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Levels, Trends and Differentials of Infant and Child Mortality in Yemen

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I. Introduction

Yemen, a mountainous and fertile country, is situated in the southwestern corner of the Arabian Peninsula. The census estimates show a total population of 6.5 million on February 1, 1975, including 1.2 million Yemenis abroad on census night (Allman and Hill, 1978). Information on fertility and mortality is scarce. Estimates show a crude birth rate of 46 per 1000 and a crude death rate of over 25 per 1000 in 1976. The infant mortality is estimated to be 210 per 1000 (United Nations, 1979; Allman and Hill, 1978).

In this paper we study the levels, trends, and differentials of infant and child mortality in Yemen. The data used in this study are from the 1979 Yemen Fertility Survey conducted as a part of the World Fertility Survey. A brief description of the data and its quality is given in Section II. Section III presents information on time trends in infant and child mortality for Yemen and for the major regions of Yemen. Infant and child mortality differentials by selected demographic and socioeconomic variables are given in Section IV. Section V presents the results from multivariate regression analysis performed to study the net effects of selected demographic and socioeconomic factors. The effect of breastfeeding on infant and childhood mortality is studied separately and is discussed in Section VI.

Mortality rates for four age intervals of life are presented in the paper. The definitions of these rates are consistent with conventional demographic usage. The infant mortality rate (${}_1q_0$) represents the probability of dying between birth and one year of age. The neonatal rate is the probability of dying between birth and one month of age, while the post neonatal rate represents the probability of a birth dying in the last 11 months of infancy (i.e., neonatal and post neonatal rates sum to the infant mortality rate). The child mortality rate (${}_4q_1$) represents the probability of a child who survives to age one dying between age one and age five.

A few points about the Yemen Fertility Survey data which affect our analysis should be clarified. First, the data evaluation in Section II found that the data on age at death suffered from age misreporting (heaping at 12 completed months of age). An adjustment was made to correct this defect. For about one percent of the deaths, there was no information available on age at death. They were excluded from the study.

The second point concerns the types of data available for the study of the determinants of mortality. A wide variety of factors are related to infant and child mortality levels. These can be grouped under the headings of genetic, demographic and socioeconomic factors. Genetic factors, which include such things as birth defects and birth weight, are particularly important in determining mortality rates within a few days of birth. Demographic factors refer to the attributes of a birth which are biologically determined (e.g., mother's age at birth and birth order). In general, these factors influence the state of health of a newborn and are particularly influential in determining neonatal mortality rates. Socioeconomic factors are those characteristics of the parents or household which determine the quality of the environment to which an infant or child is exposed. A great many variables representing socioeconomic characteristics have been shown to be associated with infant and child mortality. Some of the variables found to be strongly related to mortality are the following: social class, parental education, household income, mother's work status, housing conditions, availability of piped water, breastfeeding and supplemental feeding practices, prenatal maternity care and access to preventive and curative health services. These factors usually impact more strongly on late infant and early child mortality than on neonatal mortality.

In the individual woman's survey there is no information about genetic influences on mortality, but there is a rather complete set of variables on demographic factors and a fair number of variables representing socioeconomic variables. Potentially important socioeconomic factors on which we have no

information are household income, housing conditions, availability of piped water, supplemental feeding practices, prenatal care and access to health services. Thus, variables which specifically represent these factors are not included in our analysis.

The third point affecting analysis concerns the type of information available for studying the relationship between breastfeeding and mortality. The information on breastfeeding is extremely limited and the sample is very selective. For this reason analysis of the effects of breastfeeding on mortality was carried out separately from the main analysis pertaining to differentials.

II. Evaluation of Data

The 1979 Yemen Fertility Survey collected pregnancy history data from ever married women by means of an individual woman's questionnaire. For each reported birth, data were collected on the date of birth, sex, survival status and, if appropriate, age at death. The coding of age at death was in terms of completed months of age. We evaluate the quality of these data by the analysis of 1) sex ratios at birth, 2) age distributions of deaths and proportions of unknown deaths, 3) truncation bias, and 4) ratio of deaths in the neonatal and post-neonatal periods. For the purpose of data evaluation, the data are grouped into one ten year birth cohort (1946-55), four five year birth cohorts (1956-60, 1961-65, 1966-70, and 1971-75) and one two year birth cohort (1976-78).

Sex Ratio at Birth

The retrospective information on vital events could suffer from sex-selective recall of births because the attitude favoring male children prevails in many societies. An examination of sex ratio at birth, which varies within a relatively narrow band of 100 to 107, is commonly used to detect this problem. Sex ratios by period of birth from the Yemen Fertility Survey (YFS) are shown in Table 1. For all births the sex ratio is 109, which is slightly above the normal expected range. The sex ratios for different periods shown in Table 1 vary between 102.4 and 126.1, which is reasonable, judging from the size of the sample on the basis of which of these ratios are calculated, except for the birth cohort 1966-70. However, for the birth cohort 1966-70, the sex ratio among infant deaths is 104.4, which does not indicate a sex selective recall among deaths. This analysis, therefore, does not show that the sex selective recall problem is very serious in this data set.

Age Reporting of Deaths

Data on age at death suffered from two kinds of problems: 1) age mis-

reporting and 2) missing information on age at death.

Overall for about 1 percent of the total deaths reported in the survey complete information on age at death was not available. This percent figure was generally lower for recent birth cohorts. Further, if the survey reported the year of death, but the month was missing, by matching with the year of birth it was possible to determine the age interval (in years) in which the death occurred. However, if the death occurred before age one, it was not possible to assign it to the neonatal/post-neonatal segment. No further adjustment was performed to correct this deficiency; as such, the rates reported here are understated to a certain degree.

An examination of the age at death distribution in completed months during the first 24 months of the YFS data shows that heaping occurs at 6, 12, 18 and 24 months of age (Figure 1). The degree of heaping is most pronounced at 12 months, indicating a net transfer of deaths out of infancy, which would tend to negatively bias infant mortality rates. Moreover, heaping at 12 months is more pronounced in the earlier birth cohorts than the recent birth cohorts, a situation which would result in an understatement of the magnitude of the decline in infant mortality rates.

Three alternative procedures were used to correct for age heaping at 12 months. The first procedure involved an abritrary redistribution of half of the deaths at 12 months back into infancy (Goldman et al, 1980). The second procedure involved calculating the probabilities of dying between birth and exact age two [q(2)] from the reported number of births from 0 to 23 months of age and estimating infant mortality rates with the aid of the West and South Model life table systems of Coale and Demeny (1967). The third procedure was identical to the second, except that q(2) values were calculated after adjustin for age heaping at 24 months (by redistributing half of the deaths at 24 months to under age two). The q(2) values on which the infant mortality rates of the second and third adjustment procedures are presented in Table 3.

The infant mortality rates estimated from these procedures, along with unadjusted rates, are in Table 2. As expected, procedure II always resulted in higher rates than the unadjusted rates. The differences between these rates ranged between 8 to 26 points, indicating the high degree of heaping at 12 months in the data. Adjustments through the South model always resulted in lower rates than the unadjusted rates. The West model rates provided higher rates than the unadjusted rates prior to 1970, and low rates since then. The West model results were not surprising because of the high degree of age misreporting at death prior to 1979. Allen and Hill (1980) estimated the infant mortality of Yemen during 1975 to be 210 per 1000. This figure is higher than any of the figures for the corresponding period reported in Table 2. Because procedure I resulted in a higher rate than that of unadjusted rates, and this procedure easily facilitated the multivariate analysis, in this paper we used the conservative approach of performing all analysis using this procedure.

Truncation Bias

The pregnancy history data of the YFS, as is true with all pregnancy history data, are susceptible to truncation effects. The YFS collected retrospective data from women who, at the time of the survey, were between the ages of 15 and 49. Thus, for the time period 0 to 5 years preceding the survey, the collected data are representative of births to women of all reproductive ages. However, for the time period 20 to 25 years preceding the survey, the collected data are representive of only births to women up to age 30 (i.e., the birth data for earlier time periods are truncated). If the risk of infant mortality is correlated with mother's age at birth, the truncated data may yield biased estimates of infant mortality.

Truncation bias has the potential of being serious for time periods in which the observed distribution of births (by age of mother) differs sub-

stantially from the true distribution. The birth distributions observed in the survey by age of mother and by time period are represented in Table 5 (Panel A). The potential for truncation bias occurs in the 1946-55, 1956-60 and 1961-65 birth cohorts. In those cohorts, births under age 20 constitute 61 (231/376), 39 (234/598) and 36 (463/1304) percent, respectively, of all observed births. This contrasts sharply with the most recent birth cohort where births under age 20 constitute only 17 (338/1933) percent of observed births. Since infant mortality rates are relatively high for women under age 20, the observed data may yield positively biased infant mortality estimates for the 1946-55, 1956-60 and 1961-65 birth cohorts.

We tested for bias in the mortality estimates for 1946-55, 1956-60 and 1961-65 by a standardization procedure. Standardized infant mortality rates were computed for the 1966-70, 1971-75 and 1976-78 birth cohorts on the basis of observed (i.e., truncated) birth distributions of the 1946-55, 1956-60 and 1961-65 birth cohorts. The standardized rates provide an appropriate basis for comparison of rates across cohorts. All standardized rates showed an increase over the observed rates. This suggests that that 1946-55, 1956-60 and 1961-65 birth distributions were favorable for high death rates. However, all standardized rates preserved the same time trends noted in the observed rates.

