Studies
in
Population and Development

No. 09-03

Progress towards Child Survival over Two decades in Madhya Pradesh India: 1981-2001

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Abstract

Using the estimates of child survival probability obtained on the basis of children ever born and children surviving data collected at different population census, this paper analyses progress towards child survival in Madhya Pradesh during the two decades between 1981 and 2001. The analysis reveals that the probability of survival in the age group 1-4 years has decreased in the state and in many of the districts during the 1990s. It appears that this decrease in the probability of child survival in the age group 1-4 years has been the result of the policy shift in child survival efforts during the 1990s. The analyses stresses the need of reinvigorating child survival efforts to accelerate the progress towards child survival in the state.

Key Words
Child survival, survival probability, Madhya Pradesh, India

Introduction

Madhya Pradesh has the dubious distinction of having the lowest probability of survival in the first five years of life among the constituent states of India. Although, infant mortality in the state decreased from around 145 infant deaths per 1000 live births during 1971-73 to around 74 infant deaths per 1000 live births during 2007, yet the state has always been ranked as the poorest state of the country in terms of child survival (Government of India, 1999; 2008). Persistence of very high infant and child mortality in the state has a reflection in terms of life expectancy. During the period 1970-75, the expectation of life at birth in Madhya Pradesh was the fourth lowest among the major states of the country (Government of India, 1999a). However, during the period 2001-05, the expectation of life at birth in the state was the lowest in the country (Government of India, 2007). An accelerated improvement in child survival remains a major development challenge in Madhya Pradesh.

In this paper, we analyse the progress towards child survival in Madhya Pradesh between 1981 and 2001 through a district-based approach. Adoption of the district-based approach in analysing the progress towards child survival is important from at least two counts. First, inter-district diversity in almost all aspects of social and economic development including health of the people is very strong in Madhya Pradesh and this disparity has persisted over time. It has been argued that reducing the inter-district disparity may be an optimal yet feasible strategy for accelerated improvement in child survival probability in the state.

The second reason for a district-based approach for analysing the progress towards child survival is the recent emphasis on decentralisation of the public health care delivery system in India as articulated in the National Rural Health Mission which has recently been launched by the Government of India to bring about architectural corrections in the health care delivery system (Government of India, 2005). One of the objectives of the Mission is the decentralisation of the public health care delivery system so that it can effectively address the health needs of the people. The Eleventh Five-Year Development Plan of the Government of Madhya Pradesh also emphasises a decentralised approach for achieving its goals one of which is the reduction in infant and child mortality (Government of Madhya Pradesh, 2007).

A district-based approach in analysing the progress towards child survival in Madhya Pradesh is also required because of the changes in the administrative boundaries of the state. The erstwhile state of Madhya Pradesh that existed before 1 November 2000 was divided into the states of Chhattisgarh and the present state of Madhya Pradesh. As such estimates of infant and child mortality for Madhya Pradesh prior to 1 November 2000 are not comparable to

the estimates of infant and child mortality for Madhya Pradesh that existed after 1 November 2000. There has also been a reorganisation of the districts within the state that has resulted in the change in the administrative boundaries of many districts of the state. In 1981 and 1991, there were 45 districts in the state. As the result of the reorganisation of districts in 1998, the number of districts in the state increased to 60. However, with the division of the erstwhile state of Madhya Pradesh into the states of Chhattisgarh and existing Madhya Pradesh, the number of districts in the existing Madhya Pradesh again reduced to 45, although the administrative boundaries of these new districts were not the same as the administrative boundaries of old districts. There are, however, 29 districts in the existing Madhya Pradesh where there has been no change in the administrative boundaries since 1981. The analysis presented here is therefore confined to these 29 districts. These 29 districts accounted for more than 70 per cent population of the state at the 2001 population census.

Data Source

The most commonly used source of data on mortality in India is the Sample Registration System (Government of India, 2008). However, the system does not provide district level estimates of the probability of survival or probability of death by age. District level estimates of child survival probabilities are also not available either from the National Family Health Survey or from the District Level Household Survey. The only source of information at the district level that can be used for estimating child survival probabilities in India is the population census. Information about children ever born and children surviving collected from every currently married women in the reproductive age group at the time of the population census can be used to estimate the probability of survival in the first year of life as well as in the first five years of life (United Nations, 1988). Using this approach, the Registrar General of India has prepared estimates of probability of death in the first year of life and in first five years of life on the basis of the information available through 1981 and 1991 population census for all districts in the country (Government of India, 1997). Using the same approach, estimates of probability of death in the first year of life and in first five years of life have been prepared by the author on the basis of 2001 population census for the 45 districts of Madhya Pradesh as they existed at the time of 2001 population census (Ranjan, 2008). Out of these 45 districts, there has been no change in the administrative boundaries since 1981 in 29 districts. It is therefore possible to analyse the progress towards child survival in Madhya Pradesh by measuring the change in the child survival probabilities in these 29 districts. These estimates constitute the basis for the present analysis.

Methodology

The key variable used in the present analysis is the probability of survival from birth to age 5 years (${}_5p_0$) which is related to the probability of death in the first five years of life (${}_5q_0$) through

$$ {}_5p_0 = 1 - {}_5q_0 \quad (1) $$

The probability of survival up to 5 years may also be written as

$$ {}_5p_0 = {}_1p_0 * {}_4p_1 \quad (2) $$

or

$$ 1 - {}_5q_0 = (1 - {}_1q_0) * (1 - {}_4q_1) \quad (3) $$

Denoting ${}_5p_0$ by u, ${}_1p_0$ by i and ${}_4p_1$ by c, the change in u over time can be decomposed as

$$ \nabla u = u_2 - u_1 = (i_2 - i_1) * c_1 + (c_2 - c_1) * i_1 + (i_2 - i_1) * (c_2 - c_1) \quad (4) $$

The first term on the right hand side of equation (4) gives the contribution of the change in ${}_1p_0$ to the change in ${}_5p_0$ on the assumption that there is no change in ${}_4p_1$ whereas the second term gives the contribution of the change ${}_4p_1$ to the change ${}_5p_0$ on the assumption that there is no change in ${}_4p_1$. The third term on the right side of equation (4) is the interaction term. It takes into account simultaneous changes in ${}_1p_0$ and ${}_4p_1$. Interaction effects arise because the change in ${}_1p_0$ and the change in ${}_4p_1$ do not add up to the change in ${}_5p_0$. Interaction effects are generally difficult to explain (Horiuchi, Wilmoth, Pletcher, 2008). They basically represent incomplete separation of the contribution of the change in ${}_1p_0$ and the change in ${}_4p_1$ to the change in ${}_5p_0$. As such, it has usually been considered desirable to allocate them among the main effects (Das Gupta, 1993). One way is to follow the Goldfield's rule of "allocating interactions to various individual factors on the principle of equal distribution of all variables involved in each interaction" (Durand, 1948).

Alternatively, let

$$ c = (c_1 + c_2)/2, \text{ and} $$
$$ i = (i_1 + i_2)/2, $$

then, it is easy to show that (Kitagawa, 1955)

$$ \nabla u = u_2 - u_1 = (i_2 - i_1) * c + (c_2 - c_1) * i $$
$$ \nabla u = \nabla i + \nabla c \quad (5) $$

We shall be using equation (5) to analyse the contribution of the change in ${}_1p_0$ and in ${}_4p_1$ to the change in ${}_5p_0$.

