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Determinants of Infant Mortality in a Backward Region of North India: Are Socio-economic or Demographic Factors Dominant?

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ABSTRACT

Several socio-economic factors have been found to be associated with infant and childhood mortality in the developing countries. However, the relative importance of socioeconomic and demographic factors in influencing infant mortality, varies with the level of socioeconomic development of the nation. Some studies have observed that in a traditional society, demographic factors affect infant mortality more than the socio-economic factors. In the early stages of development, demographic factors are replaced by socio-economic factors, and in the later stages the effect of demographic factors becomes very small. This paper will explore this hypothesis in a backward region of India (Mewat region of Haryana State), with a view to contributing to a better understanding of the relative importance of socio-economic and demographic factors on infant mortality. The data employed in this study were obtained by conducting a field survey between April 1996 and February 1997 of factors affecting infant and child survival in the Nuh and Taoru blocks of the Mewat region of Haryana State. Cox proportional hazards model was used to analyse the relative effects of demographic and the socio-economic factors. Finally, some policy implications of the findings are suggested.

DETERMINANTS OF INFANT MORTALITY IN A BACKWARD REGION OF NORTH INDIA: ARE SOCIO-ECONOMIC OR DEMOGRAPHIC FACTORS DOMINANT?

Santosh Jatrana

INTRODUCTION

Several socio-economic factors have been found to be associated with infant and childhood mortality in the developing countries. However, the relative importance of socio-economic and demographic factors in influencing infant mortality, varies with the level of socio-economic development of the nation (Gubhaju, Streatfield & Majumder, 1991). Kim (1988) observed that in a traditional society, demographic factors affect infant mortality more than socio-economic factors. In the early stages of development, demographic factors are replaced by socio-economic factors, and in the later stages the effect of demographic factors becomes very small. This paper will explore this hypothesis in a backward region of India (Mewat region of Haryana State), with a view to contributing to a better understanding of the relative importance of socio-economic and demographic factors on infant mortality.

Mewat provides an ideal situation for exploring this hypothesis because Mewati society is a traditional one and Mewat is a less developed area of India. The Government of Haryana State has declared this region a "backward region". It is one of the least developed parts of India and has little information on mortality and general health conditions. The majority of the Mewat region falls in Haryana which is a State of the northern region of the Indian Union. Haryana State as a whole is fairly well developed and it has the second highest per capita income in India (Government of India, 1998) but Mewat has remained a backward region even after Independence. The area lags behind the rest of Haryana on almost every yardstick of development, even though the farthest point of Mewat is no further than 145 kilometres from Delhi, the national capital. The overall literacy rate in Mewat is 23.1 percent, whereas for Haryana as a whole the literacy rate is 55.3 percent (Mewat Development Agency, 1994; 1995b). The Infant Mortality Rate (IMR) in Mewat is 91 (Jatrana, 1999)

while for Haryana State as a whole the IMR is 68 (Registrar General of India, 1997). Mewat is predominantly rural, covering an area of 1874 sq.km. with 491 villages and 5 towns (Mewat Development Agency, 1995a). A large part of the 700,000 or so inhabitants of this region have agriculture as their main occupation.

METHODS

The data employed in this study were obtained by conducting a field survey between April 1996 and February 1997 of factors affecting infant and child survival in the Nuh and Taoru blocks of the Mewat region of Haryana State. Three villages with population in the range of 500-3000 were selected from each block on the basis of simple random sampling. This range was chosen to eliminate villages that were too small or too large. In the sampled villages, all those households were visited which had experienced a live birth in the three years preceding the survey (Holi festival 1993-Holi festival 1996). A reference to Holi, an important festival in India, was expected to facilitate recall and thus, reporting of births and deaths. Children born during this period formed the universe of the study. Of 950 children thus identified, 83 had died during infancy and the remaining 867 had either survived beyond their first birthday or were censored by the survey date. In the survey, a mother who had a live birth during the reference period was considered as a respondent. If there were more than one woman in the household who had a live birth during the reference period, all were selected for the survey. If a woman had two or three births in the given period, all births were included.

Information on socio-demographic, housing and environment factors of the household was collected by questioning the mothers through a structured questionnaire. The socio-economic variables used in the following analysis are education of mother, education of father, mother's work status, father's occupation, type of family, ownership of land, and ownership of livestock (Table 1). Demographic factors (which are also called maternal factors) are maternal age at birth, preceding birth interval, survival of previous child and utilisation of colostrum[1].