The Proportion of Infant Deaths in the Neonatal Period

The proportion of infant deaths that occur in the neonatal period (during the first month of life) is sometimes used to assess the completeness of reporting of the neonatal deaths. The proportion of the neonatal deaths is known to vary inversely with the level of infant mortality. At levels of infant mortality in excess of 100 per 1000, it has been widely accepted that about one third of infant deaths occur in the neonatal period. This view is

based on historical data from western sources (U.N., 1954)*, and on the rationale that infectious diseases, which cause infant deaths primarily in the post-neonatal period, are primarily responsible for high infant mortality rates.

Table 6 presents infant mortality rates and the proportion of infant deaths which occur in the neonatal period as reported in the survey. The proportion of neonatal deaths averages around 30 percent during most of the periods. A slow rising trend is noticed. This rise is consistent with the slow declining trend in infant mortality. Further, proportions are also reasonable if compared to the experience of western populations. Thus, this analysis shows no apparent gross underreporting of neonatal deaths in the survey based on the criterion described above.

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* The applicability of such an age pattern of mortality within infancy among the developing populations is, however, questioned. Two recent studies that have analyzed Bangladesh data found that at levels of infant mortality 128 and 150, 60 percent of infant deaths occurred in the neonatal period (Stoechel and Chowdbury, 1972).)

III. Time Trends in Mortality Rates and Regional Differences

Levels and Trends

Table 7 presents neonatal, post neonatal, infant and child mortality rates by sex for four birth cohorts from 1961 to 1978. All the rates display a trend of declining mortality for this period.

Between 1961-65 and 1976-78, the infant mortality rate of both sexes combined declined by 39 percent (from 257 to 157), the post neonatal mortality rate declined by 43 percent (from 182 to 104), and the neonatal mortality rate declined by 33 percent (from 75 to 50). Between 1961-65 and 1971-75 the child mortality rate of both sexes combined declined by 39 percent (from 155 to 95).

The separate rates for males and females show time trend patterns which are similar to the pattern of both sexes combined. However, when rates are compared a particularly striking difference is observed. The percent of decline for NN mortality for males is twice that of females (42 percent versus 21 percent) for this period. This might be the result of a tendancy on the part of respondents to report male NN deaths with greater reliability than female NN deaths. It is well known that women in less developed regions show a tendancy not to recall very early infant deaths that occurred a long time in the past. Since male births have traditionally been given more significance than female births in Moslem cultures, it may be that these women were more likely to remember male NN deaths rather than female NN deaths. This conjecture is supported by the fact that for males the ratio of NN to PNN deaths more closely resembles the pattern observed in other countries than does the same ratio for females. It should be noted, however, that this is only conjecture and, in view of the age misreporting and missing data problems in this data set, should be viewed with some skepticisim. The trend for the IMR as a whole was quite similar for the sexes, with the rate for males being consistently higher than for females. This pattern is common to most countries and reflects the greater risks to males

of genetic defects. The child mortality rates are generally higher for females than for males. This reverse pattern of sex differences is generally observed in populations in which a preference for male children exists, and is thought to suggest the possibility of preferential care of male offspring.

Regional Estimates

Table 8 shows infant mortality rates for the four major regions of Yemen, and Table 9 shows the corresponding child mortality rates. In interpreting these rates it must be remembered that regional location was determined by place of residence at the time of the survey, but that the mortality rates pertain to time periods in the past when the respondents may have lived somewhere else. Also, the rates in the East region are based on a relatively small number of cases and thus would have relatively large sample errors. Hence, these rates should be considered only for discerning broad patterns.

The same general patterns can be observed in both the infant and the child mortality data. The rates are usually highest in the North, next highest in the West, and lowest in the South. The relative position of the East rates is unstable, probably due to the larger sampling error in the data from this region. The time trend patterns of the regional rates are similar for both infant and childhood mortality, with the exception of the East rates which showed a much larger decline than the other regions (about 60% for both IMR and CMR, versus averages of 40% for these rates). Again, this may be due at least in part to the larger sampling error in the data from this region. With one exception (South IMR in 1976-78), all regions show uninterrupted decline in both rates for the period under consideration.

IV. Bivariate Analysis: Mortality Differentials

This analysis of differentials is restricted to births which occurred in the ten year period preceding the survey, i.e. from 1970 through 1978. This restriction was applied to minimize the bias from the truncation effect. Also, the use of the most recent data minimizes the problem of memory and recall lapse that may exist in the data.

Mortality rates for the neonatal, post neonatal, infant, and childhood ages are presented for selected demographic and socioeconomic characteristics and are discussed below.

Demographic Factors

Demographic factors which are biological attributes at birth are considered proximate correlates of mortality. Age of mother at time of birth, birth order and birth interval are the demographic factors most commonly used. The earlier studies seem to show that there is apparently a range for each of these factors in which risk of infant death is minimal (U.N., 1954; Suchindran and Adlakha, 1981; Sullivan, et al, 1983). The mortality differentials by demographic characteristics are given in Table 10.

Mother's Age

Generally, infant mortality rates are very high for very young mothers, decrease to a minimum for 25-30 year olds, then rise again at first slowly, and then rapidly, as the mothers approach menopause. These age effects are considered to be both biological and behavioral. The frequency of premature or low weight births and complications associated with pregnancies varies at different ages (Shapiro, et al, 1969). There is evidence, however, to suggest that age effects are also mediated by behavioral factors, perhaps associated with the mother's increasing experience in infant care. Some of the excess mortality noted for older mothers may be due to a higher prevalence of unwanted births (Davanzo, et al, 1983).

Table 10 shows the infant and childhood mortality rates by age of mother. The infant mortality rates by mother's age display the expected U-shaped pattern. The infant mortality decreases from 204.1 when mother's age is less than 20, to 144.9 when mother's age is 30-34, a reduction of 29 percent. The rate begins to rise slowly to 172.9 when the mother is between ages 40-44. The neonatal rates follow the same age pattern as the infant mortality except that in the 40-44 age group, the rate shows a slight decline. This is perhaps due to misplacement of deaths under one month to one month, especially by older mothers. Some evidence of this can be seen in the high rate of post neonatal deaths among the 40-44 year old mothers. Except for the 40-44 year old group, perinatal mortality rates show a declining trend. The child mortality rate does not fluctuate very much with age. The small numbers of observations may be a reason for not seeing a consistent child mortality pattern.

Birth Order

The mortality of first born babies is generally high. The first born children are subject to the detrimental biological influences of primaparity and young maternal age (Davanzo, et al, 1983). Births of orders 2-5 generally experience low mortality while births of order 6 or greater experience comparatively higher mortality. The higher death rates of children of higher birth orders may be attributed to pernicious behavioral factors.

Table 10 shows that in Yemen the infant mortality rate declines from 192.2 for first order births to 149.8 for births of orders 3-4, and it rises to 190.8 for births of order 7 or more. The neonatal rates follow the same birth order pattern as the infant mortality rates. The post neonatal rate is lowest for birth order two and generally increases thereafter with the increase in birth order. The childhood mortality rates do not show a consistent pattern with the birth order.

Preceding Birth Interval

Several mechanisms have been suggested in the literature for the manner in which child spacing affects the survival of infants. The "Maternal Depletion Syndrome" (Jelliffe, 1966) is often cited as an obvious mechanism causing deleterious affects on infant and early child survival. A mother with repeated pregnancies and especially short birth intervals does not have sufficient time for both physical and nutritional recovery, and is therefore more likely to have pregnancy losses and lower birth weight babies (Hobcraft, et al, 1983; DeSweemer, 1984). In addition, birth interval may be viewed as a measure of the amount of pressure on the mother for the care of children. When a birth interval is short, there will be at least two young children in a family, this may cause severe pressure on the mother responsible for the care, and, thus result in higher infant and childhood mortality.

The infant and childhood mortality rates for various categories of birth intervals are given in Table 10. The results show that, in Yemen, the infant mortality is reduced by more than half when the previous birth interval changes from less than 24 months to 24-59 months. The rate is further reduced by half when the interval length increases to 60 or more months. The neonatal, post neonatal and child mortality rates follow a birth interval pattern similar to that of the infant mortality rates.

Survivorship of the Previous Birth

The mortality risks among children within a family are presumably correlated because they share the same environment. Also the death of a child usually results in a shorter birth interval, which as stated before can have deleterious effects on infant survival. It has been stated, for example, that a mother's grief for the death of the child can have a profound effect on the survival of the next child (DeSweemer, 1984).

The Yemen data given in Table 10 indicate that the infant mortality rate increases from 138.3 when the previous baby has survived, to 277.6 when the previous baby has died. A similar affect can be seen for mortality during neonatal, post neonatal and childhood ages.

Socioeconomic Factors

In any society the incidence of infant and child mortality, under existing levels of social and economic development, including public health and medical facilities, may very between different social and economic strata. These variations may be reflections of differentials in the sophistication of parents with relation to understanding and practice of modern methods of child care, and of differentials in their access to modern health care facilities. In this section we present results on infant and child mortality by selected parental characteristics.

Mortality rates were computed for five socioeconomic characteristics: mother's education, father's education, father's occupation, work status of mother since marriage and place of residence (Table 11). The characteristics data generally apply to the survey date while mortality data are for the longer period from 1970 to 1979. It is possible that socioeconomic conditions have changed over time. Thus, observed relationships of these variables to mortality rates are subject to this time discrepancy.

For the purpose of discussion, the selected variables can be broadly divided into three categories: 1) social class status (mother's education, father's education, father's occupation); 2) work status (whether mother has worked since marriage); and 3) residence (rural or urban).