The change in the probability of survival in different age groups also varies by districts. This variability can be captured through the variance of the distribution of the change in the survival probability across the districts. It is easy to show that

$$ Var(\nabla u) = Var(\nabla i) + Var(\nabla c) + 2Cov(\nabla i, \nabla c) \quad (6) $$

where *Var* stands for variance and *Cov* stands for covariance between the variables under consideration. This decomposition reveals how inter-district variation in the change in ${}_1p_0$ and in ${}_4p_1$ contribute to the inter-district variation in the change in ${}_5p_0$. This approach moves the analysis in the direction of the causal analysis, which aims at understanding the sources of variation in ${}_5p_0$ across the districts.

The decomposition of the change in ${}_5p_0$ into the change in ${}_1p_0$ and the change in ${}_4p_1$ is necessary to analyse the progress towards child survival. The reason is that the causes of death responsible for mortality in the first year of life are radically different from the causes of death that are responsible for mortality in the age group 1-4 years. Information available from the Registrar General of India on the causes of death on the basis of medical certification of the cause of death suggests that certain conditions originating in the perinatal period were responsible for 67 per cent of the deaths in the age group 0-1 year in India during the year 1998. This proportion was 87 per cent in Madhya Pradesh (Government of India, 2003). By contrast, infectious and parasitic diseases and diseases of the respiratory system were responsible for majority of the deaths in the age group 1-4 years (46 per cent in India and 74 per cent in Madhya Pradesh). The different causes of death pattern in the age group 0-1 year as compared to the age group 1-4 years suggests that factors influencing ${}_1p_0$ are different from the factors that influence ${}_4p_1$. During the first year of life, the child is exposed to particular stresses and hazards which are not faced by a child in the life after one year (Wills and Waterlow, 1958). During the first year of life, key factors that influence the probability of survival are physiological factors, quality of medical care to the mother and the child, especially during pregnancy, at the time of delivery and immediately after delivery and a host of social, economic and cultural attributes (Hijazi, 1979). Maternal factors such as nutritional status of the mother, parity, age at pregnancy, etc. also play a very significant role in deciding ${}_1p_0$. On the other hand, key factors that influence ${}_4p_1$ are mainly acute respiratory infections, diarrhoeal diseases, vaccine preventable diseases, especially measles and poor nutritional status of the child (Pan American Health Organisation, 1979). Effects of poor nutritional status have been found to be the most severe in young growing children. It has been estimated that almost 60 per cent of deaths in children below five years of age are due to poor nutritional status of children and its interactive effects on diseases that can be prevented easily such as measles, acute respiratory infections, etc. Because of the very strong impact of malnutrition on ${}_4p_1$, it has been advocated that ${}_4p_1$ or, equivalently, ${}_4q_1$ should always be taken to indicate widespread malnutrition among children (Bengoa, et al, 1959).

Child Survival in Madhya Pradesh

Although child survival probability in Madhya Pradesh has shown an improving trend during the 20 years under reference, yet, it has always remained lower than the national average. Estimates based on the children ever born and children surviving data available through 1981, 1991 and 2001 population census support this observation (Government of India, 1997; Ranjan, 2008). These estimates suggest that ${}_5p_0$ in Madhya Pradesh increased from 0.803 to 0.859 between 1981 and 2001 as compared to the increase from 0.848 to 0.903 in India. During the same period, ${}_1p_0$ increased from 0.850 to 0.906 in Madhya Pradesh and from 0.885 to 0.931 in India while ${}_4p_1$ increased from 0.945 to 0.948 in Madhya Pradesh but from 0.958 to 0.970 in India. The increase in ${}_4p_1$ has however been confined to the period 1981 through 1991 as, in both Madhya Pradesh and India, ${}_4p_1$ actually decreased, instead of increasing between 1991 and 2001. As the result of the increase in ${}_4p_1$, the increase in ${}_5p_0$ nearly stagnated in Madhya Pradesh whereas it increased in India during the period 1991 through 2001.

Estimates of child survival probability obtained through the children ever born and children surviving information available through population census suggest that, out of every 1000, 197 live born failed to survive to their fifth birth day around the year 1981. This number reduced to 141 around the year 2001. This means that, between 1981 and 2001, for every 1000 live born, about 56 deaths of children 0-5 years could be saved in Madhya Pradesh (Table 2). In India, by contrast, about 55 deaths of children in the age group 0-5 years could be saved for every 1000 live births. Among the 56 deaths saved for every 1000 live born, 50 were saved during the period 1981 through 1991. By contrast, during the period 1991 through 2001, only about 6 deaths for every 1000 live births could be saved. Moreover, out of the 50 under five deaths saved for every 1000 live births in Madhya Pradesh during 1981 through 1991, about 17 or about one third were confined to the first year of life whereas 33 or about two-third were confined to the age group 1-4 years. During the period 1991 through 2001, however, all the under-five deaths saved were confined to the first year of life. In fact, the number of deaths in the age group 1-4 years increased during the period 1991through 2001 as compared to the period 1981 through1991. Because of this increase in the number of deaths in the age group 1-4 years for every 1000 live born, the number of under five deaths saved during the 1990s decreased substantially compared to under five deaths saved during the 1980s. Interestingly, the number of 1-4 years deaths saved during the period 1981 through 1991 for every 1000 live births were equal to the increase in the number of 1-4 years deaths during the period 1991-2001 as the result of the decrease in

${}_4p_1$ so that there had been neither increase nor decrease in the number of 1-4 years deaths for every 1000 live births during the period 1981 through 2001.

It may also be seen from table 2 that improvement in ${}_5p_0$ during the period 1981 through 2001 was primarily due to the improvement in ${}_4p_1$. However, during the period 1991 through 2001, improvement in ${}_5p_0$ was due to the improvement in ${}_1p_0$ as ${}_4p_1$ decreased, instead of increasing during this period. Obviously, transition in child survival in Madhya Pradesh had a different characterisation in the period 1981 through 1991 as compared to the period 1991 through 2001.

Deaths in 1-4 years of age for every 1000 live births increased in India also during the period 1991 through 2001. During the 1980s, around 20 deaths for every 1000 live births could be saved in India as a whole as the result of the improvement in ${}_4p_1$ (Table 2). However, during the period 1991 through 2001, ${}_4p_1$ decreased so that the number of deaths in the age group 1-4 years increased by around 11 for every 1000 live births. As the result of the decrease in ${}_4p_1$, ${}_5p_0$, instead of increasing, decreased marginally in the country as a whole around 2001 as compared to 1991.