[1] These demographic factors were found to be significantly associated with infant mortality.

Education, especially of mothers, is important in health behaviour and health practices which have a great influence on the survival of young children. Since Caldwell's (1979) study in Nigeria many studies have demonstrated a strong association between maternal education and child survival at the household level; however, the nature of the relationship is not fully understood (Cochrane *et al.,* 1980; Cleland and van Ginneken, 1988; Bicego and Boerma, 1993). In this study, level of education of mother is used as a measure of women's resources for nurturing their children. In Mewat the educational level is very low. The majority only finishes primary education. Some do not have any formal education but they know how to read and write by going to mosques. It may not be worthwhile to take into account only level of education as a measure of women's resources in these circumstances, so in this study level of education and literacy were combined to form a category classified as literate which differentiates from illiterate. A similar approach was adopted for paternal education.

Mother's work status or occupation is also considered an important factor affecting infant and child mortality (Arriaga and Hobbs, 1982: 173; Hobcraft *et al*., 1984: 196). The mother's work status determines the amount of time and care a mother can give to her child, and it may determine the amount of resources (income) available to the mother and thus her access to various goods and services. Women's work may also have an effect on child health through lack of time for breastfeeding. However, results obtained in studies conducted so far are mixed and appear to be inconclusive. In this study, mother's work refers to whether or not the mother was in some form of employment at any time during the reference period, for which the woman was paid in cash or kind. Hence the variable has two categories, working and not working.

Ownership of land and livestock and occupation of father determine the socio-economic status of the households in India (Sandhya, 1986: 95; IIPS, 1995a). But only a few previous studies have examined these variables, despite their pervasive influence on economic well-being in an agricultural economy (Driver, 1963; Smucker *et al.,* 1980; Frenzen and Hogan, 1982; Tuladhar and Stoeckel, 1983; Nagarajan, 1990:147; Casterline *et al.,* 1992). In this study amount of land owned, rather than amount cultivated is examined because land

ownership reflects an important dimension of wealth, and thus permanent income, that may not be fully reflected in net income during one year (Casterline *et al.*, 1992: 250). Occupation of father was classified as working as a labourer or not working as a labourer.

Table 1 Distribution of live births by categories of independent socio-economic and demographic variables, Mewat, 1996

Variables	Live births	Infant deaths
Education of mother		
Literate	248 (26)	12
Illiterate	702 (74)	71
Education of father		
Literate	455 (48)	29
Illiterate	495 (52)	54
Mother's work status		
No	680 (72)	59
Yes	270 (28)	24
Father working as labourer		
No	481 (49)	28
Yes	469 (51)	55
Type of family		
Joint/ extended	398 (42)	25
Nuclear	552 (58)	58
Owning any land		
Yes	518 (55)	31
No	432 (45)	52
Owning any livestock		
Yes	776 (82)	64
No	174 (18)	19
Maternal age at childbirth		
< 20 years	361 (38)	48
20 + years	589 (62)	35
Preceding birth interval		
<24 months	296 (31)	41
24 + months & 1st births	654 (69)	42
Survival of previous child		
Alive & 1st births	657 (69)	46
Dead	293 (31)	37
Utilisation of colostrum		
Yes	333 (35)	12
No & never breastfed	617 (65)	71
Total	950 (100)	83

Source: Mewat field data, 1996

Note: Figures in parenthesis are percentages to total live births.

The type of family will influence infant mortality indirectly through an effect on the life style, food habits, and decision when an infant falls sick to take it to the doctor (Sandhya, 1985, 111). In this study, type of family was categorised as joint/extended if other family members lived in the house and contributed to the expenses of the household, and nuclear if

husband and wife lived on their own and not with the husband's family. Type of family was thought to affect infant mortality through the availability of other members of the family, besides the mother and father, to look after the children, especially when the mother went out to work.

Possession of livestock in Mewat can be important as regards child survival as it may provide nutritious food (milk). In addition, livestock can be a source of household income: animals or their products, for instance milk, can be sold to obtain cash with which to purchase food, other goods and services such as health services. Possession of livestock refers to whether or not there were cattle, sheep or goats in the household at the time of survey. No information was collected about the number or the specific type of livestock; nor was information collected about how long they had been reared.

