The Pakistan Development Review
Vol. XXI, No. 4 (Winter 1982)

Infant-Child Mortality and Son Preference as Factors Influencing Fertility in Pakistan

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The paper explores and then establishes the role of infant and child mortality on fertility levels in Pakistan, largely because of universal and prolonged breastfeeding practices in the country It is found that the tendency to compensate for child death is stronger among those couples who had a male child loss than among those with experiences of female child losses. It is contended that if the Population Welfare Programme is to be implemented successfully in Pakistan, the current emphasis on supply of contraceptive services will have to yield to. that on more comprehensive maternal and child health services.

I. INTRODUCTION

Large family size, which is a manifestation of 'historically' high fertility, has typically contributed to high rate of population growth in Pakistan as well as in other countries with similar demographic characteristics. High fertility is considered to be associated with a number of factors which include, among others, incidence of infant and child mortality and preference for a male child. It is now generally realized that fertility level in Pakistan cannot be reduced only by ensuring an abundant supply of contraceptives. The motivation for a small family depends on requisite changes in social and cultural attitudes and economic conditions that influence the reproductive behaviour of couples.

The area of specific concern in this study is the desire of the parents to have children in general but sons in particular, which desire, coupled with their high infant and child mortality experience, may result in a high level of fertility, particularly among the couples who have either no living son or have fewer living sons than desired by them. The preference for son is associated with certain social, cultural and economic considerations such as keeping the family name alive and obtaining a modicum of social and economic security for parents in times of their illness and unemployment as well as in their old age.

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In most of the predominantly agricultural countries like Pakistan, there is no provision for old-age pension to provide support for elderly persons; nor is there a social security system which can support families against illness, unemployment or the death of the primary bread-winner. The literature discussed in the subsequent paragraphs informally argues that couples respond to such conditions by preferring sons to daughters or at least by striving to have one surviving son. It is postulated that given high infant- and child-mortality levels in Pakistan, such behaviour leads to high subsequent fertility.

Several studies conducted on sex preference indicate that although preference for sons is universal its intensity varies from one culture to another. While it is less in countries like the U.S.A. and Latin American countries it is particularly strong in the Far Eastern and Middle Eastern countries. Definitive empirical support for the son-preference thesis has been found in Taiwan [7, 9, 10, 30, 34, 35, 36], the Philippines [29], India [2, 6, 17, 21, 37], Muslim or Muslim-dominated countries of the Middle East, Pakistan and Bangladesh [5, 8, 13, 18, 24, 25, 38]. There appears to be sufficient indications that preference for sons, where it exists, is an important determinant of fertility and procreative behaviour but that its impact differs with variations in social, cultural, and economic settings.

The positive effects of infant-child mortality on fertility have been demonstrated in various studies. This relationship has been found to be strong for countries with high levels of infant and child mortality such as India [31, 32, 33, 37], Bangladesh [27], Pakistan [16], Egypt [13], Turkey [1], The Philippines [3], Ghana, Upper Volta and Nigeria [11]. For Taiwan, a country with low mortality, the relationship has been found to be slightly weaker, [14, 26]. The magnitude of this effect has not been fully established in many of these studies, most of which have been confined to countries which are in the initial or intermediate stages of demographic transition, and lack adequate controls for confounding socio-economic and demographic variables and have also suffered from methodological problems. The studies most carefully done relate mostly to Taiwan, which is in an advanced stage of demographic transition. For Pakistan, only one study [16] on the interrelationships of infant-child mortality and fertility has been done but it does not take into account the effect of preference for sons along with infant and child mortality on fertility. Therefore, the present study aims at filling the gap in our understanding of the relationship between infant-child mortality, sex preference and fertility behaviour in the country.

II. OBJECTIVES OF THE STUDY

Using data from the Pakistan National Impact Survey (1968-69)[1], the present study aims at investigating and explaining how the sex composition of live births and surviving children, and sex differentials in infant and child mortality up to specific parity affect the subsequent fertility behaviour of the couples.[2] It also examines the combined effects of son-preference and infant-and-child mortality on fertility behaviour of couples by taking into consideration the biological and behavioural components, both jointly and separately, by isolating their effects on subsequent fertility.

In testing the hypothesis about the influence of infant-child mortality and son-preference on fertility behaviour, it is to be kept in view that couples generally have at least a vague notion about the size and composition of their family. Whether they limit the size of their family once the desired number of children has been achieved will depend, among other factors, on the extent to which they already have had experienced infant- and child-mortality and on their preference for male children. Hence, there is a presumption that the couples who have greater number of female children or those who have recently suffered the loss of a child, particularly of a male child, will have, at each parity level, higher 'subsequent fertility', a larger number of additional children desired and thus a higher family size.

On the basis of this general conjecture, it is postulated that at each parity (birth order) the subsequent fertility, as measured by the parity progression ratio[3] to the next parity and total number of live births to the time of survey, is positively associated, and the birth interval to the next parity is negatively associated, with the following:

(i) the number of female children out of a given number of surviving children,
(ii) the number of infant and child deaths experienced up to a given parity, and
(iii) the greater number of male than female deaths of children at the given parity.

III. METHOD OF ANALYSIS

In this section, the child-bearing experience of women at the given parity is examined. Its impact on subsequent fertility has been examined with respect to the following:

(i) Whether the women had another birth (parity progression ratio);
(ii) How soon they had their next birth measured by the length of succeeding birth intervals; and
(iii) The eventual number of live births they experienced at the time of the survey.

[1]For details of the National Impact Survey (1968-69), See [19].

[2]The term "Subsequent Fertility" has been used in this study to include 'total number of live births' up to the time of the survey, mean and median 'birth intervals' between successive parities, and 'parity progression ratios'.

[3]It may be defined as the percentage of females having *n+1* births out of all females who ever had *n* births.