Social Class Status

Education of parents, especially of the mother, has been found to be correlated with infant mortality (Davanzo, et al, 1983; Sullivan, et al, 1983; Suchindran and Adlakha, 1981), but not necessarily with neonatal mortality

(Niswander, et al, 1972). In addition, infant and child mortality differentials, measured in terms of income or occupation, show that mortality decreases with an increase in social class (Adlakha, 1970; Chase, 1984). The associations of these socioeconomic variables may be through their influence on their living standards, child spacing and child care practices.

Because most parents are reported to be uneducated, mortality rates for only two educational classes, literate and illiterate, are computed. Both post neonatal mortality and infant mortality are lower when the mother is literate. However, the neonatal rates are almost identical for the two educational classes of mothers. This result is consistent with the observation of Niswander, et al, that neonatal mortality is not associated with mothers' education.

The mortality rates of all ages are consistently lower among children of literate fathers, but the difference is very pronounced only during the early childhood period.

With regard to the father's occupation, pronounced differentials in mortality rates are observed between children of white collar workers and those of other workers. The children of white collar workers experience 39 percent less infant mortality and 50 percent less child mortality compared to the overall mortality experience of the population. (Note that only 5 percent of the children are born to white collar fathers.) The mortality differentials among other occupational groups are not very pronounced.

Mother's Work Status

The mother's hours of work (other than housework), her occupation, and the distance between her work place and home are generally considered factors associated with mortality during infancy and childhood. The relationships are once again indirect or through a common cause. Previous studies have shown that the association between work status and infant and childhood

mortality is not consistent. Davanzo, et al (1983) found no statistically significant association between work variables and infant and childhood mortality in Malaysia. However, in Jordan, Sullivan et al (1983) found a significant relationship.

In this study the work status of mothers was known only at the time of the survey, and therefore women were classified into only two groups based on whether or not they had worked after marriage. When births are classified into these two categories, the results show a slight decline of mortality rate among women who have never worked.

Place of Residence

Many studies have found important rural/urban differences in infant and childhood mortality (see United Nations, 1972, for review). Although a number of conditions exist in rural areas which may tend to promote health (e.g., women breastfeed more in rural areas), the investment in schools, public health and medical facilities is generally greater in urban areas, and therefore, mortality may be lower in these areas.

The effect of the place of residence on infant and child mortality is given in Table 11. For all age intervals, mortality rates are lower for urban areas than rural areas. The difference is larger (about 40 percent reduction in urban areas) during the post neonatal and early childhood period.

V. Multivariate Analysis: Net Effects

In this section we discuss the net effect of various demographic and socioeconomic factors on infant and childhood mortality. The approach followed here is that of Sullivan, et al (1983). Results are presented separately for the neonatal, post neonatal, infant and childhood age intervals. For each age interval, a logistic regression model was used to investigate the effect of the selected factors on mortality.

The logistic model is specified as follows:

$$\log\left(\frac{q}{1-q}\right) = \beta_o + \beta_1 x_1 + \ldots + \beta_r x_r + E$$

where q is an age-specific mortality rate (neonatal, post neonatal, infant or childhood),

x_i denotes an independent variable,

β_i denotes a regression coefficient, and

E is the error term.

The independent variables fitted in the model were those previously considered, namely demographic factors (mother's age at birth, length of the preceding birth interval, survivorship of the previous birth and birth order) and socioeconomic factors (mother's education, father's education, mother's work status, father's occupation and place of residence). Model I included only demographic factors, Model II only socioeconomic factors, while Model III included both sets of factors. A comparison of the β coefficients for Models I and III can determine whether any significant relationships between demographic factors and death rates are explainable through their association with the socioeconomic variables. Similarily, the comparison of the coefficients for Models II and III can determine whether any significant relationship between socioeconomic variables and death rates are explainable through their correlation with the demographic variables.

To provide an indication of the impact of an independent variable on a mortality probability, we have calculated two additional statistics for all variables found to be significant in the model: the absolute response value and the relative risk (see Sullivan, et al, 1983, for definition and the method of estimation). However, the results are discussed here in terms of relative risk, the risk of death in a specified category compared with a baseline category.

The data for the main regression model is restricted to births in the 10 years preceding the survey (1970-1978). Since earlier analysis showed that the length of the preceding birth interval and survivorship of the previous birth are strongly associated with mortality rates, these variables are included in the analysis; this requires restricting the data set to births of order two or higher.[1)]

Neonatal Mortality (NN)

Table 12 presents regression results for the neonatal period. Model I indicates all demographic variables (age, birth order, length of preceding birth interval and survivorship of previous birth) have a significant effect on NN mortality. A comparison of Models I and III indicates that the significant effects of the demographic variables remain after controlling for the socio-economic factors.

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1) To determine if our findings concerning the net effects of particular factors on mortality are valid when first births are added to the universe we ran regression models dropping the variables concerning length of the preceding birth interval and survivorship of the previous birth with data from Jordan Fertility Survey (Sullivan et al, 1983) and Egyptian Fertility Survey (Adlakha, et al, 1983). The model was run with data exclusive as well as inclusive of first order births. The results were identical for neonatal and post neonatal mortality; dropping the variables did not make any change. For infant and child mortality, the exclusion of first order births from the universe did not make any significant change in the results. However, when the two demographic variables were dropped the effect of birth order changed from non-significance to significance. Since the dropped variables are correlated with birth order, this result is not a surprising one.

The neonatal mortality rates show a linear decline with age. The decline is marginally significant. The slight upward trend with age is not statistically significant. This type of age pattern is very common among populations with very high rates of mortality. Although the neonatal mortality is high at all ages, the neonatal mortality was reduced by 42 percent when mother's age at birth changed from 18 to 30 (Table 13).

The birth order is found to have a significant positive relationship to NN mortality. The risk of NN mortality is 1.6 times as great when birth order changes from 2 to 7.

The preceding birth interval shows a significant negative relationship to NN mortality. When the birth interval changes from 12 to 24 months, the risk of NN mortality is reduced by at least 40 percent. A significant net effect of preceding birth interval, after controlling for the death of the previous child and socioeconomic factors, indicates that these variables cannot fully account for all birth interval effects.

The survival of the previous birth implied a lower NN mortality. The risk of NN death is 2-3 times greater when the previous birth has died than when the previous birth has survived.

Models II and III show that none of the socioeconomic factors considered have a significant net effect on the neonatal mortality. Although not statistically significant, the results show lower neonatal mortality rates when the mother is literate, when she has never worked, or when the father is a white collar worker.

Post Neonatal Mortality (PNN)

Among the demographic factors, only the length of the preceding interval and the survivorship of the previous birth extend an influence on post neonatal mortality. Unlike neonatal mortality, the age of the mother and the birth order had no significant impact on the post neonatal mortality (Table 14).

The length of the preceding interval shows a negative effect on the PNN mortality. The risk of PNN mortality is reduced by 60 percent when the birth interval changes from 12 to 36 months.

The survivorship of the previous birth had significant impact on PNN mortality. The risk of PNN mortality is 1.63 times greater when the previous infant has died than when it survived (Table 15).

As seen in Table 10, the PNN mortality is very high at older ages and among all birth orders. It is hypothesized that part of the age-parity effects can be affected through child spacing (e.g., births of very high orders among young mothers means short child spacing) (Hobcraft, et al, 1983). In Yemen, it seems that age and parity effects are fully accounted for through child spacing and child survival (births of high orders are most likely to die during the neonatal period).

Among the socioeconomic variables only place of residence is found to have a statistically significant net effect on PNN mortality. The risk of PNN mortality in rural areas is 1.4 times greater than in urban areas.

Infant Mortality

Results of infancy (i.e., NN and PNN periods combined) need not necessarily follow from the separate analysis of the NN and PNN periods. Since the standard type of analysis looks at infant death as one category we present here the results in that format (Table 16 and 17).

The results for infant mortality combines the results from both the neonatal and post neonatal period. As in the PNN period, mother's age has no significant effect on infant mortality. But birth order shows significant positive effects. Like NN and PNN mortality, both the length of the preceding birth interval and the survivorship of previous birth show significant influence on infant mortality. Infant mortality is reduced by almost fifty percent when the birth interval increased from 12 to 36 months. Also, the infant mortality almost doubled

when the status of the previous birth changed from "alive" to "dead". Among the socioeconomic factors, only the place of residence affects the infant mortality. Parental education is not significantly related to infant mortality. Similar results have been observed in other studies (Davanzo, et al, 1983). One reason for this result may be that in Yemen 98 percent of the births occurred to illiterate women. Mother's work status and father's occupation are also found to have no significant effect on infant mortality. When mother's education and other proximate variables are taken into account, status variables, such as father's occupation and work status, are generally less important determinants of infant mortality (Cochrane, et al, 1980). Also, it should be remembered that in the present study these status variables were measured at the time of the survey, not at the time of birth of the children.

Child Mortality

The net effect of demographic and socioeconomic variables on child mortality rates differed from the effect of these variables on infant mortality (Tables 18 and 19).

Among demographic variables, only the length of the preceding birth interval shows any significant net effect. The risk of death is reduced by 60 percent when the birth interval increases from 12 to 36 months.

Among socioeconomic factors father's occupation and place of residence show a significant net effect on childhood mortality. The children of white collar workers show a lower rate of mortality than the children of agricultural workers (not statistically significant); however, the children of transitional workers show a significantly high mortality. The child mortality of the transitional group is 1-2 times greater than that of the agricultural group. Also, the risk of child mortality is 2.3 times greater in rural areas than in urban areas.

