Infant Mortality Levels, Time Trends and Determinants in Jordan: A Summary of Findings

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BREAST-FEEDING AND INFANT MORTALITY FACT SHEET: JORDAN
(WORLD FERTILITY SURVEY, 1976)

	BREAST-FEEDING			MORTALITY RATE/1000[3]		
	Percent of Sample[1]	Percent Ever Breast-Fed	Mean Duration in Months[2]	Neonatal	Postneonatal	Infant
TOTAL SAMPLE	100	90.4	11.0	30.7	39.9	70.6
1. AREA OF RESIDENCE						
Urban	45	89.3		28.0	35.9	63.9
Urban Migrant	21	90.7	11.8			
Always Urban	24	88.7	9.6			
Rural	55	91.9	12.4	36.4	48.9	85.3
2. REGION OF RESIDENCE						
Amman 1 & 2	33	88.9	9.6			68.9
Zarka	15	91.1	10.3			53.8
Towns	12	88.6	11.1			68.6
Villages	40	91.9	12.4			84.3
3. SEX OF CHILD						
Male	51	90.4	11.5	31.8	32.0	63.8
Female	49	90.3	10.5	29.5	48.4	77.9
4. WORK STATUS OF MOTHER[4]						
Does not work/ never worked	85	91.1	11.1	30.2	39.8	70.0
Works at home/worked	9	92.7	10.8			
Works away/worked	6	88.9	8.4	33.3	41.2	74.5
5. EDUCATION OF MOTHER[5] (in years)						
Zero	52	91.2	13.2	32.2	45.4	77.6
1 to 3/1 to 5	7	92.5	12.2	32.2	39.9	72.1
4 to 6/6 and over	20	90.8	9.9			
7 to 9	13	89.3	7.8			
10 and over	8	83.5	6.9			
6. FATHER'S OCCUPATION						
Modern	17	88.4	9.4	23.6	28.2	51.8
Transitional	40	90.5	11.8	30.0	46.4	76.4
Mixed	34	90.4	10.1	34.6	38.6	73.2
Traditional	8	93.4	13.7	30.2	34.2	64.5

[1]Based on sample of last 2 live births in 4 years preceding the interview.
[2]Based on current status technique.
[3]Based on births between 1966 and 1975.
[4]For mortality rate, work status is either never worked or worked.
[5]For mortality rate, education in years is either zero, 1-5 or 6 years and over.

SOURCES: Akin, J.S., Bilsborrow, R., Guilkey, D. and Popkin, B.M. (1983). "Breast-feeding Patterns and Determinants in Jordan."

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INFANT MORTALITY LEVELS, TIME TRENDS AND DETERMINANTS IN JORDAN: A SUMMARY OF FINDINGS

by

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I. INTRODUCTION

In a recent paper, the authors present a methodology for analyzing the mortality data collected in the 1976 Jordan Fertility Survey (Sullivan, et. al., 1982). This report summarizes the findings of that paper. However, before presenting results, several points about the Jordan Fertility Survey (JFS) which affected the analysis should be stated.

First, various tests were made to evaluate the quality of the mortality data from the individual woman's survey. Those tests revealed some problems but did not impinge the overall credibility of the data. Evidence was found indicating some underreporting of infant deaths (especially for the neonatal age interval and for the birth cohorts before 1946) and some misreporting of age-at-death. The data were adjusted to correct the latter problem. The adjustment increased the estimated infant mortality rates for the recent birth cohorts by about 3 percent. The point to note here is that this was the only adjustment made to the data. All results presented in this paper are based on adjusted data.

Second, the sample for JFS was not self-weighting. However, all results presented here, with the exception of those in Section V, are based on the weighted data.

Third, mortality rates for four age intervals are presented in this paper:

Infant Mortality	the probability of dying between birth and one year of age.
Neonatality Mortality	the probability of dying between birth and one month of age.
Post-Neonatal Mortality	the probalility of dying between one month and one year of age.
Childhood Mortality	the probability of a child, who survives to age one, dying between age one and age five.

The fourth point concerns the data available for the study of the determinants of mortality. The factors which influence infant and child mortality levels can be grouped under the headings of genetic factors (birth defects and birth weight), demographic factors (mother's age at birth, birth order, etc.) and socioeconomic factors (characteristics of the parents, the dwelling unit or the community in which an infant or child is reared). The individual woman's questionnaire contains no information about genetic factors, but does contain a rather complete set of variables on demographic factors and a fair number of variables representing socioecomonic factors. The socioeconomic factors on which we have no information, but which have been shown in other studies to affect mortality, are: household income, housing conditions, availability of piped water, supplemental feeding practices, prenatal care and access to health services.

II. MORTALITY LEVELS

In this section, we report mortality rates estimated by both direct and indirect procedures and the results of an investigation of the age pattern of mortality below age five.

Direct Mortality Estimates

Neonatal, post-neonatal, infant and childhood mortality rates were computed for the five year birth cohorts between 1956 and 1975 (Figure 1). The rates display a persistent and regular decline over time. Between 1956 and 1970, the infant mortality rate declined by 40% (from 120.6 to 72.0), the NN rate by 21% (from 41.8 to 32.9), the PNN rate by 50% (from 78.8 to 39.1) and the childhood mortality rate by 63% (from 51.0 to 19.1). The larger relative declines of PNN and childhood mortality than in the NN mortality is not surprising. When socioeconomic conditions improve over time, NN rates which are related to genetic and biological factors usually decline more slowly than PNN and childhood rates which are primarily associated with environmental factors.

In general, the sex-specific rates display the same time trend as the rates for both sexes combined. However, when comparing male and female rates for a single point in time, an important difference emerges. NN mortality rates are consistently higher for males, while PNN and childhood mortality rates are generally higher for females. The excess of male NN mortality is common to most populations and reflects a greater susceptibility of male births to mortality from genetic causes. However, in most populations, male mortality continues to exceed female mortality in the PNN and early childhood age intervals. The data for Jordan indicate the reverse pattern, which suggests the possiblity of preferential care of male offspring.

From the JFS data it is only possible to compute rates for subregions of the country defined according to the size of a community. Mortality rates were estimated for four such units: (i) Amman (the capital city), (ii) the cities of Zarka and Irbid, (iii) towns between 10,000 and 100,000 and

(iv) villages (Figure 2). With regard to time trends, the rates display the same pattern as do the rates for the whole country (ie., mortality declined approximately equiproportionately and on the order of 35 to 50 percent in each area between 1956 and 1970). As far as differentials are concerned, the rates are generally lowest in the cities of Amman, Zarka and Irbid, intermediate in the towns and highest in the villages.

Indirect Mortality Estimates

In countries where the vital registration system is deficient, infant mortality rates can be estimated indirectly from the information on children ever born and children surviving. This is done by aggregating the data for women in five-year age (or marital duration) intervals to obtain the proportion dead of children ever born to women of an age (or marital duration) interval. For the proportion dead statistics are transformed into mortality rates by standard indirect models (United Nations, 1982).

For the purpose of indirect mortality estimation, statistics on the proportion dead of children ever born were obtained by aggregation from the JFS pregnancy history data. The South variant of the Sullivan Model (1972) was used to obtain mortality estimates. The time period to which the estimates apply were estimated from the Coale-Trussell model (1978). Table 2 presents the indirect estimates along with direct estimates for comparable time periods. In general, the indirect estimates agree quite well with the direct estimates. For both sexes combined, the estimates from the age model for 1974 and 1972 (73.1 and 69.5) and from the duration model for 1975 (74.1 and 74.3) approximate the direct estimate for 1971-75 (69.3). Similarly, the indirect estimates for 1969 (71.1) and 1970 (71.7) are very close to the direct estimate for 1966-70 (72.0).

III. A COMPARISON OF IMR ESTIMATES

IMR estimates for Jordan, based on different data sources are shown in Table 3. The registration of deaths in Jordan is severely deficient so that estimation with registration data is unreliable. Accordingly, the estimate of 160 based on the Brass model and the 1961 census is probably the best available indicator of the level of infant mortality in Jordan around 1960.

