MFLS samples for 1970 and 1966/67 contained only women aged 35-43 and 35-39, respectively. See the text for implications.

Our data by age groups show the middle group to be the largest user in each year. However, the youngest group has experienced the largest increase over time.

Summary

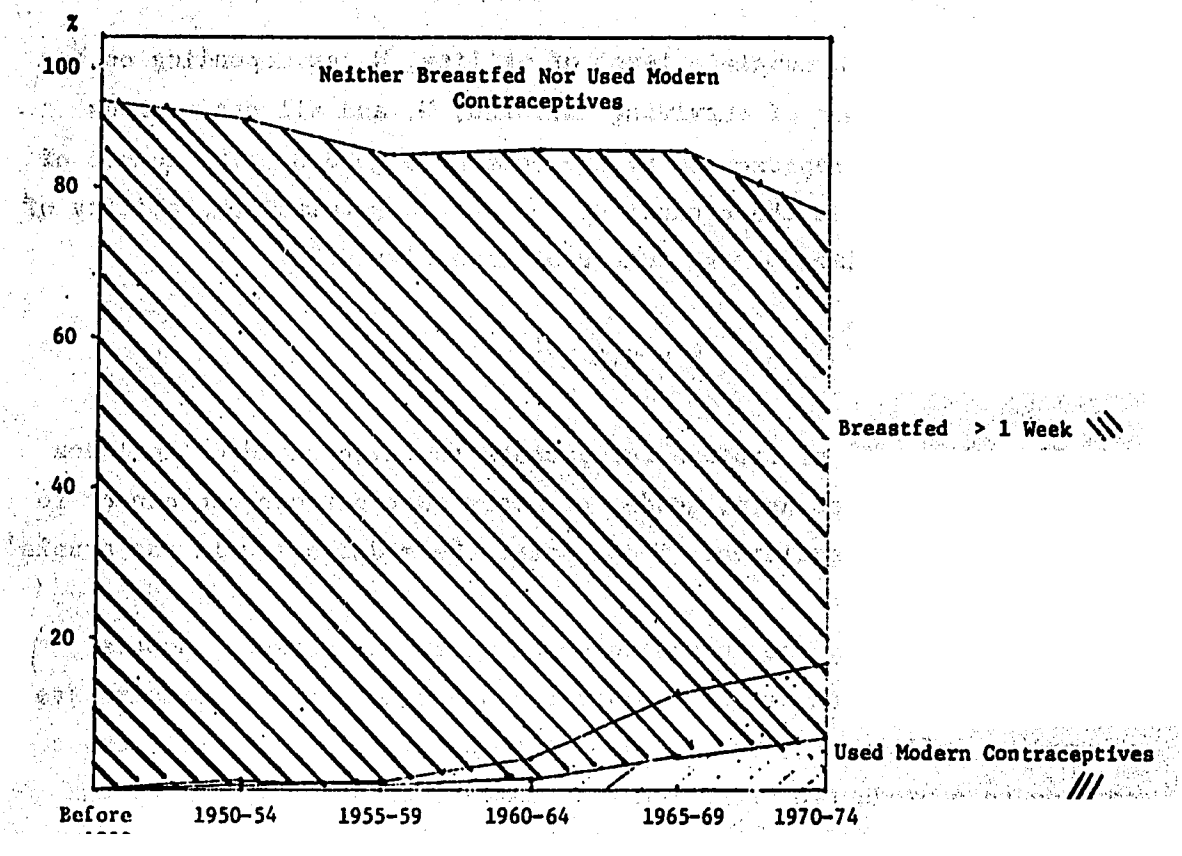
Despite the increased usage of contraceptives, Figure 6 indicated that lengths of closed menstruating intervals have generally fallen over time.[1] Length of the other part of the pregnancy interval -- postpartum amenorrhea -- has also fallen over time for younger women, proably due to sizeable decreases in the likelihood of breastfeeding and in the length of breastfeeding among those who do breastfeed.

[1]This may occur because most of the increasing contraceptive use has been in open intervals or because retrospective reporting bias might differentially affect trends in menstruating intervals and in contraceptive use. We discuss these possibilities below.

As a final note, Fig. 9 illustrates the simultaneous trends in breastfeeding (for any purpose) and contraceptive use. Although the percentage of all pregnancy intervals in which modern contraceptives were used has risen, the use of breastfeeding by women who do not use modern contraceptives has fallen even faster, the net result being a consistent increase over time in the proportion of birth intervals during which women were not protected by either breastfeeding or a modern contraceptive

Figure 9

Trends in Breastfeeding and Use of Modern Contraceptives
(Proportion of pregnancy intervals in which each was done)



We now turn to a model of family behavior and a series of regression analyses focused on understanding the reasons for these trends and variations.

III. A CONCEPTUAL MODEL

In two other papers[1] we develop a comparative static model of family behavior regarding breastfeeding, contraceptive use and birth-spacing. Since testing most of the model's predictions is beyond the scope of this paper, it suffices here to describe the model's structure in order to focus the discussion of regression results to follow.

Parents are assumed to value surviving children for two sets of reasons. In one set are whatever personal, familial and social factors that induce people to have children. These can be represented in a utility function

$$U = u(N, G) \tag{1}$$

that characterizes a couple's level of utility, U, as depending on two arguments: the number of surviving children, N, and all other goods valued by couples, represented by the composite good G. The number of surviving children is the product of the common survival probability of the children, S, times B, the number of live births.[2]

$$N = S.B \tag{2}$$

The other set of reasons for parents to value children includes whatever transfers of help, goods, or money that parents can expect to receive from their children. These enter the model below in the couple's budget constraint.

Couples can buy the composite good, G, in the market. However, both S and B are products of activities in the household. Couples are assumed to influence S, the survival probability of their children, according to a production function that summarizes both biological and behavioral relationships:

---

[1] W.P. Butz (1978a, 1978b)

[2] We assume that all a couple's children have the same probability of surviving to, say, age 20, and that survival is the only attribute of children, other than their economic transfers, that interests parents. Relaxing the first restriction to allow different survival probabilities, for example by parity or sex, would complicate the model considerably. Relaxing the second restriction is not bothersome. We need only suppose

(3) $$S = \alpha(L, T_s, T_o, E_W, H)$$

The inputs are:

L = length of breastfeeding

T_s = amount of time the wife spends with a child (apart from time spent breastfeeding)

T_o = the amount of others' time spent with a child

E_W = education of the wife

H = purchased food and medical care for children,

all of whose marginal products are assumed positive.

The determination of B, number of live births, is less easily characterized. Because we wish to investigate relationships involving birthspacing, it is useful to posit a simple relationship between the number of live births, the length of time the woman is married between menarche and menopause, F, and the average length of closed birth interval, I:

(4) $$F/(B-1) \equiv I.$$ [1]

F is the woman's age at menopause minus her age at first marriage (or first union) minus the number of years of marital separation, divorce of widowhood. One could posit equations explaining each of these variables. Since our interest here is in other matters, we assume instead that F is determined exogenously.[2] In its simplicity,

(footnote continued)

that S is a scale that increases monotonically with whatever combination of attributes, including survival, couples are assumed to value in their children. Such a scale can be thought of as the "child quality" concept in the household production literature on fertility. One might then add several additional inputs to the production function in expression (3).

[1] Hence, if a woman is at risk of pregnancy for 20 years and has 5 live births, her average closed birth interval lasts 5 years; if she has eight live births, the average closed birth interval is less than 3 years.

[2] To the extent that age at marriage, age at menopause, and years without a husband present are functions of variables in the model--such as the woman's wage, schooling, or nutritional and health status--coefficient estimates in regressions that assume F to be exogenous may be biased.

expression (3) also removes other interesting issues from the model's domain, notably the couple's opportunity to compress its births into a small portion of the woman's fertile and married years.[1]

However, our primary interest is in the determinants of I, the average birth interval. It consists of three additive parts, the length of post-partum infertility or amenorrhea, (or more accurately, annovulation) A, the length of the menstruating interval, M, and the term of the pregnancy that closes the interval, D:

$$I \equiv A + M + D. \tag{5}$$

We assume D to be exogenous. As with S above, both A and M are influenced by the couple's activities. A depends positively on the mother's length and intensity of lactation after the child's birth, L, and negatively on her health and nutritional status, H_W. The biological relationships that connect these variables can be summarized in a production function,

$$A = \beta(L, H_W). \tag{6}$$

Lactation depends, in turn, on how much time the wife spends breastfeeding, T_L, and on her health and nutritional status, H_W:

$$L = \gamma(T_L, H_W), \tag{7}$$

where both marginal products are assumed positive. These relationships are also biological.

The other component of the birth interval is length of the menstruating interval, M, during which the woman is at risk of becoming pregnant. M depends positively on the effectiveness and length of contraceptive methods used, which we summarize for simplicity in one

[1]With an increasing supply of modern contraceptives, women may closely space their children to conserve their time in childbearing, knowing that they can later contracept effectively. Likewise, higher wage women may also compress their childbearing into fewer years, so as to lessen their time out of the labor market.

variable, C, on the wife's education, E_W, which may influence the effectiveness with which she uses contraceptives, and on the length of time she and her husband are separated in the birth interval, K.[1] M depends negatively on her health and nutritional status, H_W, to the extent these affect her fecundity. We represent these relationships in another production function:

$$M = \delta(C, E_W, H_W, K). \tag{8}$$

Expressions 3, 6, 7 and 8 embody the technical possibilities at the couple's disposal for bearing and rearing the number of surviving children they desire. These possibilities are constrained both biologically, as in the relationship between the wife's lactation and amenorrhea, and behaviorally, as in the relationship between her education and length of menstruating interval.

In addition to these constraints, the couple also faces a budget constraint that limits their expenditures of income and time to the amounts available. They are assumed to distribute their income among the goods available for purchase: food and medical care for children, H, at price P_H; contraceptives, C, at price P_C; and all other goods and services, G, at price P_G. The wife is assumed to distribute her available waking hours, T, among breastfeeding, T_L, other child care, T_S, and work for income, T_W.[2] How the husband spends his time is assumed important only as it affects the couple's income. This family income comes from three sources. One is the time the wife spends working, T_W, for which she earns a wage, W_W. Another is the help, goods or money that parents receive from children, represented as W_N per child over his or her lifetime. The third, Y, includes all other sources including the husband's earnings, returns on assets and transfer payments. These time and income allocations can be represented in a full wealth constraint that equates expenditures of time and money to the amount of wealth available:

---

[1] If separation takes place primarily for the purpose of preventing conception, one might include it in C.

[2] We assume that all women have the same number of "available waking hours," and hence that the combined time spent sleeping and other pursuits, including leisure, is the same for all.

$$(9) \qquad H \cdot P_H + C \cdot P_C + G \cdot P_G + T_S \cdot W_W + T_L \cdot W_W = T \cdot W_W + N \cdot W_N + Y$$

where $T = T_S + T_L + T_W$.[1]

We derive testable implications from this structure by assuming that couples maximize their utility function

$$(1) \qquad U = u(N, G)$$

subject to the set of household production functions,

$$(3) \qquad S = \alpha(L, T_S, T_O, E_W, H)$$

$$(6) \qquad A = \beta(L, H_W)$$

$$(7) \qquad L = \gamma(T_L, H_W)$$

$$(8) \qquad M = \delta(C, E_W, H_W, K),$$

subject to a budget constraint,

$$(9) \qquad H \cdot P_H + C \cdot P_C + G \cdot P_G + T_S \cdot W_W + T_L \cdot W_W = T \cdot W_W + N \cdot W_N + Y,$$

and subject to identities,

$$(2) \qquad N \equiv S \cdot B$$

$$(4) \qquad F/(B-1) \equiv I \text{ and}$$

$$(5) \qquad I \equiv A + M + D.$$

One can think of this structure as generating a demand for and a supply of surviving children within the household. The demand has two sources: economic returns that raise family income, and utility returns to parents. The supply of surviving children also has two sources: number of live births to the couple and the probability that an infant will survive to a particular age. Parents can influence this survival probability by adjusting how much attention they give their children, how long they breastfeed them, and how much food and medical care they give them. Given the available technology, the same survival

[1] Alternatively, $H \cdot P_H + C \cdot P_C + G \cdot P_G = T_W \cdot W_W + N \cdot W_N + Y$.

probability can be had by decreasing some of these inputs as long as one or more others are increased. The optimization process implies that couples make these substitutions in response to changes in the relative costs of breastfeeding, medical care, food and the wife's time.

In contrast to survival, which must be produced using scarce resources, this model assumes that live births occur costlessly, given the wife's health and nutritional status.[1] Rather than expend resources to produce infants, we assume that couples must expend resources to avoid them. Given a desired number of surviving children and a particular probability of child survival, the couple can achieve its resulting desired number of births and the implied average birth interval by adjusting either the length of post-partum amenorrhea or the length of the menstruating interval.[2] Since the sum of these two quanities (plus the exogenously determined duration of pregnancy) equals the birth interval, they are perfect substitutes for each other in determining the number of live births. Hence, lactation and contraception are also substitutes, though not in general perfect ones; the optimization process implies that couples also adjust the amounts of lactation and contraception in response to changes in their relative costs.