Parental education and mother's work status are found to have no significant net effect on childhood mortality. Only 2 percent of the children who survived

to age one were offspring of mothers classified as literate in the survey. However, almost 40 percent of such children were offspring of fathers classified as literate. Although the father's education is generally negatively correlated to child mortality, it is a less important determinant of child mortality when other proximate variables are taken into account.

VI. Breastfeeding: Gross and Net Effects on Mortality

Breastfeeding influences mortality in two ways. As a direct effect breastfeeding, due to its nutritional value, influences the health of the infant, and thereby increases chances of survival. Breastfeeding also indirectly affects the child's survival through its influence on child spacing. Early cessation of breastfeeding increases the risk of pregnancy, resulting in a short birth interval, which as discussed earlier, is found to have deleterious effects on child survival. Although full breastfeeding (without supplements) is found to substantially reduce the mortality of infants, very long full breastfeeding can be detrimental to a child's health, for it does not provide enough energy for the older infant. Therefore, it is postulated that the effect of full breastfeeding on mortality becomes positive during the last months of the first year (Davanzo et al, 1983; Rowland, et al, 1981).

The Yemen Fertility Survey collected information on whether the birth was breastfed and, if breastfed, the duration of breastfeeding, for the last two births of respondents. Several aspects of the data limit their suitability for an analysis of the relationship between breastfeeding and mortality. First, the information on breastfeeding is extremely limited. The data do not provide information on 1) the frequency of breastfeeding and supplemental feeding, and 2) the reasons for never breastfeeding or cessation of breastfeeding. Second, there is evidence that information on the duration of breastfeeding was not always accurately reported by respondents.[2] Third, the universe consisting of the last two births of women constitute a very selective population.[3]

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2) The evidence is of two kinds: first, the data on the duration at which breastfeeding stopped exhibited a substantial degree of heaping at 6, 12, and 18 months; second, for several cases, the duration of breastfeeding exceeded either age or age at death of the child. The latter cases were excluded from the analysis.

3) The post neonatal mortality rate of this population is found to be 105 which is slightly below the corresponding rate of 115.4 observed for all the births during the same period.

The analysis which follows is restricted to births occurring between 1970 and 1979 for which data on breastfeeding is available.[4] There were 2205 such births who had survived the first month of life; 232 of these births died during the post neonatal period. The analysis involves computing mortality rates for breastfeeders and non-breastfeeders for the following age intervals: the early PNN periods (1-5 months); the late PNN period (6-11 months); the entire PNN period (1-11 months) and the childhood age interval.[5]

Gross Effects

For the purpose of computing mortality rates, births are classified as breastfeeders or non-breastfeeders following two alternate procedures. In the first procedure, for each age interval investigated, births are classified according to their breastfeeding status at the beginning of the age interval. Mortality rates for cases classified by breastfeeding status according to this procedure are presented in Table 20. For the age interval 1-5 months, mortality rates of breastfeeders were lower than for non-breastfeeders. The mortality among the non-breastfeeders, the never breastfed and those who stopped breastfeeding during the first month is not very different in this age interval. (Only 5 percent of the children who survive to month one were never breastfed and one percent had stopped breastfeeding during the first month.) Mortality rates for breastfeeders and non-breastfeeders were almost identical during 6-11 months. The never breastfed, who constitute only five percent of children surviving to six months, however, experienced a higher mortality

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4) The life table analysis performed in this section included births between 1970 and the interview date for which breastfeeding information is available.

5) No analysis is conducted for the NN period (0 months). This is because it is probably the case that many neonatal deaths, even late neonatal deaths, occur to infants who are too ill to breastfeed, so that the causation runs from illness to breastfeeding status rather than vice-versa.

than the breastfeeders or those who had been previously breastfed. During the post neonatal period (1-11 months), the breastfeeders experienced lower mortality rates than the non-breastfeeders. For the age interval 12-59 months, the mortality rate for those who were previously breastfed was slightly lower than the rate for the breastfeeders.

In the second classification procedure births are classified as breastfeeders for each month of age on the basis of their breastfeeding status at the close of the previous month. This procedure involves the calculation of monthly death probabilities by breastfeeding status and the calculation of mortality rates for broad age intervals from the monthly rates (i.e., the life table approach). The life table calculations for the interval 1-11 months are illustrated in Table 21. The corresponding life table data are given in Table 22. Because of the small sample size, life table calculations were not extended beyond 12 months. Table 22 shows that for the age interval 1-5 months, non-breastfeeders have two times as great a mortality rate as the breastfeeders. However, for the age interval 6-11 months, the rate is virtually identical.

Net Effects

We further investigated the differential mortality rates for breastfeeders and non-breastfeeders among gross rates by estimating the net effect after controlling for a number of confounding factors. Logistic models were fitted with data on births of order 2 and higher for which breastfeeding data were available. The model included all demographic and socioeconomic variables used earlier and, in addition, a dummy variable which indicated the breastfeeding status of the child at the beginning of the age interval under investigation. Separate models were fitted for each of the age intervals 1-5 months, 6-11 months, 1-11 months and 12-59 months. The results are given in Table 23.

Contrary to the gross effects, the net effect of breastfeeding for 1-5

months age interval is found to be not significant. (The sign of the coefficient shows that the mortality risk is less among breastfeeders.) This contrasting result may be due to the smaller number of non-breastfeeders in the beginning of the age interval 1-5 months.

Also, the net effect of breastfeeding is not significant in the 6-11 and 12-59 months age interval. This is consistent with the gross rates in Table 20.

It is interesting to note that in the post neonatal period, the birth interval effects are still statistically significant even after controlling for the breastfeeding, the survivorship of the previous birth and a number of socioeconomic factors. It suggests that biological factors associated with short spacing (e.g., birth weight) have an important effect on the post neonatal mortality. However, in the early childhood period, the effect of birth interval becomes slightly weaker when controlled for breastfeeding behavior.

VII. Summary

This paper presents an analysis of the levels, time trends and determinants of infant and child mortality in Yemen. The data come from the individual woman's questionnaire of the 1979 Tunisia Fertility Survey which, for the collection of mortality data, employed the pregnancy history technique. Much of the analysis was conducted in terms of four mortality rates for neonatal (0 months), post neonatal (1-11 months), infant (0-11 months) and childhood ages (12-59 months).

1. An evaluation of the accuracy of the mortality data revealed two types of problems. First, evidence was found indicating misreporting of age at death. An adjustment to the data to approximately correct this defect was made. Second, for about one percent of the total deaths reported in the survey, information on the age at death was not available. No correction or adjustment was made for this problem. As a result, the estimated rates in this paper are slight underestimates of the period levels. Both of these problems were pronounced for the birth cohorts prior to 1970.

2. For the birth cohort immediately preceding the survey (1976-78), the level of infant mortality was estimated as 157 per 1000 for both sexes and 163 for males and 145 for females. For the birth cohort 1971-75, the level of child mortality was 95 per 1000 for both sexes, 78 for males and 112 for females.

3. The analysis of time trends in mortality for the 15 year period from 1961 to 1978 indicated substantial declines in neonatal, post neonatal, infant and child mortality. Neonatal mortality declined by almost 33 percent, and the post neonatal mortality by almost 43 percent. The child mortality declined by about 39 percent during the period 1961-75. This finding is consistent with the frequent observation that with the improvement of socioeconomic conditions in a population over time, mortality rates for age intervals further removed from the time of birth decline relatively faster.

4. A persistent pattern of mortality differentials by sex was found in the data. For all the birth cohorts between 1961 and 1978, male neonatal and post neonatal mortality exceeded female neonatal mortality, but male childhood mortality was less than corresponding female mortality. This pattern suggests preferential care and treatment of male offspring.

5. Estimates of infant and child mortality showed considerable regional differences. The East region experienced considerably lower risk of infant and childhood mortality than other regions. The North and West regions consistently showed very high mortality during infant and early childhood periods.

6. Analysis of mortality differentials was restricted to data on births in the 10 year period from 1970 to 1978. Differentials (without any other controls) were calculated for four demographic factors: mother's age at birth, birth order, survivorship of the previous birth and length of the preceding birth interval. Neonatal mortality rates were high among very young mothers. The post neonatal rates were high among both very young and very old mothers. The first births and birth order 7 or higher generally experienced higher death rates during infancy but not during the early childhood period. The birth interval and the survivorship of the previous birth had a significant negative influence on the mortality rate of all age intervals.

Differentials (without any other control) were investigated for five socioeconomic factors: mother's and father's education, mother's work status, father's occupation and place of residence. Mother's and father's education, father's occupation and mother's work status did not exhibit pronounced differentials. Urban areas had lower mortality than the rural areas.

7. Multivariate analysis with a logistic regression model was conducted to determine the net effect of the demographic and socioeconomic factors on infant and childhood mortality. Separate regression runs were made for the neonatal, post neonatal, infant and childhood ages. For the neonatal period

all four demographic factors had a statistically significant effect on mortality. None of the socioeconomic variables showed any significant effect on NN mortality. For the post neonatal period, the birth interval and the survivorship of the previous birth showed statistically significant negative effects. However, mother's age and birth order did not have any significant influence on the mortality during this period. Among the socioeconomic factors only place of residence showed any significant effect on post neonatal mortality. The urban residents experienced lower mortality than rural residents. The factors that significantly influenced infant mortality were birth order, birth interval, survivorship of previous birth and place of residence. For the childhood interval only the birth interval, place of residence, and father's occupation showed statistical significance. The influence of the length of previous birth interval was substantial for all age intervals. The influence seems to be biological (low birth weight associated with short spacing) as well as behavioral (competition of children for mother's time).