From the point of view of reporting of vital events, the measure carrying maximum accuracy is the parity progression ratio, which, in order of declining accuracy, is followed by eventual number of live births and birth intervals. But the birth interval is a more sensitive measure of a change in reproductive behaviour. Three fertility measures have been analyzed separately in the present study as dependent variables. These are: (i) total number of live births; (ii) birth intervals; and (iii) parity progression ratios. The complete pregnancy history of currently married women to the time of the survey has been examined by following their attainment of specific parities. This is done separately for parities 2, 3 and 4.[4]

The Multiple Classification Analysis (MCA)

The technique used in this study is that of Multiple Classification Analysis (MCA).[5] The details of specification are given in Appendix A. The format of the MCA specified for each of the three dependent variables in this paper consists of Models 1, 2 and 3. These three models relate to three separate dependent variables, viz. (i) total number of live births, (ii) birth interval to the next parity, and (iii) parity progression ratio to next parity, respectively. These dependent variables, along with the predictor variables, are shown as

$$Y_i = \bar{Y} + \beta_{1j} + \beta_{2k} + \beta_{3l} + \beta_{4m} + \beta_{5n} + \beta_{6p} + \beta_{7q} + \beta_{8r} + E_i$$

The independent predictor or control variables are:

(a) *Primary Control Variables*

1. Proportion of female children among survivors;
2. Number of deaths prior to specific parity;
3. Number of male deaths prior to specific parity; and
4. Sex of infant death of (*n–l*) birth, *n* representing birth by which the specific parity was achieved.

(b) *Control Variables*

1. Place of residence (rural/urban);
2. Education of mother;
3. Adequacy of family living; and
4. Length of exposure time from parity *i* to the time of survey.

[4]The analysis beyond parity 4 is not possible as the number of females in the sample becomes small. Moreover, analysis of parity 1 is not done because two of the primary predictor variables are non-existent for parity 1 and it was felt that the findings from parity 1, using other primary predictor variables, would not contribute substantially to what would be found from parities 2, 3 and 4.

[5]This technique handles dichotomous dependent variables and independent (predictor) variables with scales ranging from nominal to ordered numeric. The multivariate analysis is performed separately for each of the three dependent variables. The MCA technique is similar to a multiple regression analysis which allows the use of ordinal or nominal predictors. For detailed information about MCA, refer to [4].

These predictor variables have been checked for statistical independence and multicollinearity in order to minimise interaction effects among them.

The three models have been run separately for parity 2, parity 3 and parity 4 to study the hypotheses described in the latter part of Section 2. In the models using live births and birth intervals, the dependent variables are measured on an interval scale, whereas in the model using parity progression ratio the dependent variable is dichotomous. The discussion of the results of the analysis is mainly focussed on primary predictor variables which have been used to test the above-mentioned hypotheses in each of the three models. It may be mentioned here that in each of the three models used, the relative importance of the predictor variables has been shown by ranking them according to their β coefficient values.

IV. RESULTS OF THE ANALYSIS

MODEL 1

1. The Effect of Predictor Variables on Total Number of Live Births

The findings of Model 1 relate to the dependent variable of 'total number of live births' per woman at the time of the survey. These are presented for parities 2, 3 and 4 in Appendix Table 1. The total number of live births (grand mean) for parities 2, 3 and 4 are 5.02, 5.64 and 6.27, respectively. The adjusted values of multiple R^2s for parities 2, 3 and 4 are statistically significant at the five-percent level[6] (Appendix Table 1). In the following section, the relationships of the primary predictor variables and the control variables with the number of live births are discussed in order to test the hypotheses given in the latter part of this section.

2. Primary Predictor Variables and Live Births at Each Parity

(i) *Proportion of Female Children among Survivors and Number of Live Births*

The first hypothesis that, at each parity, the total live births are higher when the number of surviving female children exceeds the number of surviving male children is tested by using the predictor variable 'proportion of female children among survivors' for parities 2, 3 and 4 separately. The findings are shown in Appendix Table 1. The findings for parities 2, 3 and 4 do not show any clear trend as

[6]The analysis is carried out in two different runs; Run A and Run B. In run A all predictor variables are used whereas in Run B, one of the predictor variables, "Total number of male deaths", is dropped because of its high correlation with "Total number of prior deaths". In Appendix Tables only the results from Run A are presented. However, the Run B results, available with the Editor of this *Review*, can be seen on request.

postulated in the hypothesis. Hence, the evidence does not fully support the hypothesis. However, the F-ratio test indicates that this variable in all the parities has explained a significant portion of the variance of the dependent variable (total live births).

(ii) *Number of Prior Deaths and Live Births*

In the second hypothesis it was postulated that the total number of live births will be higher among couples who experienced deaths of their children prior to specific parities than among those who did not experience such deaths. It was further postulated that at any given parity, subsequent fertility will be positively correlated with the magnitude of infant and child mortality. This hypothesis is tested by using the primary predictor variable, 'total number of prior deaths', for parities 2, 3 and 4 separately.

Appendix Table 1 indicates that the values of unadjusted deviations from the grand mean are observed to be in the expected direction for all three parities, indicating that the higher the number of prior deaths at a specific parity, the higher the number of live births to the time of the survey. But it is reversed in the case of Run A when this variable is adjusted for other predictor variables. Hence, it may be concluded that in all the three parities the findings do not support the hypothesis. However, the contribution of this variable to the variance of the dependent variable (total live births) is found to be statistically significant in all the three parities. In Run B where the variables relating to the 'total number of prior male deaths' are dropped from the MCA equation, it is noted that the deviations from the grand mean are smaller than in Run A. Moreover, the curve in parity 2 is very close to the grand mean, indicating that in this parity the death of previous child has no noticeable effect on fertility. The findings do not support the hypothesis. Perhaps at this early parity, couples are yet to be motivated to compensate for the loss of their previous child. At parities 3 and 4, there is an indication of the motivation of compensation of child loss(es). The evidence, however, partially supports the hypothesis. The effect of this variable on total live births in all parities is statistically significant.