Note also that number of live births is influenced by these supply-side factors quite apart from the couple's demand for surviving children. For example, separation from husband tends to lengthen the menstruating interval, whether it occurs to avoid pregnancy or for any other reason. In addition, women of lower health and nutritional status are expected to experience longer amenorrhea and longer menstruating intervals unless they compensate by breastfeeding less or contracepting less. Finally, wives whose time breastfeeding is more costly may breastfeed less and, therefore, have more live births,

[1]Alternatively, we could assume conceptions to occur costlessly; and S to represent the probability that a conception results in a child who lives to some arbitrary age.

[2]The number of births that "occur costlessly" is the biological maximum for the period the wife is fecund, assuming no lactation or other contraception. Since societies in which many couples desire

quite apart from any change in their demand for children.[1]

In the papers cited above, we investigate the comparative static properties of this household model. Assuming that the four household production functions are linear homogeneous, we derive reduced form expressions for the endogenous variables of principal interest: number of live births, N; child survival probability, S; post-partum amenorrhea, A; menstruating interval, M; length of breastfeeding, L; and contraceptive use, C. These expressions relate log differentials of the dependent variables to log differentials of the variables we take as exogenous: prices (availabilities) of purchased food and medical care for children, P_H, contraceptives, P_C, and other goods and services, P_G; wife's wage, W_W; help received from each surviving child, W_N; other income, Y; wife's health and nutritional status, H_W; wife's education, E_W; length of period at risk of pregnancy, F; amount of time spent with the child by persons other than the mother T_O; and extent of spouse separation in the birth interval, K. The coefficients for these variables are themselves functions of (i) consumption and production elasticities, (ii) the relative shares of

(footnote continued)
more births than the biological maximum are not known, we ignore this possibility.

[1]These factors are sometimes classed together as the determinants of "natural fertility." This term refers to the number of births that occur in the absence of any practices intended to restrict fertility. Even if women in some society breastfeed for months, refrain from coitus during certain periods, and live apart from their husbands at other times, the society may be called a natural fertility population if investigators conclude that these practices are undertaken for purposes other than fertility regulation.

Seen in the context of this model, the concept of natural fertility has little interest. To the extent that people's breastfeeding, coital frequency and cohabitation resond systematically to changes in the costs and returns of these behaviors, their fertility also responds systematically. Hence, fertility variations in a "natural fertility" population should be no less predictable than in any other, once both the demand for children, as we describe it here, and the supply are adequately understood. For the same reason, there is no inherent difficulty in formulating public policy to change fertility when it is contrained more by supply than by demand considerations, though the policies may differ considerably.

the factors in their production functions, and (iii) the relative shares of the values of mother's time and each purchased good in full wealth.

These reduced form equations indicate the change in a dependent variable expected to result from specified changes in any or all of the exogenous variables. The expression for contraceptive use, for example, shows that its demand is derived from the couple's demand for surviving children. In equilibrium, couples' contraceptive use is influenced by the determinants of that demand and by, among other things, the price of contraceptives and the determinants of the cost of their principal substitute, breastfeeding. Similarly, the demand for breastfeeding arises from its value in reducing the number of live births and in increasing child survival probabilities. Breastfeeding time is determined principally by the factors that influence this demand and by the costs of breastfeeding and of its substitutes, contraceptives and children's food and medical care.

Few universal predictions arise from this model. Fortunately, though, a number of predictions result from differences in the usual magnitudes of particular elasticities and relative shares in different settings, e.g., in urban vs. rural areas. The regression analyses in the next section are preliminary to tests of most of these predictions, so we are content here with only a short list of expectations that are tested below:[1]

Determinants of Post-partum Amenorrhea. Clinical and field studies point unambiguously to a positive effect of breastfeeding, especially full (unsupplemented) breastfeeding, on the length of amenorrhea.

Women of higher health and nutritional status and lower parity should exhibit shorter post-partum amenorrhea, since their reporductive systems should recover faster following pregnancy.

Determinants of Breastfeeding. The price of contraceptives and of infant foods and medical care should be positively related to the tendency to breastfeed and the length of breastfeeding. Stated in another way,

[1] We omit descriptions of the certeris paribus conditions for these expectations, as well as mention of possible reversals under empirically unlikely conditions. Readers interested in these details are referred to Butz (1978a, 1978b).

increased availability of these substitutes for breastfeeding should tend to reduce breastfeeding.

Both biomedical and behavioral links in the model point to a positive association between the mother's health and nutritional status and her breastfeeding.

Though the model contains the possibility of a reversal, the cost of the mother's time should be negatively associated with breastfeeding in most circumstances.[1]

Determinants of the Menstruating Interval. Length of menstruating interval should be positively associated with length of contraceptive use.

Length of menstruating interval should be positively associated with wife's education, since it is hypothesized to influence contraceptive effectiveness.

Length of menstruating interval should be positively associated with extent of separation from husband.

Length of menstruating interval should be negatively associated with the wife's health and nutritional status, since these may be positively related to fecundity.

Depterminants of Contraceptive Use. The price (availability) of contraceptives should be negatively (positively) associated with contraceptive use.

The responsiveness of contraceptive use to the price (availability) of infant foods should be negative (positive), since a higher price induces women to breastfeed more and, therefore, require contraceptives less.

The extent of separation from spouse should be negatively related to contraceptive use, since these two are substitutes in lengthening the menstruating interval.[2]

[1]The reversal can arise because women with higher time costs demand fewer children, other things equal, and thus have an incentive to use contraception, of which breastfeeding is one type.

[2]The relationships between the cost of the wife's time and contraceptive use are complex in this model. Testing the hypotheses that emerge from assumptions about patterns of elasticities and weights is beyond the scope of this paper.

The usual distinction between biological and behavioral factors in fertility determination is missing from this model. Instead, specific factors of each type appear as influences on either the supply of or demand for breastfeeding, contraception, and surviving children. The resulting system recognizes that program and community factors can influence biological processes both directly (as in the effect of a cleaner water supply on child mortality) and indirectly (as in the effect of increased contraceptive supply on fertility). An implication is that studying biological or behavioral factors in isolation can have serious statistical drawbacks.

IV. REGRESSION RESULTS

We now discuss ordinary least squares regression results that bear on some hypotheses of the model, as well as on other hypotheses advanced in the literature. Since these regressions use a preliminary working sample from only a small portion of our data, test maily the more obvious hypotheses, and do so in a simple (and at points not most appropriate) statistical framework, they should be regarded as quite preliminary.

The regressions for length of postpartum amenorrhea and length of menstruating interval are structural specifications, similar to expressions (6) and (8) above. The other regressions are mixed structural/reduced form equations that include community-level variables that reflect the supplies of medical care, contraceptives, and infant foods.[1] The variables used in these regressions are defined, along with their sample means and standard deviations, in Appendix D.

Postpartum Amenorrhea

Women in our sample rep[illegible] rtum amenorrhea of 7-1/2 months. Since this is over a third of their average interpregnancy interval, it is clearly an important component of birth spacing. Figure 2 showed that average length of amenorrhea for 15- to 24-year-olds, the highest fertility group, has halved between the 1940s and the early 1970s. Without the substitution of contracepting methods to lengthen the menstruating interval, this loss of five months of amenorrheic protection would have reduced the average length of birth interval in this group by about one-fourth. Hence, the importance of understanding the determinants of length of postpartum amenorrhea is clear.

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[1]Though these community-level variables are certainly more nearly exogenous to family members' behavior than are variables that describe members' characteristics or activities, they are in general not completely exogenous. For example, communities with a high demand for contraceptives are more likely to have contraceptives sold in their stores and probably to have a public family planning clinic. In addition, couples interested in limiting their family size may move to communities in which modern contraceptive services are available.

The relationship of lactation to length of birth intervals has long been suspected (probably much longer by mothers than by scientists) But only in the last 15 years has evidence begun to establish that the relationship is with length of post-partum amenorrhea and not mainly or entirely due to cultural taboos on sexual intercourse during lactation. Table 4 shows a very strong empirical relationship between length of lactation and length of postpartum amenorrhea in our data. The coef-

Table 4

AMENORRHEA LENGTH (MOS.) REGRESSIONS (n=4067)
(t-statistics in parentheses)

	(1)		(3)
Length of Breastfeeding (mos.)	.382 (39.92)		
Length of Full Breast-feeding (mos.)		.480 (20.29)	.467 (19.66)
Length of Partial Breast-feeding (mos.)		.370 (37.21)	.347 (33.05)
House Sanitation Index			-.314 (-4.93)
Distance to Nearest Dr. or Hospital			.0417 (1.62)
Age of Mother			.0001 (0.00)
Parity			.177 (2.86)
Calendar Year			-.0415 (-2.52)
Intercept	3.479 (23.86)	3.419 (23.45)	6.210 (6.32)
R^2	.282	.286	.297

ficient estimates in column (1) indicate that on average one month of breastfeeding time is associated with about 11 days of amenorrhea and that the average amenorrhea following a live birth in the absence of breastfeeding lasts about 3-1/2 months. An implication is that 12 months of breastfeeding lengthen this time to 8 months.[1]

[1]Other studies indicate that the association between lactation and amenorrhea eventually weakens as lactation lengthens. Few women in most populations remain amenorrheic for more than 18 months following a birth no matter how long they lactate. We do not investigate these nonlinearities in this preliminary analysis.

Table 5 indicates that these regression coefficients are similar to those from other studies that investigated the relationship between length of postpartum amenorrhea and length of breastfeeding.[1] The slope coefficient of .38 in the Malaysian data is equal to the mean of

Table 5

ASSOCIATION OF LACTATION AND AMENORRHEA IN FIVE STUDIES[2] (IMPLIED COEFFICIENTS FROM REGRESSION OF AMENORRHEA ON LACTATION LENGTH)

Country	Slope	Intercept
Colombia	.35	7 weeks
Thailand	.40	10 weeks
South Korea	.30	14 weeks
Taiwan	.45	16 weeks
Malaysia (this study)	.38	15 weeks

implied coefficients from the other studies, while our intercept estimate is near the high end (but consistent with the other Asian studies). Pierotti (1969) reported return of menstruation to nonlactating mothers in 6 to 10 weeks in a number of studies in industrialized countries, and Osteria (1978) found that menstruation returned to nearly half of nonlactating women within the first month postpartum in a sample of Philippine women who delivered in a Manila hospital. That these studies indicate faster resumption of menses that the figures from less-developed countries shown in Table 5 may reflect differences in average maternal

[1] This similarity is remarkable since the other studies used prospective data, while our sample includes retrospectively reported information from as long as 30 years before the interview. We have not adjusted the breastfeeding or amenorrhea data for age-heaping and other problems that frequently occur in retrospective data on these variables. (see Lesthaeghe and Page (1978) for an excellent discussion of these problems.) Though our data seem well behaved without such adjustments, we will investigate these possibilities in future work.

[2] The coefficients for all countries except Malaysia are estimated from Van Ginnekan (1978), Figure 5, p. 190. The data in that figure are from Van Ginnekan (1974), p. 201, for Colombia and Thailand; from Kwon, *et.al.* (1972) for S. Korea; and from Jain, *et.al.* (1970), p. 262. for Taiwan.

nutrition and health.[1] We return below to a discussion of nutrition and health effects on amenorrhea.

The second regression in Table 4 shows the association between full and partial breastfeeding separately, and postpartum amenorrhea. It suggests that full lactation is significantly more effective in prolonging amenorrhea than is partial (supplemented) lactation. Other studies have also found that menstruation returns much sooner in women who give their infants supplementary foods, holding constant length of lactation.[2] Tyson and Perez (1978) and others are establishing the biochemical mechanism underlying the observed empirical relationship. In essence, suckling causes the release of prolactin in the mother. Prolactin facilitates milk production and inhibits the release of gonadotrophins which initiate resumption of the menstrual cycle. Although this process may contain thresholds and nonlinearities, the more intense is suckling, the less likely in general that menstruation will resume. Hence, there is an important distinction between full breastfeeding and breastfeeding accompanied by supplementary food or water.

Since our sample contains observations ranging over about 30 calendar years and all parities and relevant ages of women, we partial out the effects of these variables in regression (3). Other studies have reported positive correlations between age and amenorrhea and between parity and amenorrhea, with the age relationship usually stronger.[3] With a much larger sample, our data show the dominant relationship to be with parity, with an additional birth yielding an average of over 5 days of additional amenorrhea. This suggests that the reproductive system may require longer to recover after several births, though the high sample collinearity between age and parity calls for caustion in interpreting the difference between their coefficient estimates.

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[1] Most women in Osteria's Philippine sample had at least some high school education and may, therefore, have nutritional and health characteristics more similar to women in industrialized countries.

[2] Perez, et al. (1972); Chen, et al. (1974).

[3] Jain, A., et al. (1970); R.G. Potter (1963); Potter, et al. (1965).