8. Analysis was also performed to determine the effect of breastfeeding on mortality. Separate analysis was necessary for the breastfeeding variable because the information on breastfeeding was available only for a woman's last and next to the last birth. The age intervals for which the analysis (including regression analysis) were different from the main analysis and were the early post neonatal period (1-5 months), the late post neonatal period (6-11 months) and the childhood age interval (12-59 months).

The breastfeeders in the 1-5 months age interval experienced lower mortality rates than the non-breastfeeders. However, the multivariate analysis showed that when other factors were controlled for, the difference in the mortality rates of breastfeeders and non-breastfeeders was not statistically significant. The effect of breastfeeding was not significant in 6-11 and 12-59 months of life.

VIII. Program and Policy Implications

The findings reported in this paper have implications for health programs designed to reduce 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. To effectively reduce mortality, screening programs must be coupled with interventions which address the special problems of high risk infants and children. 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. The characteristics identified in this paper which are useful for screening are:

1. Age of mother: births to women under age 20 have especially high neonatal mortality.
2. Birth order: first births and births of order 6 or greater have higher mortality, especially during the neonatal period.
3. Birth interval: births following a birth interval of less than 24 months have high rates of neonatal, post neonatal and childhood mortality.
4. Survivorship status of the previous birth: births following a birth that died have high neonatal and post neonatal mortality.
5. Breastfeeding: births which are never breastfed or which are weaned in early infancy have high mortality in the early post neonatal period.

urban/rural

This not true in Nicaragua because [illegible]

Implications for Policy

Our findings have implications for government policy in the areas of family planning and education. The results suggest that the national family planning program has a signficant role in reducing infant and child mortality.

The high levels of neonatal mortality among births to young women indicate that the family planning program can reduce mortality by delaying the first pregnancy of women who marry below age 20. Births of very high order are generally unwanted births and such births are subject to high mortality risks. Similarly, the relatively high mortality in the neonatal, post neonatal and childhood periods of births which occur after a birth interval of less than 24 months is a strong case for birth spacing. In the Yemen sample 19 percent of the births occurred to women under 20. Also, 19 percent of the births were of order 7 or more and 44 percent of the births occurred after a spacing of less than 24 months. 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.

Implications for Further Research

Our investigation has revealed several areas which could benefit from additional study.

Infant and Childhood Mortality Levels

Because the Yemen Fertility Survey is retrospective in nature, there is some evidence that the level of mortality is underestimated, especially in the past and in some special groups. The available estimates of infant mortality for the 1971-75 period (a rate of 210 per 1000) are lower than what is reported in the survey (an adjusted rate of 171 per 1000). Also, for about 1 percent of deaths the date of death was unknown. Thus, it is important to conduct further evaluative study to validate the estimates obtained in the study.

Determinants of Mortality

The Yemen Fertility Survey did not include information on a number of proximate determinants of mortality such as birth weight, duration of gestation, etc. Also, our analysis did not include variables pertaining to the respondent's

dwelling unit or community residence. Variables reflecting these factors could be very useful and should be considered in subsequent analysis.

The Effect of Breastfeeding

Our analysis of the relationship between breastfeeding and mortality was hampered by the limited information on breastfeeding. The following types of data should be collected in future surveys which investigate this relationship:

1. Reasons for never breastfeeding and for cessation of breastfeeding;
2. Suckling ability at birth and at the time of cessation of breastfeeding;
3. The frequency of breastfeeding at a specified age (say, at one month of age);
4. Practices relating to supplemental feeding;
5. The general state of health of each birth; and
6. Whether or not sick children are selected for continued breastfeeding at ages when healthy children are weaned.

Figure 1

Proportion of Deaths Under 25 Months by Age at Death and Period

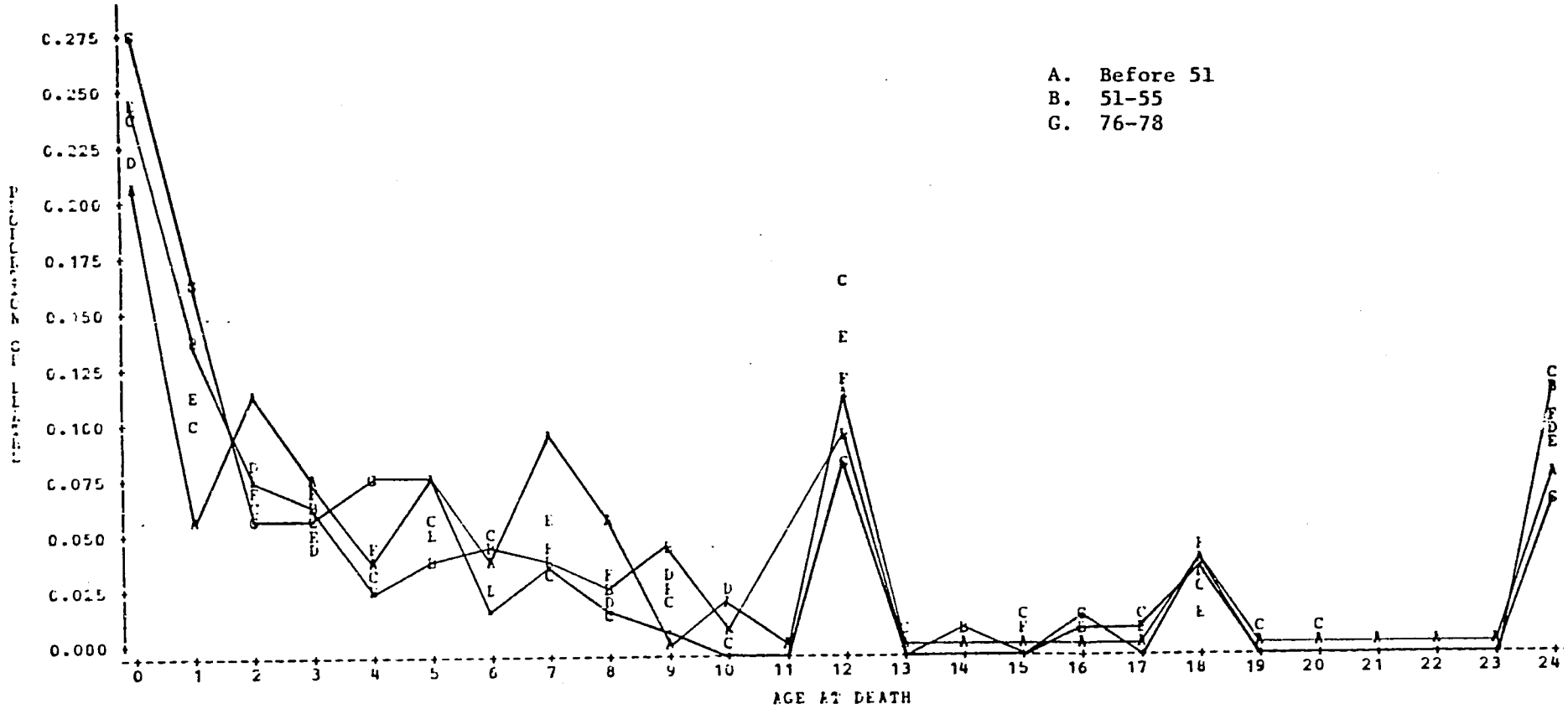

Table 1

Sex Ratios of Births and Infant Mortality Rates by Birth Cohort Based on Unadjusted Survey Data[a]

(The 1979 Yemen Fertility Survey)

Birth Cohort	Births			Infant Mortality Rates		
	Males	Females	Sex Ratio	Males	Females	Sex Ratio
1976-78[b]	981	952	102.6	153.5	137.1	112.0
1971-75	1499	1385	109.3	172.8	135.1	127.9
1966-70	1032	835	126.1	200.2	191.9	104.4
1961-65	660	644	102.4	245.6	218.4	112.5
1956-60	312	286	104.6	268.8	172.6	155.7
1946-55	197	179	115.3	341.0	261.6	130.3

Notes: a) Results are based on data which are not adjusted in any manner. Rates are per 1000.

b) Excludes births occurring within one year of the interview date.

Table 2

Unadjusted and Adjusted Infant Mortality Rates
by Sex and Birth Cohort[a]

(The 1979 Yemen Fertility Survey)

Birth Cohort	Unadjusted IMRs	IMRs Adjusted for Age Heaping at 12 Months				
		Procedure I	Procedure II		Procedure III	
			West	South	West	South
		BOTH SEXES				
1976-78[b]	148.1	156.5	131.1	124.7	136.0	128.8
1971-75	157.5	170.5	157.1	145.7	165.7	152.3
1966-70	203.6	226.6	203.7	181.9	213.8	190.1
1961-65	231.1	257.3	246.8	216.9	261.2	228.6
1956-60	224.6	246.1	243.1	213.9	260.8	228.4
1946-55	307.6	326.5	310.1	268.9	326.4	282.4
		MALES				
1976-78[b]	153.5	163.1	149.7	140.4	154.3	144.3
1971-75	172.8	184.7	166.4	153.9	174.7	160.4
1966-70	200.2	226.1	208.2	186.9	218.9	195.8
1961-65	245.6	274.3	263.5	232.7	275.2	242.4
1956-60	268.8	290.9	290.5	255.2	305.0	268.1
1946-55	341.0	353.6	331.2	289.4	347.7	303.5
		FEMALES				
1976-78[b]	137.1	145.0	112.7	109.3	117.6	113.5
1971-75	135.1	150.3	146.7	136.8	155.7	143.6
1966-70	191.9	209.5	198.2	176.1	207.7	183.6
1961-65	218.4	239.0	229.5	201.0	246.6	214.6
1956-60	172.6	190.5	195.3	173.8	215.2	189.6
1946-55	261.6	283.6	286.2	246.5	302.3	259.5

Notes: a) Rates are per 1000.

b) Unadjusted and adjusted (Procedure I) rates for 1976-79 exclude births occurring within one year of the interview date. Adjusted rates (Procedures II and III) for 1976-79 are based on q(2) values which were computed from data which excludes births occurring within two years of the interview date.