Two sets of IMR estimates are available from the JFS data: (i) those derived from the individual women's survey (i.e., pregnancy history data), and (ii) those dervied from the household survey*. The IMR estimates from the former source are about 70 per 1000 while those from the latter source are about 90 per 1000. The two sets of estimates differ by 29 percent, leaving considerable uncertainty about the current level of infant mortality in Jordan.

IV. BIVARIATE ANALYSIS: MORTALITY DIFFERENTIALS

Differentials in NN, PNN, infant and child mortality were investigated for selected demographic and socioeconomic characteristics. The analysis was restricted to births which occurred during the 10 years preceding the survey (i.e., births between 1965 and 1975)

Demographic Characteristics

Mortality rates were computed for four demographic factors: (i) age of

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* The household survey included two types of information on mortality. First, it elicited information on deaths of members of the household occurring during the 24 months preceding the survey. Second, it collected information on the proportion of children who died amongst the children ever born to women of various ages of sex of child. The latter source of information was used to get the estimates reported here. The information obtained through the direct question was not available at the time of this analysis.

the mother at birth, (ii) birth order, (iii) length of the preceding birth interval, and (iv) survivorship of the previous birth (Figure 3). For the neonatal period, all four demographic factors were strongly associated with mortality. Mother's age at birth displayed a U-shaped pattern with relatively high rates for women under 20 years and over 40 years of age. A similar U-shaped pattern was displayed by birth order with relatively high rates for orders 1 and 2, and orders 5-7. With respect to birth interval, neonatal mortality was almost twice as high for births with an interval of less than 24 months than for births with an interval of 24 months or more. Finally, survivorship of previous birth reveals the strongest differentials; NN rates being three times as high when the previous birth had died rather than survived.

For the PNN period, neither age of mother nor birth order exhibited a strong association with mortality. However, birth interval and survivorship of the previous births showed associations as strong as in the case of the NN interval. Births with short intervals and births following a birth which had died experienced relatively high PNN mortality rates.

All four demographic factors displayed strong association with infant mortality (Table 4). The relationships were very similar to that of the neonatal mortality.

For the childhood age interval, no factor except birth interval exhibited a strong association with mortality; childhood mortality for births with a birth interval of less than 24 months was twice as high as for births with an interval of 24 or more months.

Socioeconomic Characteristics

Mortality rates were computed for five socioeconomic factors: mother's and father's education (years of schooling), work status of mother since marriage

worked, never worked), father's occupation (agriculture, transitional, blue or white collar), and place of residence (rural or urban) (Figure 4). In contrast to our finding with respect to demographic characteristics, the differentials by socioeconomic characteristics are more pronounced when progressing from the NN to the PNN period and to the childhood age interval. This is not surprising since mortality at older childhood ages is more influenced by enviornmental than by biological factors and environmental factors are reflected by socioeconomic variables while biological factors are primarily reflected by demographic variables.

For the NN period, three socioeconomic factors were strongly associated with mortality: mother's education, father's education, and place of residence. Mortality rates between the lowest and highest categories of mother's education (none vs 6+ years) differed by 23 percent while for the extreme categories of father's education (0-5 years vs 10+ years), the rates differed by 50 percent. In the case of place of residence, the rates were about 30 percent higher in rural than in urban areas.

For the PNN interval, all factors were strongly associated with mortality with the exception of mother's work status. Mortality rates for births to

Infant mortality exhibited relationships to socioeconomic characteristics in a manner similar to neonatal mortality. Infant mortality rate was lowest among children of women with 6 or more years of education, of fathers with 10+ years of education and of white collar workers. In addition, infant mortality was high in rural areas (Table 5).

For the childhood age interval, all socioeconomic factors were strongly associated with mortality. The differentials, although more pronounced than in the PNN period, display similar patterns. With respect to mother's work status, the rates for births to mothers who had worked were about 50 percent higher than the rates for births to mothers who had never worked.

V. MULTIVARIATE ANALYSIS: MORTALITY DETERMINATNS

An investigation of mortality differentials can be helpful for identifying the factors affecting mortality; however, because of the inter-relationships among demographic and socioeconomic factors the relative importance of the various factors can only be determined by an analysis which simultaneously controls all factors. This section describes such an analysis by means of multivariate models.

The Model for Multivariate Analysis

A logistic regression model was used for the multivariate analysis. The model was applied once for the analysis of the effect of demographic and socioeconomic factors and once for the analysis of the effect of breast-feeding on mortality. This procedure was followed because the breastfeeding data are available for only the last two live births of respondents in the JFS questionnaire while demographic and socioecomonic data are available for all of their births.

From the regression model, it is possible to determine which factors had an independent and statistically significant effect on mortality and the magnitude of that effect. In this report, we present results only on factors found to be statistically significant. Results are reported in terms of the relative mortality risk associated with a particular value of some factor.

Demographic and Socioeconomic Factors

The data set for this analysis consisted of births between January 1966 and August 1975 of birth order two and higher. The independent variables in the model were those previously specified:

Demographic Factors	Socioeconomic Factors
Mother's Age at Birth	Mother's Education
Birth Order	Father's Education
Length of Preceding Birth Interval	Mother's Work Status
Survivorship of the Previous Birth	Father's Occupation
	Place of Residence

The analysis was carried out separately for the NN, PNN and childhood age intervals.

For the NN period, the factors having a statistically significant effect on mortality were mother's age, birth order, birth interval and survivorship of the previous birth. Figure 5 indicates the relative mortality risk for various values of these factors. Relative to the risk of mortality for births to women aged 18, the risk is .88 times as great for births to women aged 20, .78 times as great for births to women aged 30 and 1.45 times as great for births to women aged 40. This U-shaped pattern with the highest mortality at the extreme ages of childbearing is consistent with the findings of other studies. With respect to birth interval, the relative risk of NN mortality decreased sharply when the birth interval increased from < 24 to 24-35 months (relative risk of .61) and to 36+ months (relative risk of .37). Finally, a substantial risk differential was associated with survivorship of the previous birth; the risk being 2.21 times as great when the previous birth had died than when it had survived. This simply indicated a strong intrafamily correlation of mortality risks.

For the PNN period, the statistically significant factors were birth interval, survivorship of the previous birth, place of residence and father's occupation. Figure 5 indicates that the risk of mortality decreased sharply when the birth interval increases from < 24 to 24-35 months (relative risk of .49) and to the 36+ months (relative risk of .24) and increased substantially when the previous birth had died rather than survived (relative risk of 1.60).

With respect to place of residence, mortality risks were greater in rural areas (relative risk of 1.41) than in urban areas. This finding may not reflect the effect of place of residence per se but of factors such as the accessibility to health services, water supply and other factors not included in our model. Finally, a significant difference was found with respect to father's occupation; births to fathers in transitional occupations having a relative risk 1.69 times as great as births to fathers employed in agriculture.

Results for infancy indicated that mother's age at birth, length of the preceding birth interval, survivorship of the previous birth and place of residence were significantly related to mortality. The relative risk ratios indicated only marginal differences in mortality probabilities for a change in mother's age at birth (relative risk of 0.78 when age changed from 18 to 30) or place of residence (relative risk of 1.29 when residency changed from urban to rural). However, the differences in mortality probabilities were quite substantial for a change in the length of the preceding birth interval. The risk of mortality was reduced by 70 percent when the length of the preceding changes from 12 to 36 months and was increased by 86 percent when the survivorship status of the previous birth changed from alive to dead.

For the childhood age interval, only birth interval and mother's work status were significantly related to mortality levels. The risk of childhood mortality decreased when the birth interval increased from <24 to 24-35 months (relative risk of .72) and to 36+ months (relative risk of .51), while the mortality risk for births to mothers who had worked was greater (relative

risk of 1.76) than that of births to mother's who had never worked. Both of these effects can be interpreted as due to factors which deplete the amount of time a mother has available for the care of a particular child.