The calendar year effect is also statistically significant, implying a decline in average length of postpartum amenorrhea of one month between 1950 and 1974, independent of changes associated with other variables in the regression. One reason why this decline may have occurred is improving maternal health and nutrition. The house sanitation index and distance to nearest doctor or hospital in 1976 are included in regression (3) to capture the effects of change and variations in these factors. Although these two variables are certainly crude proxies, their coefficient estimates do have appropriate signs: women living in homes with more sanitary characteristics and in close proximity to medical care tend to begin menstruation sooner following a birth, other things equal.[1] Though the calendar year effect is significant with these other variables entered in regression (3), its magnitude is larger (-.0499 with t-statistic of -3.04) in another regression that excluded the nutrition and health proxies. Hence, part of the observed decline in amenorrhea appears due to health and/or nutrition improvements; if better proxies for these improvements were available, the estimated calendar year effect in regression (3) might be further reduced.[2]

Finally, it is important to reiterate that the regressions in Table 5 indicate that lactation affects birthspacing through its relationship with amenorrhea. Alternative mechanisms such as intercourse taboos during lactation or behavioral replacement of a child who died while nursing[3] may exist, but they would emerge in variations in the length of the menstruating interval, not in amenorrhea.

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[1] Only a few studies present direct evidence concerning this relationship. See Frish(1975); Jelliffe and Jelliffe(1972); Delagdo et.al.(1978); and Huffman, Chowdhury and Sykes(1978)

[2] Jain, et.al.(1970) found negative but generally insignificant partial correlations between lactation length, on the one hand, and urban residence and education, on the other. These relations also exist in our data, but are dominated by the more specific proxies entered in regression(3)

[3] See Knodel and Van de Walle(1967), pp. 112-114, for evidence that this child mortality effect dominates the lactation-birthspacing relationship in historical Bavarian data.

Breastfeeding

Table 6 shows estimated regression coefficients for variables that infludence breastfeeding and, hence indirectly affect post-partum amenorrhea and birthspacing. The dependent variables reflect four aspects of breastfeeding: (1) whether the child was breastfed, and among those who breastfed, (2) total number of months of breast-feeding, and its two subparts, (3) number of months of full breast-feeding (with no other food or drink, including water), and (4) number of months of partial (supplemented) breastfeeding.[1]

We first look for evidence concerning the hypothesized relation-ships between breastfeeding and the opportunity cost of mothers' time. Since breastfeeding is a time-intensive activity that cannot be easily combined with many types of labor market jobs, women who can earn high salaries or who live in areas with high labor demand are expected to breastfeed less. Popkin (1978) found generally nega-tive partial associations of breastfeeding variables with women's work participation in his regressions on a sample of rural women in the Philippines. Other studies have looked at relationships with urbanization and socioeconomic status, rather than with the more specific characteristics of women's work and communities that we ex-amine.

In this preliminary analysis, we account for job-related factors using five variables that refer to the last job the woman held in the two years prior to the child's birth. Though these variables cannot necessarily be assumed exogenous to current behavior, their coeffi-cients can, nevertheless, provide a weak test of the hypotheses. A dummy variable representing that the woman was employed in the previous two years is the most important work-related variable. Women

[1]We also eastimated a Tobit regression of total months breast-fed that shows no important differences from the corresponding OLS regression.

BREASTFEEDING REGRESSIONS*

(t-statistics in parentheses)

Dependent Variable:	Whether Breastfed (Dummy=1 if Breastfed) [n = 4067] (1)	Length Breastfeeding for Children Who Breastfed [n = 3319] (2)	Length Full Breastfeeding for Children Who Breastfed [n = 3319] (3)	Length Partial Breastfeeding for Children Who Breastfed [n = 3319] (4)
Explanatory Variables:				
Characteristics of Mother's Last Job Within 2 Yrs. Before Pregnancy				
Outcome:				
Wife Employed Within 2 Yrs.	-.0699 (-3.05)	-4.310 (-5.47)	-.863 (-2.36)	-3.504 (-4.50)
Earnings	-.0001 (-0.39)	.0013 (0.15)	-.0019 (-0.50)	.0031 (0.38)
Distance to Work	.0236 (2.36)	.270 (0.78)	-.195 (-1.21)	.446 (1.36)
Self-employed	.0151 (0.82)	.857 (1.39)	.192 (0.67)	.678 (1.11)
Agricultural Occupation	.0598 (3.12)	2.605 (3.94)	-.0068 (-0.02)	2.622 (4.02)
Schooling of Mother	.0004 (0.20)	-.121 (-1.58)	.0449 (1.27)	-.158 (-2.09)
House Quality Index	-.0162 (-7.35)	-.471 (-6.20)	-.0126 (-0.36)	-.450 (-6.00)
Birthweight of Child	.0133 (2.97)	.882 (5.65)	-.0246 (-0.34)	.905 (5.87)
Distance to Family Planning Clinic in 1977	.0018 (0.53)	-.328 (-2.94)	-.0036 (-0.07)	-.327 (-2.97)
Distance to Family Planning Clinic*1970-74 Dummy	-.0127 (-1.65)	-.229 (-0.77)	.0369 (0.27)	.275 (0.94)
Contraceptives Sold in PSU in 1977	-.0406 (-2.62)	-3.121 (-10.08)	-.492 (-2.09)	.637 (9.24)
Contraceptives Sold in PSU* 1970-74 Dummy	-.0662 (-1.88)	1.122 (0.92)	.228 (0.40)	.757 (0.63)
Contraceptives Sold Within 3 Mi. of PSU in 1977	-.0608 (-2.81)	2.859 -3.96)	2.262 (6.75)	.160 7.24)
Contraceptives Sold Within 3 Mi.* 1970-74 Dummy	-.0954 (-2.12)	1.843 -1.14)	-.721 (-0.96	.168 0.73)
No. Infant Foods Sold in PSU in 1977	-.0135 (-4.00)	-.362 (-3.27	.246 (4.79	.602 -5.51)
No. Infant Foods Sold*1970-74 Dummy	-.0252 (-3.48)	-.665 (-2.63)	-.187 (-1.59	.475 (-1.90)
1970-74 Dummy	.245 (3.68)	6.187 (2.73)	1.500 (1.42)	.76 (2.12)
Age of Mother	-.0104 (-6.82)	.313 (5.75)	.180 (7.07	.133 (2.46
Parity	.0266 (8.14)	-.372 (-3.18)	-.184 (-3.39	-.170 (-1.47
Calendar Year	-.0044 (-4.34)	-.153 (-4.43)	-.101 (-6.33	-.0527 (-1.55
Child Not Breast-fed Because It Died First	-.208 (-4.80)			
Intercept	1.434 (19.45)	18.711 (7.51)	3.129 (2.70)	15.613 (6.34)
R^2	.183	.143	.071	.149

*The e regressions also contain intercept adjustment dummies for missing information on the community variables; these coefficient estimates are of no inherent interest and are not presented.

The samples for regressions (2), (3), and (4) also exclude children who were still breastfeeding at the time of the survey or at the time they died.

so employed are seven percentage points less likely to breastfeed their child, holding constant the other variables in regression (1). Among women who do breastfeed, those who had recently been employed breastfeed an average of 4-1/3 months less, as seen in regression (2) (3-1/2 months less partial breastfeeding and 7/8 months less full breastfeeding). This is 1/3 less than the mean length of breastfeeding in the sample. Having accounted for this aspect of employment history, variations in earnings, distance to job and whether self-employed are rarely statistically significant in the four regressions.[1] Only whether the most recent job was agricultural has an independent influence: given that the woman was employed, she was considerably more likely to breastfeed and to breastfeed longer if her job was agricultural. We expect this result since in Malaysia childcare is easier to combine with most agricultural activities than with other occupations.

Variations in mothers' schooling level are not associated in these regressions with the propensity to breastfeed, but having begun, more highly-educated mothers show some tendency to delay introduction of first food (regression 3) while totally weaning their children at a younger age (regression 4). Jain et al. (1970) showed length of lactation negatively associated with mothers' education in an Indian sample, as did Osteria (1978) in a Philippine sample. However, neither study presented partial correlations holding women's work variables constant. Our data also show a significant negative association between women's schooling and the breastfeeding variables when the five work variables are omitted. This suggests that more educated women breastfeed less, on average, because of the types of jobs they hold.

The house quality index is strongly negatively associated with the propensity to breastfeed and with length of total and partial breastfeeding in Table 6, though it shows no influence on length of full breastfeeding. To the extent that this scale is a proxy for family wealth or income, we expect negative relationships throughout. Higher

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[1]Since a woman's market wage is presumably an important determinant of whether she is employed, part of the influence of earnings on breastfeeding might be picked up in these regressions by the intermediate employment dummy. Indeed, the earnings coefficient is negative and nearly statistically significant in regressions that omit the employment dummy. In subsequent work, we will explore this relationship further by imputing wages to nonworking women.

income facilitates purchase of modern contraceptives and infant foods, both substitutes for breastfeeding. Higher income may also increase desired family size, other things equal, and hence lower the demand for breastfeeding as a contraceptive. Osteria's (1978) finding that lactation length is negatively associated with a socioeconomic status scale may also reflect a wealth effect, though only age and mothers' education were held constant in her regressions.

Table 6 also shows that larger birthweight infants are significantly more likely to be breastfed and are breastfed longer, on average.[1] Hence, mothers appear to invest more nursing time in babies who, being heavier, are more likely to survive. It could also be that some low-birthweight infants are retained in the hospital, even in an incubator, making nursing difficult.[2]

The community variables are included in these regressions to measure the availability of modern substitutes for breastfeeding in the community. Availability of privately sold modern contraceptives in or near the community exerts a strong negative influence on the tendency to breastfeed and the length of breastfeeding.[3] Most of these effects are strong over the whole sample but become much more powerful for births since 1970.[4] This reflects the fact that these community variables, measured in 1976 or 1977, are decreasingly relevant for earlier births. Interestingly, proximity to a family planning clinic has the opposite effect. The coefficient estimates suggest that clinic personnel may be encouraging women to breastfeed.[5]

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[1]The relationship between birthweight and length of full breastfeeding is negative (though not significant), perhaps because larger babies require supplementation sooner.

[2]Other regressions suggest that male babies tend to be full breastfed somewhat longer but partial breastfed somewhat shorter than females, though the coefficient estimates are not statistically significant. There is no discernible sex difference in the total length of breastfeeding. To the extent that full breastfeeding is beneficial at early ages, this may indicate better care for male babies. However, further analysis of the relationship is required.

[3]Jain et al. found a significant partial correlation between breastfeeding length and whether the mother had previously used a contraceptive. Our data also show this effect, but we discuss instead regressions containing the more exogenous community variables reflecting the supply of contraceptives.

[4]For 1970-74 births, the effect of a particular community variable is the sum of the coefficient of the variable entered alone and of the coefficient of its interaction with the 1970-74 dummy.

[5]It will be interesting to find out if such an effort is intentionally carried out.

By far the most significant community-level variable is the number of different infant foods sold in the community. This crude measure of baby food availability is strongly negatively associated with three of the measures of breastfeeding activity, and more strongly since 1970. However, the significant positive coefficient in the full breastfeeding regression is puzzling.

These results, taken together, suggest that women do reduce their breastfeeding as contraceptive and infant food substitutes become more available, though there is the hint that family planning programs may impede this substitution. When we replace these specific community factors with metropolitan and town residence dummies in regressions not shown here, the dummies have significant negative coefficients. The strong relationship that Jain et al. (1970) report between lactation and urban residence may likewise be due to specific underlying factors of the type we investigate.

Finally, we find for children who breastfeed that length of breastfeeding increases with mothers' age and decreases with the child's parity, when the other variables in the regressions are controlled. The partial associations with whether the child is breastfed are the opposite. Jain et al. (1970) and Osteria (1978) also found a significant positive association of breastfeeding length with mothers' age and Jain et al. found a weak positive partial association with parity

Even controlling for changes and variations in all these factors, the calendar year coefficient in regression (1) indicates that an "unexplained" decline of about 10 percentage points in the propensity to breastfeed occurred between 1950 and 1974. Among infants who were breastfed, regressions (3) and (4) show a large decline in length of full breastfeeding and a modest decline in the length of partial breastfeeding as well.[1]

[1]Using a survey of rural women in Laguna Province of the Philippines, Popkin (1978) estimated a regression model focused on testing hypotheses similar to ours. He placed less emphasis on factors associated with mothers' work, and more on women's attitudes toward breastfeeding, the influence of visits by infant food companies, and the influence of other children's presence in the household. In general summary, his results suggest a

Overall, our impression is that breastfeeding patterns in Malaysia have responded as we hypothesize to trends and variations in the costs of that activity and availability of substitutes. Many public health discussions of breastfeeding declines in less-developed countries emphasize the importance of infant food company activities. Our estimates support this idea that increased availability of infant foods induces some women to switch from nursing. This influence appears no more important, however, than the availability of contraceptives, which also seems to induce mothers to switch from nursing. Likewise, mothers' work histories and job characteristics have important effects.