Table 3

Unadjusted and Adjusted Values of the Probability of Dying Between Birth and Age Two[a] [q(2)] by Sex and Birth Cohort

(The 1979 Yemen Fertility Survey)

Birth Cohort	Unadjusted q(2)[b]			Adjusted q(2)[c]		
	Both Sexes	Males	Females	Both Sexes	Males	Females
1976-78[d]	163.6	184.3	142.8	170.1	190.4	149.6
1971-75	197.1	205.5	187.8	207.9	215.8	199.3
1966-70	255.1	256.8	252.9	267.5	269.7	264.7
1961-65	307.3	322.7	291.5	324.4	336.3	312.2
1956-60	302.9	354.1	249.3	324.0	371.8	274.0
1946-55	381.5	400.5	359.5	400.1	419.0	378.3

Notes: a) Rates are per 1000.

b) Used to estimate IMRs of Table 2 (Procedure II).

c) Used to estimate IMRx of Table 2 (Procedure III).

d) Excludes births occurring within two years of the interview date.

Table 4

Estimates of Infant Mortality Rate from the Survey Data
and the NAS Report by Birth Cohort

(The 1979 Yemen Fertility Survey)

Survey Estimates

Birth Cohort or Period	Unadjusted	Adjusted For Age Heaping at 12 Months	Other Rates*
1976-78	148.1	156.5	210
1971-75	157.5	170.5	
1966-70	203.6	226.6	
1961-65	231.1	275.3	

* Allman and Hill (1978)

Table 5

Births and IMRs by Mother's Age at Birth and Birth Cohort[a]

(The 1979 Yemen Fertility Survey)

Mother's Age at Birth	Birth Cohort					
	1946-55	1956-60	1961-65	1966-70	1971-75	1976-77[b]
Panel A: Births						
<20	231	234	463	498	561	338
20-24	126	199	360	482	807	578
25-29	19	143	278	414	657	472
30-34	0	22	176	273	445	278
35-39	0	0	27	172	259	137
40-44	0	0	0	28	137	95
45-49	0	0	0	0	18	35
All Ages	376	598	1304	1867	2884	1933
Panel B: IMRs						
<20	332.0	228.3	299.2	268.7	192.2	193.3
20-24	315.5	282.4	256.9	215.5	166.7	152.8
25-29	233.3	223.4	233.9	187.8	171.1	156.9
30-34	*	131.9	195.6	201.8	145.3	117.2
35-39	*	*	188.5	187.4	144.8	126.7
40-44	*	*	*	187.7	191.6	149.4
45-49	*	*	*	*	101.9	174.4
All Ages	321.1	241.8	256.9	218.7	168.3	154.2
Panel C: Standardized IMRs						
Standardized on the 1946-55 Birth Dist.		246.2	281.7	246.9	182.6	177.9
% Deviation of STD. IMR from OBS. IMR		2	10	1	9	15
Standardized on the 1956-60 Birth Dist.			265.4	229.2	176.9	168.3
% Deviation of STD. IMR from OBS. IMR			3	5	5	9
Standardized on the 1961-65 Birth Dist.				226.1	174.3	163.2
% Deviation of STD. IMR from OBS. IMR				4	4	6

Notes: a) Results are based on data which are adjusted for heaping at 12 months in the reporting of age at death. Rates are per 1000.

b) Excludes births occurring within one year of the interview date.

Table 6

The Distribution of Infant Deaths Between the Neonatal and Post-Neonatal Periods[a]

(The 1979 Yemen Fertility Survey)

Birth Cohort	Neonatal Mortality Rate	Post-Neonatal Mortality Rate	Infant Mortality Rate	Proportion of Deaths in the NN Period
1976-78[b]	51.0	105.1	156.1	.327
1971-75	53.2	117.7	170.9	.311
1966-70	66.7	157.7	224.4	.297
1961-65	74.5	184.8	259.3	.287
1956-60	83.8	170.9	254.7	.329
1946-55	93.2	238.4	331.5	.281

Notes: a) Results are based on data which are adjusted for heaping at 12 months in the reporting of age at death. Rates are per 1000.

b) Excludes births occurring within one year of the interview date.

Table 7

Infant and Child Mortality Rates by Sex and Birth Cohort[a]

(The 1979 Yemen Fertility Survey)

Birth Cohort	Mortality Rates				Persons Exposed	
	Neonatal Mortality	Post-Neonatal	Infant Mortality	Child Mortality	Infant Mortality	Child Mortality
			BOTH SEXES			
1976-78[b]	50.2	104.0	156.5	-	1933	-
1971-75	52.9	115.4	170.5	94.6	2884	1805
1966-70	64.8	153.4	226.6	118.4	1867	1453
1961-65	75.3	181.6	257.3	155.3	1304	970
			MALES			
1976-78[b]	52.3	109.8	163.1	-	981	-
1971-75	61.6	121.3	184.7	77.5	1499	917
1966-70	74.5	151.6	226.1	112.9	1032	797
1961-65	90.3	184.0	274.3	158.8	660	481
			FEMALES			
1976-78[b]	47.1	97.9	145.0	-	952	-
1971-75	43.4	106.9	150.3	112.2	1385	888
1966-70	52.6	156.9	209.5	125.3	835	656
1961-65	59.9	179.1	239.0	152.0	644	489

Notes: a) Results are based on data which are adjusted for heaping at 12 months in the reporting of age at death. Rates are per 1000.

b) Excludes births occurring within one year of the interview date.

Table 8

Infant Mortality Rates by Region and Birth Cohort

(The 1979 Yemen Fertility Survey)

Region	Birth Cohort			
	76-78	71-75	66-70	61-65
	Rates			
North	169.1	217.6	259.2	317.4
South	135.6	119.7	170.9	177.9
West	171.3	174.6	242.2	279.9
East	105.8	166.1	183.5	291.8
Total	154.2	168.3	218.7	256.9
	Persons Exposed			
North	678	975	637	475
South	723	1136	727	497
West	416	625	418	285
East	116	148	85	47
Total	1933	2884	1867	1304

Notes: a) Rates are based on data which are adjusted for heaping at 12 months in the reporting of age at death. Rates are per 1000.

b) Excludes births occurring within one year of the interview date.

Table 9

Childhood Mortality Rates by Region and Birth Cohort

(The 1979 Yemen Fertility Survey)

Region	Birth Cohort		
	71-75	66-70	61-65
Rates			
North	121.0	148.4	191.7
South	68.9	93.4	100.6
West	108.1	114.1	196.4
East	65.3	146.3	165.3
Total	94.6	118.4	155.3
Persons Exposed			
North	570	472	322
South	761	602	408
West	385	310	206
East	89	69	34
Total	1805	1453	970

Note: a) Rates are based on data which are adjusted for heaping at 12 months in the reporting of age at death. Rates are per 1000.

Table 10

Infant and Childhood Mortality Rates by Demographic Characteristics for Births Between 1970 and 1978

(The 1979 Yemen 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	79.9	124.3	204.1	106.1	981	412
20-24	46.9	120.2	167.1	97.2	1481	586
25-29	57.1	114.0	171.2	94.8	1222	485
30-34	42.3	102.6	144.9	105.1	784	321
35-39	50.7	98.8	149.5	95.5	444	199
40-44	31.3	141.6	172.9	73.1	250	94
45-49	106.4	45.3	151.7	*	53	2
Birth Order						
1	75.1	117.1	192.2	95.5	1010	392
2	58.3	105.3	163.6	101.3	846	352
3-4	38.7	111.1	149.8	96.4	1424	592
5-6	48.1	115.7	163.8	117.5	970	417
7+	62.1	128.8	190.8	79.0	965	346
Length of the Preceding Birth Interval[b]						
<24 months	63.4	163.4	226.9	140.7	2275	914
24-35 months	41.6	67.1	108.7	18.3	956	385
25-59 months	23.1	60.4	83.4	2.0	450	182
60+	16.7	39.4	56.1	3.3	506	222
Survivorship of the Previous Birth[b,c]						
Survived	37.1	101.2	138.3	95.2	3406	1405
Died	98.0	179.6	277.6	114.0	756	290
TOTAL	55.0	115.4	170.4	98.3	5215	2099

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.

b) Excludes 1028 births which are either first order births or births of plurality more than one.

c) Excludes 25 births for which the information on the age at death of the previous birth was missing.

*) Number of births is less than 50.