It is worth noting that, contrary to the many studies, our analysis did not find that mother's or father's education had a significant effect on mortality. However, we did find that mother's education had a significant effect on PNN mortality at a marginal level of significance. In addition, when excluding selected variables from the model, the education variables were found to increase in significance. We conclude that while education may have a significant net effect on mortality, particularly for the PNN and childhood periods, that effect is not nearly as pronounced as those indicated above.

The Effect of Breastfeeding

The JFS data includes information on whether or not a respondent's last and next to last live birth was breastfed and, if breastfed, for how long.[1] From this information, variables were constructed to indicate the breastfeeding status of births at the exact ages of one, six and twelve months (i.e., continually breastfed or no longer breastfed at those ages). These variables were used in the logistic regression model to investigate the effect of breastfeeding until

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[1] The JFS data does not include information on a number of factors which would facilitate the analysis and interpretation of the effects of breastfeeding on mortality. The most important types of lacking information pertain to 1) the reasons for never breastfeeding and for stopping breastfeeding of an infant or child, 2) the suckling ability of each infant at birth and at the time of stopping breastfeeding, 3) the frequency of breastfeeding, 4) practices relating to supplemental breastfeeding, 5) the general state of health of each child and 6) whether or not infants and children who are sickly are selected for continued breastfeeding at ages when the mother would normally wean a healthy child.

a specific age on mortality in a subsequent age interval. Separate analysis was conducted for the PNN period (1-11 months), early and late subdivisions of the PNN period (1-5 and 6-11 months respectively), the childhood period (12-59 months) and the first year of the childhood period (12-23 months). Thus, in the case of the PNN period, the analysis indicates the effect of breastfeeding through one month on mortality in the 1-11 month period. Similarly, in the case of the late PNN period, the analysis indicates the effect of breastfeeding through six months on mortality in the 6-11 month period.[2]

The data set for the analysis was restricted to births in the 10 years preceding the survey for which the breastfeeding data were available. The independent variables in the analysis were the demographic and socioeconomic variables previously specified and the variables indicating breastfeeding status. Results are reported for only the breastfeeding variable.

For the PNN period, breastfeeding status had a significant effect on mortality. Figure 6 indicates that the risk of PNN mortality was 2.95 times greater for births not breastfed through one month than for births breastfed through one month. With respect to the subintervals of the PNN period, breastfeeding had a significant effect on early PNN mortality (1-5 months) but not on late PNN mortality (6-11 months).[3] Figure 6 indicates that the risk mortality in the early PNN period was 3.25 times greater for births not

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[2]The model assumes that the breastfeeding status at ages prior to the age interval under investigation affects mortality in that age interval. Conversely, it implies that breastfeeding status within the age interval under investigation does not affect mortality in that age interval. To minimize the effect of this assumption, the analysis was conducted for a number of age intervals.

[3]The sign on the coefficient of the breastfeeding variable for the late PNN period indicated lower mortality among births breastfed for six months, but the coefficient was not statistically significant.

breastfed through one month. Finally, when considering the childhood age intervals (12-59 and 12-23 months) the effect of breastfeeding on mortality was not statistically significant.[4]

Table 6 presents a breakdown of the births by breastfeeding status. About 7 percent of the children who survived to month 1 were never breastfed. The mortality rate of never breastfed children was (55.3 per 1000) 3.4 times greater than the breastfed children (16.3). However, in the case of never breastfeeders (almost 7 percent of the population) it is not known if the infant or mother was too ill to nurse, or if the decision to never breastfeed was voluntary.

Consider now the finding that mortality in the late PNN and childhood periods was not, in the statistical sense, significantly associated with breastfeeding status. This is insufficient evidence for concluding that breastfeeding for six months or longer does not reduce mortality in the late PNN and childhood periods. The fact that statistical evidence of a positive effect is lacking is due to the fact that mortality rates for breastfeeders and non-breastfeeders do not differ greatly.

Akin et al (1982) have found that mother's education and urban migration negatively affect breastfeeding in Jordan. Highly educated women have better knowledge of caring for infants and living in urban areas may provide better living conditions with availability of health services, piped water, etc. These factors may explain the lack of differences in mortality rate between breastfed and non-breastfed children during the late post-neonatal and early childhood period. In addition, there are at least two explanations which could account for this situation in spite of positive benefits being derived

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[4] For both childhood age intervals considered, the sign of the breastfeeding variable indicated lower mortality among non-breastfeeders but neither coefficient was significant even at a very marginal level.

from breastfeeding: 1) breastfeeders could suffer nutritional deficiences due to a failure to introduce supplemental feeding around the age of six months and/or 2) a selection bias could be operating by which weak or ill children continue to breastfeed beyond the age at which healthy children are weaned. If these phenomena are operating, the appropriate program migh be one which encourages breastfeeding beyond six months (about 23 percent of the women in the sample do not breastfed beyond six months), especially for ill children, and which also includes an educational component dealing with supplemental feeding practices.

IV. PROGRAM AND POLICY IMPLICATIONS

The findings reported in this paper have implications for health programs designed to reduce mortality, for various government policies which impact on mortality and for future mortality research.

Implications for Health Programs

Screening programs which identify infants and children at high risk to mortality are an accepted part of public health services (in developing countries). To effectively reduce mortality, screening programs must be coupled with interventions which address the special problems of high risk infants and children. The design of such programs is the province of medical and public health professionals. This paper merely points out appropriate screening characteristics.

An ideal screening characteristic is one which has an independent effect on mortality and which precisely identifies a subgroup of the population at high risk to mortality. Thus, while for some purposes it is help-

ful to know that rural mortality is higher than urban mortality, this fact is not helpful for developing a screening program. Instead, the characteristics identified in this paper which are useful for screening are:

1. Age of Mother at Birth: births to women aged 20 and below and aged 40 and above have especially high NN mortality.

2. Survivorship Status of the Previous Birth: births following a birth that died have high NN and PNN mortality.

3. Birth Interval: births following a birth interval of less than 24 months have high rates of NN, PNN and childhood mortality.

4. Breastfeeding: births which are never breastfed or which were weaned in early infancy have especially high mortality in the early PNN period.

Implications for Policy

Our findings have implications for government policy in the areas of family planning, education, and female labor force participation. While setting policy may not be as quick in affecting a change in mortality levels as a program which provides special care to infants at high risk to mortality, the potential for impact is greater because government policies can be designed to attack the root causes of high mortality.

Family Planning. Our findings suggest that the national family planning program has a significant role in reducing infant and child mortality. The high levels of NN mortality among births to women at the extreme ages of childbearing indicates that the family planning program can reduce mortality by delaying the first pregnancy or women who marry below age 20 and by providing the means of limiting fertility of women above the age of 40. Similarly, the relatively high mortality in the NN, PNN and childhood periods of births which occur after a birth interval of less than 24 months is a

strong case for birth spacing. These findings have implications concerning the population to which the family planning program is targeted, the post-partum component of that program, and the educational components of the national MCH and family planning programs.

Education programs. Since World War II there has been a pervasive trend toward increasing levels of education throughout the world. This trend has occurred in Jordan as part of the development process and, no doubt, will continue. The trend has beneficial effects on the quality and richness of life, the ability of mothers to care for children and probably has contributed to recent declines in infant and childhood mortality in Jordan. The findings of this paper should be considered within the framework of increasing levels of education and should focus on mechanisms by which that trend can be influenced to impact positively on mortality levels.

Our multivariate analysis found only a weak association between parental education and mortality levels. The analysis of Akin, et.al., (1982) found a strong negative effect of mother's education on the decision to ever breastfeed and a weak negative effect of mother's education on the duration of breastfeeding. Thus, education is probably working through breastfeeding in such a way that its positive effects on ability to care for children is mitigated by the curtailment of breastfeeding among more educated women.