Within Madhya Pradesh, level and trend in the child survival probability varied widely across the districts. Summary measures of inter-district variation in ${}_5p_0$, ${}_1p_0$ and ${}_4p_1$ in Madhya Pradesh are given in table 2 and presented in Figure 1 for those districts where the administrative boundary remained unchanged during the period under reference. Figure 1 suggests that there has been a consistent improvement in ${}_1p_0$ in all districts between 1981 and 2001. The median ${}_1p_0$ in the 29 districts increased from 0.846 to 0.905 while the mean value increased from 0.849 to 0.906. The trend has however not been so consistent in case of ${}_4p_1$. In five districts - Rewa, Sidhi, Jhabua, Seoni and Balaghat, ${}_4p_1$ actually decreased in 2001 as compared to that in 1981. In fact, median ${}_4p_1$ decreased marginally in the year 2001 as compared to the year 1991. The reason is that in 15 of the 29 districts included in this analysis, ${}_4p_1$ decreased during the 1990s. Because of the decrease in ${}_4p_1$, improvement in ${}_5p_0$ slowed down during the period 1991-2001 compared to the period 1981-2001 in most of the districts.

The good sign, however, is that the inter-district disparity or inequality in the three survival probabilities is reducing over time as may be seen from decreasing values of the Gini index and coefficient of variation (Table 3). This implies that the improvement has been faster in districts having relatively low levels of child survival probability as compared to districts having relatively higher level of survival probability. This observation is supported by figure 2 which presents the increase in ${}_5p_0$ during the period 1981-91 and 1991-2001 by

the level in 1981 and 1991 respectively. It is well known that mortality during childhood can be classified into the 'soft' rock of childhood mortality and the 'hard' rock of childhood mortality. When child survival probability is low, most of the child deaths are due causes which constitute the 'soft' rock of childhood mortality. As the child survival probability improves, an increasing proportion of child deaths are due to causes which constitute the 'hard' rock of childhood mortality. The 'soft' rock of childhood mortality can be eroded through low cost appropriate technology such as immunisation against vaccine preventable diseases and oral rehydration therapy but eroding the 'hard' rock of childhood mortality is difficult as it requires advanced medical technology and a highly efficient health care delivery system.

Figure 2 also indicates that improvement in ${}_5p_0$ slowed down during the period 1991-2001 as compared to the period 1981-1991 in most of the districts. During the 1980s, ${}_5p_0$ improved in all the 29 districts of the state included in this analysis, although at varying pace. However, during 1990s, this probability decreased in three districts whereas it improved only marginally in two districts. The very fact that ${}_5p_0$ remained less than 0.900 in all but one district of the state around the year 2001 suggests that the 'soft' rock of under-five mortality is still quite substantial and the state has still to go a long way to achieve levels of child survival as articulated in the Millennium Development Goals. What is even more concerning is the fact that despite prevailing low levels, the pace of improvement in the probability of survival during childhood appears to have slowed down in many districts. It appears that existing child survival efforts in the state have not been able to maintain the pace in the improvement in ${}_5p_0$, especially in ${}_4p_1$ which has actually decreased in the state and in a number of districts during the period 1991-2001.

The foregoing analysis suggests that improvements in the child survival probability in the state has not been uniform. There has been considerable slowdown in the improvement in ${}_5p_0$ during the 1990s as compared to the 1980s because, instead of increasing, ${}_4p_1$ actually decreased in the state as a whole and in many of its districts. Moreover, the pace of improvement in all the three survival probabilities varied widey across the districts. Very little is currently known about the factors and conditions that may be responsible for the increase in ${}_4p_1$ in the state as a whole and in many of its districts during the 1990s. In any case, it appears obvious from the present analysis that the ongoing child survival interventions and programmes have not been able to address causes and conditions that are primarily responsible for the deaths in children in the age group 1-4 years. It is however clear that the factors and conditions that influence the risk of death in the first year of life are essentially different from the factors and conditions that influence the risk of death in 1-4 years of life.

Decomposition of the Change in Survival Probability

The contribution of the change in ${}_1p_0$ and the change in ${}_4p_1$ to the change in ${}_5p_0$ can be measured through the decomposition analysis based on equation (5). Results of the decomposition analysis are presented in table 4 and depicted in figures 5 through 7. For the state as a whole, almost 95 per cent improvement in ${}_5p_0$ between 1981 and 2001 was the result of the improvement in ${}_1p_0$. Improvement in ${}_4p_1$ accounted for just about 5 per cent of the increase in ${}_5p_0$. The contribution of the increase in ${}_1p_0$ and in ${}_4p_1$ to the increase in ${}_5p_0$ has however been different in the 1980s as compared to 1990s. In the 1980s, improvement in ${}_5p_0$ was largely the result of the improvement in ${}_4p_1$ whereas, in the 1990s, improvement in ${}_5p_0$ was the result of the improvement in ${}_1p_0$ as ${}_4p_1$ decreased instead of improving during this period.

Inter-district variations in the improvement in the probability of survival during childhood have also been found to be very strong. Absolute improvement in ${}_5p_0$ between 1981 and 2001 ranged from 0.126 to 0.027 across the districts. In 4 districts the improvement was more than 0.100 whereas in 8 districts it was less than 0.050. Moreover, in most of the districts, at least two-third of the improvement in ${}_5p_0$ was the result of the improvement in ${}_1p_0$. The decomposition analysis also confirms that, compared to the period 1981-91, ${}_4p_1$ decreased during 1991-2001 not only in the state but also in most of its districts.

The inter-district variability in the change in ${}_5p_0$ can be explained in terms of the inter-district variability in the change in ${}_1p_0$ and inter-district variability in the change in ${}_4p_1$. It may be seen from table 5 that inter-district variability in the change in ${}_1p_0$ and inter-district variability in the change in ${}_4p_1$ contributed almost equally to the inter-district variability in the change ${}_5p_0$. During the period 1981-91, however, inter-district variability in the change in ${}_5p_0$ was largely the result of inter-district variability in the change in ${}_4p_1$ but, during the period 1991-2001, the inter-district variability in the change in ${}_5p_0$ was the result of inter-district variability in the change in ${}_1p_0$.

The decomposition analysis also reveals that, in general, ${}_1p_0$ improved in the state and in most of the districts except in district Bhopal during the 1980s and Ujjain, Jhabua and Vidisha districts, during the 1990s. Reasons for the increase in ${}_1p_0$ in these districts are not known. However, it appears that the consistency in child survival efforts over time as well as across the districts is lacking in the state. Among the districts where ${}_1p_0$ increased either during 1981-91 or during 1991-2001, Bhopal and Ujjain are regarded as comparatively better developed districts of the state with a high proportion of urban population, better literacy levels and a high concentration of health care facilities, especially private health care facilities. On the other hand, Jhabua and Vidisha districts are

amongst the most poorly developed districts with low urbanisation, very low level of literacy and near absence of private health care delivery institutions. Similarly, some of the districts where ${}_4p_1$ increased either during 1981-1991 or during 1991-2001 are relatively better developed districts whereas other are relatively poorly developed ones. Obviously, the level of social and economic development in the district may not be the only factor in deciding the levels and trends in child survival probability across the districts. Unfortunately, there has been little systematic attempt to explore the factors that explain the inter-district variations in child survival probability in the state.