However, the downward trend in the case of all deaths (i.e. two deaths in parity 3 and three deaths in parity 4) may reflect a traumatic or negative psychic effect on couples indicating that those who had the painful experience of repeated child deaths may not be compensating for such losses due to various socio-biological reasons.[7] This downward trend may also be due to deficient data which, in turn, may be due to under-reporting of births. This under-reporting may be attributable to couples' sad experience of losing all of their previous children which would have

[7] For example, it is possible that such women may under-report their births particularly those who have survivors.

made them superstitiously reluctant to report their existing living children, particularly male children, thinking that the disclosure of this may in some way affect their fortune adversely and cause their living children, particularly the male ones, to die. Hashmi [12], during the field work for the 1961 Census, observed the tendency on the part of some couples to withhold information about their male children because of their superstitious belief that such information, if given to strangers, may bring down on their male children the influence of "evil eye" (locally called *nazar-i-bud).*

(iii) *Number of Prior Male Deaths and Live Births*

In the third hypothesis it was mentioned that at each parity the total number of live births will be higher among couples who experienced more male than female deaths. This hypothesis is tested with the use of the predictor variable, 'the total number of male deaths prior to specific parity'. The unadjusted deviations from the grand mean in all the three parities are observed in the expected direction as postulated in the hypothesis. Even when adjustments are made for various other predictor variables (Appendix Table 1), the adjusted deviations from the grand mean are found to be in the expected direction. The findings indicate that the sex composition of the dead children has a noticeable effect on fertility even when other variables have been controlled. The findings further indicate that couples compensate more for the loss of male child/children than for the loss of female child/children, indicating a strong behavioural effect which is dominant in the case of a male death. Hence, in all parities, the evidence supports the hypothesis that male deaths have a strong positive effect on fertility. This predictor variable itself has explained a significant portion of the variance of the total live births for all parities.

(iv) *Sex of Infant Death and Live Births*

Although the effect of sex differential on infant mortality is studied for all the three dependent variables (viz. total number of live births to the time of the survey, subsequent birth interval, and subsequent parity progression ratio), its impact is, as expected, greater when measured by birth interval than when it is measured by the other two dependent variables.

The unadjusted and adjusted deviations from the grand mean are observed in the expected direction among the "no-infant death" and the "infant death" groups. The results are in the expected direction for parities 2 and 3, indicating that couples experiencing male infant death end up with a higher number of live births than those experiencing female infant deaths. However, for parity 4, the results are not consisted with the expected pattern (Appendix Table 1). The effect of this variable on total live births is statistically significant for all the three parities.

3. Control Variables and Live Births at Each Parity

The effect of control variables on total number of live births is discussed briefly for "adjusted" findings only.

(i) *Length of Exposure Time*

It is clear from Appendix Table 1 that, as expected, women with a shorter exposure time have experienced fewer live births than those having a longer exposure time. This variable has explained a significant proportion of the variance of total live births for each of the three parities.

(ii) *Education of Wife*

The generally observed negative relationship between education and fertility; i.e. literate women experience fewer live births than illiterate women, is also observed for Pakistan. The variable of wife's education is indicated to have contributed a significant portion of variance of the total live births for parities 2 and 3.

(iii) *Adequacy of Family Living*

It is observed that couples with inadequate living standards experienced more live births than couples who enjoy adequate or more than adequate living standards. This again is in accordance with expectations. The effect of this variable on the total number of live births is statistically significant for all the parities.

(iv) *Place of Residence (Rural/Urban)*

This variable shows that at each parity, urban women experienced more live births than rural women but it is not statistically significant for each of the three parities.

MODEL 2

1. The Effect of Predictor Variables on Subsequent Birth Interval

The findings of Model 2 relate to the dependent variable 'birth interval' from parity i to parity $i+1$. Appendix Table 2 shows average birth intervals (grand mean) to the next parity for parities 2, 3 and 4 as 32.3 months, 31.9 months and 32.0 months, respectively. The adjusted multiple R^2s for parities 2, 3 and 4 are statistically significant.

2. Primary Predictor Variables and Subsequent Birth Intervals at Each Parity

(i) *Proportion of Female Children among Survivors and Subsequent Birth Intervals*

When the subsequent birth interval is considered the dependent variable for testing the first hypothesis, it is observed that the evidence does not seem to substantiate this hypothesis at parity 2. At parity 3, however, the findings show an expected pattern, and at parity 4 this pattern is found to be true for couples with 'all-male' survivors compared to those who had 'all-female' survivors. But for surviving children of both the sexes, this pattern does not hold, as noted in Appendix Table 2.

In conclusion, it may be stated that, except at parity 3, the evidence does not support this hypothesis. Moreover, this variable has not explained a significant portion of the variance of the birth interval for any of the parities.

(ii) *Total Number of Prior Deaths and Subsequent Birth Intervals*

At parities 2 and 3, the evidence does not support the hypothesis. However, at parity 4 the general trend in Run A is the same as hypothesized and the trend becomes quite clear and even more in the expected direction in the case of Run B. That is, the longest birth interval is found in the 'no-death' group and thereafter it declines consistently with an increase in the number of deaths. The effect of this variable on the dependent variable for both the runs is statistically significant at parity 2 only (Appendix Table 2).

(iii) *Total Number of Prior Male Deaths and Subsequent Birth Intervals*

The findings do not support the third hypothesis in parity 2. In parities 3 and 4, the findings for two and three male deaths respectively seem to support the hypothesis. However, results for other categories are not so consistent. The influence of this variable on the dependent variable is insignificant for parities 3 and 4 for which the hypothesis is true.

(iv) *Sex of Infant Death and Subsequent Birth Intervals*

It was mentioned earlier that the impact of sex differentials in infant mortality is indicated more by the birth interval dependent variable than by the other dependent variables. The findings show that adjusted deviations do not differ much from the unadjusted deviations, indicating that the other control variables have not influenced the values of unadjusted deviations.

For all the parities, the findings are consistent with the hypothesis that longer birth intervals will be found in the 'no-infant death' group than in the 'infant death' group. Within the 'infant death' group, couples having had male infant death experienced shorter birth intervals compared to those who had had female infant deaths. This difference is quite large at parity 3 where women having had female 'infant deaths' experienced birth intervals about 4.5 months shorter and the women with male infant deaths experienced birth intervals 8.7 months shorter than the overall average (Appendix Table 2). This difference in birth intervals between groups experiencing male and female infant deaths may largely be attributed to a behavioural response of couples, indicating that those experiencing male infant death compensate for the loss earlier than those who experience female infant death. This again shows that sex-specific infant mortality in favour of males has a strong positive behavioural influence on subsequent fertility. The effect of this variable on the dependent variable (birth interval) is statistically significant for parities 2, 3 and 4.

3. Control Variables and Subsequent Birth Intervals at Each Parity

The effect of control variables on subsequent birth intervals is briefly discussed below for "adjusted" findings only.