Maternal age at birth is an important variable in Mewat, where childbearing begins at an early age. Higher infant mortality is expected for children of young mothers. Maternal age at birth was categorised as less than 20 years and 20 years or more. This variable is a proxy for the mother's physiological, mental and emotional maturity; it also measures the mother's experience with child care. The preceding birth interval is the interval before the birth of the child in question; so the effect of the preceding birth interval is considered in relation to the younger of the two children. Ideally, first births are left out of the analysis of preceding birth interval and survival of the preceding child because they are not preceded by another birth. Because of the small sample size, first births in this study have been merged with those with a preceding birth interval of 24 months or longer. Similarly, for the variable "survival of the preceding child", where there was no preceding birth the child was put in the same category as those whose preceding sibling was alive. Madise and Diamond (1995) used a similar approach in their analysis of these two variables. In this study, the preceding child was coded as being alive if it survived until its first birthday or until conception of the index child if this occurred earlier.

Birth intervals indicate the pace of childbearing. This variable was included to determine the behavioural mechanism that may be operating, because current evidence for the most frequently suggested mechanisms of maternal depletion, sibling competition, and

increased infectious disease transmission is fragmentary and inconclusive (Boerma and Bicego, 1992). The survival status of the preceding child was included to capture the effects of intra-familial mortality. Biological, social and behavioural mechanisms may be operating in determining the survival status of the previous child and infant mortality, but these are not yet well understood (Winikoff, 1983).

Use of colostrum is important for infant survival. Colostrum, the first milk, is important to the newborn for its anti-infective properties (Ogra, Losonsky and Fishaut, 1983:82; Goldman, Goldblum and Hanson, 1990: 69; Ashraf, Jalif and Zaman, 1991: 488). Colostrum and breastmilk are sufficient for newborn infants; it is not necessary to feed them anything else. In fact, when the neonate is given anything else, contamination may cause infection, leading to diarrhoea. Moreover colostrum provides natural immunity for the child (IIPS, 1995a). In Mewat, of children who were ever breastfed, 65 percent were not fed colostrum.

The categorisation of the independent variables was based on theoretical grounds, as well as on the basis of the distribution of births with respect to the different variables. A partitioning of the sample according to various background characteristics of its members produces such small sub-groups that estimates are unstable and the interpretation of results difficult. Hence, distribution of various variables is collapsed into two broader categories in order to alleviate the problem of excessively small cell size. All the independent variables included in the regression analysis were dummy coded.

As the unit of analysis, children born three years preceding the survey were selected as the study population for the analysis of infant mortality. A dichotomous dependent variable, child's survival status through infancy, has been given a value of 1.00 if the child failed to survive through infancy and zero otherwise. The Cox proportional hazard regression model (Cox, 1972) was fitted to determine the effect of each variable and to investigate the partial effects of multiple factors on infant mortality. Both univariate and multivariate models are fitted. The results in the univariate model describe the gross effect, while the results in the multivariate model describe the net effects, that is the effects after controlling for the effects of other variables in the model. A variable was considered significantly associated with mortality

when its *p* value was below 0.10. This relatively high significance level was chosen instead of the usual 0.05 in order not to miss any possible variables associated with infant mortality.

The results of the proportional hazards models including values of exp(β) and regression coefficient β are presented in Tables 2, 3 and 4. Exp(β) represents the risk of dying associated with each covariate, relative to the risk for the reference category. The reference category was preferably the category with theoretically the lowest risk of mortality. The relative risk for the reference category of each covariate is unity. Values greater than unity indicate that the relative risk of dying is greater for this group, compared with the reference group, whereas values less than unity indicate a decrease in the risk (Pebley & Stupp, 1987; Santow & Bracher, 1994). The regression coefficient β in the hazard model indicates the relationship between the independent variable and the hazard of dying (the force of mortality). A positive coefficient indicates that the variable is associated with an increased hazard of dying and has a negative relationship with survival.

Three proportional hazard regression models are fitted. First, a univariate Cox's proportional hazard regression model was fitted to examine the effect of each socio-economic variable on infant mortality (Model 1, Table 2). Second, a multivariate model was fitted to estimate the effects of each of these variables net of other socio-economic variables (Model 2, Table 3). The third model was also a multivariate model which was fitted to see the net effect of socio-economic and demographic factors affecting infant mortality (Model 3, Table 4). The purpose was to see to what extent their relative importance varied when other socio-economic factors and demographic factors were introduced as controls.