Length of Menstruating Interval

We now turn to the other primary component of the birth interval--the menstruating interval, during which the woman is at risk to conceive. Table 7 contains regressions of length of closed menstruating intervals on variables reflecting the use of contraceptives by type. We also include mother's age and parity and the calendar year time trend, as well as the house sanitation index which is a proxy for the health conditions that affect fecundity, and two variables reflecting separation from husband.

Each individual contraceptive use variable in regression (1) is a dummy that equals one if that particular contraceptive was the only one (not considering breastfeeding) reported used in the birth interval, zero otherwise. The last four variables in the contraceptive use section of the list account for use of more than one type in the same interval. Hence, the categories are mutually exclusive, with no contraceptive use (other than breastfeeding) being the omitted category.

The results in regression (1) indicate that IUD use is associated with by far the longest increase in the menstruating interval, 27-1/2 months. Pill use has the second largest significant coefficient, followed by safe time (rhythm), condom, abstinence, and folk methods. Use

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negative influence of mothers' work participation and a positive effect, if any, of visits by infant food companies. Other variables show differing relationships for different samples and dependent variables, though most results are consistent with his hypotheses.

Table 7

LENGTH OF CLOSED MENSTRUATING INTERVAL (MOS.) REGRESSIONS*

(n = 3553)

(t-statistics in parentheses)

Explanatory Variable: Contraceptive Use	Contraceptive Variable Equals 1 if It Was Used in the Interval (see variable definitions)	Contraceptive Variable Equals Length of Time (Mos. The Contraceptive Was Used In The Interval
Pill	9.987 (7.76)	.614 (12.58)
IUD	27.582 (3.27)	.821 (5.02)
Other Female Methods	6.568 (1.03)	.524 (2.06)
Condom	6.541 (1.93)	.500 (3.68)
Abstinence	4.975 (2.29)	.398 (4.87)
Safe Time Method	8.338 (3.30)	.569 (6.76)
Withdrawal	-1.604 (-0.29)	.068 (0.19)
Folk Methods	3.094 (2.84)	.273 (2.88)
Two Modern Methods	19.874 (4.83)	.752 (7.52)
First Method Modern	16.908 (3.30)	.811 (5.44)
Second Method Modern	5.859 (0.78)	.431 (1.42)
Two Traditional Methods	-2.107 (-0.57)	.335 (1.33)
House Sanitation Index	-.403 (-2.33)	-.565 (-3.41)
Missing or Different Husband	2.914 (2.83)	2.979 (2.98)
Separation from Husband	.0872 (4.55)	.0696 (3.73)
Age of Mother	.363 (4.10)	.327 (3.82)
Parity	-.489 (-2.60)	-.385 (-2.21)
Calendar Year	-.209 (-4.54)	-.205 (-4.65)
Intercept	18.183 (6.58)	18.809 (7.10)
	.050	.104

*These regressions also contain an intercept adjustment dummy for missing information on length of husband's separation.

of other female methods has a sizeable coefficient, but it is not statistically significant. Use of withdrawal is negatively associate with length of the interval, though the coefficient is not significantly different from zero. Use of two modern methods (pill and condom combination in two-thirds of the cases) increases the length of the menstruating interval by nearly 20 months. Use of one modern and one traditional method lengthens the interval by 17 months when the modern method is used longest, but not significantly when the traditional method is used longest. Finally, use of two traditional methods is not significantly related to the length of intervals.

This pattern of coefficients could arise either because some methods are used for longer periods than others or because some methods have higher use-effectiveness for the same period of use. Table 8 shows the number and percent of closed menstruating intervals in which each contraceptive type was used, along with the mean length of use.

The last column shows that the average duration of use differs greatly among methods, with the IUD having by far the longest duration and folk methods the shortest. The table also exhibits the small proportion of intervals that were reported protected by any method other than breastfeeding.

The second regression in Table 8 features durations of contraceptive use as explanatory variables and, hence, produces estimates of contraceptive use-effectiveness. The IUD has both the longest duration of use (in the very few intervals it was used) and the highest use-effectiveness, with one month of use associated with 25 additional days of contraception. Pill use, however, is characterized by relatively short average duration (third from the shortest), but relatively high use-effectiveness, resulting in 18 additional days protection for each month of use. Incidentally, though this is high relative to the other methods, it is much lower than estimates of pill effectiveness in industrialized countries. On average, Malaysian women appear to use the pill less effectively. The use-effectiveness of two modern methods and of mixed modern-traditional with the modern method used longest fall between those of the IUD and the pill.

Table 8

INCIDENCE AND LENGTH OF CONTRACEPTIVE USE, BY TYPE
(EXCLUDING BREASTFEEDING)

Contraceptive Type	No. of Intervals Used	Percent of Closed Intervals Used	Avg. Duration of use (in mos.)
Pill	195	5.4%	16.7
IUD	4	0.1	38.8
Other Female Methods	7	0.2	18.6
Condom	25	0.7	19.6
Abstinence	61	1.7	20.8
Safe Time Method	47	1.3	22.1
Withdrawal	9	0.3	14.2
Folk Methods	204	5.7	7.6
Two Modern Methods	17	0.5	29.5
One Modern and One Traditional Method	16	0.4	26.2
Two Traditional Methods	21	0.6	9.5
ALL TYPES	597	16.8%	

Other female methods, condom, abstinence and safe time methods have smaller coefficients in regression (1) than the pill, in spite of experiencing longer average duration of use. The reason, evidenced in regression (2), is that these methods' use-effectiveness is below that of the pill. It is interesting to note also that withdrawal is the only method with no estimated effectiveness at all and that use of folk methods is significantly associated with longer menstruating intervals.

In regressions not presented, we also investigated the role of mothers' level of schooling in contraceptive effectiveness. Interactions between schooling and the contraceptive use dummies in regres-

sion (1) of Table 7 show significant differential effects of schooling by type, with use of the pill and of other female methods showing the largest positive interactions with schooling. However, these differences are primarily due to associations between schooling and duration of use and not to a relationship between education and the efficiency of using a particular type of contraceptive.

Three considerations are important to keep in mind when interpreting these estimates of contraceptive effectiveness. First, during interviewing, after all pregnancy outcomes were recorded and the respondent had been asked whether she or her husband did anything to delay or prevent each next pregnancy, interviewers asked a probing question about contraceptive use in pregnancy intervals longer than 2 years. Hence, the resulting data are probably more likely to miss contraceptive uses in short birth intervals than in longer ones. This implies that all the contraceptive use coefficients in Table 7 may be biased upward. However, relative effectiveness across the different types is probably little affected. This problem is common to most studies with retrospectively collected data.

The second consideration is that these regressions are run on a sample that excludes open birth intervals. The result is that we exclude 13 percent of all intervals, but 26 percent of the intervals in which contraceptives were used, many of these being relatively long and featuring relatively effective (use of) contraceptives. When open intervals are included in subsequent analysis, we expect the estimated effectiveness of the more effective methods to increase.[1]

The third consideration is that some methods, particularly IUD, withdrawal, and "other female methods," are so infrequently used in our sample, that inferences concerning their effectiveness cannot safely be made to the population level.

Turning now to the other variables in the regressions, we see that the menstruating interval is significantly longer on average if during the interval in question the woman had no husband or a different husband than her spouse at time of interview. Separation from husband also significantly lengthens the time to next conception. The house

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[1]Until this is done, detailed comparisons of our effectiveness estimates with other estimates are premature. In general, however, our estimates are considerably below those found in the U.S., and relative ranking of methods is also somewhat different.

sanitation index is included as a proxy for the woman's health. Its significantly negative coefficient is consistent with our expectation that healthier women should be more fecund and conceive sooner, other things the same.[1]

The association of interval length with parity is negative, probably because the menstruating intervals associated with high parity observations tend to be shorter by arithmetic necessity, given a limited number of childbearing years. The coefficient of mother's age, however, is positive. This reflects the well-known declines in female fecundity and capacity to carry a pregnancy to full term after age 30. On average, an additional five years of age are associated with about 7 additional weeks before the next conception.

The estimated association with calendar year is quite large and very significant: between 1950 and 1974, this coefficient implies a decline of 5 months in the average length of menstruating intervals, after correcting for the influence of the other factors in the regression. This is the same strong time trend that dominated the series in Figure 6 , and we see here that it exercises a significant independent effect. Though this trend may reflect increasing fecundity not captured in the house sanitation index, we suspect that part of it is due to greater underreporting of births that took place farther in the past. If variations in this tendency to underreport were statistically independent of variations in the other explanatory variables in the regression, the calendar year variable would pick up the influence of underreporting and the other coefficient estimates would be unbiased. In reality, the variables are probably not distributed completely independently, causing some bias in the coefficients of interest.

Contraceptive Use

We now turn to the determinants of contraceptive usage. In subsequent work we will investigate the determinants of usage by

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[1] Distance to nearest doctor or nurse, other possible influences o fecundity, were not significant when entered in the menstruating interval regressions.

type, but here we concentrate on three summary variables: whether modern contraceptives were used, whether any contraceptive (other than breastfeeding) was used, and number of months any contraceptives (other than breastfeeding) were used. The unit of observation for each of these variables is use in a pregnancy interval. At the end of this subsection, we discuss some descriptive comparisons of the characteristics of users, by type.

Table 9 shows OLS regressions for each dependent variable, first on closed pregnancy intervals only (regressions 1, 3, 5) and then on all pregnancy intervals including those still open at date of interview (regressions 2, 4, 6).[1] The latter regressions show generally more significant coefficient estimates. This is expected since couples in circumstances most conducive to contraceptive use are likely to use efficient methods and use them more efficiently, resulting in more intervals still open at date of interview. Hence, the model should better explain these couples' behavior. Contraceptives do tend to be used much more in open intervals, as indicated by the very significant open interval dummies in these regressions.

As discussed above in section III, the relationship between a woman's cost of time and her contraceptive use is complex. One difficulty is that women who can earn high wages are hypothesized to desire fewer children, other things (including family income) the same, but they may also want to space them close together so they can return quickly to the labor market. Hence, the impact of work-related variables on contraceptive use is ambiguous in simple specifications of the type presented in Table 9.

These regressions indicate that women with higher earnings are somewhat less likely to contracept (at least in closed intervals), suggesting that they may, on balance, be compressing their births into a shorter

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[1] A probit regression for use of modern contraceptives shows results similar to those in regression (1) of Table 9, except that the community variables are generally less significant. Subsequent research will include polytomous logit analysis of type of contraceptive used.

Table 9

CONTRACEPTIVE USE REGRESSIONS*

[N = 3553 for closed intervals and 4067 for all intervals]

(t-statistics in parentheses)

Dependent Variable:	Used Modern Contraceptives in the Interval		Used Some Contraceptives (except breastfeeding) in the Interval		Length of Contraceptive Use in the Interval (Mos.)	
Explanatory Variable:	Closed Intervals (1)	All Intervals (2)	Closed Intervals (3)	All Intervals (4)	Closed Intervals (5)	All Intervals (6)
Characteristics of Mother's Last Job Within 2 Yrs. Before Pregnancy Outcome:						
Weekly Earnings	-.002 (-1.07)	-.0001 (-0.29)	-.0004 (-1.50)	-.0004 (-1.27)	-.0086 (-1.31)	-.0069 (-0.62)
Distance to Work	.0127 (1.93)	.0142 (2.09)	.0131 (1.30)	.0156 (1.64)	.0578 (0.25)	.124 (0.34)
Self-employed	-.0082 (-0.69)	.0085 (0.69)	.0409 (2.26)	.0553 (3.20)	.456 (1.10)	.922 (1.38)
Agricultural Occupation	-.0138 (-0.96)	-.0271 (-1.81)	-.0872 (-3.95)	-.0967 (-4.61)	-.981 (-1.94)	-1.811 (-2.24)
Schooling of Mother	.0148 (8.62)	.0164 (9.27)	.0141 (5.39)	.0165 (6.65)	.472 (7.88)	.781 (8.17)
House Quality Scale	.0035 (1.98)	.0049 (2.68)	.0125 (4.68)	.0145 (5.67)	.210 (3.43)	.349 (3.54)
Sex Ratio of Children in Chinese Families	.0432 ( )	.0541 ( )	.0222 ( )	.0365 ( )	.846 ( )	1.960 ( )
Sex Ratio of Children in Indian Families	.0552 ( )	.0625 ( )	.0788 ( )	.0811 ( )	.844 ( )	.967 ( )
Sex Ratio of Children in Malay and other Families	-.0125 (-1.89)	-.0218 (-1.19)	.0648 (2.15)	.0744 (2.89)	.390 (0.65)	1.343 (1.35)
A Child Died in the 2 Yrs. Before Next Preg.	-.0262 (-1.40)	-.0329 (-1.59)	-.0349 (-1.22)	-.0414 (-1.42)	-.443 (-0.68)	-.510 (-0.46)
Missing or Different Husband	.0245 (1.62)	.0131 (0.83)	-.0110 (-0.47)	-.0287 (-1.29)	.153 (0.29)	-.770 (-0.90)
Separation from Husband	.0001 (1.95)	.0001 (2.11)	.0002 (3.20)	.0002 (3.19)	.0060 (4.88)	.0048 (2.25)
Distance to Family Planning Clinic* 1970-74 Dummy	.0055 (0.99)	.0093 (1.59)	.0289 (3.39)	.0307 (3.76)	.512 (2.63)	.585 (1.86)
Contraceptives Sold in PSU*1970-74 Dummy	.0583 (2.09)	.0202 (0.75)	.0583 (1.37)	.0556 (1.47)	1.859 (1.91)	1.918 (1.32)
Contraceptives Sold Within 3 Miles*1970-74 Dummy	.0049 (0.14)	-.0134 (-0.40)	.129 (2.48)	.137 (2.93)	2.354 (1.97)	3.790 (2.10)
Number of Infant Foods Sold in PSU*1970-74 Dummy	.0231 (4.17)	.0243 (4.45)	.0228 (2.63)	.0225 (2.93)	.264 (1.36)	.547 (1.85)
Age of Mother	-.0015 (-0.88)	-.0044 (-2.71)	.0048 (1.88)	.0023 (1.02)	.132 (2.26)	.190 (2.15)
Parity	.0312 (3.42)	.0541 (6.19)	.0326 (2.34)	.0582 (4.73)	.780 (2.44)	2.685 (5.67)
Parity*Mother's Age	-.0009 (-2.92)	-.0014 (-5.02)	-.0011 (-2.48)	-.0017 (-4.48)	-.0275 (-2.64)	-.0814 (-5.47)
Calendar Year	-.0487 (-4.67)	-.060 (-5.65)	-.0338 (-2.12)	-.0447 (-2.99)	-.397 (-1.09)	1.220 (2.12)
(Calendar Year)^2	.0005 (5.31)	.0006 (6.42)	.0003 (2.40)	.0004 (3.36)	.0037 (1.25)	-.010 (-2.57)
Open Interval Dummy		.190 (13.31)		.195 (9.69)		17.717 (22.92)
Intercept	1.259 (4.07)	1.590 (5.02)	.863 (1.83)	1.167 (2.62)	6.854 (0.63)	-43.805 (-2.56)
R^2	.140	.202	.092	.142	.094	.193