(i) *Length of Exposure Time*

The findings indicate that women with shorter exposure time experienced shorter birth intervals than women with longer exposure time, excepting women who had an exposure time of 20 years or more in whose case, perhaps due to the effect of recall lapses, the birth interval shortened. This variable in all parities has explained a significant portion of the variance of birth interval.

(ii) *Place of Residence (Rural/Urban)*

This variable indicates that urban women of parities 3 and 4 experienced shorter birth intervals than rural women and the contribution of this variable to explaining the portion of the variance is statistically significant. In parity 2, the trend is reversed but the effects here are not statistically significant.

(iii) *Education of Wife*

Illiterate women in parities 2 and 4 have experienced shorter birth intervals than literate women. In parity 3, however, the reverse is observed (Appendix Table 2), but the contribution of this variable is not statistically significant.

(iv) *Adequacy of Family Living*

This variable indicates that couples with inadequate family living had experienced shorter birth intervals than those who had adequate or more than adequate family living. However, the influence of this variable is not statistically significant.

MODEL 3

1. The Effect of Predictor Variables on Subsequent Parity Progression

The findings of Model 3 relate to the dependent variable, parity progression ratio from parity i to $i+1$. The findings of this model are presented for parities 2, 3 and 4 separately in Appendix Table 3. The values of adjusted multiple R^2s for parities 2, 3 and 4 are statistically significant (Appendix Table 3).

In the following section, the relationship of the primary predictor variables with the parity progression ratio is discussed for testing the various hypotheses listed at the end of Section II.

2. Primary Predictor Variables and Parity Progression Ratios at Each Parity

(i) *Proportion of Female Children Among Survivors and Subsequent Parity Progression Ratios*

The first hypothesis is further tested by taking parity progression ratio as the third dependent variable. The findings do not support the hypothesis in parity 3 whereas in parities 2 and 4 these are observed to be somewhat consistent with the hypothesis. However, this variable has explained a significant portion of the variance of the dependent variable in all the three parities.

(ii) *Total Number of Prior Deaths and Subsequent Parity Progression Ratios*

Appendix Table 3 indicates that the values of unadjusted deviations from the grand mean are generally in the expected direction for all the parities. An exception is noted in parities 3 and 4 for women who lost all their previous children. But when this variable is adjusted for control variables the trend is totally reversed and the evidence does not support the hypothesis. The findings in parity 2 are in the expected direction. In parity 4, except for the 'three-death group', it also seems that the adjusted results are in the expected direction. However, the contribution of this variable to the variance explained is statistically significant.

(iii) *Total Number of Prior Male Deaths and Subsequent Parity Progression Ratios*

At parity 2, the unadjusted deviations are in the expected direction, but after adjustment the parity progression ratio increases for female death and declines in the case of male death. At parities 3 and 4, unadjusted and adjusted deviations are alike. The hypothesis is supported at parity 3 but is strongly supported at parity 4. The effect of this variable in explaining the portion of the variance of dependent variable is statistically significant for all the three parities (Appendix Table 3).

(iv) *Sex of Infant Death and Subsequent Parity Progression Ratios*

Appendix Table 3 shows that the unadjusted deviations from the grand mean are observed to be in the expected direction except in the case of parity 3 where women experience a higher parity progression ratio in the case of female infant death than in the case of male infant death. The adjusted deviations from the grand mean differ very much from unadjusted deviations. However, on the whole, except at parity 3, the findings appear to be consistent with the expected pattern. Except for parity 2, the effect of this variable on the dependent variable is statistically significant.

3. Control Variables and Subsequent Parity Progression Ratios at Each Parity

The effect of control variables on subsequent parity progression ratios is briefly discussed below. Only "adjusted" findings are discussed except where it is noted otherwise.

(i) *Length of Exposure Time*

The findings indicate that women with shorter exposure time experienced lower parity progression ratios. The values consistently increase with increase in exposure period. The effect of this variable on the dependent variable is statistically significant for all the three parities.

(ii) *Education of Wife*

This variable has explained a significant portion of the variance of the parity progression ratio for parities 2 and 3 but not for parity 4. In parities 3 and 4, literate women have experienced higher parity progression ratio than illiterate women, but in parity 2 it is reversed.

(iii) *Adequacy of Family Living*

The effect of this variable on the dependent variable is statistically significant in parity 2 only, where the parity progression ratio has been noted to be higher in the case of adequate or more than adequate living group.

(iv) *Place of Residence (Rural/Urban)*

In parities 2 and 4, rural women have experienced lower parity progression ratios than urban women but this trend is reversed in parity 3 where urban women have experienced lower parity progression ratios than their rural counterparts. However, the effect of this variable is not statistically significant in any of the parities.

V. SUMMARY OF MAJOR FINDINGS

(a) Model 1

The findings of Model 1 (total live births to the time of the survey) are summarized for each of the three hypotheses in Table 1 (Columns 4–6). It is observed that as the "proportion of female children among survivors" increases the total number of live births to the date of survey decreases. The "total number of deaths prior to specific parity" has a negative relationship with parity 2 and a positive relation with parity 3 and parity 4. When the "total number of male deaths prior to specific parity" is used as primary predictor variable, its association with the total number of live births to the date of survey is found to be positive for all parities. The association of "male infant death" to the total number of live births is found positive for parities 2 and 3. All these associations are statistically significant for all parities. When all the predictors taken together are considered, the values of Multiple Correlation Coefficients are statistically significant for all the three parities (Table 1, columns 4, 5 and 6).

(b) Model 2

The findings of Model 2 (Birth Interval) summarized in Table 1(Cols. 7–9) indicate that the "proportion of female children among survivors" has negative association with the subsequent birth interval for women of parity 3. This association is in the reverse order for women of parities 2 and 4 but statistically none of these associations is significant. The "total number of deaths prior to specific parity" increases the subsequent birth interval for women of parities 2 and 3 but for parity 4 women the interval is reduced. However, these relationships are not significant except for parity 2. The association of birth interval with the "total number of male deaths prior to specific parity" is found to be positive for parities 3 and 4 and negative for parity 2. However, these relationships are found to be significant for parity 2 only. In the case of the "sex of infant death", the association of male infant death to the subsequent birth interval is found to be positive for all parities indicating that those couples who experienced male infant death compensated for the loss earlier than those who experienced female infant death, which shows a strong behaviour response influencing subsequent fertility. All these associations are statistically significant for all the parities. The values of Multiple R^2s are statistically significant for all parities.