These findings imply that materials on infant and child care should be included in school curriculum and that such materials should be presented as part of the educational component of public health programs (e.g., to women receiving maternity care services). Elements which should be stressed include the benefits of breastfeeding all births well into infancy, the need for special care for infants too ill to breastfeed and the need for supplemental feeding at about six months of age.

Implications for Further Research

Our investigation has revealed several areas which could benefit from the additional study of existing data or from the study of certain types of data not currently available for Jordan.

Infant and childhood mortality levels. Because of the defects of the Jordan registration system, it is probable that census and survey data will be the main source of mortality estimates for the country for some years into the future. Given this prognosis, it is particularly disturbing that the IMR estimates from the JFS household survey (90 per 1000) exceed the estimates from the JFS individual woman's survey (70 per 1000) by 29 percent. This not only creates ambiguity about the current level of infant mortality in Jordan, but can be expected to plague attempts to evaluate time trends of mortality for years to come. Our analysis showed clearly that the differences between the estimates were due to differences in the CEB-CS data collected in the two surveys rather than to biases associated with different techniques of analysis.[5] An analysis of both data sets, including a review of the sampling procedure by which women enumerated in the household survey were selected for the individual woman's survey and the matching of observations contained in both data sets, might reveal the source of the data differences. Additionally, the data already collected by the Jordan Demographic Survey (1981-82) and soon to be analyzed may help clarify this issue.[6] Finally, the 1983 Jordan Fer-

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[5] We should stress that this assessment of the JFS data is not unique but is instead, quite consistent with other attempts at evaluating these data (e.g. Abdul-Aziz, 1983, forthcoming).

[6] The Jordan Demographic Survey is being conducted by the Department of Statistics of the Hashemite Kingdon of Jordan in conjunction with the International Program of Laboratories for Population Statistics. Field work was completed between November 1981 and February 1982. Analysis will begin in early 1983. Dr. A.L. Adlakha is the POPLAB project monitor

tility Survey, expected to be conducted early next year, could also contribute to the solution of this problem if care is taken to make the plan of data collection and analysis compatible with that of the earlier surveys.[7]

The effect of socioeconomic factors. Our multivariate analysis of the relationship between socioeconomic factors and mortality did not include variables pertaining to the characteristics of the respondent's dwelling units or community of residence. The JFS household questionnaire contains information on dwelling units (e.g., source of drinking water, possession of a refrigerator, etc.) and the JFS community level questionnaire contains information on the distance to various health facilities. Variables reflecting these factors could be included in subsequent analysis of the data if the observations on each data set were matched.

The effect of breastfeeding. Our analysis of the relationship between breastfeeding and mortality was hampered by the limited information on breastfeeding in the JFS data. A list of the types of data which should be collected in future surveys which investigate this relationship is as follows:

1. Reasons for never breastfeeding and for stopping breastfeeding.
2. Suckling ability at birth and at the time of stopping breastfeeding.
3. The frequency of breastfeeding at a specific age (say, at one month of age).

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[7] This survey is currently in the planning stage. It will be conducted by the Department of Statistics of the Hashemite Kingdom of Jordan and the Center for Disease Control. The current plan calls for a nationally representative sample.

4. Practices relating to supplemental feeding (say, the type and quantity of foods given at six months of age).

5. The general state of health of each birth.

6. Whether or not sick children are selected for continued breastfeeding at ages when healthy children are weaned.

Certainly, the exact procedures for collecting some (or all) of these data should be decided within the framework of the objectives of a specific survey. However, it should be noted, that an elaborate series of questions, while desirable for some purposes, is not required in order to obtain potentially useful data. For example, in the case of never-breastfed infants, it would be extremely helpful to know if the mother chose not to breast feed or if the infant (or mother) was too ill to breastfeed.

REFRENCES

Abdul-Aziz, Abdullah. (1983). "Evaluation of the Jordan Fertility Study 1976." Scientific Report No. 42, World Fertility Survey, London, England.

Akin, John, Richard Bilsborrow, David Guilkey and Barry Popkin. (1982). "Breastfeeding Patterns and Determinents in Jordan." Paper submitted to USAID/Washington in partial fulfillment of Contract number AID-NE-C-1713.

Coale, Ansley and Paul Demeny. (1966). Regional Model Life Tables and Stable Populations. Princeton. Princeton University

Coale, A.J., and Trussell, T.J. (1978). Estimating the Time to Which Brass Estimates Apply. Annex I to Fine-Tuning Brass-Type Mortality Estimates with Data on Ages of Surviving Children, by Samuel Preston and Alberto Palloni in Population Bulletin of the United Nations, no. 10-1977. New York: United Nations, Department of Economic and Social Affairs.

Sullivan, Jeremiah M. (1972). Models for the Estimation of Dying Between Birth and Exact Ages of Early Childhood. Population Studies, 26(1): 79-97.

Sullivan, J.M., A.L. Adlakha and C.M. Suchindran. (1982). "Report of a Methodology for Studying the Levels, Time Trends and Determinents of Infant and Child Mortality with Data from the 1976 Jordan Fertility Survey." Paper submitted to USAID/Washington in partial fulfillment of contract number AID-NE-C-1713.

United Nations (1972). Indirect Techniques for Demographic Estimation, Manual X, Population Studies, No. 81, United Nations, New York.

FIGURE 1
NEONATAL, POST-NEONATAL AND CHILD MORTALITY RATES
BY SEX AND BIRTH COHORT
(THE 1976 JORDAN FERTILITY SURVEY)