Table 11

Infant and Childhood Mortality Rates by Socioeconomic Characteristics for Births Between 1970 and 1978

(The 1979 Yemen 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						
Literate	55.1	55.3	110.5	*	109	45
Illiterate	55.0	116.7	171.8	155.5	5106	2054
Father's Education						
Literate	52.4	108.8	161.2	135.7	2105	860
Illiterate	56.9	119.9	176.8	166.1	3110	1239
Mother's Work Status						
Worked	60.7	115.6	176.2	167.1	2329	929
Never Worked	50.2	115.2	165.4	142.1	2886	1170
Father's Occupation[b]						
Agriculture	57.2	126.9	184.0	173.0	1906	798
Transitional	52.5	120.4	172.9	162.3	1140	468
Blue Collar	57.9	101.5	159.5	123.9	1495	571
White Collar	29.5	74.6	104.2	76.6	256	111
None	*	*	*	*	48	18
Place of Residence						
Urban	47.5	80.7	128.2	93.9	720	315
Rural	56.2	120.7	176.8	163.9	4495	1784
TOTAL	55.0	115.4	170.4	153.4	5215	2099

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.

b) Excludes 370 births for which information on father's occupation was missing.

Table 12

Net Effects on Neonatal Mortality Probabilities of Demographic and Socioeconomic Factors

(The 1979 Yemen Fertility Survey)

Variable	Regression Results by Model					
	Model I Demographic Variables		Model II Socioeconomic Variables		Model III All Variables	
	Beta Coeff.	Std. Error	Beta Coeff.	Std. Error	Beta Coeff.	Std. Error
Intercept	-.664	1.024	-3.641**	.509	-1.169	1.123
Mother's Age at Birth						
Age	-.124+	.073	-	-	-.143+	.075
Age Squared	.002	.001	-	-	.002	.001
Birth Order	.088*	.035	-	-	.101**	.036
Length of Preceding Birth Interval	-.021**	.006	-	-	-.022**	.006
Survivorship of Previous Birth						
Survived	-.464**	.080	-	-	-.449**	.080
Died	.464**	.080	-	-	.449**	.080
Mother's Literacy						
Illiterate	-	-	.584	.511	.638	.514
Literate	-	-	-.584	.511	-.638	.514
Father's Literacy						
Illiterate	-	-	-.028	.080	-.023	.081
Literate	-	-	.028	.080	.023	.081
Mother's Work Status						
Worked	-	-	.104	.080	.131	.082
Never Worked	-	-	-.104	.080	-.131	.082
Father's Occupation						
Agriculture	-	-	.119	.426	.097	.423
Transitional	-	-	.153	.161	.158	.162
Blue Collar	-	-	.198	.165	.147	.167
White Collar	-	-	-.470	.358	-.402	.359
Place of Residence						
Urban	-	-	.013	.125	-.045	.127
Rural	-	-	-.013	.125	.045	.127
Number of Observations	3889		3889		3889	
Model of Chi-Square	70.41**		7.14		79.52**	
Degrees of Freedom	5		7		12	
D Statistic	0.200		0.000		0.191	

Notes: a) The regression models were fit with the maximum likelihood procedure so the standard R-square statistics could not be computed. However, the quantity "D" which has an interpretation similar to R-square was computed (Harrell, 1980).

Symbols: + Significant at the 10% level.
* Significant at the 5% level.
** Significant at the 1% level.

Table 13

Neonatal Mortality: Absolute Mortality Differential and Relative Risk Ratios for Selected Factors

(The 1979 Yemen Fertility Survey)

Variable	Absolute Mortality Differential	Relative Risk Ratio
Reference Neonatal Mortality Rate: 53.0[a]		
Mother's Age at Birth		
from 18 to 20	-6.3	0.880
25	-16.8	0.683
30	-22.1	0.582
35	-24.0	0.547
40	-23.0	0.566
Birth Order		
from 2 to 3	5.3	1.100
5	17.5	1.329
7	31.9	1.602
Length of the Preceding Birth Interval		
from 12 to 24	-11.8	0.778
36	-21.0	0.603
Survivorship of the Previous Birth		
from Alive to Dead	67.7	2.278

Notes: a) For the calculation of the reference mortality rate, all variables in Model III (Table 12) were set at their mean values except the following:

Variable	Reference Value
Mother's Age at Birth	18 Years
Birth Order	2
Length of the Preceding Birth Interval	12 Months
Survivorship of the Previous Birth	Alive

Table 14

Net Effects on Post-Neonatal Mortality of Demographic and Socioeconomic Factors

(The 1979 Yemen Fertility Survey)

Variable	Regression Results by Model					
	Model I Demographic Variables		Model II Socioeconomic Variables		Model III All Variables	
	Beta Coeff.	Std. Error	Beta Coeff	Std. Error	Beta Coeff.	Std. Error
Intercept	-1.563*	.764	-2.247**	.218	-1.622*	.780
Mother's Age at Birth						
Age	.039	.054	-	-	.023	.055
Age Squared	-.001	.001	-	-	-.000	.001
Birth Order	.021	.025	-	-	.033	.026
Length of Preceding Birth Interval	-.040**	.005	-	-	-.041**	.005
Survivorship of Previous Birth						
Survived	-.304**	.060	-	-	-.290**	.060
Died	.304**	.060	-	-	.290**	.060
Mother's Literacy						
Illiterate	-	-	.106	.221	.124	.225
Literate	-	-	-.106	.221	-.124	.225
Father's Literacy						
Illiterate	-	-	.027	.055	.008	.057
Literate	-	-	-.027	.055	-.008	.057
Mother's Work Status						
Worked	-	-	-.040	.054	-.006	.055
Never Worked	-	-	.040	.054	.006	.055
Father's Occupation						
Agriculture	-	-	.156	.249	.139	.254
Transitional	-	-	-.116	.103	-.098	.105
Blue Collar	-	-	.086	.104	.021	.106
White Collar	-	-	-.126	.202	-.062	.205
Place of Residence						
Urban	-	-	-.135	.089	-.197*	.090
Rural	-	-	.135	.089	.197	.090
Number of Observations	3699		3699		3699	
Model Chi-Square	149.85**		11.89		163.84**	
Degrees of Freedom	5		7		12	
D Statistic	0.226		0.000		0.226	

Notes: a) The regression models were fit with the maximum likelihood procedure so the standard R-square statistic could not be computed. However, the quantity "D" which has an interpretation similar to R-square was computed (Harrell, 1980).

Symbols: + Significant at the 10% level.
* Significant at the 5% level.
** Significant at the 1% level.

Table 15

Post-Neonatal Mortality: Absolute Mortality Differential and Relative Risk Ratios for Selected Factors

(The 1979 Yemen Fertility Survey)

Variable	Absolute Mortality Differential	Relative Risk Ratio
Reference Post-Neonatal Mortality Rate: 123.2[a]		
Length of Preceding Birth Interval		
from 12 to 24	-43.6	0.656
36	-72.7	0.410
Survivorship of the Previous Birth		
from Alive to Dead	77.3	1.628
Place of Residence		
from Urban to Rural	49.1	1.399

Notes: a) For the calculation of the reference mortality rate, all variables in Model III (Table 14) were set at their mean values except the following:

Variable	Reference Value
Length of the Preceding Birth Interval	12 Months
Survivorship of the Previous Birth	Alive
Place of Residence	Urban

Table 16

Net Effects on Infant Mortality Probabilities of Demographic and Socioeconomic Factors

(The 1979 Yemen Fertility Survey)

Variable	Regression Results by Model					
	Model I Demographic Variables		Model II Socioeconomic Variables		Model III All Variables	
	Beta Coeff.	Std. Error	Beta Coeff.	Std. Error	Beta Coeff.	Std. Error
Intercept	-.628	.642	-1.978**	.203	-.771	.661
Mother's Age at Birth						
Age	-.009	.046	-	-	-.027	.046
Age Squared	.000	.001	-	-	.000	.001
Birth Order	.040*	.022	-	-	.054*	.022
Length of Preceding Birth Interval	-.035**	.004	-	-	-.035**	.004
Survivorship of Previous Birth						
Survived	-.371**	.051	-	-	-.357**	.051
Died	.371**	.051	-	-	.357**	.051
Mother's Literacy						
Illiterate	-	-	.213	.205	.242	.208
Literate	-	-	-.213	.205	-.242	.208
Father's Literacy						
Illiterate	-	-	.011	.047	.002	.049
Literate	-	-	-.011	.047	-.002	.049
Mother's Work Status						
Worked	-	-	.001	.046	.031	.048
Never Worked	-	-	-.001	.046	-.031	.048
Father's Occupation						
Agriculture	-	-	.147	.220	.132	.225
Transitional	-	-	-.042	.089	-.034	.091
Blue Collar	-	-	.117	.090	.060	.093
White Collar	-	-	-.222	.180	-.158	.183
Place of Residence						
Urban	-	-	-.095	.075	-.156*	.077
Rural	-	-	.095	.075	.156*	.077
Number of Observations	3889		3889		3889	
Model Chi-Square	204.22**		12.85+		221.31**	
Degrees of Freedom	5		7		12	
D Statistic	0.237		.000		0.239	

Notes: a) The regression models were fit with the maximum likelihood procedure so the standard R-square statistic could not be computed. However the quantity "D" which has an interpretation similar to R-square was computed (Harrell, 1980).

Symbols
+ Significant at the 10% level.
* Significant at the 5% level.
** Significant at the 1% level.