(c) Model 3

The findings of Model 3 indicate that when parity progression ratio is considered there is a positive association of the "proportion of female children among survivors" with parity 2 and parity 4 but with parity 3 the association is negative (Table 1, Cols. 10–12). All these associations are statistically significant for all parities. The parity progression ratio increases with the "total number of deaths

Table 1

Results of MCA Analyses showing Evidence about Hypotheses from Three Different Models by Specific Parities, Pakistan : 1968-69

Row	Hypothesis	Primary Predictor Variables Used in MCA Runs for Testing Hypotheses	Dependent Variables: Total Number of Live Births to the Time of Survey (Model 1), Parity 2	Model 1, Parity 3	Model 1, Parity 4	Subsequent Birth Interval (Model 2), Parity 2	Model 2, Parity 3	Model 2, Parity 4	Subsequent Parity Progression Ratio (Model 3), Parity 2	Model 3, Parity 3	Model 3, Parity 4
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1	1	Proportion of Female	*	*	*				*	*	*
2		Children Among Survivors	x	x	x	x	√	x	√	x	√
3	2	Total Number of Deaths	*	*	*	*			*	*	*
4		Prior to Specific Parity	x	√	√	x	x	√	√	x	√
5	3	Total Number of Male Deaths	*	*	*	*			*	*	*
6		Prior to Specific Parity	√	√	√	x	√	√	√	√	√
7	3a+	Sex of Infant Death	*	*	*	*	*	*		*	*
8			√	√	x	√	√	√	√	x	√
9		Statistical Significance of Adjusted Multiple R^2	*	*	*	*	*	*	*	*	*

Source: Appendix Tables 1 to 3.
* Indicates statistically significant at the 5-percent level.
x Evidence does not support the Hypothesis.
√ Evidence supports the Hypothesis.
\+ Indirectly related to Hypothesis 3.

prior to specific parity" for parities 2 and 4 but this association is negative for parity 3. All the three relationships are statistically significant. When the "total number of male deaths prior to specific parity" is used as primary predictor, its association with parity progression ratio is found to be positive for all parities. Also, this association is statistically significant for all the parities. The association of the "sex of infant death", i.e. male infant death, with parity progression ratio is found positive for parities 2 and 4. These association are statistically significant for parities 3 and 4 only. When all the predictors are taken together, the values of Multiple R^2s are statistically significant for all the three parities.

VI. POLICY IMPLICATIONS

In a country like Pakistan, where the use of contraceptives is very low and the mortality level is moderately high, the findings of this study have important policy implications. Infant and child mortality in Pakistan is between 40 and 50 percent of the total deaths, which is a large component of the overall death rate in the country. While a reduction in the infant and child mortality would substantially contribute to a decline in the total death rate, it would also help in lowering the level of fertility through lengthening the period of lactation (breast-feeding) of mothers.[8]

In Pakistan, where breast-feeding is almost universal, extending over a period of 18–24 months, a further reduction in infant mortality is expected through the improvements in health facilities which are envisaged in the current development plans. The decline of infant-child mortality is thus expected to have a dual and counter-balancing effect on the growth rate of population by reducing the levels of both fertility and mortality, which would, in turn, contribute to an improvement in the health of mothers and children. This is one of the main objectives of the current health and population welfare development programmes.

The present study suggests that concerted efforts should be made to reduce infant and child mortality through a proper balance between preventive health approaches and curative treatment of infant and child illnesses. Specific preventive care to minimise the incidence of diarrheal diseases, including mass immunisation against communicable and epidemic diseases, is much needed. Simultaneously, the process of economic and social development and the provision of nutritionally balanced diet and increased availability of modern medical and health care facilities, particularly in the rural areas, are crucial elements in lowering the prevailing high mortality of infants and children. In order to achieve this objective, the field staff of the Population Welfare Programme and other para-medical field functionaries can be trained to

[8] Better infant survival is expected to lengthen the average period of lactation by suppressing ovulation, thus prolonging the period of post-partum amenorrhea and resulting in longer average birth interval. This is a biological phenomenon which has been observed in many other countries.

teach illiterate and ignorant segments of population some of the basics of public health which in turn would help them to provide a better care to their children.

The finding of this study that the high infant and child mortality leads to increased fertility, strengthens the argument that Maternal and Child Health (MCH) services should be given due importance along with population welfare programme. This approach would not only be economical but would also help to improve the delivery of Population Planning services for achieving the desired goal of mass acceptance of family planning practices. Such a dual approach will help in creating confidence among mothers about survival chances of the children as a result of better birth care facilities being made available under the programme.

Another policy implication of this study, which emanates from the finding that higher fertility is also contributed by the shortening of lactational intervals as a consequence of infant mortality experience, is that the Islamic tradition of breast-feeding should be popularised. This would obviously lead to longer spacing between child births. The Population Welfare Programme should offer only such methods of contraception as are really safe for mothers' health. In pursuing this objectives, the contraception method to be introduced should be so selected that for child-spacing the lactational amenorrhea period may not be suppressed.

In so far as the tendency of having an additional birth as a compensation for an infant death, particularly of a male child, is concerned, it is expected that with economic and social development, expansion of education and changing role of women, the deep-rooted norm of preference for the male offspring will be reduced.

VII. CONCLUSIONS

The principal point emerging from our study is that the experience of infant and child mortality has direct bearing on fertility levels. This is especially pronounced because of the universality of prolonged breast-feeding practices in Pakistan. Furthermore, it is found that those who lost their male children compensated for the child loss comparatively more than those with female child losses, indicating that sex preference is an important factor in determining the fertility behaviour of couples.

From the above findings, the preference for male children is quite obvious. This is also supported by the evidence provided by the findings of the 1975 Pakistan Fertility Survey [20] which showed that 77 percent of the women who had three or more living children with two living sons did not want any more children. This percentage increased to 90 percent when all the living children were male. Using data of the National Impact Survey (same as used in this study), Khan and Sirageldin [15] have shown that "the negative inducement of the number of living sons on wanting additional children is about three times that due to the number of living daughters. This is as true for wives' responses as for their husbands'." In Pakistan, where practice of contraception is still limited to an insignificant proportion of the population

while breast-feeding is universal and extends over a long period of time, a reduction in infant-child mortality will reduce fertility through the biological mechanism. It is, however, to be recognised that at times a reduction in mortality can lead to a rise in the numbers of survivors and consequently the net result, at least in the immediate future, may be a net growth of the population.