* These regressions also contain intercept adjustment dummies for the 1970-74 period and for missing information on length of husband's separation and on the community information variables. They also contain two dummy variables that equal one for Chinese and Indian families.

period outside the labor market.[1] Given their earnings, women are less likely to contracept if their last job was close to home and in an agricultural occupation. Both these job characteristics reduce the incompatibility between child care and employment, leading to reduced incentive to shorten the number of child bearing and rearing years and hence a reduced incentive to contracept. Self-employed women tend, if anything, to contracept more. We would expect self-employment to reduce the costs of child care, but the regressions indicate the opposite association on balance. It may be that types of self-employment differ significantly in their extent of campatibility with child care.

Next, note the highly significant positive relationships between mother's schooling and these measures of contraceptive use. These coefficients may reflect the influence of persisting differences in the cost of mother's time at home not accounted for by our other variables, of modernity, or of differential access to birth control information. However, the fact that coefficients on the work variables are not appreciably changed when mothers' schooling is omitted (in regressions not shown) suggests that these schooling effects are not working primarily through female employment and opportunity cost factors. This conclusion is also suggested by the fact that in Table 6 mothers' schooling had little effect on breastfeeding, a very time-intensive activity. In future work, we will investigate in detail the role of mothers' schooling in affecting fertility goals, choice of contraceptive type, length of use, and use-effectiveness by type.

The coefficient estimates for the house quality index are also difficult to interpret in this simple specification. They suggest that wealthier couples are more likely to contracept and for longer periods. That the relationship (and elasticity) is much stronger with all contraceptive types than with modern ones means that it arises from more than an income effect on purchased contraceptives. Further analysis is required

[1]The dummy variable indicating whether the mother worked for income in the two years prior to the birth was not significant in the regression and hence is not included in the equations presented in Table 9.

to trace the effects of income and wealth on couples' desired fertility, desired spacing, and choice of contraceptive type.

The next row of coefficients indicates that parents who suffered a recent child death seem less likely to contracept and, hence, more likely to seek a replacement birth, though the coefficient estimates are not statistically significant.[1] The positive coefficient estimates for husbands' separation are puzzling.

Following in the table are community-level variables for the availability of contraceptives and infant foods.[2] Availability of contraceptives in stores is positively related to contraceptive use since 1970, but distance to the nearest family planning clinic has no effect at all on the tendency to use modern contraceptives. In fact, families living nearer a family planning clinic are significantly <u>less</u> likely to contracept with any method, and they use contraceptives for a shorter period of time. More detailed analysis of this relationship is warranted, but it may be that some women close to a clinic are discouraged from using traditional contraceptive methods before they have effectively substituted modern methods.

The availability of marketed infant foods in the community has a surprisingly significant positive effect on use of modern contraceptives since 1970. These foods are a substitute for breastfeeding a child. When they are readily available, mothers tend to use them (see Table 6) and apparently seek at the same time to substitute for the other function of lactation by using other contraceptive methods.

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[1] A comprehensive review of the literature concerning effects of child mortality on subsequent fertility is provided in Dean (1977).

[2] These community variables had effects only since 1970, so we discuss speficiations containing only the variables interacted with the 1970-74 dummy variables.

Altogether, the strong performance of these community-level variables points to the important influencesof privately marketed contraceptives and weaning foods on contracepting behavior.

The effect of parity on contraceptive use is positive, as expected if parents become more serious about preventing another birth as they approach their fertility goal. The interaction of parity with mothers' age indicates that young women of a given parity contracept significantly more than older women in the same circumstances. With more childbearing years remaining, the younger woman's incentive to contracept is greater. These effects are considerably stronger in the sample including open intervals because high parity women are more likely to be using an effective contraceptive that keeps the last interval open, especially if they have reached high parity at a young age.

The year and year-squared variables are entered to reflect exogenous changes in contraceptive supply and effectiveness. Holding constant the other variables in the equation, these coefficients imply that the probability of any contraceptive method (except breastfeeding) being used has increased since the late 1950s, and that the probability of a modern method being used has increased since around 1950.

Although a multivariate (polytomous) analysis of type of contraceptive chosen is beyond the scope of this paper, the simple descriptive statistics in Table 10 illustrate interesting, often surprising differences in the characteristics of users of different types. Despite some small cell sizes, these statistics also provide additional insights into the use-effectiveness differences shown in Table 7 . The unit of observation is again the pregnancy interval, including both open and closed intervals. Each column refers to the average characteristics of all woman-intervals in which that particular contraceptive was used, either alone or together with some other type. (Thus, intervals in which two types, other than breastfeeding, were used are double counted.)

The summary indicators (last four columns) show the same patterns evident in regressions (2) and (4) in Table 9: users tend to be more highly educated and wealthier than nonusers. Within the groups of users, those using modern methods are considerably

Table 10

CHARACTERISTICS OF CONTRACEPTIVE USERS, BY TYPE OF CONTRACEPTIVE USED
(UNITS OF OBSERVATION ARE PREGNANCY INTERVALS)

Each Column Refers to All Intervals in Which the Particular Contraceptive Was Used Alone or Together With Some other Method:

	Pill (n=227)	IUD (n=19)	Injection (n=9)	Other Female (n=6)	Condom (n=65)	Abstinence (n=97)	Safe Time (n=81)	Withdrawal (n=14)	Folk Methods (n=312)	All Contraceptive Methods (n=899)	All Modern Methods (n=444)	No Contraceptives Used (n=3175)	All Intervals (n=[illegible])
Average Date of Use	69.8	65.8	70.8	62.0	69.2	66.2	67.8	65.4	63.3	66.8	69.4	63.0	65.8
Parity	3.94	4.30	3.44	2.83	2.98	4.21	2.69	3.36	3.97	3.84	3.80	3.77	3.7[illegible]
Schooling of Mother	4.59	3.60	4.56	5.33	5.49	2.96	6.49	2.21	2.19	3.66	4.77	2.05	2.[illegible]
% Where Contraceptives Available in Pol	43.7	28.6	55.6	0.00	52.5	39.0	65.2	18.2	13.9	33.5	4.21	34.6	34.[illegible]
If No Contraceptives Available in Pol, % Where Available Within 3 Mi. of Pol	37.4	33.3	50.0	100.0	77.3	78.6	92.6	55.6	22.7	38.3	44.5	30.7	32.[illegible]
Average Daily Earnings of Those Who Worked Within the 2 Yrs. Before the Birth	28.49	21.26	31.86	40.00	24.76	14.06	38.14	28.67	7.18	21.29	28.28	17.32	18.3[illegible]
House Quality Index	5.7	7.8	5.4	7.5	6.1	5.5	8.3	6.0	2.9	4.9	5.8	3.4	3.8
% Metropolitan	24.1	30.0	22.2	33.3	40.0	34.0	65.4	28.6	1.9	21.7	25.7	13.6	15.[illegible]
% Town	28.0	30.0	33.3	33.3	21.5	25.8	29.6	35.7	26.0	27.0	27.0	20.5	22.[illegible]

more highly educated. Contraceptive use, especially of modern methods, is concentrated in more recent time periods. It is interesting that in these simple descriptive statistics there are virtually no parity differences among modern users, traditional users, and nonusers.

Some interesting differences emerge when we stratify further by type of contraceptive used. All contraceptive methods are used in more recent intervals compared to intervals in which no contraceptive was used. Pill, injection, and condom are used in the latest intervals on average. Average IUD use is surprisingly early (mid-1960s), and occurs in higher parity intervals than any other contraceptive type or than intervals in which no contraceptive was used.

Each type of modern contraceptive is used by women who are more highly educated on average than those using traditional methods; those users are in turn more highly educated than women not practicing contraception. But there are several surprises: IUD users have the lowest education of all modern users, while users of other female methods and condom are among the most highly educated in the sample. But the biggest surprise is that women practicing the rhythm method have the highest educational attainment of all--6-1/2 years, well above the sample average of 2.4 or the users' average of 3.7 This helps explain why the rhythm method appeared to be relatively more effective than expected in the regressions in Table 7. Rhythm users also rank highest on the house quality index, women's earnings, and proportion living in metropolitan areas. Only 5 percent of rhythm uses are by women living in rural areas as compared to over 50 percent of all contraceptive users and 60 percent of all intervals. (By contrast, 72 percent of users of folk methods, 98.4 percent of whom are Malay, live in rural areas.) It is interesting that couples practicing the rhythm method, a technique requiring no contraceptive materials, are more likely to live in or near a PSU where contraceptive devices are available than are couples who use these devices.

Length of Closed Pregnancy Interval

We have discussed the determinants of the length of the two main parts of the closed birth interval by estimating separate regressions

explaining length of post-partum amenorrhea and length of menstruating interval. Table 11 presents regressions explaining the length of the closed birth interval itself.[1]

The coefficient estimates in regression 1 give the average additional months of protection that can be expected to accompany use of each contraceptive type. We can now see the effect of breastfeeding relative to other contraceptive methods. It is an effective way of delaying the next conception, but ranks lower than almost all other methods considered. Even safe time and folk methods afford longer protection.

The coefficient estimates in regression 2 of Table 11 indicate effectiveness per month of use. In accordance with regression 1, they suggest that full breastfeeding, though it is strongly related to birth-spacing, is among the least effective of the contraceptive methods employed. Full breastfeeding appears less effective per month of use than safe time methods, on a par with abstinence, and more effective than folk methods and withdrawal.

Included in the second regression is an interaction term between length of partial breastfeeding and a dummy variable indicating use of modern contraceptives. Where breastfeeding and other methods are used concurrently, this term provides a correction for "double counting." The significant negative coefficient indicates a substantial interaction; breastfeeding's contraceptive effectiveness is cut in half, on average, for women who use modern contraceptives. This effect may be related to the lactation-inhibiting effect of estrogen-progestogen birth control pills.[2] The earlier discussion of breastfeeding regressions indicated that use of modern contraceptives is associated with reduced breastfeeding in this sample. The finding here suggests that

[1]The closed birth interval includes length of the pregnancy that closes the interval, as well as length of amenorrhea and menstruating interval.

[2]See Buchanan (1975), pp. J58-J62, and Tables 5 and 6.