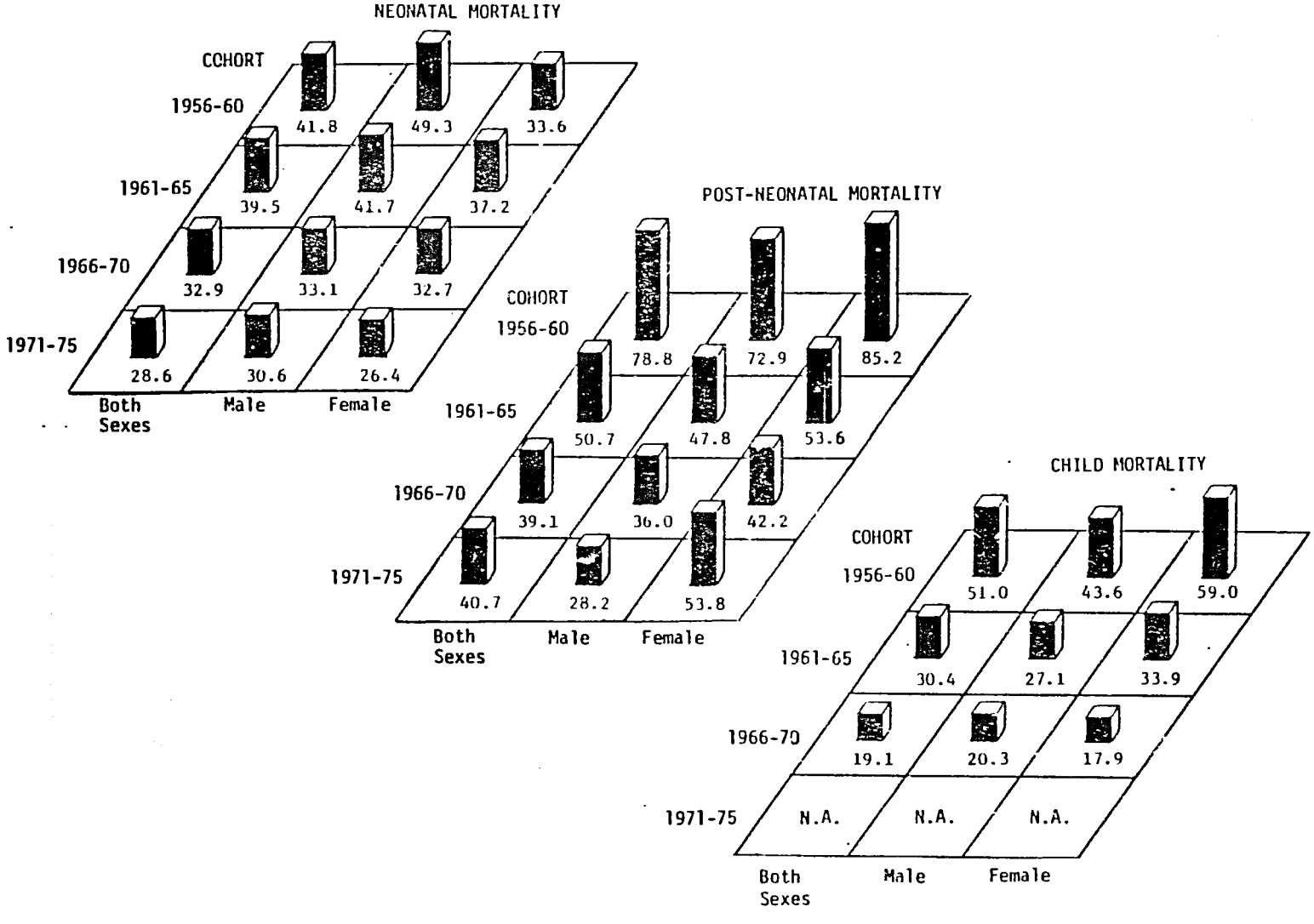

FIGURE 2

INFANT AND CHILD MORTALITY RATES
BY REGION AND BIRTH COHORT
(THE 1976 JORDAN FERTILITY SURVEY)

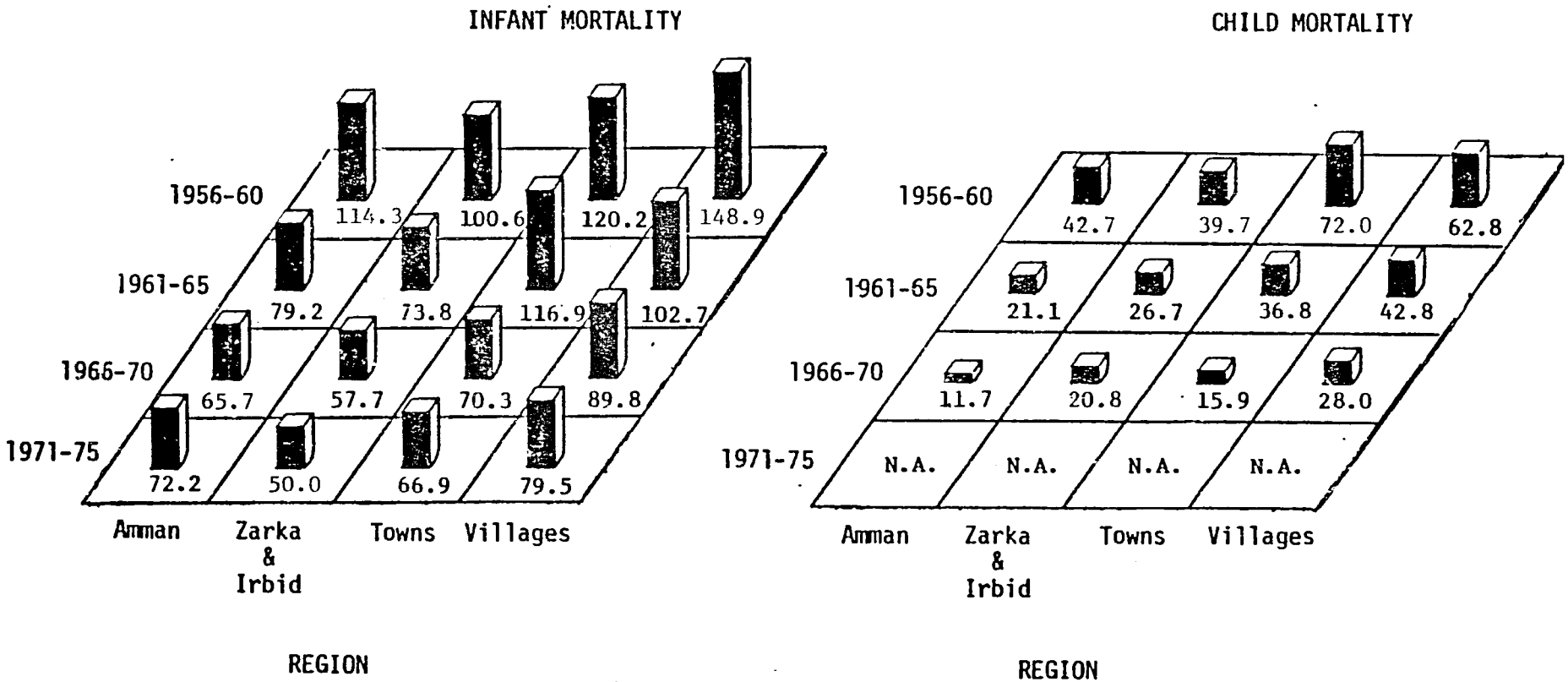

FIGURE 3

NEONATAL, POST-NEONATAL AND CHILDHOOD MORTALITY RATES
BY DEMOGRAPHIC CHARACTERISTICS FOR BIRTHS
BETWEEN 1966 AND 1975
(THE 1976 JORDAN FERTILITY SURVEY)