In demographic jargon, it can be stated that the reduction of infant-child mortality would result in an overall increase in the Net Reproduction Rate (NRR) due to a better infant and child survivorship and a smaller corresponding reduction in fertility.[9]

In view of the fact that health programmes in the country would contribute a further reduction in mortality, a reduction in the Net Reproduction Rate (NRR) must be achieved through a successful population planning programme. An integrated health and population strategy at the functional level is likely to enhance the chances of achieving the desired results in population and development.

[9]Preston [23] has shown that when infant mortality rate falls from 200 per thousand live births to 50 per thousand live births, the probability of a female newborn surviving to age 30 rises by approximately five percent. Unless the average number of children born per woman falls by at least the same proportion, the NRR will rise as a result of this decline. He has further mentioned [23] that in a population in which birth control practices are absent, only one-third of mortality-induced increase in NRR was typically offset by involuntary (biological) mechanisms that acted to reduce fertility.

Appendix A

The format of the MCA specified for each of the three dependent variables is referred to in this paper as Models 1, 2 and 3. These three Models (Models 1, 2 and 3) respectively relate to dependent variables (i) Total number of live births (ii) Birth intervals and (iii) parity progression ratios. These dependent variables, along with the predictor variables, are as follows:

$$Y_i = \bar{Y} + \beta_{1j} + \beta_{2k} + \beta_{3l} + \beta_{4m} + \beta_{5n} + \beta_{6p} + \beta_{7q} + \beta_{8r} + E_i$$

where

Y_i = dependent variable representing total number of live births to the time of survey (Model 1) or

= dependent variable representing birth interval to the next parity (Model 2)

= binary dependent variable representing parity progression ratio to the next parity (Model 3)

$\bar{Y}$ = grand mean of each dependent variable (i.e. total number of live births, or birth intervals, or parity progression ratios);

β_{1j} = adjustment to the average live births caused by category j of the place of residence. Thus

1_j = Urban residence
2_j = Rural residence

β_{2k} = adjustment to the average live births* caused by category k of education of wife. Thus

$1k$ = Illiterate wife
$2k$ = Literate wife

β_{3l} = adjustment to the average live births* caused by category l of adequacy of family living. Thus

$1l$ = Not adequate living
$2l$ = Adequate or more than adequate living

β_{4m} = adjustment to the average live births* caused by category m of length of exposure time from parity i to the time of survey. Thus

1_m = 0–1 year
2_m = 2–3 years
3_m = 4–6 years
4_m = 7–9 years
5_m = 10–14 years
6_m = 15–19 years
7_m = 20 and more years

β_{5n} = adjustment to the average live births* caused by category n of proportion of females among survivors (e.g. for parity 4). Thus

1_n = All female survivors
2_n = One male three female survivors
3_n = One male two female survivors
4_n = Two male, two females or one male, one female survivors
5_n = Two males, one female survivors
6_n = Three males, one female survivors
7_n = All male survivors

β_{6p} = adjustment to the average live births* caused by category p of total number of deaths prior to specific parity; e.g. for parity 4, p = 0, 2, 3. Thus

0_p = No death
1_p = 1 death
2_p = 2 deaths
3_p = 3 deaths

β_{7q} = adjustment to the average live births* caused by category q of total number of male deaths prior to specific parity; e.g. for parity 4, q = 0, 1, 2, 3, 4. Thus

0_q = No death
1_q = Female death/deaths
2_q = 1 male death
3_q = 2 male deaths
4_q = 3 female deaths

β_{8r} = adjustment to the average live births* caused by category r of sex of infant death of last birth; e.g. for parity 4, r = 0, 1, 2. Thus

0_r = No infant death
1_r = Female infant death
2_r = Male infant death

E_i = Error term (i.e. random fluctuation of the actual values around the predicted value of the dependent variable).

*It is to be noted that average live births which have been used in the equation for Model 1 are only given for illustrative purposes. For Models 2 and 3 this variable is substituted respectively by the variables 'birth interval' and parity 'progression ratios'.

Appendix B

Table 1

Multiple Classification Analysis of Total Number of Live Births up to the Time of Survey by various Predictor Variables for Parities 2, 3, and 4, Pakistan 1968-69

Predictor Variables	Parity 2: Deviations From Grand Mean			Parity 3: Deviations From Grand Mean			Parity 4: Deviations From Grand Mean		
	Unadjusted	Adjusted	Beta value	Unadjusted	Adjusted	Beta value	Unadjusted	Adjusted	Beta value
Exposure time (in years) for having additional birth from parity *i* to the date of survey*									
(i) 0-1	−3.001	−2.949	0.753	−2.619	−2.582	0.726	−2.196	−2.110	0.676
(ii) 2-3	−2.462	−2.429		−2.085	−2.048		−1.548	−1.545	
(iii) 4−6	−1.530	−1.519		−1.116	−1.098		−0.958	−0.943	
(iv) 7−9	−0.461	−0.471		−0.290	−0.295		−0.039	−0.028	
(v) 10−14	0.637	0.627		0.676	0.664		0.716	0.712	
(vi) 15−19	1.549	1.544		1.841	1.830		1.685	1.647	
(vii) 20+	2.732	2.696		2.509	2.456		2.775	2.669	
Total Number of Prior Deaths*									
(i) No death	−0.111	0.134	0.102	−0.255	0.212	0.121	−0.370	0.204	0.130
(ii) One death	0.383	−0.463		0.378	−0.325		0.166	−0.140	
(iii) Two deaths				0.552	−0.414		0.752	−0.205	
(iv) Three deaths							0.570[1]	−0.526	

Continued –

Appendix B Table 1 – (*Contd.*)