Table 11

LENGTH OF CLOSED PREGNANCY INTERVAL REGRESSIONS (n = 3553)*

(t-statistics are in parentheses)

Independent Variable	Contraceptive Variable Equals 1 If It Was Used In The Interval	Contraceptive Variable Equals No. Mos. The Contraceptive Was Used In The Interval
Length of Full Breastfeeding		.454 (6.92)
Length of Partial Breastfeeding	2.182 (2.47)	.565 (19.31)
Contraceptive Use:		
Pill	8.052 (6.03)	.638 (12.61)
IUD	23.356 (2.67)	.807 (5.00)
Other Female Methods	3.924 (0.59)	.538 (2.14)
Condom	4.264 (1.20)	.532 (3.96)
Abstinence	3.779 (1.68)	.455 (5.64)
Safe Time Method	5.063 (1.92)	.559 (6.73)
Withdrawal	-2.214 (-0.38)	.0753 (0.21)
Folk Method	4.117 (3.63)	.358 (3.81)
Two Modern Methods	16.919 (3.97)	.770 (7.78)
First Method Modern	13.787 (2.60)	.810 (5.50)
Second Method Modern	3.307 (0.42)	.308 (1.03)
Two Traditional Methods	-1.874 (-0.49)	.423 (1.70)
No. Mos. Partial Breastfeeding* Use of Modern Contraceptive		-.275 (-2.04)
House Sanitation Index	-.950 (-5.25)	-.544 (-3.19)
Missing or Different Husband	2.628 (2.46)	2.513 (2.55)
Separation from Husband	.0888 (4.49)	.0800 (4.34)
Age of Mother	.428 (4.65)	.320 (3.77)
Parity	-.456 (-2.43)	-.294 (-1.71)
Calendar Year	-.260 (-5.43)	-.194 (-4.40)
Intercept	35.113 (11.27)	28.096 (10.43)
R^2	.048	.186

*These regressions also contain an intercept adjustment for missing information on length of husband's separation.

the contraceptive effectiveness of the breastfeeding that remains is reduced. The important implication is that the effectiveness of modern contraceptives can be partially offset through their effects both on the extent of breastfeeding and on breastfeeding's effectiveness in prolonging postpartum amenorrhea.

It is also interesting that partial breastfeeding has a coefficient of .54 (over the whole sample) in Table 11, compared to .35 to .37 in the amenorrhea regressions,[1] whereas the full breastfeeding coefficient has nearly the same value (.45-.48) in both the amenorrhea and pregnancy interval regressions. This apparent reversal of contraceptive importance of full and partial breastfeeding probably occurs because some women stop (partial) breastfeeding when they become pregnant again or when they have their next child. If so, the estimated coefficient for partial breastfeeding in Table 11 is biased upward, and the effect estimated in the amenorrhea regression (Table 4) is more accurate.

The remaining coefficient estimates in Table 11 are similar to those in the separate amenorrhea and menstruating interval regressions discussed above.

Infant Mortality

In addition to its contracepting function in delaying the onset of post-partum ovulation, breastfeeding has another function that parents may value: it nourishes infants and for a time protects them from infection. In Table 12 we estimate the effects of full and partial breast-

[1] The Table 11 estimates imply coefficients of .290 and .565 for intervals with and without use of modern contraceptives, respectively Since about 10 percent of the intervals in the sample included such contraceptive use, the average partial breastfeeding coefficient in regression (2) is about .54.

Table 12

INFANT MORTALITY REGRESSIONS*

(n = 4067)

(t-statistics in parentheses)

Independent Variables	Dependent Variable = 1 if child died before one year of age (1)	(2)	(3)	(4)
Length of Full Breastfeeding (mos.)	-.0035 (-5.11)	-.0037 (-5.29)	-.0036 (-5.23)	-.0040 (-5.72)
Length of Partial Breastfeeding (mos.)	-.0025 (-8.51)	-.0030 (-9.92)	-.0034 (-10.9)	-.0040 (-12.4)
Birthweight of Child	-.0127 (-4.87)	-.0126 (-4.87)	-.0124 (-4.79)	-.0115 (-4.40)
Sex of Child = Male	.0217 (3.58)	.0205 (3.40)	.0204 (3.40)	.0209 (3.51)
No. of Other Pregnancies in the 15 Mos. Preceding This Birth	.0185 (2.23)	.0207 (2.51)	.0212 (2.58)	.0249 (3.03)
No. of Other Pregnancies in the 15-24 Mos. Preceding This Birth	.0061 (0.87)	.0067 (0.97)	.0074 (1.07)	.0111 (1.60)
Mother's Schooling	-.0034 (-3.03)	-.0005 (-0.41)	-.0008 (-0.70)	-.0020 (-1.63)
House Sanitation Index		-.0073 (-3.21)	-.0058 (-2.57)	-.0040 (-0.83)
House Quality Index**		-.0079 (-3.25)	-.0041 (-1.66)	-.0019 (-0.76)
Distance to Nearest Dr. or Hospital			.0030 (3.16)	.0016 (1.65)
Distance to Nearest RN or Public Medical Clinic			.0022 (1.27)	.0033 (2.13)
No. infant foods sold in PSU			-.0065 (-3.69)	-.0032 (-1.75)
Age of Mother	-.0025 (-2.82)	-.0018 (-2.00)	-.0014 (-1.62)	.0002 (0.20)
Parity	.0047 (2.42)	.0041 (2.11)	.0034 (1.77)	.0001 (0.07)
Calendar Year	-.0015 (-2.93)	-.0013 (-2.63)	-.0016 (-3.10)	-.0018 (-3.60)
Race:				
Chinese				-.0578 (-7.00)
Indian				-.0300 (-2.82)
Other				.0409 (1.26)
Intercept	.288 (8.31)	.287 (8.31)	.337 (8.68)	.316 (8.09)
R^2	.044	.055	.065	.077

*Equations (1) and (2) also include an intercept adjustment dummy for missing information on the number of infant foods sold in the PSU.

**The coefficient and t-statistic shown here refer to the total effect of the house quality index (i.e., includes the portion that works through the house sanitation index).

feeding and of other factors on the infant mortality rate, one measure of child health and nutritional status.[1]

We see in Table 12 that children who are breastfed longer, either with or without other food, have a significantly better chance of survival.[2] Full breastfeeding has a somewhat larger effect, though the difference between the full and partial breastfeeding coefficients is not statistically significant at the 5-percent level. Wray (1978) reviews other studies showing similar effects. In nonlinear specifications not presented here, we found that the effect of full breastfeeding on the probability of child death becomes smaller the longer the child is breastfed; full breastfeeding no longer significantly affects child survival after 7 months. By contrast, the effect of partial breastfeeding is nearly linear throughout the first year of life.

Other studies (e.g., Spiers and Wang, 1976; Lee et al., 1976; Srinvasa et al., 1976; Lechtig, et al., 1978) have demonstrated a statistical association between birthweight and subsequent mortality. Our data also show a strong relationship. An additional pound of birthweight is associated with a 11 to 13 point drop in the infant mortality rate (measured per 1,000 live births).

Nearly all infant mortality data show higher death rates for males than for females. Ours are no exception, showing males to experience around 21 more infant deaths per 1,000 births than females, when other factors are held constant.[3]

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[1]Children whose age at death or death date is unknown are excluded from our working sample. Hence, the prevalence of infant mortality is underestimated in this working sample.

[2]To avoid the possibility of reverse causation that might arise because some women stop (or do not start) breastfeeding because the child dies, we have also estimated the same specifications presented here for a subsample excluding children who stopped breastfeeding because they died. All results were similar to those presented here.

[3]This number drops slightly, to 19, when the birthweight variables are excluded (and goes to 20 when all explanatory variables other than sex are dropped). These differences are larger than those found in Malaysian Vital Statistics (1971) which report an average 1966-68 infant death rate of 52.6 for males and 42.0 for females. Our data imply infant death rates of 50 for males and 30 for females, suggesting that births of females

Early clinical studies of infant mortality (e.g., Woodbury, 1925) showed that the shorter the pregnancy interval prior to a birth, the lower the survival prospects of the child. Later studies suggested that this effect of a preceding short interval on infant mortality was only indirect, with birthweight being the important intermediate variable;[1] i.e., a preceding short interval reduces the child's birthweight (a relationship we also find in the next subsection) and that lower birthweight is associated with a higher risk of infant mortality. In equation (1) we report a significant direct effect of a preceding short interval (measured by the number of other pregnancy outcomes in the 15 months preceding this birth), even when birthweight is controlled.[2] Intervals of 15-24 months length also increase the risk of mortality, although the coefficient is small and usually not significant at the 5-percent level. The possibility that these relationships are partly behavioral (parents invest less either intentionally or inadvertently in a child that comes too soon following the preceding one) is an interesting topic for future research.

In regression (1), children of more educated women appear to have significantly higher probabilities of survival. However, when we include our house sanitation and quality indices in regression (2), the education coefficient is no longer significant, suggesting that it may be because educated women are more likely to be wealthy and to live in healthy surroundings, rather than education per se, that increases their

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who died may be underreported in our data or that respondents may more readily forget the death date or age of dead daughters. Further analysis will investigate the relative importance of these possibilities.

[1]Spiers and Wang (1976) found that "the introduction of birthweight (as a matching variable) left no significant differences in the distribution of pregnancy invervals between cases (that died) and controls (who survived the first year of life)." They interpret this as evidence that short pregnancy interval exerts its influence on risk of death in infancy through its effect on birthweight.

[2]Interestingly, in our data the effects of preceding short intervals on infant mortality are unchanged when birthweight is not controlled.

children's probability of survival.[1] In regression (3), when we add variables measuring distance to the nearest doctor or hospital, distance to the nearest nurse or public medical clinic, and infant food availability, the sanitation and house quality coefficients become smaller, but are still statistically significant. The further infants are from modern medical care, the lower their probability of survival. Children also have significantly better survival prospects, other things the same, in areas where more infant foods are available.[2,3]

The probability that an infant will die is negatively related to its mother's age and positively related to the child's birth order, in our data. The positive parity coefficient is consistent with evidence presented in biomedical studies (e.g., Gulick, 1972) and suggests that parents are less able (or want less) to care well for higher-order births.[4]

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[1]Lechtig, et al. (1978) report significant negative associations in Guatemalan data between maternal nutrition and socioeconomic status, on the one hand, and infant mortality on the other.

[2]Among the "other things" held constant in these regressions are length of full and partial breastfeeding. Table 6 above indicates that women breastfeed less, on average, where other infant foods are more readily available. Hence, providing infant foods may not have the net effect of decreasing mortality, if the resulting breastfeeding declines have a more powerful harmful effect. These preliminary estimates in Tables 6 and 12 suggest that the net effect of infant food availability, as measured here, is beneficial, though accounting for declines in length of breastfeeding reduces the effect by more than one fifth. Estimating the magnitude of these net effects of community and program variables is an important aspect of our further research.

[3]In regressions not reported here, we have included dummy variables indicating that the woman lives in a metropolitan or other urban area. Their coefficients were significantly negative when the community variables and sanitation and house quality indices were excluded, but became completely insignificant when these more specific characteristics of families and communities were held constant.

[4]The simple correlation between parity and infant mortality is not statistically significant. (Some biomedical studies, e.g., Srinvasa, et al., 1976, suggest that the simple relationship is U-shaped instead of linear.)

The significantly negative calendar year coefficient indicates that there has been a downward trend in the reported incidence of infar mortality (despite the fact that reporting bias should have the opposite effect). Other things the same, the infant mortality rate has decreased by around 1.5 deaths per 1,000 births per year. We attribute this to health improvements not captured in our other explanatory variables.

In regression (4) we include race dummies, which show significant differences in infant mortality among racial groups, even when the othe explanatory variables are held constant. The coefficients of these other variables typically become even larger in absolute value and more significant when the race dummies are added. For example, the coefficient of number of other pregnancies in the 15-24 months preceding this birth is significant at the 10 percent level in regression (4).[1]

Birthweight

Tables 6 and 12 above suggest that birthweight is an important influence on whether and how long a child is breastfed and on its probability of survival. We therefore briefly discuss determinants of birthweight in our sample.

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[1]An interesting reversal occurs for the mother's education coefficient and the house sanitation and quality coefficients; when race dummies are included, the former becomes significant again while the latter become insignificant. Age and parity also become insignificant when race is controlled. In future work, we will estimate separate regressions for the various racial groups to investigate these differences further.

The equations shown in Table 12 were also estimated using as the dependent variable a dummy that equalled one if the child died before two years of age. The realtionships and elasticities were virtually identical to those shown in Table 12.

In regressions not presented here, we also included interactions of the community variables and a 1970-74 dummy to test whether the effect of the community variables, which refer to the situation at the time of the interview in 1976, are stronger in the most recent period. These interactions were never statistically significant.

Table 13 shows two regressions for the sample of live births for whom actual birthweight was reported.[1]

We include mothers' schooling, distance to the nearest doctor or hospital, and distance to the nearest registered nurse or medical clinic as proxies for the mothers' health and nutritional status, which have been found in biomedical studies to be important determinents of children's birthweight in malnourished populations (Habicht et al., n.d.).[2] We find that more highly-educated women give birth to larger babies, although the relationship is only statistically significant at the 10-percent level in regression (2). Biomedical studies (e.g., Rush, 1974) have also found positive relationships between birthweight and mothers' education or some other measure of her socioeconomic status.

Distance to the nearest doctor or hospital is not significantly associated with birthweight but distance to the nearest nurse or medical clinic is, in the expected negative direction. Women who are closer to these places which can provide nutritional guidance and prenatal care give birth to significantly larger babies, especially in the 1970-74 period. Other things the same, women who gave birth in 1970-74 and lived in a PSU in which there was a nurse or public medical clinic gave birth to babies around a pound larger than comparable women living in PSUs where the nearest nurse or medical clinic was more than 10 miles away.