Child Survival Policies

The pattern of transition in child survival in Madhya Pradesh, highlighted above, is a reflection of child survival policies adopted by the Government of India and implemented by the Government of Madhya Pradesh. Health and survival of children has been a priority development issue in India even before Independence. The First Health Survey and Development Committee constituted during the colonial rule has devoted one full chapter on health services for mothers and children and another chapter on health services for school children (Government of India, 1946). The Committee recommended that all new born should be kept under observation for up to five years ad their weight and progress records should be kept in order to ensure their survival, growth and development. After Independence, concern for child survival and health at the policy level is reflected in all Five-year Development Plans. However, issues related to child survival and health were always tagged with issues related to the health of the mother. A prophylaxis schemes was also launched during the 4th Five-year Development Plan to combat nutritional anaemia among pregnant and lactating women as well as children up to five years of age, and prophylaxis against blindness due to vitamin-A deficiency among children under 5 years of age. In the Fifth Five-year Development Plan (1974-78), child survival and health became a component of the Minimum Needs Programme of the Government of India along with family planning activities. A pilot programme was also launched during the Seventh Five-year Development Plan period for the control of acute respiratory infections, primarily pneumonia, through standard case management practices by paramedical workers.

The real push to child survival efforts in India was given in 1975 when Integrated Child Development Services were launched. Subsequently, the Expanded Programme of Immunization was launched in 1978 which dealt specifically with the problems or diseases conditions of children 0-6 years of age. The Scheme primarily focussed on weight recording of children and

nutrition supplementation to all children who were found to be low weight for age (Government of India,). On the other hand, the Expanded Programme of Immunization focussed on reducing morbidity and mortality in children through immunisation against vaccine preventable diseases - Diphtheria, Pertussis, Tetanus, Poliomyelitis, childhood tuberculosis and typhoid. The goal was to provide immunisation services to all eligible children and women by 1990 (Sokhey, Kim-farley, Bhargava, 1989). The Expanded Programme of Immunisation was replaced by the Universal Immunisation Programme in 1985 which aimed at providing high quality immunization services to all communities in order to prevent mortality, morbidity and disability from diseases that are preventable through the optimum use of vaccines that are currently available and vaccines that become available from time to time. In addition, the Oral Rehydration Therapy Programme was also launched in the year 1986-87 for reducing mortality due to dehydration caused by diarrhoea among children.

As the result of these programmes and interventions, there has been a marked improvement in ${}_4p_1$ as revealed through the present analysis. Improvement in ${}_1p_0$ was however not as sharp as ${}_4p_1$ because many of these interventions were directed towards children 1-4 years of age. They had only a limited impact on ${}_1p_0$ as they were not designed to effectively address the factors that contribute to the risk of death during infancy, especially factors related to pregnancy and child birth with the result that the gains in ${}_1p_0$ were not as remarkable as the gains in ${}_4p_1$.

The Universal Immunisation Programme and other child survival interventions introduced during the 1980s got subsumed in the Child Survival and Safe Motherhood Programme launched in the year 1992. Although, child survival and health remained one of the key components of this new programme, yet the emphasis was clearly on meeting the reproductive health needs of the people. This shift became more evident and more dominating when the Child Survival and Safe Motherhood Programme was replaced by the Reproductive and Child Health Programme in 1997, although there had been little change in programme objectives and programme goals. Child survival continued to be one of the important interventions of the programme but the shift in the programme implementation strategy towards reproductive health including neonatal care at the cost of child survival interventions appears to have resulted in a decrease in ${}_4p_1$ in India as well as in Madhya Pradesh and the resulting decrease in India and near stagnation in Madhya Pradesh in the probability of survival in the age group 0-5 years.

Current child survival efforts in Madhya Pradesh are organised under the reproductive and child health component of the National Rural Health

Mission which was launched by the Government of India in the year 2007. The Mission aims at architectural corrections in the public health care delivery system. One of the goals of the Mission is the reduction in the infant mortality rate. The Mission is however silent about the risk of death in the age group 1-4 years. Similarly, the XI Five-year Development Plan of Madhya Pradesh aims at reducing the infant mortality rate to 40 infant deaths per 1000 live births but there is no reference to mortality in children 1-4 years of age (Government of Madhya Pradesh, 2007). The National Population Policy, announced in the year 2000, does not have any reference to mortality in children 1-4 years of age (Government of India, 2000).

The unacceptably high levels of the risk of death in children aged 1-4 years and the increase in this risk in many districts of the state appears to be a reflection of the nutritional status of children. It is argued that mortality in children 1-4 years of age is high in populations where post weaning nutrition is poor (Le Gros Clark, 1951). On the basis of the relationship between the risk of death and the level of malnutrition in children aged 1-4 years, it is also argued that mortality in 1-4 years can be equated to some extent with malnutrition in early childhood and the death rate in the age group 1-4 years may be treated as an index of malnutrition (Wharton, 1971; Wills and Waterlow, 1958). It has also been estimated that nearly 60 per cent of deaths in children under 5 years are due to malnutrition and its interactive effects on preventable diseases like diarrhoea and pneumonia. Most of these deaths are confined to the age group 1-4 years as effects of malnutrition are the most severe in young growing children.

The decrease in ${}_4p_1$, in the context of the above arguments suggest that the prevalence of malnutrition in children below 5 years of age in Madhya Pradesh and in Many districts of the state has increased over time. This conjecture is supported by the information available through the National Family Health Survey according to which, the proportion of low weight for age children in the state increased from around 51.1 per cent in 1992 to almost 58 per cent in 2005-06 (International Institute for Population Sciences, 1995; 2008). The National Family Health Survey also suggests that more than 60 per cent of the children aged 1-4 years were low weight for age.

The state response to the problem of malnutrition in children below five years of age has been in the form of *Bal Sanjivani* Campaign (Government of Madhya Pradesh, 2009). Launched in the year 2001, the *Bal Sanjivani* Campaign essentially comprised of weighing of all children below five years of age in the state and grading of children according to their nutritional status on the basis of Gomez scale. The severely malnourished children identified through the campaign or otherwise were given a rehabilitation package comprising of

hospitalisation for a period of 14 days. Nutrition Rehabilitation Centres have been established in the public health care delivery institutions for the purpose. However, there is no intervention for children with mild and moderate grade malnutrition.

Since 2001, twelve *Bal Sanjivani* campaigns have been organised throughout the state and it is claimed that the Campaign has resulted in a significant decrease in the prevalence of low weight for age children. However, results of the *Bal Sanjivani* campaign do not conform to the findings of the National Family Health Survey which suggests that the prevalence of low weight for age children in the state has increased. There are some serious concerns about the quality of data on nutritional status of children available through the campaign. A process evaluation of the campaign carried out in 2004 reported that one third of the Aanganwadi workers were not able to identify the nutritional grade of the child and 30 per cent were not having the record of the weight of children who were not enrolled (Government of Madhya Pradesh, 2004). Although, the campaign was designed to increase the awareness of the community about nutritional status of children and how to monitor the nutritional status, yet, there have been little substantial efforts to address the issue other than hospitalisation of children with severe malnutrition. There has also been little followup of the children who were discharged from the hospital/nutritional rehabilitation centre.