One important limitation of this kind of study is that the deaths of children are related to characteristics of the family at the time of survey. Because the household and socio-economic covariates are available only for the time of the interview and the living standard of the family may change during the period, it is likely that a child born in the distant past was exposed to the risk of death under a different set of socio-economic conditions than those recorded in the survey. Thus, to reduce the time differentials between the two variables, the sample has been limited to births in the last three years. Moreover, there is no documented

evidence which suggests that the living standards have changed rapidly in Mewat. Another limitation is that some mothers may have omitted information on the birth and death of their children. In general, such problems would tend to underestimate the true magnitude of any differentials.

The principal weakness of these data is the small number of deaths on which they are based, relative to the inferences I desire to make. The total sample used in this analysis contains 950 singleton births, of which 83 had died in infancy by the time of the survey. Since the primary focus of this study is differential mortality and not the overall levels of infant and child mortality, these numbers are adequate for studying the determinants of infant mortality. Moreover, the underlying purpose of this survey design was the maximisation of the quality of the information while at the same time obtaining a sample size large enough for multivariate analysis. The fixed budget of time and money necessitated a choice between quality and quantity. Quality of information was generally favoured over the size of the sample. With this in mind, sample villages were visited several times before interviews were conducted. This was done to build close and extensive contacts with the respondents. This method reduced suspicion and increased rapport thereby, increased the accuracy of the data and improved the quality of information.

RESULTS

A univariate proportional hazard model is presented in Table 2. It shows that variables significantly associated with infant mortality at the univariate level were education of mother, education of father, occupation of father, type of family and ownership of land. Table 3 presents the risk of infant death associated with each variable, controlling for other socio-economic variables. It appears from the analysis that none of the socio-economic factors except ownership of land and father's occupation had a significant influence on mortality during infancy in the multivariate model. Controls for the socio-economic factors reduced the significance level of the effect of ownership of land and father's occupation and also reduced the range of the coefficient. Nonetheless, infants whose fathers were working as labourers were one and a half times as likely to die as those whose fathers were not labourers. Similarly

infants born in families owning no land were one and a half times as likely to die as infants in families owning some land.

Table 2 Summary results[a] from Cox proportional hazards model for the effect of socio-economic factors on infant mortality: Model 1 (Univariate model), Mewat, 1996

Covariates	Regression coefficient β	Exp (β)	SE	95% confidence interval
Education of mother				
Literate	0.0000	1.0000		
Illiterate	0.7580*	2.1340	0.3121	1.1575-3.934
Education of father				
Literate	0.0000	1.0000		
Illiterate	0.5602*	1.7510	0.2302	1.1151-2.7496
Mother's work status				
No	0.0000	1.0000		
Yes	0.0298	1.0302	0.2421	0.6410-1.6559
Father working as labourer				
No	0.0000	1.0000		
Yes	0.7146***	2.0435	0.2332	1.2964-3.2210
Type of family				
Joint/extended	0.0000	1.0000		
Nuclear	0.5416**	1.7187	0.2398	1.0753-2.7470
Owning any land				
Yes	0.0000	1.0000		
No	0.7242***	2.0631	0.2269	1.3224-3.2187
Owning any livestock				
Yes	0.0000	1.0000		
No	0.2962	1.3447	0.2613	0.8058-2.2440

Source: Mewat field data, 1996

Note: [a]Results based on a total of 950 cases: 83 died during infancy; 867 either survived the infancy period or were censored at survey date.

*p<0.10 **p<0.05 ***p<0.01

Table 3 Summary results[a] from Cox proportional hazards model for the effect of socio-economic factors on infant mortality: Model 2[b] (Multivariate model), Mewat, 1996

Covariates	Regression coefficient β	Exp (β)	SE	95% confidence interval
Education of mother				
Literate	0.0000	1.0000		
Illiterate	0.3637	1.4386	0.2833	0.8257- 2.5064
Education of father				
Literate	0.0000	1.0000		
Illiterate	0.0549	1.0564	0.2742	0.6173- 1.8079
Father working as labourer				
No	0.0000	1.0000		
Yes	0.4715*	1.6028	0.2342	0.9084- 2.4862
Type of family				
Joint/extended	0.0000	1.0000		
Nuclear	0.1887	1.2077	0.2698	0.7116- 2.0495
Owning any land				
Yes	0.0000	1.0000		
No	0.4352*	1.5453	0.2076	0.7435 - 3.2118

Source: Mewat field data, 1996.