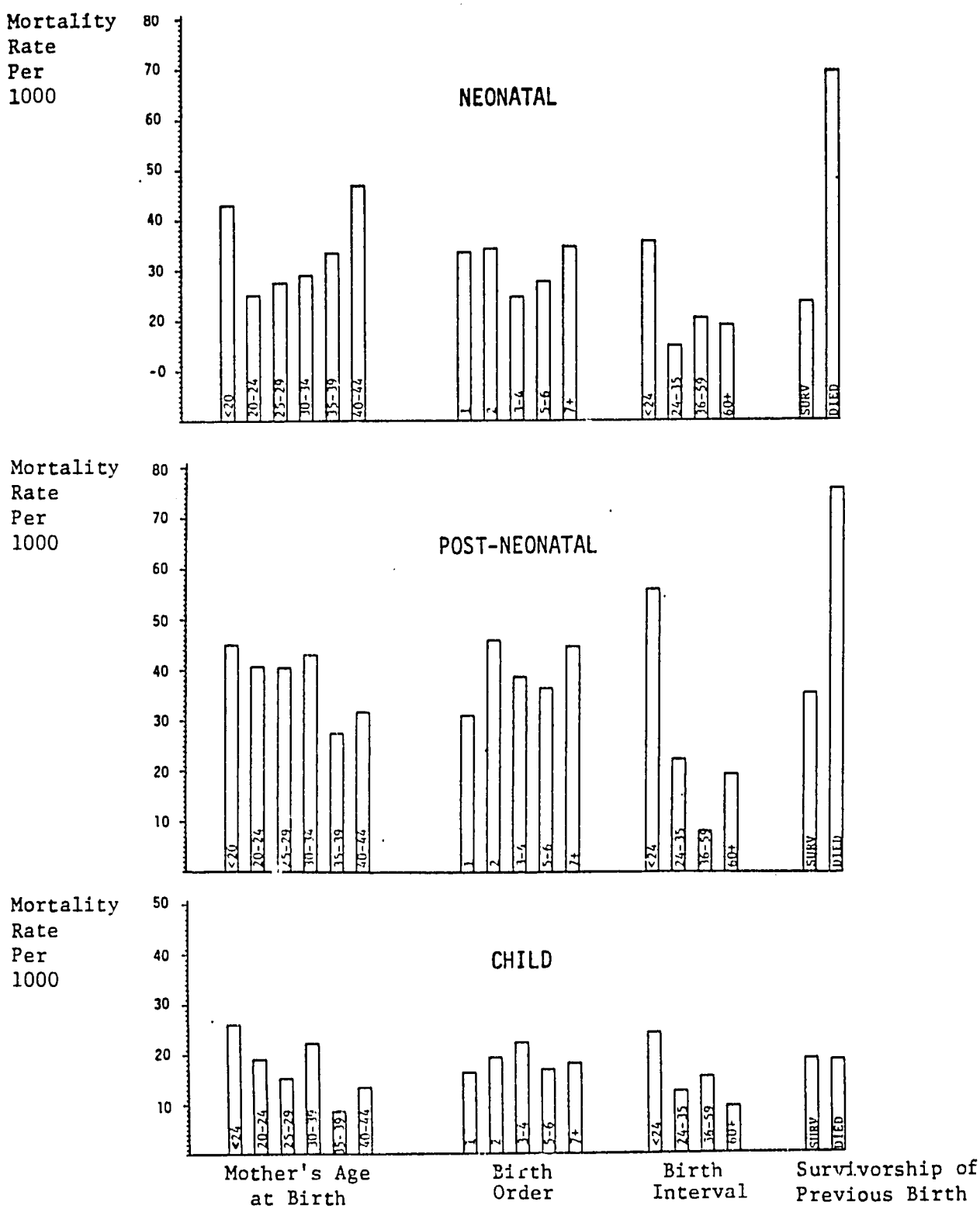

FIGURE 4

NEONATAL, POST-NEONATAL AND CHILDHOOD MORTALITY RATES
BY SOCIOECONOMIC CHARACTERISTICS
FOR BIRTHS BETWEEN 1966 AND 1975
(THE 1976 JORDAN FERTILITY SURVEY)

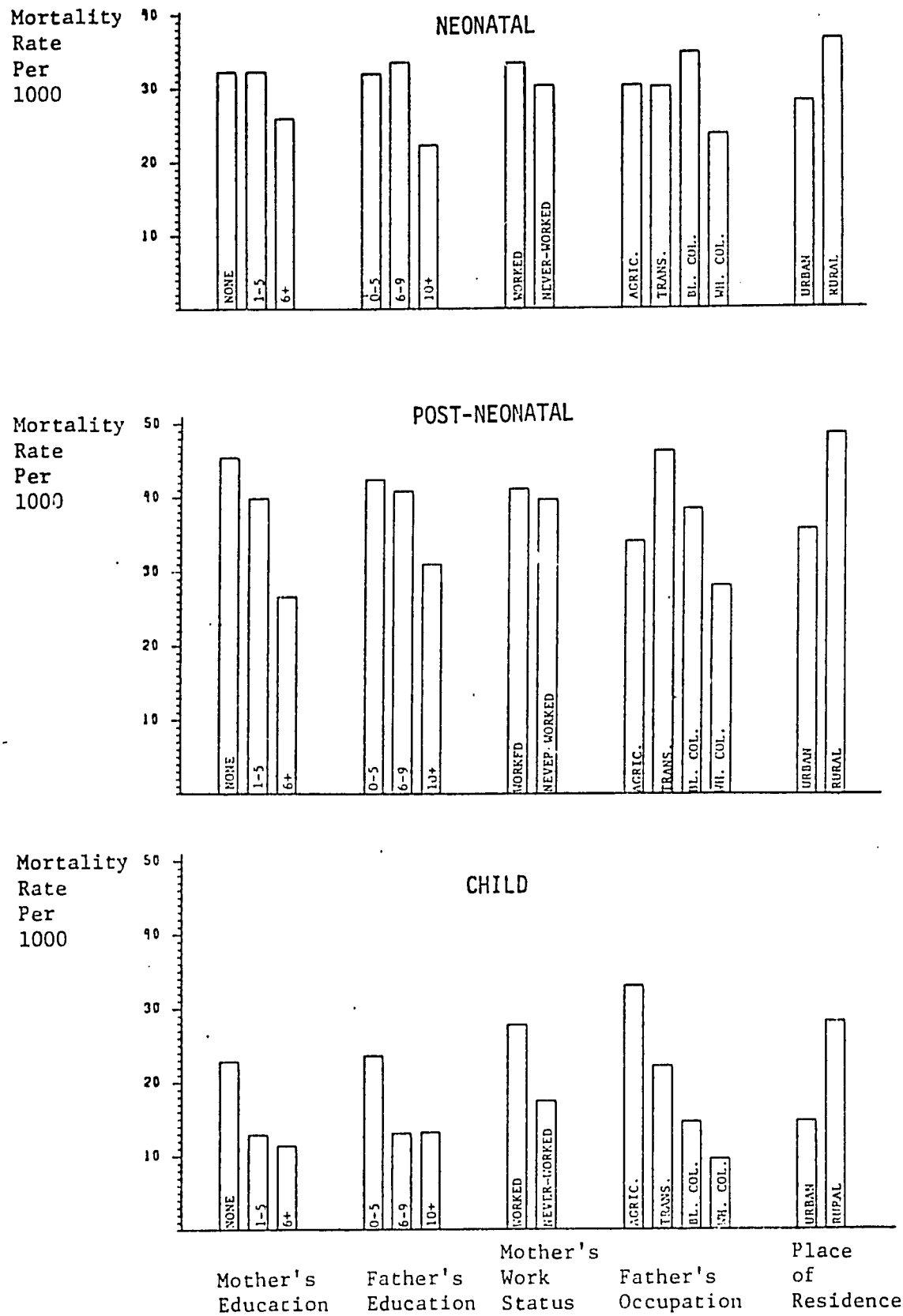

FIGURE 5

RELATIVE RISK OF NEONATAL, POST-NEONATAL AND CHILD MORTALITY BY DEMOGRAPHIC AND SOCIOECONOMIC FACTORS (THE 1976 JORDAN FERTILITY SURVEY)