One of the major drawbacks of the official approach towards child survival in India and in Madhya Pradesh is that child survival efforts have not been designed, planned and implemented in the context of the disease burden in children. Rather, they have increasingly been driven by the medical technology and associated supply side push and implemented in a normative manner (Madhvi, 2003). There is little empirical evidence in India and in Madhya Pradesh about the pattern of morbidity and mortality in children that may constitute the basis for child survival efforts. Epidemiological consideration such as prevalence rates of common childhood illnesses and causes of child deaths are simply not available. Since, morbidity and mortality in childhood is strongly conditioned by local conditions, it is imperative that this information must be available at the grass roots level so that the local context of child survival is imbedded into child survival efforts. However, there has hardly been any noteworthy attempt in this direction. The only source of information for estimating child mortality below the state level continues to be the information on children ever born and children surviving collected during the decennial population census. Even this information is available up to the district level only. Below the district level, no information on child mortality is available. On the other hand, there is hardly any information about childhood

morbidity even at the state level that may constitute the basis for child survival and child health interventions.

Another concern is that there is no mechanism to measure the impact of child survival efforts on morbidity, disease burden and mortality of children. Performance of child survival efforts is generally measured in terms of output indicators like coverage rates of different child survival interventions but the link between output indicators and the impact indicators remains ill-defined, especially at the grass roots level - the interface with the people - primarily because information related to morbidity and mortality among children is missing.

It is obvious that policies and programmes towards child survival and health in the state needs reinvigoration in view of the fact that the risk of death in the age group 1-4 years continues to be unacceptably high and appears to have increased over time. Since, both levels and trends in child survival probability varies widely across the districts, a decentralised, district based approach is required to plan for child survival and child health interventions which may be extended right up to the village level in due course of time. This is a tall order as the district level capacity to organise these efforts does not exist at present. Building a reliable and efficient child survival and child health information system, especially at the district level appears to be the key to reinvigorate child survival efforts and to accelerate the improvement in the child survival probability in the state. This will ensure evidence-based planning for child survival and an objective assessment of the impact of child survival interventions. There is, however, little initiative in this direction.

Conclusions

The analysis presented here suggests that the progress towards child survival in Madhya Pradesh does not appear to be satisfactory in the context of either the Millennium Development Goals or the XI Five-year Development Plan objectives. There has been improvement in the survival probability in the first year of life but improvement in survival probability has faltered during the 1-4 years of life so that improvement in the child survival probability in the age group 0-5 years almost stagnated in Madhya Pradesh during the 1990s. The decrease in the survival probability in children aged 1-4 years suggests an increase in the prevalence of malnutrition in children, an observation which is also supported by the information available from other sources. It is in this context that the current policies and programmes directed towards survival of children in the state need to be revisited. It is important that child survival policies and programmes are designed in the broader development context and improvements in the quality of life and not in the narrow perspective of health

imperative that is the case at present. Child survival needs to be viewed as perhaps the most sensitive indicator of social and economic development and the quality of life. Improving the survival chances of the new born is not only a human rights imperative but also a sound economic decision.

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Table 1: Survival probability in different age groups of the childhood period in Madhya Pradesh and India.

Year	Madhya Pradesh			India		
	1981	1991	2001	1981	1991	2001
${}_5p_0$	0.803	0.853	0.859	0.848	0.906	0.903
${}_1p_0$	0.850	0.867	0.906	0.885	0.923	0.931
${}_4p_1$	0.945	0.984	0.948	0.958	0.982	0.970

Source: Government of India (1997) and Ranjan (2008)

Remarks: Estimates for the year 1981 and 1991 are for undivided Madhya Pradesh whereas estimates for the year 2001 are for the existing Madhya Pradesh.

Table 2: Distribution of under-five deaths (for every 1000 live births) in Madhya Pradesh and India by age.

Age group	Madhya Pradesh				India			
	Number of deaths for every 1000 live births			Number of deaths saved for every 1000 live births between 1981 and 2001	Number of deaths for every 1000 live births			Number of deaths saved for every 1000 live births between 1981 and 2001
	1981	1991	2001		1981	1991	2001	
0-1 year	150	133	94	56	115	77	69	46
1-4 years	47	14	47	0	37	17	28	9
0-5 years	197	147	141	56	152	94	97	55

Source: Author's calculations.

Table 3: Estimates of ${}_1p_0$, ${}_4p_1$ and ${}_5p_0$ in districts of Madhya Pradesh, 1981, 1991 and 2001.

Districts	${}_1p_0$			${}_4p_1$			${}_5p_0$		
	1981	1991	2001	1981	1991	2001	1981	1991	2001
Bhind	0.871	0.895	0.924	0.913	0.951	0.964	0.795	0.851	0.891
Shivpuri	0.821	0.880	0.894	0.921	0.909	0.937	0.756	0.800	0.838
Guna	0.850	0.876	0.890	0.916	0.919	0.933	0.779	0.805	0.830
Tikamgarh	0.805	0.858	0.901	0.901	0.948	0.944	0.725	0.813	0.851
Chhatarpur	0.818	0.864	0.900	0.896	0.927	0.942	0.733	0.801	0.848
Panna	0.815	0.868	0.882	0.896	0.917	0.924	0.730	0.796	0.815
Sagar	0.836	0.862	0.902	0.933	0.961	0.945	0.780	0.828	0.852
Damoh	0.811	0.834	0.895	0.933	0.966	0.937	0.757	0.806	0.839
Satna	0.819	0.858	0.889	0.927	0.929	0.932	0.759	0.797	0.829
Rewa	0.827	0.851	0.903	0.954	0.945	0.946	0.789	0.804	0.854
Sidhi	0.839	0.889	0.891	0.951	0.939	0.934	0.798	0.835	0.832
Ratlam	0.857	0.872	0.899	0.938	0.976	0.942	0.804	0.851	0.847
Ujjain	0.894	0.923	0.915	0.931	0.924	0.956	0.832	0.853	0.875
Shajapur	0.851	0.884	0.919	0.902	0.941	0.960	0.768	0.832	0.882
Dewas	0.881	0.903	0.904	0.925	0.965	0.947	0.815	0.871	0.856
Jhabua	0.856	0.908	0.899	0.958	0.915	0.942	0.820	0.831	0.847
Dhar	0.884	0.901	0.919	0.938	0.974	0.960	0.829	0.878	0.882
Indore	0.916	0.929	0.944	0.969	0.975	0.979	0.888	0.906	0.924
East Nimar	0.839	0.871	0.906	0.943	0.975	0.949	0.791	0.849	0.860
Rajgarh	0.830	0.875	0.905	0.934	0.935	0.948	0.775	0.818	0.858
Vidisha	0.856	0.893	0.888	0.893	0.906	0.930	0.764	0.809	0.826
Bhopal	0.909	0.906	0.929	0.957	0.988	0.968	0.870	0.895	0.899
Sehore	0.854	0.875	0.908	0.885	0.939	0.950	0.756	0.822	0.863
Raisen	0.843	0.859	0.913	0.918	0.956	0.955	0.774	0.821	0.872
Betul	0.842	0.854	0.909	0.942	0.960	0.951	0.793	0.820	0.864
Narsimhapur	0.838	0.880	0.914	0.950	0.968	0.955	0.796	0.852	0.873
Chhindwara	0.862	0.881	0.911	0.933	0.974	0.954	0.804	0.858	0.869
Seoni	0.851	0.874	0.916	0.962	0.970	0.958	0.819	0.848	0.878
Balaghat	0.846	0.859	0.907	0.963	0.970	0.949	0.815	0.833	0.861
Gini Index	0.018	0.014	0.008	0.014	0.014	0.007	0.026	0.019	0.015
CV (x1000)	0.040	0.018	0.004	0.018	0.017	0.003	0.110	0.044	0.025

Source: Government of India (1997), Ranjan (2008)

Table 4: Decomposition of the change in ${}_5p_0$ into the change in ${}_1p_0$ and ${}_4p_4$ in districts of Madhya Pradesh, 1981 through 2001.