Note: [a]Results based on a total of 950 cases: 83 died during infancy; 867 either survived the infancy period or were censored at survey date.

[b] Model contained all covariates listed in Table 2 that were significantly associated ($p<0.10$) with infant mortality.

*P<0.10

Now to test the hypothesis about the relative importance of socio-economic factors, the adjustments were made for the demographic/ maternal factors (Table 4, Model 3). The results indicate that once the maternal factors were introduced, the effects of father's occupation and ownership of land were reduced and no longer significant at the 10 percent level. All maternal factors are significantly related with infant mortality in Mewat.

Table 4 Summary results[a] from Cox proportional hazards model for the effect of socio-economic demographic and cultural factors on infant mortality: Model 3[b] (Multivariate model) Mewat, 1996

Covariates	Regression coefficient β	Exp (β)	SE	95% confidence interval
Father working as labourer				
No	0.0000	1.0000		
Yes	0.1528	1.1651	0.2563	0.7051- 1.9253
Owning any land				
Yes	0.0000	1.0000		
No	0.3135	1.3682	0.3140	0.7051- 1.9253
Maternal age at birth				
<20 years	0.0000	1.0000		
20 + years	1.0986***	2.9998	0.2426	1.8645- 4.8265
Preceding birth interval				
<24 months	0.0000	1.0000		
24+ months & 1st births	0.4922*	1.6360	0.2715	0.9609- 2.7853
Survival of previous child				
Alive & 1st births	0.0000	1.0000		
Dead	0.6539*	1.9231	0.3541	0.9608- 3.8493
Utilisation of colostrum				
Yes	0.0000	1.0000		
No	1.2429***	3.4657	0.3166	1.8632- 6.4464

Source: Mewat field data, 1996

Note: [a]Results based on a total of 950 cases: 83 died during infancy; 867 either survived the infancy period or were censored at survey date.

[b] Model contained all covariates listed in Table 3 that were significantly associated ($p<0.10$) with infant mortality, with addition to demographic and cultural covariates to model.

*P<0.10

***p<0.000

DISCUSSION

It has been argued that the relative importance of the effect of socio-economic and demographic factors on infant mortality varies with the level of socio-economic development of the nation. Gubhaju *et al.* (1991), using data from Nepal, argued that in less developed areas, at early stages of development demographic rather than socio-economic factors are more important determinants of infant mortality. The analysis of Mewat field data 1996 was consistent with the hypothesis that when infant mortality rates were high, demographic/ maternal factors such as maternal age, previous birth interval, survival of preceding child and utilisation of colostrum were the important determinants, while socio-economic factors were less important.

Utilisation of colostrum emerged as the most important factor influencing infant mortality in Mewat, followed by maternal age at birth, survival of previous child and preceding birth interval. Tradition in Mewat supports the practice of delaying initiation of breastfeeding, thereby depriving the infant of valuable colostrum. In Mewat there is a belief that colostrum or the first milk has remained in the breast for nine months during pregnancy and is therefore harmful. There is also a religious belief that dropping milk on Mother Earth will ensure a continuous flow of milk; otherwise breastmilk will dry up. The colostrum is discarded because of the general belief that it is 'heavy', so difficult to digest or not good for the child. As the colour of the initial milk is not pure white, there is a perception that in the first one or two days, mother's milk is not pure and could harm the child. Pre-lactation food includes water with honey, sugar or jaggery or plain water, or cow or buffalo milk diluted with water. I observed that the mode of giving pre-lactation food is often unhygienic as the diluted milk or water and sugar mixture is fed to the infant with a piece of cotton or a rag, and fingers are used to feed honey. Because of the general lack of knowledge about cleanliness and hygiene, these pre-lactation practices could easily cause infection and lead to diarrhoea.