Length of the birth interval appears to influence the birthweight of the subsequent child. The negative but insignificant coefficient of the variable measuring the number of other pregnancy outcomes in the 15 months preceding this birth suggests that short birthspacing may contribute to low birthweight of the subsequent child, as has been found in clinical studies (e.g., Bhalla et al., 1974).

[1]The same specifications were also run for the subsample that did not report birthweight, using the approximate weight scale as a dependent variable. The results were similar to those reported here.

[2]In regressions not reported here, we include our house sanitation and house quality indices, but their coefficients are never statistically significant.

Table 13

Birthweight Regressions
(n = 2852)
(t-statistics in parentheses)

Independent Variables	(1)	(2)
Schooling of Mother	.005	.0104
	(0.72)	(1.32)
Distance to Nearest:		
Doctor or Hospital	.0157	.0119
	(1.55)	(1.13)
Dr. or Hosp. x 1970-74 Dummy	-.0050	-.0038
	(-0.29)	(-0.22)
Nurse or Medical Clinic	-.0764	-.0474
	(-4.85)	(-2.87)
Nurse or Med. Clinic x 1970-74 Dummy	-.0273	-.0238
	(-0.90)	(-0.79)
1970-74 Dummy	.117	.119
	(1.53)	(1.56)
No. of Other Pregnancies In The 15 Mos. Preceding This Birth	-.0866	-.0748
	(-1.43)	(-1.24)
Sex of Child = Male	.0951	.0916
	(2.05)	(1.99)
Race = Chinese		.0453
		(.79)
Race = Indian		-.482
		(-6.43)
Race = Other		.0098
		(.03)
Age of Mother	-.0013	-.134
	(-.20)	(-1.92)
Parity	.0140	.0388
	(.99)	(2.60)
Calendar Year	-.0043	-.0062
	(-.93)	(-1.34)
Intercept	7.04	7.39
	(25.3)	(26.3)
R^2	.021	.040

* The sample is restricted to infants whose mothers knew their exact birthweights.

It is well known that male babies are generally larger than female ones; our results are consistent with this. The difference in male and female birthweights is statistically significant, though small in magnitude (around 1-1/2 ounces).[1]

In equation (2) we add race dummies and find that Indians give birth to significantly smaller infants than other Malaysians. The difference is large -- around 1/2 pound -- and persists in alternative specifications.

When race is controlled, age and parity have statistically significant effects on birthweight, though in opposing directions. When the other factors in the regressions are controlled, there has been no significant change in birthweight over time.[2]

A Comment on R^2

Most of the preceding regressions show R^2s below .2, which is the usual result with individual level data. It may be worth noting that for our purposes, the level of R^2 is considerably less important than the statistical significance of individual coefficient estimates. For example, if primary interest is in estimating the lengthening of birth intervals associated with having a local family planning clinic, or the relative effectiveness of physicians vs nurses in reducing infant mortality, it is statistically significant estimates of regression coefficients that suggest the answer. These may point to, say, a five percent change in the target variable associated with, say, a 10 percent change in the program variable. It is much less important whether five percent or 90 percent of the variation in the target variable is "explained" by the regression.

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[1] The mean male birthweight in our sample is 6.83 and the mean female birthweight is 6.73. The difference is statistically significant at the 2 percent level.

[2] When birthweight is regressed on calendar year alone, its coefficient is positive (.0011) but insignificant (t=0.33).

V. CONCLUSIONS AND IMPLICATIONS

These regression estimates outline the basic behavioral and biological relationships that connect birthspacing to its proximate determinants and to some of its more indirect causes in Peninsular Malaysia. The data show that both the incidence and length of breastfeeding has been falling in Malaysia since World War II. Use of modern contraceptives has increased rapidly since the early 1960s. Nevertheless, the proportion of closed birth intervals protected by neither breastfeeding nor any other contraceptive practice has steadily grown. The result has been a fairly general decline in the average length of closed birth intervals. Although additional analysis of open birth intervals is required, this trend has probably tended to keep fertility rates from fall- rapidly, particularly among younger women. Another probable consequence of the shortened birth intervals has been the failure of infant mortality rates to fall as rapidly as they might have otherwise; our estimates indicate that a baby born at the close of a short birth interval has a significantly lower chance of surviving its first year.

Moving beneath these trends, our analysis has found relationships between length of postpartum amenorrhea and its determinants that are very close to estimates from a number of prospective surveys and clinical studies. Length of full breastfeeding has the strongest influence, followed by length of partial (or supplemented) breastfeeding. Variables associated with the mother's nutritional status also have significant coefficient estimates.

The strongest estimated influences on breastfeeding incidence and duration are variables reflecting the mother's work experience prior to the child's birth and the availability in the community of substitutes i... breastfeeding--infant foods and modern contraceptives. And there is the intriguing suggestion that proximity to a family planning clinic encourages breastfeeding, though not nearly as strongly as proximity to privately sold countraceptives discourages it.

In its capacity to delay the next birth, unsupplemented lactation is considerably less effective per month of use than the IUD, pill, and safe time (rhythm) methods, on a par with abstinence and more effective

than folk methods. Use of all these methods, including folk methods, is significantly associated with longer closed birth intervals in this sample. Moreover, there is a suggestion that use of modern contraceptives interferes with the role of lactation in extending postpartum amenorrhea.

As in the case of breastfeeding, contraceptive use responds significantly to variations in the community supply of modern contraceptives. The supply of infant foods also has a positive influence, as our model predicts. More highly schooled and wealthier women are much more likely to contracept and to do so with modern methods.

The infant mortality regressions show a strong salutary influence of both breastfeeding and the availability in the community of commercial infant foods. When the negative effect of infant food supply on breastfeeding is netted out, infants still have a somewhat higher chance of survival in communities where more alternative foods are available. Infants with wealthier parents, better sanitary conditions in the home, and more highly educated mothers have significantly higher survival probability, as do those born near a doctor's office or hospital. Larger birth weight is significantly associated with higher survival probability.

Finally, our attempt to explain sample variations in birthweight shows that children born in a community near a nurse or medical clinic tend to weigh more. Proximity to a doctor or hospital has no measurable effect. Also, babies born at the close of a short birth interval tend to weigh less at birth.

The picture that emerges from these estimates, though incomplete, is one of systematic biological mechanisms and behavioral responses, both capable of being set in motion by community and program characteristics. In particular, declines in breastfeeding and increases in modern contraceptive use are associated in these data with the increasing cost of women's time at home and with the growing availability of modern contraceptives and infant foods, all of which have been part of the Malaysian development process.

Considering the inherent limitations of retrospective life history surveys, these analyses have pushed the data very hard, though only scratching the surface of what they have to offer. The estimates closely resemble results from prospective studies in a number of countries and are generally consistent with expectations from a model not specific at all to the Malaysian setting, suggesting that our methodology, and to some extent the resulting estimates, have wide applicability. In future work, we will concentrate on separate parts of the birthspacing system, making more use of the underlying theory and of the rest of the data in this survey. The results reported here suggest that such intensive work should be worthwhile, since the possibilities for estimating the direct and indirect impacts of specific community characteristics and public programs appear unusually promising.

APPENDICES

APPENDIX A

THE WORKING SAMPLE

We started with 1262 households from round 1 of the survey. From these, 92 households were excluded because remaining nonchronological dates precluded their being processed by RETRO (Rand's computer program for processing the retrospective life history data). The remaining 1170 households had 5589 pregnancies. Of these, we dropped 414 cases (pregnancies) which had missing, "don't know", or inconsistent codes for the variables used here (or used to construct these). In addition, we excluded 500 pregnancies which ended (i.e., the pregnancy interval began) after December 1974, 35 more that were still breastfeeding at the time of the interview, 374 where length of post-partum amenorrhea = 0 (either open intervals where the woman was still amenorrheic at the time of the interview, cases where there was no menstruation between pregnancies, or non-livebirths). In addition, we inadvertently dropped an additional 64 cases where the woman was using contraceptives at the time of the interview (many of these were sterilizations, hence we have no intervals in the sample referring to couples where the wife has had a hysterectomy or the husband a vasectomy). Also, we excluded 135 pregnancies where the household's PSU number had a typographical error that precluded its being matched with the community level data, leaving us with a working sample of 4067 livebirths and pregnancy intervals, of which 3553 were closed intervals and 514 open.*

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*Most of the 1008 intervals excluded for reasons other than missing data can be incorporated into the analysis when they are "closed" or updated with Round II and III information or otherwise corrected. Furthermore, observations with missing data on some variables could still be used for other analyses where the missing variables are not used, or could be used in all analyses after substituting imputed values.

APPENDIX B

Tables Showing Characteristics of the Sample (corresponding to text discussion on pp. 4-6.)

TABLE B1

DISTRIBUTION AND AVERAGE HOUSEHOLD SIZE, BY ETHNIC GROUP AND TYPE OF AREA

Ethnic Group	Three Main Cities[a]	Type of Area: Towns[b]	Rural	Total
Malay	62 (24.6)[c] (10.3%)[d]	96 (34.9%) (15.9%)	444 (60.4%) (73.8%)	602 (47.7%) (100.0%)
Chinese	151 (59.9%) (30.2%)	146 (53.1) (29.2%)	203 (27.6%) (40.6%)	500 (39.6%) (100.0%)
Indian	38 (15.1%) (25.5%)	33 (12.0%) (22.1%)	78 (10.6%) (52.3%)	149 (11.8%) (100.0%)
Other	1 (0.4%) (9.1%)	0 (0.0%) (0.0)	10 (1.4%) (90.9%)	11 (0.9%) (100.0%)
TOTAL	252 (100.0%) (20.0%)	275 (100.0%) (21.8%)	735 (100.1%) (58.2%)	1262(100.0%) (100.0%)
Average Household Size (# Persons)	6.2	6.4	6.3	6.3

[a] Kuala Lumpur, Ipoh, and Penang.

[b] Other than the three largest cities, a town with population over 10,000 in 1967 or less than 10,000 where it is estimated that at least 50% of the work force is engaged in non-agricultural occupations.

[c] #'s to the right in parentheses are column totals.

[d] #'s underneath in parentheses are row totals.

TABLE B2

AGE DISTRIBUTION (IN %) OF FEMALE AND MALE HEADS OF HOUSEHOLDS

Age	Females	Males
<20	3.8	0.4
20-24	12.6	18.9
25-29	17.8	
30-34	18.6	34.3
35-39	18.9	
40-44	14.8	46.4
45+*	13.6	
TOTAL	100.0%	100.0%
(n)	(1261)	(1126)

*45-50 for females

TABLE B3

EDUCATIONAL ATTAINMENT OF MALE AND FEMALE HOUSEHOLD HEADS

Average Numbers of Years of School Completed, by Age and Sex

Age	Female	Male
< 20	5.2 (49)	6.0 (5)
20-29	5.6 (383)	7.6 (213)
30-39	3.5 (471)	6.3 (386)
40+	1.8 (358)	4.3 (522)
Total	3.7 (1261)	5.6 (1126)

Percentage Distribution of Educational Attainment*

Educational Level	Female	Male
None	35.0	12.8
Standard 1-3	18.7 ←	18.2
Standard 4-5	14.0	19.8 ←
Standard 6	17.9	23.4
Remove	0.5	0.8
Form 1-3	6.9	11.6
Form 4-5	5.9	8.8
Form 6	0.4	1.3
University	0.5	2.1
Not Known	0.2	1.1
TOTAL	100.0	100.0
(n)	(1260)	(1140)

*(←) arrow indicates median category

TABLE B4

EMPLOYMENT STATUSES OF FEMALE AND MALE HEADS OF HOUSEHOLD, AT TIME OF SURVEY
(percentage distribution)

Employment Status	Females	Males
Paid employee - full-time	22.2	59.2
Paid employee - part-time	3.9	1.8
Self-employed/own account	5.9	22.1
Worker in family business	16.3	2.3
Employer (paying wages)	0.9	9.1
Home products/services for sale	4.9	1.0
No income-producing activity	45.9	4.5*
TOTAL	100.0	100.0
(n)	(1260)	(1140)

*includes one student.

TABLE B5

MAIN OCCUPATIONS OF FEMALE AND MALE HOUSEHOLD HEADS AT TIME OF INTERVIEW
(percentage distribution)

Occupation [Code]	Female	Male
Professional, Technical, and Related Workers [01-19]	2.9	6.7
Administrative and Managerial Workers [20-21]	0.2	1.2
Clerical and Related Workers [30-39]	1.3	5.0
Salesworkers [40-46]	9.5	12.7
Service Workers [50-59]	3.1	2.9
Agricultural, Animal Husbandry, and Forestry Workers, Fishermen and Hunters [60-64]	28.4	34.6
Production and Related Workers, Transport Equipment Operators and Laborers [70-98]	5.5	21.9
Other Occupations (not elsewhere classified, inadequately described, not state) [69, 99]	3.3	10.7
None [00]	45.9	4.2
TOTAL	100.0	100.0

APPENDIX C

BIRTH DATE VERIFICATION

The majority of birthdates used in this study have been verified with a document, making the age and date and corresponding birth interval data used here unusually reliable. Table C1 shows the percentages of birthdates that were verified with a document (birth certificate or identity card). In the top half of Table C1, we see that over 80% of the birthdates of household members have been so verified. The percentages are generally inversely related to current age, but are remarkably high -- always over 50% -- even for those who were over 65 at the time of the survey. The extent of verification is greatest, perhaps surprisingly, in rural areas and lowest in urban areas. This is probably due to the fact that more of the inhabitants or urbanized areas are Chinese and Indians, some of whom are immigrants.