District	1981-91			1991-2001			1981-2001		
	∇u	∇i	∇c	∇u	∇i	∇c	∇u	∇i	∇c
Bhind	0.056	0.022	0.034	0.040	0.028	0.012	0.096	0.050	0.046
Shivpuri	0.044	0.054	-0.010	0.038	0.013	0.025	0.082	0.068	0.014
Guna	0.026	0.024	0.002	0.025	0.013	0.012	0.051	0.037	0.014
Tikamgarh	0.088	0.049	0.039	0.038	0.041	-0.003	0.126	0.089	0.037
Chhatarpur	0.068	0.042	0.026	0.047	0.034	0.013	0.115	0.075	0.039
Panna	0.066	0.048	0.018	0.019	0.013	0.006	0.085	0.061	0.024
Sagar	0.048	0.025	0.023	0.024	0.038	-0.014	0.072	0.062	0.010
Damoh	0.049	0.022	0.027	0.033	0.058	-0.025	0.082	0.079	0.003
Satna	0.038	0.036	0.002	0.032	0.029	0.003	0.070	0.065	0.004
Rewa	0.015	0.023	-0.008	0.050	0.049	0.001	0.065	0.072	-0.007
Sidhi	0.037	0.047	-0.010	-0.003	0.002	-0.005	0.034	0.049	-0.015
Ratlam	0.047	0.014	0.033	-0.004	0.026	-0.030	0.043	0.039	0.003
Ujjain	0.021	0.027	-0.006	0.022	-0.008	0.029	0.043	0.020	0.023
Shajapur	0.064	0.030	0.034	0.050	0.033	0.017	0.114	0.063	0.051
Dewas	0.056	0.021	0.035	-0.015	0.001	-0.016	0.041	0.022	0.020
Jhabua	0.011	0.049	-0.038	0.016	-0.008	0.024	0.027	0.041	-0.014
Dhar	0.049	0.016	0.033	0.004	0.017	-0.013	0.053	0.033	0.020
Indore	0.018	0.013	0.005	0.018	0.015	0.004	0.036	0.027	0.009
East Nimar	0.058	0.031	0.027	0.011	0.034	-0.023	0.069	0.063	0.005
Rajgarh	0.043	0.042	0.001	0.040	0.028	0.012	0.083	0.071	0.012
Vidisha	0.045	0.033	0.012	0.017	-0.005	0.021	0.062	0.029	0.033
Bhopal	0.025	-0.003	0.028	0.004	0.022	-0.018	0.029	0.019	0.010
Sehore	0.066	0.019	0.047	0.041	0.031	0.009	0.107	0.050	0.057
Raisen	0.047	0.015	0.032	0.051	0.052	-0.001	0.098	0.066	0.032
Betul	0.027	0.011	0.016	0.044	0.053	-0.008	0.071	0.063	0.008
Narsimhapur	0.056	0.040	0.016	0.021	0.033	-0.012	0.077	0.072	0.004
Chhindwara	0.054	0.018	0.036	0.011	0.029	-0.018	0.065	0.046	0.019
Seoni	0.029	0.022	0.007	0.030	0.040	-0.011	0.059	0.062	-0.004
Balaghat	0.018	0.013	0.005	0.028	0.046	-0.018	0.046	0.058	-0.013

Source: Author's calculations.

Table 5: Decomposition of inter-district variation in the change in ${}_5p_0$ into inter-district variation in the change in ${}_1p_0$ and the change in ${}_4p_1$ in Madhya Pradesh.

Inter-district variation	1981-91	1991-2001	1981-2001
Var (∇u)	0.000337	0.000261	0.000698
Var (∇i)	0.000361	0.000299	0.000348
Var (∇c)	0.000191	0.000322	0.000344
Cov(∇i, ∇c)	-0.000108	-0.000142	0.000003

Source: Author's calculations

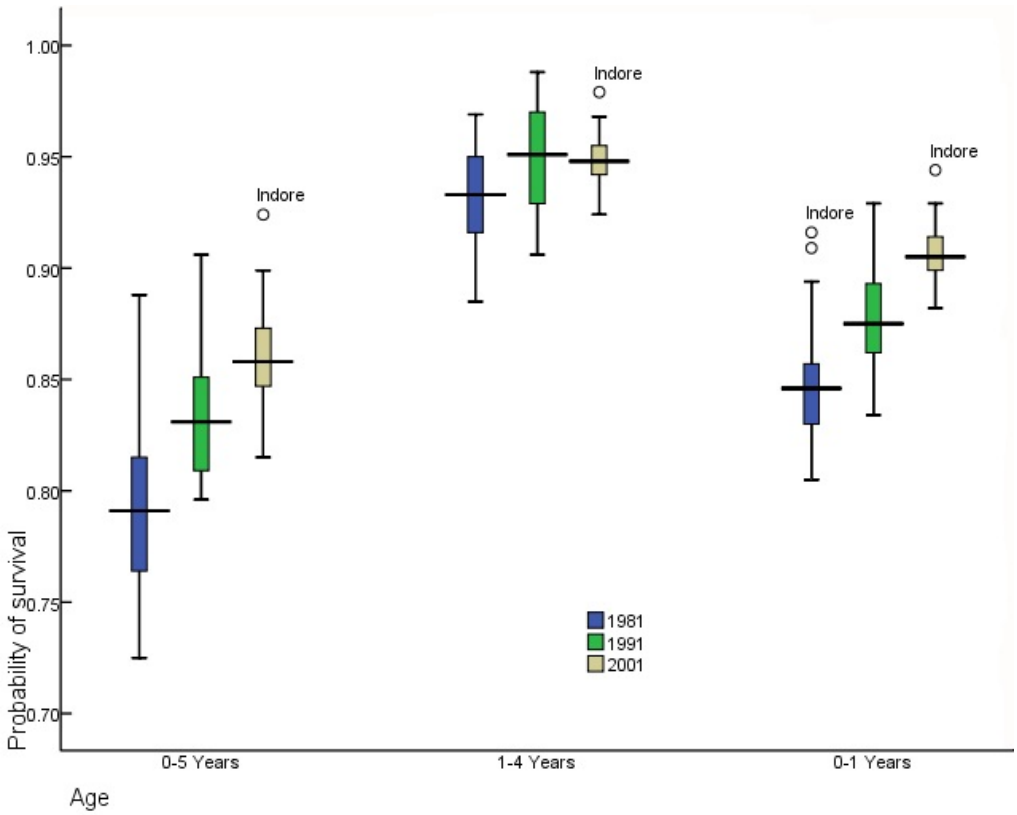

Figure 1*Figure 1: Trends and inter-district variations in child survival probability*.