Predictor Variables	Parity 2			Parity 3			Parity 4		
	Deviations From Grand Mean		Beta value	Deviations From Grand Mean		Beta value	Deviations From Grand Mean		Beta value
	Unadjusted	Adjusted		Unadjusted	Adjusted		Unadjusted	Adjusted	
Total Number of Prior Male Deaths*									
(i) No death	−0.111	−0.111	0.084	−0.255	−0.255	0.146	−0.370	−0.370	0.189
(ii) Female deaths/deaths	0.153	0.366		0.387	0.385		0.081	0.195	
(iii) One male death	0.553	0.395		0.380	0.425		0.435	0.405	
(iv) Two male deaths				0.973[1]	0.531		0.655	0.393	
(v) Three male deaths							2.396[1]	2.045	
Sex of Infant Deaths*									
(i) No death	−0.105	−0.042	0.047	−0.101	−0.038	0.055	−0.076	−0.037	0.055
(ii) Female	0.818	0.264		0.771	0.120		0.604	0.378	
(iii) Male	0.689	0.354		0.771	0.470		0.396	0.074	
Education of Respondent*									
(i) Illiterate	0.075	0.030	0.039	0.046	0.022	0.032	0.014	0.022	0.040
(ii) Literate	−0.727	0.296		−0.511	−0.242		−0.190	−0.296	
Proportion of Females among Survivors*									
(i) FF, F	0.115	0.021	0.032			0.017			0.076
(ii) FFF, FF, F				0.139	0.002				
(iii) FFFF, FFF, FF, F							0.414	0.054	
(iv) MFFF							−0.261	0.218	
(v) MFF				−0.330	0.023		0.067	−0.243	
(vi) MF	−0.200	−0.091		0.419	−0.056				
(vii) MMF				−0.232	−0.035		0.144	−0.177	
(viii) MMFF, MF							−0.053	0.129	

Continued –

Appendix B Table 1 – (*Contd.*)

Predictor Variables	Parity 2			Parity 3			Parity 4		
	Unadjusted	Adjusted	Beta value	Unadjusted	Adjusted	Beta value	Unadjusted	Adjusted	Beta value
(ix) MMMF							−0.559	−0.112	
(x) MM, M	0.139	0.090							
(xi) MMM, MM, M				0.187	0.054				
(xii) MMMM, MMM, MM, F							0.240	0.066	
Adequacy of Family Living*									
(i) Not adequate	0.283	0.045	0.015	0.195	0.074	0.029	0.147	0.039	0.017
(ii) Adequate or more than adequate	−0.200	0.032		−0.147	−0.056		−0.117	−0.031	
Place of Residence of Respondent									
(i) Urban	0.100	0.069	0.025	0.070	0.042	0.017	0.110	0.094	
(ii) Rural	−0.079	−0.055		−0.057	−0.034		−0.087	−0.075	0.041
Grand Mean	5.022			5.642			6.271		
S.D. of Grand Mean	2.452			2.234			2.030		
Number of Cases	1,567			1,300			1,049		
R^2* (Adjusted)	0.581			0.543			0.485		

[1] Cases with cell frequency less than 50.
* F.Ratio test is statistically significant at the 5-percent level, the exception being the place of residence of respondent for parities 2,3, and 4, and education of Respondent categories of parity 4.

Table 2

Multiple Classification Analysis of Birth Intervals to the Next Parity by various Predictor Variables, Parities 2, 3, and 4, Pakistan: 1968-69

Predictor Variables	Parity 2			Parity 3			Parity 4		
	Deviations From Grand Mean		Beta value	Deviations From Grand Mean		Beta value	Deviations From Grand Mean		Beta value
	Unadjusted	Adjusted		Unadjusted	Adjusted		Unadjusted	Adjusted	
Exposure time (in years) for having additional birth from parity *i* to the date of survey*									
(i) 0-1	−15.969[1]	−14.663	0.132	18.548[1]	−14.556	0.132	−18.469[1]	−15.119	
(ii) 2-3	−4.415	−4.328		−6.613	−6.431		−7.196	−7.438	0.196
(iii) 4–6	−1.556	−1.781		−2.816	−3.243		−0.975	−1.416	
(iv) 7–9	−1.790	−1.732		1.341	1.195		−0.459	−0.834	
(v) 10–14	0.777	0.818		1.266	1.338		2.789	2.875	
(vi) 15–19	2.969	2.989		2.011	2.006		1.387	1.730	
(vii) 20+	0.348	0.390		0.450	0.893		2.031	2.790	
Total Number of Prior Deaths*									
(i) No death	−0.448	−0.087	0.010	−0.042	0.083	0.025	0.854	−0.354	0.033
(ii) One death	1.419	0.277		−0.014	−0.501		−0.727	0.676	
(iii) Two deaths				0.363	1.366		−0.089	−0.242	
(iv) Three deaths							−2.226[1]	−1.472	
Total Number of Prior Male Deaths*									
(i) No death	−0.448	−0.448	0.065	−0.042	−0.042	0.029	0.854	0.854	0.068
(ii) Female deaths/deaths	−0.651	−0.286		−0.110	−0.018		−0.059	−0.109	
(iii) One male death	2.878	2.621		0.520	0.497		−1.357	−1.428	
(iv) Two male deaths				−3.011	−3.507		1.133[1]	1.522[1]	
(v) Three male deaths							−7.969[1]	−6.960[1]	
Sex of Infant Deaths*									
(i) No death	0.717	0.782	0.125	0.913	0.933	0.130	1.016	0.850	0.122
(ii) Female	−3.751	−4.985		−4.278	−4.423		−5.883	−4.979	
(iii) Male	−5.994	−5.576		−8.553	−8.678		−6.448[1]	−5.316[1]	
Education of Females among Survivors*									
(i) Illiterate	−0.069	−0.051	0.011	0.286	0.230	0.042	−0.050	−0.123	0.026
(ii) Literate	0.772	0.571		−3.773	−3.036		0.669	1.631	
Proportion of Females among Survivors*									
(i) FF, F	0.910	0.608	0.301						
(ii) FFF, FF, F				0.559	−0.063				
(iii) FFFF, FFF, FF, F							−0.506	−0.409	0.041
(iv) MFFF							0.885	0.967	
(v) MFF				−0.545	−0.508	0.015	−1.234	−0.052	
(vi) MF	−0.449	0.123		−0.224	−0.056		−0.796	−1.130	
(vii) MMF				−0.052	0.150				
(viii) MMFF							1.881	0.970	
(ix) MMFF, MF							−0.067	−0.365	
(x) MMM, MM, M				0.281	0.396				
(xi) MMMM, MMM, MM, F							0.461	0.699	
(xii) MM, M	−0.282	−0.667							
Adequacy of Family Living*									
(i) Not adequate	0.091	−0.203	0.011	−0.478	−0.586	0.026	−0.555	−0.469	0.025
(ii) Adequate or more than adequate	0.069	0.153		0.378	0.464		0.452	0.383	

Continued –

Appendix B Table 2 – (Contd.)