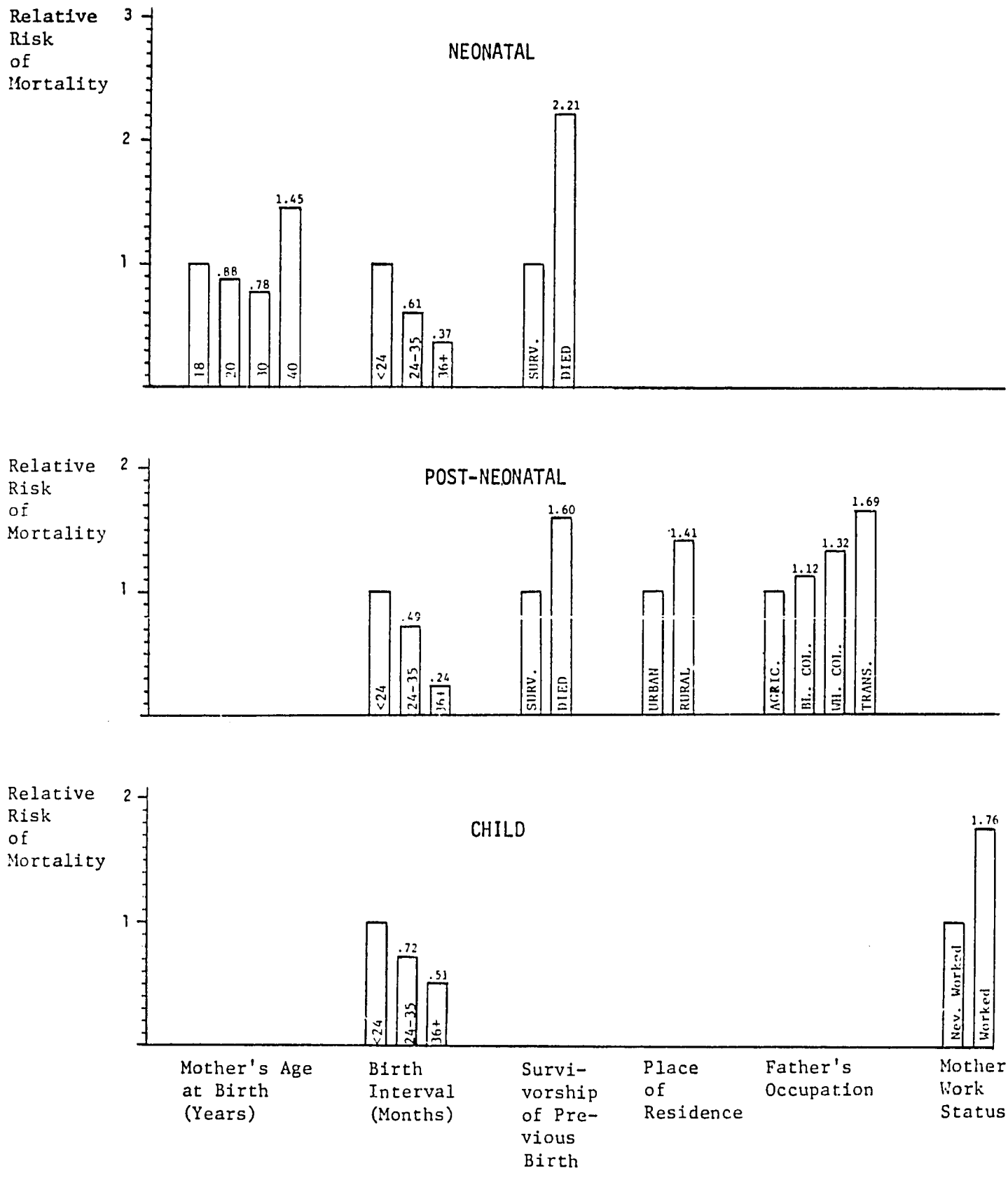

FIGURE 6
RELATIVE RISK OF POST-NEONATAL
Post-Neonatal Mortality
BY BREASTFEEDING STATUS
(THE 1976 JORDAN FERTILITY SURVEY)

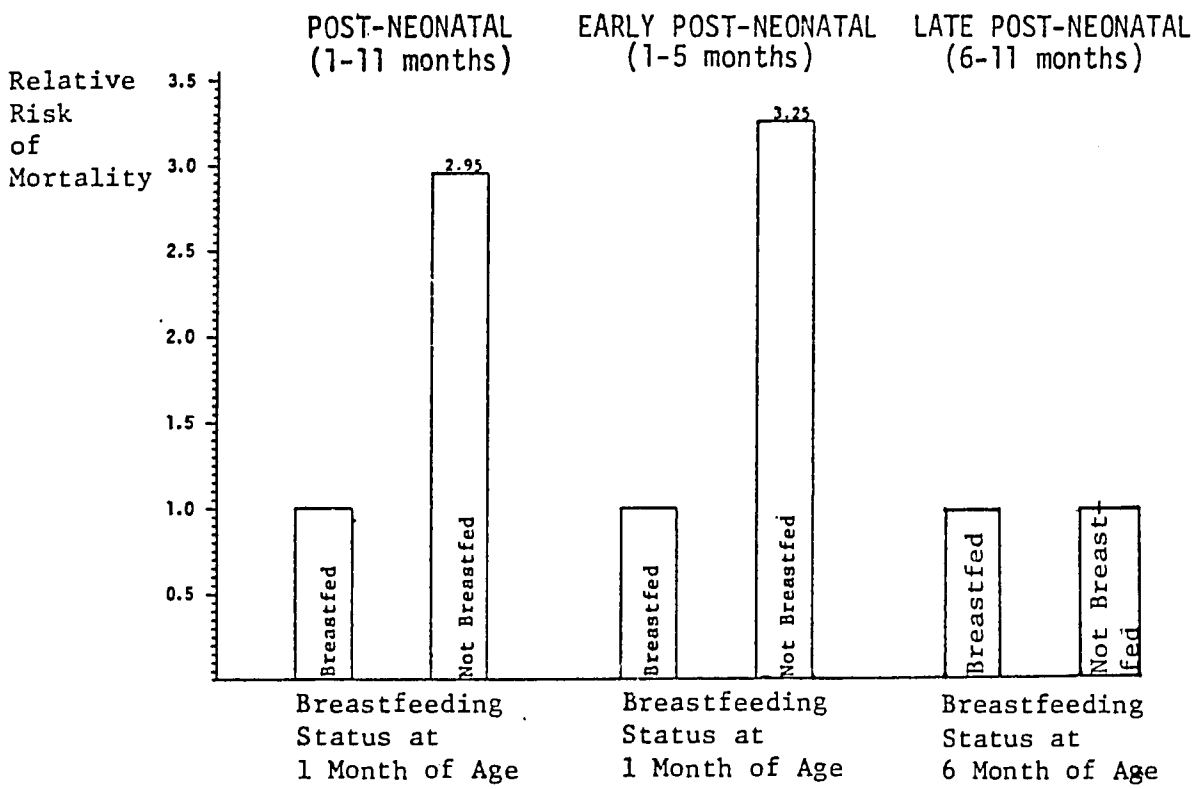

Table 1

Observed Infant and Child Mortality Rates for the Period 1966-73 and Predicted IMRs Based on Various Life Table Systems

(The 1976 Jordan Fertility Survey)

Observed Mortality Rates		Predicted IMRs ($_1\hat{Q}_0$) Based on the Observed Value of $_4Q_1$ and the Regional Model Life Table Systems			
$_1Q_0$	$_4Q_1$	West	North	East	South
		Both Sexes			
73.4	18.7	54.4 (-26%)	41.4 (-44%)	64.7 (-12%)	72.2 (-2%)
		Males			
69.1	18.2	58.0 (-16%)	43.4 (-37%)	67.0 (-3%)	76.9 (+11%)
		Females			
77.8	19.9	51.3 (-34%)	39.9 (-49%)	63.1 (-19%)	68.2 (-12%)

Notes: a) Figures in parenthesis indicate the percent deviation of predicted values ($_1\hat{Q}_0$) from directly estimated values ($_1Q_0$).

Table 2

Indirect IMR Estimates and Direct IMR Estimates for Comparable Time Periods

(The 1976 Jordan Fertility Survey)

Indirect IMR Estimates		Direct IMR Estimates[b]
Age Model[a]	Duration Model[a]	
	BOTH SEXES	
73.1 (1974)	74.7 (1975)	69.3 (1971-75)
69.5 (1972)	64.3 (1973)	
71.1 (1969)	71.7 (1970)	72.0 (1966-70)
	MALES	
68.3 (1974)	57.1 (1975)	58.8 (1971-75)
71.1 (1972)	66.2 (1973)	
66.9 (1969)	68.3 (1970)	69.1 (1966-70)
	FEMALES	
77.7 (1974)	90.6 (1975)	80.2 (1971-75)
67.7 (1972)	62.2 (1973)	
74.7 (1969)	75.0 (1970)	75.5 (1966-70)

Notes: a) Indirect estimates are from the South variant of the Sullivan age and duration models (1972). Rates are per 1000.

b) Direct estimates are based on data which are weighted and adjusted for heaping at 12 months in the reporting of age at death.

Table 3

Infant Mortality Estimates for Jordan, Various Sources

Time Period	Data Source and Estimation Technique	IMR Estimates		
		Both Sexes	Males	Females
	Registration Data			
1961[a]	Registration Data Direct Estimate	n.a.	57.8	72.4
1977[b]	Registration Data Direct Estimate	14.9	15.8	14.0
	Census Data			
1961[c]	1961 Census Data Indirect Estimate (Brass Age Model)	160	n.a.	n.a.
	1976 Jordan Fercility Survey			
1971-75[d]	Pregnancy History Data Direct Estimate	69.3	58.8	80.2
1974[e]	Pregnancy History Data Indirect Estimate (Sullivan Age Model, South)	73.1	68.3	77.7
1974[f]	Household Survey Data Indirect Estimate (Trussell Age Model, South)	90	82	87
1976[g]	Household Survey Data Indirect Estimate (Trussell Age Model, South)	89	n.a.	n.a.
1976[h]	Household Survey Data Indirect Estimate (Trussell Age Model, South)	89	n.a.	n.a.
1976[i]	Household Survey Data Indirect Estimate (Trussell Age Model, South)	89	n.a.	n.a.