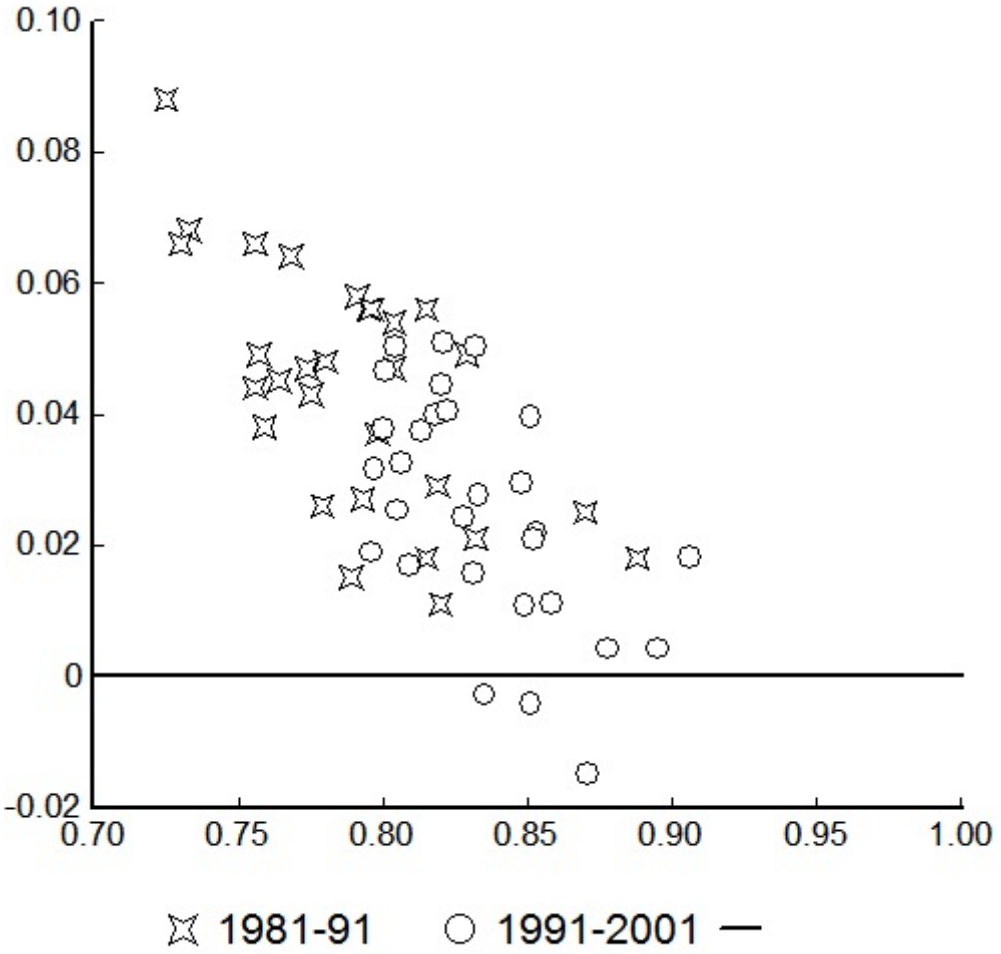

Figure 2*Figure 2:* *Relationship between the improvement and initial level of survival probability in the age group 0-5 years in districts of Madhya Pradesh.*

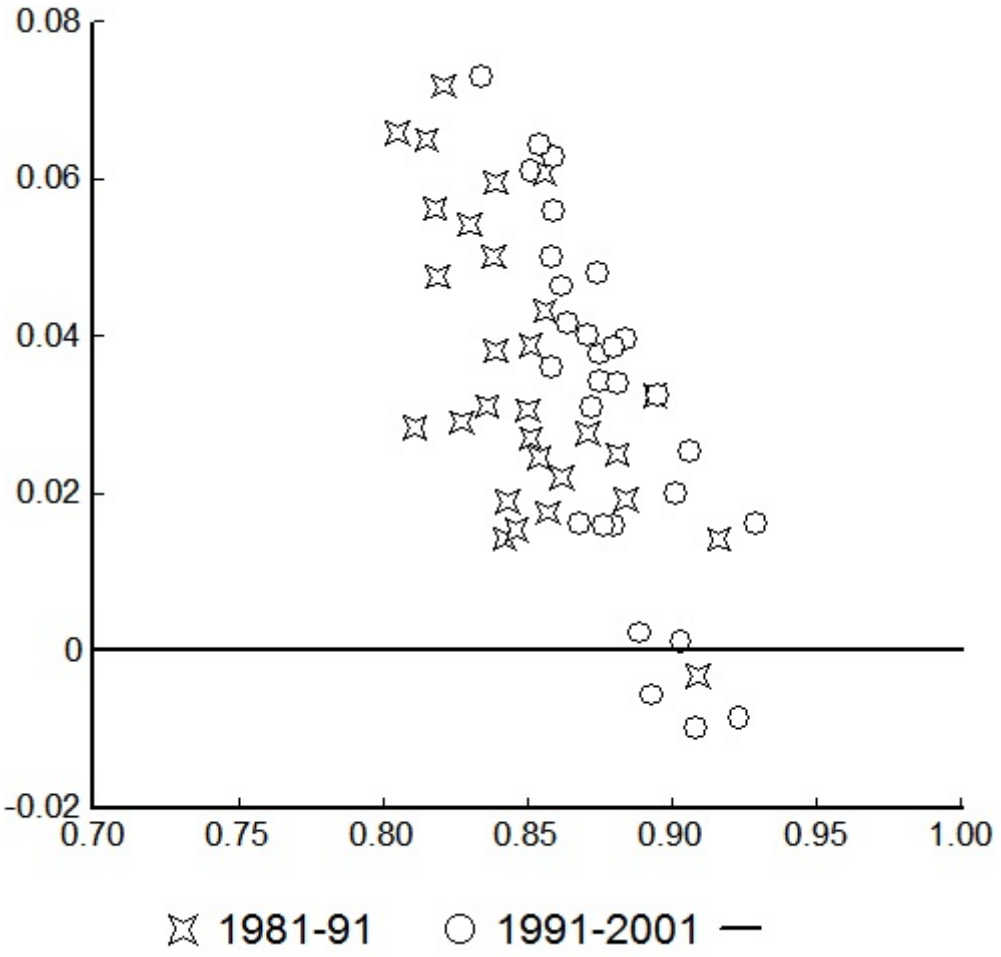

Figure 3*Figure 3:* *Relationship between the improvement and initial level of survival probability in the age group 0-1 year in districts of Madhya Pradesh.*