In the bottom half of the table, we see that over 70% of the dates of live births to women in our sample have been verified with a document. For any year period, the verification percentage is always lower in the bottom panel that the top, because the latter refers to people alive at the time of the survey, whereas the former includes children no longer alive at the time of the survey, some of whom may have lived only a few hours, and children no longer living with their parents, who may have taken their documents with them.

TABLE C1

PERCENT BIRTHDATES VERIFIED WITH A DOCUMENT*, BY YEAR AND TYPE OF AREA

Birth Year	Percent of Household Members for Whom Documents Inspected			
	Main Cities	Other Towns	Rural	Total
1900-1909	58.6**	51.3**	74.0	66.3
1910-1919	39.5**	65.7**	80.0	67.4
1920-1929	54.0	77.5	86.8	78.8
1930-1939	64.5	73.3	86.8	79.3
1940-1949	48.7	76.4	84.0	73.7
1950-1959	55.2	80.2	84.3	77.2
1960-1969	70.8	86.2	91.8	86.7
1970-1976	65.9	83.7	90.7	84.7
TOTAL	61.1	80.5	88.0	81.1
(n)	(1573)	(1756)	(4617)	(7946)

PERCENT OF LIVEBIRTHS LISTED IN FEMALE PREGNANCY HISTORY WHOSE DATES WERE VERIFIED WITH DOCUMENT (INCLUDES CHILDREN NO LONGER ALIVE OR NO LONGER AT HOME AT TIME OF SURVEY)

1940-1949	21.4**	9.3**	16.2	15.5
1950-1959	52.3	56.1	48.7	50.7
1960-1969	69.5	82.6	84.1	81.2
1970-1976	65.3	82.6	86.7	82.0
TOTAL	63.3	73.9	72.7	71.5
(n)	(916)	(1242)	(3504)	(5664)

*Birth certificate or identity card.

**n < 50

APPENDIX D

DEFINITIONS OF VARIABLES USED IN REGRESSIONS AND MEANS AND STANDARD DEVIATIONS

		Mean[a] (standard deviation)
A CHILD DIED 2 YEARS BEFORE NEXT OUTCOME	A dummy that equals one if any child (including one born at the beginning of the interval in question) died within the two years before the pregnancy outcome that closes the interval in question	.0524[b] (.223)
AGE OF MOTHER	Mother's age in years at the time of the birth (at the beginning of the interval in question)	25.5 (5.81)
AGRICULTURAL	A dummy that equals one if the woman's last job within the two years before this birth was an agricultural occupation	.664 (.473)
BIRTHWEIGHT	Child's birthweight in pounds; = actual birthweight if the mother could report the child's exact birthweight; = 6.79 + 1.25 (APPROXWEIGHT - 3) if mother did not know child's exact birthweight but could only report it approximately where 6.79 = mean birthweight for sample reporting exact birthweight 1.25 = standard deviation for sample reporting exact birthweight APPROXWEIGHT codes are as follows: 1 = very small 2 = less than average 3 = average 4 = above average 5 = large That is, birthweights reported as codes 2 or 4 are assumed to be one standard deviation below or above the mean, while those with codes 1 or 5 are assumed to be two standard deviations below or above.	6.82 (1.17)

[a] Unless otherwise noted, a mean is for sample of all intervals, both open and closed.

[b] Mean refers to closed intervales only. The valuable = 0 for open intervals

		Mean (standard deviation)
CALENDAR YEAR	Last two digits of calendar year, e.g., 74 = 1974, of pregnancy outcome (at beginning of pregnancy interval in question)	63.8
CHILD DID NOT BREASTFEED BECAUSE IT DIED FIRST	A dummy that equals one if mother reported that she did not breastfeed the child in question because it died	.015 (.121)
CONTRACEPTIVES SOLD IN PSU	A dummy that equals one if modern contraceptives were sold in 1976 in the PSU in which the woman lives [c]	.344[c] (.474)
CONTRACEPTIVES SOLD WITHIN 3 MILES OF PSU	A dummy that equals one if contraceptives were not sold in 1976 in the PSU in which the woman lives but were sold within 3 miles of the PSU (= 0 if contraceptives were available within the PSU or if they were not available within 3 miles of it)[c]	.215[c] (.414)
DISTANCE TO WORK (TO MOTHER'S LAST JOB WITHIN 2 YEARS BEFORE THE BIRTH)	0 = worked at home or did not work within the two years prior to the birth 1 = < 1 mile from home 2 = 1-3 miles from home 3 = > 3 miles from home	1.42[d] (0.94)
DISTANCE TO NEAREST DOCTOR OR HOSPITAL	Distance, in miles, in 1976 of the PSU in which the woman lives from the nearest doctor or hospital (= 0 if doctor or hospital is in PSU)	3.20 (4.27)
DISTANCE TO NEAREST NURSE OR PUBLIC MEDICAL CLINIC	Distance, in miles, in 1976 of the PSU in which the woman lives from the nearest nurse or public medical clinic (= 0 if nurse or clinic is in PSU)	1.25 (2.34)

[c]The variables = 9 if contraceptive availability was unknown. In this case, a dummy is included to correct for this. Means refer to all women for whom value of variable is known.

[d]Mean refers to subsample that worked in the two years preceding the birth.

		Mean (standard deviation)
DISTANCE TO NEAREST FAMILY PLANNING CLINIC	Distance, in miles, in 1976 of the PSU in which the woman lives from the nearest family planning clinic (= 0 if nearest family planning clinic is in PSU)[e]	1.38[e]
EARNINGS (ON MOTHER'S LAST JOB WITHIN 2 YEARS BEFORE THE BIRTH)	Total weekly earnings (cash and kind) in ringgit in the mother's last job within the two years before this birth (= 0 if no such job)	18.36[f] (32.32)
HOUSE QUALITY INDEX	A scale ranging from 0-12, where 12 indicates best housing quality at time of this birth (house has electricity, a long-bath or shower, outer walls of brick or concrete, indoor piped water exclusively for this household's use, and an indoor flush toilet exclusively for this household's use)	3.73 (3.07)
HOUSE SANITATION INDEX	A scale ranging from 0-6 where 6 indicates most sanitary housing at time of this birth (house has indoor piped water exclusively for this household's use and an indoor flush toilet exclusively for this household's use)	2.29 (1.76)
IFANT MORTALITY	A dummy that equals one if child died before one year of age	.040 (.197)
LENGTH OF BREASTFEEDING (MOS.)	Child's age (in months) when fully weaned	12.60[g] (10.85)

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[e]This variable equals 99 if the distance to the nearest family planning clinic is unknown. In this case a dummy indicating that distance to nearest family planning clinic is unknown is included to correct for this. Mean refers to subsample for which value of variable is known.

[f]Mean refers to subsample that worked in the two years preceding the birth.

[g]Sample for this variable restricted to those who breastfed and did not stop breastfeeding because the child died.

		Mean (standard deviation)
LENGTH OF CLOSED PREGNANCY INTERVAL	Number of months from one pregnancy outcome to the next	29.00[h] (17.82)
LENGTH OF CLOSED MENSTRUATING INTERVAL	Length of closed pregnancy interval less length of post-partum amenorrhea less duration of next pregnancy	13.17[h] (17.22)
LENGTH OF CONTRACEPTIVE USE IN INTERVAL	Total number of months during the interval under consideration that the woman was protected by any contraceptive method except breastfeeding	4.74[i] (16.39)
LENGTH OF FULL BREASTFEEDING	Number of months child was breastfed without being given any other food or drink (including water) regularly, i.e., number of months until first food or drink given regularly; = 0 if child was not breastfed	1.88[j] (4.79)
LENGTH OF PARTIAL BREASTFEEDING	Number of months child was breastfed and given food or drink regularly	10.75[j] (10.73)
LENGTH OF POST-PARTUM AMENORRHEA	Number of months from pregnancy termination to first regular menstruation	7.53 (7.88)
METROPOLITAN RESIDENCE DUMMY	A dummy that equals one if, at the time of the survey, the woman resided in one of the three largest cities in Malaysia--Kuala Lumpur, Ipoh, or Penang	.154 (.361)

[h] Mean refers to closed intervals only.

[i] The mean and standard deviation for closed intervals is 2.55 (8.94). For means for specific types of contraceptives, see Table 8.

[j] Sample is restricted to those who breastfed and did not stop breastfeeding because the child died.

		Mean (standard deviation)
MISSING OR DIFFERENT HUSBAND	A dummy that equals one if the woman was not married in the interval in question or had a different husband than her husband at the time of interview (= 1 if there has been any marital status change between the birth at the beginning of the interval and the time of the survey)[k]	.085 (.280)
NUMBER OF INFANT FOODS SOLD IN PSU	The maximum number of specified infant foods available in any one store in 1976 in the PSU in which the woman lives[l]	8.95 (2.28)
NUMBER OF OTHER PREGNANCY OUTCOMES IN THE 15 MONTHS PRECEDING THIS BIRTH[m]		.166 (.385)
NUMBER OF OTHER PREGNANCY OUTCOMES IN THE 15-24 MONTHS PRECEDING THE BIRTH[m]		.278 (.456)
OPEN INTERVAL DUMMY	A dummy that equals 1 if pregnancy interval in question is open (i.e., there is no subsequent pregnancy outcome by time of interview)	.126 (.332)
PARITY	Total number of pregnancies including the one under consideration	3.78 (2.60)

[k]This dummy equals one for all births to women not currently married at the time of the survey and hence is "turned on" in many cases where a husband was not actually absent during the particular interval in question.

[l]Variable = 99 if number of maximum infant foods is unknown. In this case a dummy is included to adjust for this. Mean refers to subsample for which value of variable is known.

[m]Twin birth is counted as two outcomes.

		Mean (standard deviation)
RACE[n]		
CHINESE	A dummy that equals one if the mother is Chinese	.384 (.487)
INDIAN	A dummy that equals one if the mother is Indian	.134 (.340)
OTHER	A dummy that equals one if the mother's race is other than Malay, Chinese, or Indian	.009 (.094)
SCHOOLING OF MOTHER (YEARS) (at time of interview)	00 = No formal schooling 01 = Standard one ⋮ 06 = Standard six 07 = Remove 08 = Form one ⋮ 12 = Form five 13 = Lower form six 14 = Upper form six 15 = University - 1st year ⋮ 22 = University - 8th year	2.40 (3.02)
SELF-EMPLOYED	A dummy that equals one if the mother was self-employed in her last job within 2 years before this birth (= 0 if she didn't work in those 2 years)	.439[o] (.496)
SEPARATION FROM HUSBAND	Number of months separated from husband x completeness of separation (completeness = 1/8, 2/8, ... 7/8, or 1)	3.18[p] 14.20)
SEX = MALE	Dummy = 1 if the child is male	.515 (.500)

[n]Malay is the omitted category for these race dummies.

[o]Mean refers to subsample that worked sometime in the two years before the birth.

[p]This variable is unknown for a few women and is set equal to 99 for them. In this case, a dummy is included to correct for this. The mean presented here refers to the subsample for which the value of the variable was known.

		Mean (standard deviation)
SEX RATIO	No. male live births/(no. male and no. female live births) to the mother prior to and including this child	.513 (.334)
TOWN	A dummy that equals one if, at the time of the survey, the woman resides in a town or village, other than the 3 largest cities in Malaysia (see Metropolitan Residence Dummy), whose population was over 10,000 in 1967 or in an area of less than 10,000 where it is estimated that at least 50% of the work force is engaged in non-agricultural occupations	.222 (.415)
USED MODERN CONTRACEPTIVES IN THE INTERVAL	A dummy that equals one if the woman used a modern contraceptive[q] in the interval under consideration	.104[r] (.305)
USED SOME CONTRACEPTIVE METHOD (OTHER THAN BREASTFEEDING) IN INTERVAL	A dummy that equals one if the woman reported using any type of contraceptive, except breastfeeding, in the interval under consideration	.219[r] (.413)
WHETHER BREASTFED	A dummy that equals one if the child was breastfed for any length of time	.842 (.365)
WIFE EMPLOYED WITHIN 2 YEARS (BEFORE THE BIRTH)	A dummy that equals one if the wife had a job (including self-employment or for payment in kind) at some time in the 2 years before the birth	.451 (.498)

[q]Female sterilization, vasectomy, pill, IUD, injection, diaphragm, other female methods [e.g., cream, jelly], and condom.

[r]For means for specific types of contraceptives, see Table 9.

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