Table 17

Infant Mortality: Absolute Mortality Differential and Relative Risk Ratios for Selected Factors

(The 1979 Yemen Fertility Survey)

Variable	Absolute Mortality Differential	Relative Risk Ratio
Reference Infant Mortality Rate: 139.6[a]		
Birth Order		
from 2 to 3	6.6	1.047
5	20.6	1.147
7	35.6	1.255
Length of Preceding Birth Interval		
from 12 to 24	-43.6	.688
36	-74.6	.466
Survivorship of the Previous Birth		
from Alive to Dead	109.2	1.783
Place of Residence		
from Urban to Rural	41.8	1.299

Notes: a) For the calculation of the reference mortality rate, all variables in Model III (Table 16) were set at their mean values except the following:

Variable	Reference Value
Birth Order	2
Length of the Preceding Birth Interval	12 Months
Survivorship of the Previous Birth	Alive
Place of Residence	Urban

Table 18

Net Effects on Childhood Mortality Probabilities of Demographic and Socioeconomic Factors

(The 1979 Yemen Fertility Survey)

Variable	Regression Results by Model					
	Model I Demographic Variables		Model II Socioeconomic Variables		Model III All Variables	
	Beta Coeff.	Std. Error	Beta Coeff.	Std. Error	Beta Coeff.	Std. Error
Intercept	-1.918	1.325	-3.019**	.522	-2.243	1.402
Mother's Age at Birth						
Age	.044	.097	-	-	.010	.099
Age Squared	-.000	.002	-	-	.000	.002
Birth Order	-.050	.044	-	-	-.035	.046
Length of Preceding Birth Interval	-.038**	.008	-	-	-.042**	.008
Survivorship of Previous Birth						
Survived	-.063	.111	-	-	-.049	.113
Died	.063	.111	-	-	.049	.113
Mother's Literacy						
Illiterate	-	-	.333	.519	.364	.523
Literate	-	-	-.333	.519	-.364	.523
Father's Literacy						
Illiterate	-	-	-.091	.091	-.140	.094
Literate	-	-	.091	.091	.140	.094
Mother's Work Status						
Worked	-	-	-.019	.080	.018	.091
Never Worked	-	-	.019	.090	-.018	.091
Father's Occupation						
Agriculture	-	-	.142	.491	.154	.494
Transitional	-	-	.321+	.182	.377*	.185
Blue Collar	-	-	-.106	.203	-.130	.205
White Collar	-	-	-.357	.408	-.401	.410
Place of Residence						
Urban	-	-	-.432*	.175	-.472**	.176
Rural	-	-	.432*	.175	.472**	.176
Number of Observations	1594		1594		1594	
Model Chi-Square	40.28**		1[illegible].98*		60.80**	
Degrees of Freedom	5		7		12	
D Statistic	0.174		0.044		0.192	

Notes: a) The regression models were fit with the maximum likelihood procedure so the standard R-square statistic could not be computed. However, the quantity "D" which has an interpretation similar to R-square was computed (Harrell, 1980).

Symbols
+ Significant at the 10% level.
* Significant at the 5% level.
** Significant at the 1% level.

Table 19

Child Mortality: Absolute Mortality Differentials and Relative Risk Ratios for Selected Factors

(The 1979 Yemen Fertility Survey)

Variable		Absolute Mortality Differential	Relative Risk Ratio
Reference Child Mortality Rate: 70.9[a]			
Father's Occupation			
from Agricultural to	Transitional	16.2	1.229
	Blue Collar	-16.6	.766
	White Collar	-28.9	.592
Length of Preceding Birth Interval			
from 12 to 24		-26.6	1.625
36		-43.5	.387
Place of Residence			
from Urban to Rural		93.0	2.312

Notes: a) For the calculation of the reference mortality rate, all variables in Model III (Table 18) were set at their mean values except the following:

Variable	Reference Value
Father's Occupation	Agricultural
Length of the Preceding Birth Interval	12 Months
Place of Residence	Urban

Table 20

Mortality Rates by Age Intervals and by Breastfeeding Status at the Beginning of the Age Interval[a]

(The 1979 Yemen Fertility Survey)

Age Interval (Months)	Status at the Outset of the Age Interval	Number of Births	Number of Deaths	Mortality Rates (per 1000)
1-5	Breastfeeders	1951	117	60.00
	Non-Breastfeeders	127	20	157.48
	Never Breastfed	109	17	156.00
	Stopped Breastfeeding	18	3	166.70
6-11	Breastfeeders	1527	45	29.50
	Non-Breastfeeders	414	15	36.23
	Never Breastfed	92	5	54.30
	Stopped Breastfeeding	322	10	31.10
1-11	Breastfeeders	1951	172	88.20
	Non-Breastfeeders	127	25	196.85
	Never Breastfed	109	22	201.80
	Stopped Breastfeeding	18	3	166.70
12-59[b]	Breastfeeders	293	16	54.60
	Non-Breastfeeders	79	4	50.63
	Never Breastfed	11	1	90.09
	Stopped Breastfeeding	68	3	44.10

Notes: a) The data for this analysis consisted of all births between January, 1970 and February, 1979 (regardless of birth order) for which breastfeeding data were available (i.e., the last two live births of respondents).

b) For the calculation of child mortality rates by breastfeeding status, the data set was restricted to births born five years before the interview date.

Table 21

Life Table Mortality Rates by Breastfeeding Status[a]

(The 1979 Yemen Fertility Survey)

Month of Life	Persons Beginning the Month	Events During the Month: Deaths	Stopped Breast-feeding	Withdrawn from Observation[b]	Monthly Mortality Rate	Cumulative Mortality Rate Beginning with Month One
			Breastfeeders			
1	2581	53	84	72	.0212	.0212
2	2372	25	95	82	.0109	.0319
3	2170	21	76	85	.0100	.0416
4	1988	22	74	56	.0114	.0525
5	1836	21	70	37	.0118	.0637
6	1708	15	65	54	.0091	.0722
7	1574	12	40	37	.0078	.0794
8	1485	5	35	38	.0035	.0826
9	1407	8	43	27	.0058	.0880
10	1329	3	15	10	.0023	.0901
11	1329	6	2	18	.0046	.0942
			Non-Breastfeeders			
1	177	12	-	5	.0688	.0688
2	244	5	-	5	.0204	.0881
3	329	7	-	6	.0215	.1077
4	392	7	-	7	.0180	.1237
5	452	7	-	6	.0156	.1374
6	509	2	-	16	.0040	.1408
7	556	6	-	21	.0110	.1503
8	569	3	-	19	.0054	.1549
9	582	4	-	20	.0070	.1608
10	601	1	-	12	.0014	.1622
11	603	5	-	19	.0084	.1692

Notes: a) The data set for this analysis consisted of all births between January 1970 and the interview date (regardless of birth order) for which breastfeeding data were available (i.e., the last two live births of respondents).

b) Births under one year of age and alive at the interview date are classified as withdrawn from observation at their age in months as of the interview date.

Table 22

Life Table Mortality Rates for Selected Post-Neonatal Age Intervals by Breastfeeding Status[a]

(The 1979 Yemen Fertility Survey)

Age Interval (Months)	Mortality Rates per 1000 Births[b]	
	Breastfeeders	Non-Breastfeeders
1-5	63.7	137.4
6-11	32.6	31.8
1-11	94.2	169.2

Notes: a) The data set for this analysis consisted of all births between January 1970 and the interview date (regardless of birth order) for which breastfeeding data were available (i.e., the last live births or respondents).

b) Rates calculated from the monthly mortality probabilities of Table 21.

Table 23

Net Effects on Age-Specific Mortality Probabilities of Breastfeeding and Demographic and Socioeconomic Factors

(The 1979 Yemen Fertility Survey)

Variable	Regression Results by Age Interval							
	1-11 Months		1-5 Months		6-11 Months		12-59 Months	
	Beta Coeff.	Std. Error	Beta Coeff.	Std. Error	Beta Coeff.	Std. Error	Beta Coeff.	Std. Error
Intercept	-2.863*	1.410	-3.403*	1.665	-6.593	10.339	-11.277	5.644
Breastfeeding	-.270	.167	-.239	.199	-.111	.193	.204	.359
Mother's Age at Birth								
Age	.075	.095	.100	.112	.038	.165	.632	.388
Age Squared	-.001	.001	-.001	.002	-.001	.003	-.011+	.006
Birth Order	.058	.042	.041	.049	.087	.076	.034	.131
Length of Preceeding Birth Interval	-.030**	.007	-.040**	.009	-.015	.010	-.054+	.024
Survivorship of Previous Birth	.296**	.109	.171	.135	.488**	.169	.163	.354
Mother's Literacy								
Illiterate	-.031	.392	-.263	.400	2.772	10.071	-	-
Literate	.031	.392	.263	.400	-2.772	10.071	-	-
Father's Literacy								
Illiterate	.112	.100	.144	.119	.038	.168	-.274	.270
Literate	-.112	.100	-.144	.119	-.038	.168	.274	.270
Mother's Work Status								
Worked	.008	.094	-.088	.112	.217	.165	-.316	.264
Never Worked	-.008	.094	.088	.112	-.217	.165	.316	.264
Father's Occupation								
Agriculture	.021	.418	.097	.526	-.202	.657	.219	1.212
Transitional	-.098	.176	-.040	.215	-.189	.292	.353	.482
Blue Collar	-.030	.184	.006	.224	-.081	.303	-.784	.645
White Collar	.149	.332	-.063	.424	.472	.505	.212	.906
Residence	.473*	.195	.414+	.222	.600	.391	.784	.581
Number of Observations	1598		1598		1499		326	
Model Chi-Square	51.12*		40.00**		21.15+		18.37	
Degrees of Freedom	13		13		13		12	
D Statistic[a]	.161		.137		.000		.000	

Notes: a) The regression models were fit with the maximum likelihood procedure so the standard R-square statistic could not be computed. However, the quantity "D" which has an interpretation similar to R-square was computed (Harrell, 1980).

Symbols
+ Significant at the 10% level.
* Significant at the 5% level.
** Significant at the 1% level.

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