Continued –

Appendix B Table 2 – (*Contd.*)

Predictor Variables	Parity 2			Parity 3			Parity 4		
	Deviations From Grand Mean		Beta value	Deviations From Grand Mean		Beta value	Deviations From Grand Mean		Beta value
	Unadjusted	Adjusted		Unadjusted	Adjusted		Unadjusted	Adjusted	
Place of Residence of Respondent*									
(i) Urban	0.087	0.153	0.008	−1.394	−1.110	0.050	−1.162	−1.481	0.078
(ii) Rural	−0.070	−0.123		1.112	0.886		0.948	1.207	
Grand Mean	32.302			31.881			31.969		
S.D. of Grand Mean	16.320			19.798			17.180		
Number of Cases	1,300			1,050			828		
R^2* (Adjusted)	0.026			0.022			0.040		

[1] Cases with cell frequency less than 50.

* F-Ratio test is statistically significant at 5-percent, the exception being the sexes of infant death for parity 2, adequacy of family living for parities 3 & 4, and education of respondent for parity 4.

Appendix B

Table 3

Multiple Classification Analysis of Parity Progression Ratio to the Next Parity by various Predictor Variables for Parities 2, 3 and 4, Pakistan: 1968-69

Predictor Variables	Parity 2			Parity 3			Parity 4		
	Deviations From Grand Mean		Beta value	Deviations From Grand Mean		Beta value	Deviations From Grand Mean		Beta value
	Unadjusted	Adjusted		Unadjusted	Adjusted		Unadjusted	Adjusted	
Exposure time (in years) for having additional birth from parity *i* to the date of Survey*									
(i) 0-1	−0.809	−0.808	0.767	−0.785	−0.781	0.752	−0.715	−0.704	
(ii) 2-3	−0.303	−0.301		−0.301	−0.298		−0.162	−0.163	
(iii) 4–6	0.054	0.056		0.066	0.067		0.039	−0.040	0.630
(iv) 7–9	0.122	0.121		0.140	0.139		0.131	0.134	
(v) 10–14	0.154	0.154		0.153	0.154		0.129	0.129	
(vi) 15–19	0.152	0.152		0.183	0.182		0.161	0.155	
(vii) 20+	0.150	0.147		0.172	0.164		0.180	0.170	
Total Number of Prior Deaths*									
(i) No death	−0.017	0.011	0.539	−0.029	0.037	0.119	−0.057	0.026	
(ii) One death	0.060	0.038		0.052	−0.061		0.042	0.006	0.108
(iii) Two deaths				0.027	−0.055		0.096	−0.060	
(iv) Three deaths							0.006[1]	−0.167[1]	

Continued –

Appendix B Table 3 – (*Contd.*)

Predictor Variables	Parity 2: Deviations From Grand Mean, Unadjusted	Parity 2: Deviations From Grand Mean, Adjusted	Parity 2: Beta value	Parity 3: Deviations From Grand Mean, Unadjusted	Parity 3: Deviations From Grand Mean, Adjusted	Parity 3: Beta value	Parity 4: Deviations From Grand Mean, Unadjusted	Parity 4: Deviations From Grand Mean, Adjusted	Parity 4: Beta value
Total Number of Prior Male Deaths*									
(i) No death	−0.017	−0.017	0.086	−0.029	−0.029	0.096	−0.057	−0.568	0.149
(ii) Female deaths/deaths	0.036	0.075		0.070	0.062		0.030	0.030	
(iii) One male death	0.076	0.048		0.027	0.035		0.053	0.047	
(iv) Two male deaths				0.077[1]	0.056[1]		0.118	0.145	
(v) Three male deaths							0.211[1]	0.231	
Sex of Infant Deaths*									
(i) No death	−0.008	−0.001	0.036	−0.009	−0.003	0.026	−0.013	−0.010	0.061
(ii) Female	0.040	−0.032		0.099	0.041		0.086	0.069	
(iii) Male	0.070	0.046		0.046	−0.002		0.100	0.060	
Education of Respondent*									
(i) Illiterate	0.010	−0.0001	0.001	0.010	0.006	0.052	0.001	0.001	0.005
(ii) Literate	−0.097	0.001		−0.116	−0.068		−0.006	−0.007	
Proportion of Females among Survivors*									
(i) FF, F	0.029	0.010	0.017						
(ii) FFF, FF, F				0.014	−0.011	0.042			
(iii) FFFF, FFF, FF, F							0.061	0.012	0.063
(iv) MFFF							−0.008	0.046	
(v) MFF				−0.051	−0.019		0.052	−0.034	
(vi) MF	−0.027	−0.006		0.081	0.032				
(vii) MMF				−0.021	−0.005		−0.004	−0.042	
(viii) MMFF, MF							−0.025	−0.005	
(ix) MM, M	0.008	0.002							
(x) MMMF							−0.085	0.013	
(xi) MMM, MM, M				0.007	0.011				
(xii) MMMM, MMM, MM, M							0.031	0.008	
Adequacy of Family Living*									
(i) Not adequate	0.032	0.002	0.003	0.022	−0.002	0.003	0.012	0.003	0.070
(ii) Adequate or more than adequate	−0.022	−0.001		−0.017	0.001		−0.010	−0.003	
Place of Residence of Respondent									
(i) Urban	0.011	0.006	0.014	−0.006	−0.005	0.012	0.011	0.007	0.016
(ii) Rural	−0.009	−0.005		0.005	−0.004		−0.009	−0.006	
Grand Mean	0.830			0.808			0.789		
S.D. of Grand Mean	0.376			0.394			0.408		
Number of Cases	1,567			1,300			1,049		
R^2* (Adjusted)	0.589			0.570			0.406		

Continued –

[1] Cases with cell frequency less than 50.

* F-Ratio test is statistically significant at the 5-percent level, the exception being the sex of infant death for parity adequacy of family living for parities 3 and 4, and education of respondent for parity 4.

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