Negative ideas on colostrum are known in many societies past and present. Indian Brahminical medicine ('Susruta', second century B.C.) describes the custom of giving honey or clarified butter during the first four days of life whilst colostrum was discarded, and Soranus of Ephesus advised mothers to discard colostrum in his treatise on gynaecology and obstetrics in the second century (Wickes, 1953a: 151). The first writings in Western medical literature promoting the use of colostrum are from the seventeenth century (Wickes, 1953b: 332). Colostrum taboos can still be found in many cultures throughout the world. A study of ethnographic infant-feeding literature by Morse *et al.* (1990: 303) found that about two-fifths of 120 groups surveyed delayed breastfeeding for two or more days, considering colostrum poisonous, bad, provoking illness or 'nothing'.

Maternal age at birth was the second most significant factor affecting infant mortality. Children born to young mothers (<20 years) were at a significantly greater risk of infant mortality; they were three times as likely to die as children born to mothers over 20 years of

age). This suggests that very young mothers may not be physiologically and emotionally mature enough to adequately manage a pregnancy (Pebley and Stupp, 1987: 43). The increased risk of infant death to the younger mother may be due to biological incompetence of early childbearing, for example, at younger maternal ages, the reproductive systems have not matured sufficiently to produce strong, normal weight babies (Madise and Diamond, 1995: 97). Young mothers may bear premature and low birth weight infants because of poor nutritional status, inadequate use of antenatal care and lower educational achievements (Gribble, 1993: 139). In addition, most teenage mothers do not receive prenatal care (Trussell, 1988). They may also have poor child-care skills, which derives partly from inexperience in child rearing (Suchindran and Adlakha, 1981). Moreover, they may be unable to obtain an adequate share of food and other household resources for their children, since they may have little influence on the allocation of household resources (Ikamari, 1996). Hence, this study confirms the usual pattern of higher risks of infant mortality among children born to younger mothers.

The survival status of the preceding child was another significant factor affecting infant mortality. Children of mothers whose previous child had died in infancy were at a significantly greater risk of dying than children born to mothers without such a history, irrespective of socio-economic or other demographic settings. These results show a strong intra-family mortality correlation during infancy among successive births. The pattern in which death of the preceding child is an important risk factor for infant death indicates a clustering of deaths within certain households. Cleland and Sathar (1984: 407) suggested that the survival of successive siblings early in life, which is influenced to a large extent by endogenous causes, might be correlated. This may be a result of biological conditions such as hereditary disease, birth trauma due to small pelvis or propensity to deliver prematurely. The evidence of intra-family correlation or clustering of deaths in certain families has also been noted in Bangladesh (Swenson, 1981; Majumder, 1980; Zenger, 1993; Alam, 1995), Nepal (Gubhaju, 1986; Gubhaju *et al*., 1991; Pant, 1995), Indonesia (Hull and Gubhaju, 1986), India (Das Gupta, 1990), and Brazil (Curtis, Diamond and McDonald 1993; Sastry, 1997: 245-261). Das Gupta (1990) observed that 12 percent of families in rural Punjab had multiple child losses, which constituted 60 percent of all child deaths in her data. Curtis *et al*. (1993) in their study

in Brazil observed that 45 percent of all post-neonatal deaths were confined to only 2.5 percent of all the women interviewed.

The reasons for excess risk of mortality among infants preceded by a sibling who died in infancy could be both biological (Winikoff, 1982) and behavioural (Winikoff, 1983: 232; De Sweemer, 1984: 56-59; Pebley and Millman, 1986: 72; Hobcraft, 1987: 33; Das Gupta, 1990: 489; Boerma and Bicego, 1992: 245-246). Biological reasons include inherited genetic conditions such as sickle-cell anaemia or the tendency for some mothers to have low-birthweight or pre-term babies (Bakketeig, Hoffman and Harley, 1979). Some women experience more biological problems in pregnancy than others (for example, premature delivery, intrauterine growth retardation) and these problems are likely to be repeated in other pregnancies. Siblings also share the same home environment, family behaviour and child health practices and consequently also any risks associated with these (Curtis *et al.*, 1993). Das Gupta (1990) argues that clustering of deaths is largely a result of basic lack of ability in domestic management, irrespective of education, occupation or wealth of the families; some women are less resourceful and less well organised than others in caring for their children.