Sources:
a) United Nations, 1978 a, pg. 828.
b) United Nations, 1978 b, pg. 301.
c) U.S. Bureau of the Census, 1979, pg. 210.
d) From Table 6
e) From Table 9
f) Blacker, et al., 1980.
g) Economic Commission for Western Asia, 1978.
h) United Nations, 1982, pg. 125.
i) Jaber, Kamel Abu, et al., 1980.

Table 4

Infant and Childhood Mortality Rates by Demographic Characteristics for Births Between 1966 and 1975 (The 1976 Jordan Fertility Survey)

Characteristic	Mortality Rates per 1000 Persons Exposed[a]				Persons Exposed[a]	
	Neonatal Mortality	Post-Neonatal	Infant Mortality	Childhood Mortality	NN, PNN & Infant Mortality	Childhood Mortality
Mother's Age at Birth						
<20	43.0	45.0	88.0	26.0	1479	762
20-24	25.1	40.7	65.8	19.1	2774	1490
25-29	27.7	40.5	68.2	15.3	2455	1211
30-34	29.2	43.1	72.3	22.2	1846	955
35-39	33.6	27.6	61.2	8.6	1094	538
40-44	46.9	31.8	78.7	13.4	267	82
45-49	*	*	*	*	6	0
Birth Order						
1	33.7	31.1	64.8	16.2	1343	705
2	34.3	46.0	80.3	19.2	1263	628
3-4	24.7	38.8	63.5	22.1	2323	1227
5-6	27.8	36.6	64.4	16.8	1988	1052
7+	34.7	45.0	79.4	18.0	3004	1426
Length of the Preceding Birth Interval[b]						
<24 Months	35.9	56.2	92.1	24.0	4520	2222
24-35	15.0	22.5	37.5	12.4	2587	1438
36-59	20.5	8.2	28.7	15.3	1095	530
60+	19.1	19.6	38.7	9.4	256	114
Survivorship of the Previous Birth[b]						
Survived	23.7	35.7	59.4	18.7	7821	3980
Died	69.4	76.1	145.5	18.4	637	324
TOTAL	30.7	39.9	70.6	18.7	9921	5038

a) The analysis of neonatal, post-neonatal and infant mortality excludes births that occurred within 1 year of the date of interview. The analysis of child mortality, excludes births that occurred within 5 years of the date of interview. For all analyses, mortality rates are based on weighted data while persons exposed are unweighted sample totals.

b) Excludes 1342 births which are either first order births or births of plurality more than one.

* Number of births is less than 50.

Table 5

Infant and Childhood Mortality Rates by Socioeconomic Characteristics
for Births Between 1966 and 1975
(The 1976 Jordan Fertility Survey)

Characteristic	Mortality Rates per 1000 Persons Exposed[a]				Persons Exposed[a]	
	Neonatal Mortality	Post Neonatal	Infant Mortality	Childhood Mortality	NN, PNN & Infant Mortality	Childhood Mortality
Mother's Education						
None	32.2	45.4	77.6	22.8	5819	3137
1-5	32.2	39.9	72.1	12.9	1780	883
6+	25.9	26.6	52.5	11.4	2322	1018
Father's Education						
0-5	31.9	42.4	74.3	23.5	4958	2726
6-9	33.4	40.9	74.3	13.1	3268	1515
10+	22.2	31.0	53.2	13.2	1695	797
Mother's Work Status						
Worked	33.3	41.2	74.5	27.7	1262	643
Never Worked	30.2	39.8	70.0	17.4	8659	4395
Father's Occupation						
Agriculture	30.2	34.2	64.5	32.9	1459	709
Transitional	30.0	46.4	76.4	22.1	4092	2070
Blue Collar	34.6	38.6	73.2	14.6	3419	1746
White Collar	23.6	28.2	51.8	9.6	951	510
Place of Residence						
Urban	28.0	35.9	63.9	14.7	6071	3184
Rural	36.4	48.9	85.3	28.0	3850	1859
TOTAL	30.7	39.9	70.6	18.7	9921	5038

a) The analysis of neonatal, post-neonatal and infant mortality excludes births that occurred within 1 year of the date of interview. The analysis of child mortality, excludes births that occurred within 5 years of the date of interview. For all analyses, mortality rates are based on weighted data while persons exposed are unweighted sample totals.

Table 6

The Classification of Births Used in the Regression Model
by Breastfeeding and Survivorship Status

(The 1976 Jordan Fertility Survey)

Breastfeeding Categories	Age Interval							
	1-5 months		6-11 months		1-11 months		12-59 months	
	Births	Died	Births	Died	Births	Died	Births	Died
Not Breastfed at the Beginning of the Age Interval	273	15	817	10	273	20	324	3
Never B.F.	235	13	222	4	235	17	68	1
Stopped B.F.	38	2	595	6	38	3	256	2
Breastfed at the Beginning of the Age Interval	3328	54	2715	25	3328	84	627	12
Totals	3601	69	3532	35	3601	104	951	15

Appendix on Methodology

Two problems typically occur in studies on breast-feeding. First, respondents have a preference for certain units (digits), which is manifest in a tendency to report their duration of breast-feeding in multiples of six-months (e.g., 6, 12, 18, etc.). Existing techniques of demographers for smoothing data which is artificially heaped on particular ages or digits are not appropriate for reducing the heaping in breast-feeding duration data when breast-feeding is to be the dependent variable in a functional relationship.

The statistical estimation technique we use to correct for the digit preference problem also eliminates the second problem, the fact that the reported duration of breast-feeding is truncated, either by the birth of another child (in the case of births before the last birth) or by the date of interview (in the case of the last birth). In the case of the former, the birth of the last child truncates the previous child's breast-feeding not due to actual cessation of breast-feeding because the methods of data collection and coding used by WFS censure the breast-feeding behavior of the many mothers in low-income countries who continue breast-feeding during the first or even the second trimester of pregnancy. Statistically, the truncation problem means that the actual duration of breast-feeding is not observed for a significant proportion of children in the sample.

In the technical paper on Jordan (which this summarizes) and in a previous paper on Sri Lanka (see References), we explain why the two data problems of digit preference and truncation by interview or pregnancy make it inappropriate to use the usual statistical estimation technique of ordinary least squares regression. It is necessary to reformulate the variable being investigated, duration of breast-feeding, as an either/or breast-feeding continuation decision variable; that is, at each age of the child in months, determine whether he/she is breast-fed (=Yes) or not (=No). Children whose reported duration is (usually incorrectly) given in multiples of six are randomly assigned to the month number on either side (i.e., if twelve is reported either eleven or thirteen is randomly designated). The statistical analysis examines the factors ("explanatory variables") that influence whether the woman continues breast-feeding the child beyond the chosen cut-off date or not. The estimation technique is called the probit procedure.

Various cut-off dates are used to check the stability of the results, and, in particular, whether the factors influencing breast-feeding continuation decision differ among women who tend to be relatively longer or shorter duration breast-feeders. The duration groups are identified by breaking the sample into two groups. We used 0 and 9 months (=short duration breast-feeders) and 10 months plus (=long duration), so that our empirical work amounts to testing what factors influence women who are short-breast-feeders to continue from 0 - 4 to 5-9 months, and what factors influence the long-duration

breast-feeders to continue from 10 to 14 to at least 15 months. Factors influencing the continuation decisions of short-duration and long-duration breast-feeders may well differ. For example, the major factors influencing the decision to extend a relatively short period of breast-feeding will tend to be psychological or biological in nature, while those important in determining the extent to which women who have already breast-fed their child a substantial number of months continue to breast-feed will more often tend to be social and economic. While the choice of the nine month break is arbitrary, of the several break points tried it seemed to give the most reasonable results.