The analysis also shows that birth interval is also significantly associated with infant mortality even when the effects of socio-economic, demographic and cultural factors are controlled. A preceding birth interval of less than 24 months was associated with significantly higher infant mortality risks than birth intervals of at least 24 months. Evidence from developing countries over the last two decades shows that birth interval remains the most important predictor of infant and child mortality risks, even when controls are introduced for the confounding effects of socio-economic, demographic and environmental factors (Cleland and Sathar, 1984; Hobcraft *et al.*, 1985; Palloni and Millman, 1986; Palloni and Tienda, 1986; Pebley and Millman, 1986).

None of the socio-economic variables was significantly related to infant mortality. The significant effect of father's education and ownership of land was reduced when demographic and cultural factors were taken into account. The effect was no longer significant even at the 10 percent level. This absence of significant results for socio-economic factors is consistent

with findings from Bangladesh (Chowdhury, 1982; Phillips and Mozumder, 1984; Majumder, 1989), from Pakisthan (Knowles, 1979), from Egypt (Kelley, Khalifa, and El-Khorazaty, 1982; Hoodfar, 1984, 1986; Casterline *et al.*,1989, 1992), and from Thailand (Frenzen and Hogan, 1982).

Although there has been considerable recent emphasis on the role of parental education as a determinant of infant and child survival, these data fail to reveal a significant parental schooling effect. Despite the absence of significant effect, the estimated relative risks suggest that infant survival chances do improve with parental education. The absence of any significant influence of maternal education on mortality during infancy in Mewat may be due to the protection given by the almost universal and prolonged breastfeeding by Mewatti women, coupled with the general low level of female education. The female literacy rate in Mewat is only 10.2 percent (Mewat Development Agency, 1995b). It may also be due to small sample size or what Anker and Knowles (1980) call a "threshold" below which increases in education do not affect survival rates. This is particularly important in view of non-attendance at school in Mewat. The completion of primary schooling is stressed in many discussions (e.g., Caldwell, 1979. In the present study the education variable was divided into 'some' education and 'no' education because the percentage of women who had 5 or more years of schooling was very small. Under the prevailing conditions of low female literacy, and when few women continue their studies beyond primary level, it seems that infant mortality was not affected by education of mother to the extent that could produce any significant differences in infant mortality between the two groups of educated and uneducated mothers. The level of educational attainment will have to rise substantially beyond primary levels to achieve a noticeable impact on infant mortality in Mewat.

Thus the findings from the present study support the hypothesis that in the early stages of a society's development demographic factors are dominant and the socio-economic factors are not strong enough to greatly influence the outcome. There may be socio-cultural factors through which these independent demographic/ maternal factors are influenced. For example, the main reasons brought out from the qualitative data about why parents marry off their

daughters at an early age are to conform to tradition, and to preserve the chastity of daughters. For example a mother of a 16-year-old girl in Mewat said:

> When I was her age I became the mother of a child. She should have been married by now but it is difficult to get good boys these days. By the grace of God we will marry her by next year, otherwise she will miss her marriageable age and once that age has gone nobody will marry her. It all depends on God and a good crop. For us farmers the crop is most important' (Field Notes, Mewat, 1996).

An early age at marriage leads to an early age at childbirth because the main function of the *berbani* (wife/woman) is to bear children for her husband's family, and her status grows with the birth of children, especially males (Aggarwal, 1971: 132). A woman's affiliation with her husband's family is strengthened when she bears a son. Then she becomes 'the mother of so-and–so'. Thus there may be social factors why women in Mewat give birth at an early age, but the fact remains that these demographic/ maternal factors are affecting infant mortality in Mewat independently of socio-economic factors.

What are the policy implications of these findings? First, the organised national family welfare program, which includes efforts to raise female age at marriage, postpone the first birth at least until the age of 20, increase birth intervals and limit family size, has an important role to play in reducing infant mortality as well as enhancing the health status of mothers and children in Mewat region. Secondly, social policies attempting to promote early initiation of breastfeeding and utilisation of colostrum could make a major contribution to the reduction of infant mortality in Mewat. They could be promoted through the mass media, particularly radio, which has reached most of the families, as well as education in the schools. Both these measures would make a supportive socio-cultural environment, with the general public becoming more supportive of early initiation of breastfeeding and with increased understanding of the benefits of colostrum to the newborn. Village dais could be helpful too in promoting early initiation of breastfeeding as well as utilisation of colostrum because they are still considered to be the first contact person for delivering babies.

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