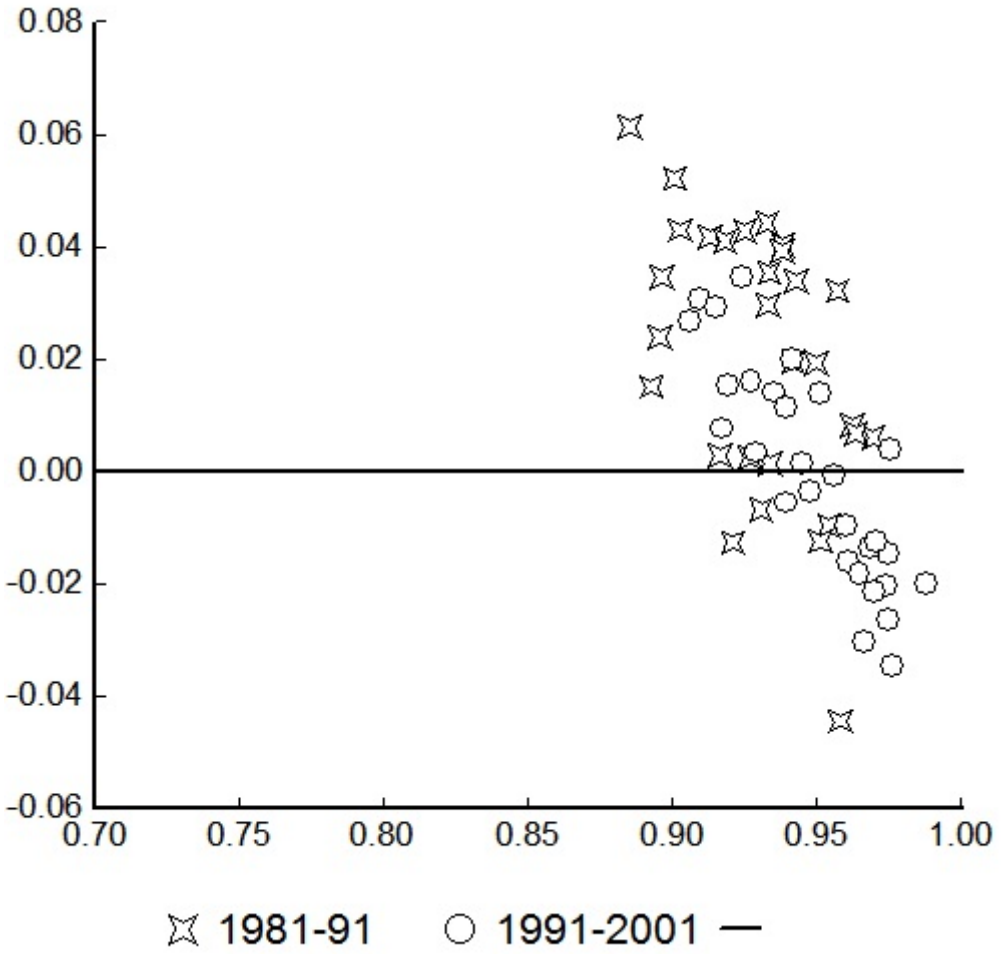

Figure 4*Figure 4:* *Relationship between the improvement and initial level of survival probability in the age group 1-4 years in districts of Madhya Pradesh.*

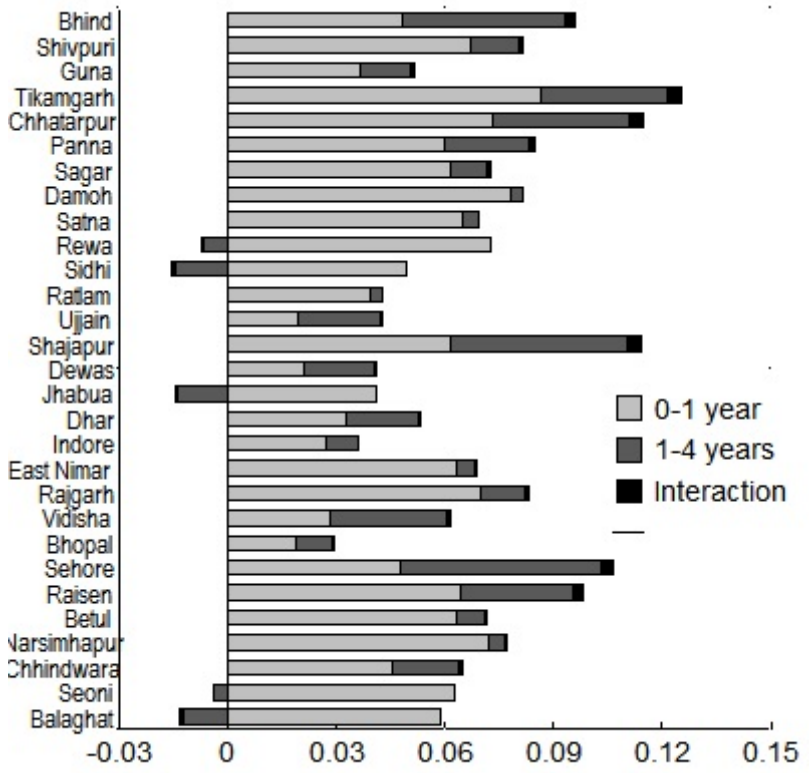

Figure 5*Figure 5:* *Decomposition of the change in the probability of survival in the age group 0-5 years in districts of Madhya Pradesh during 1981-2001.*

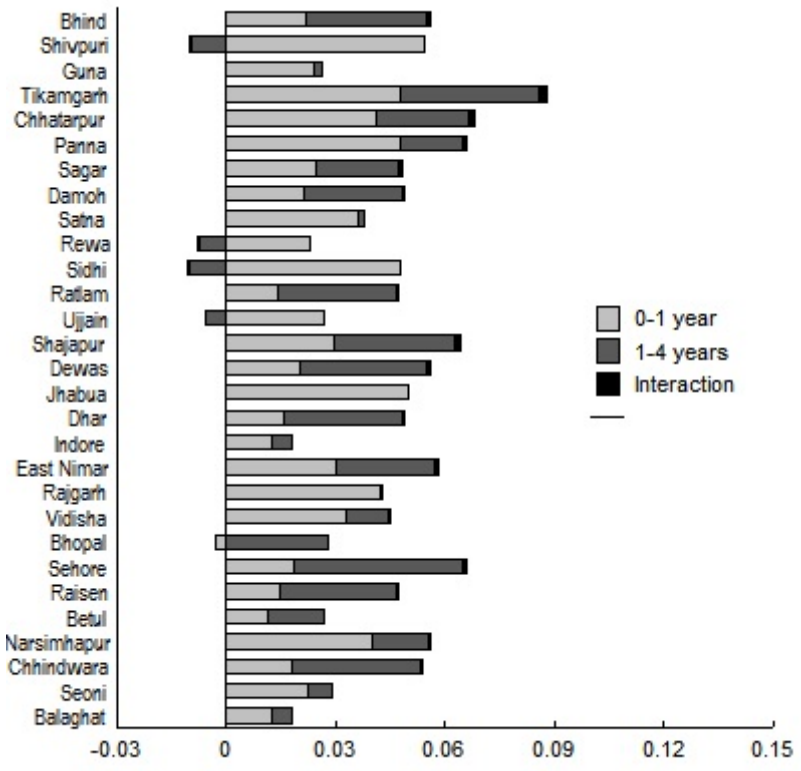

Figure 6*Figure 6:* *Decomposition of the change in the probability of survival in the age group 0-5 years in the districts of Madhya Pradesh during 1981-91.*

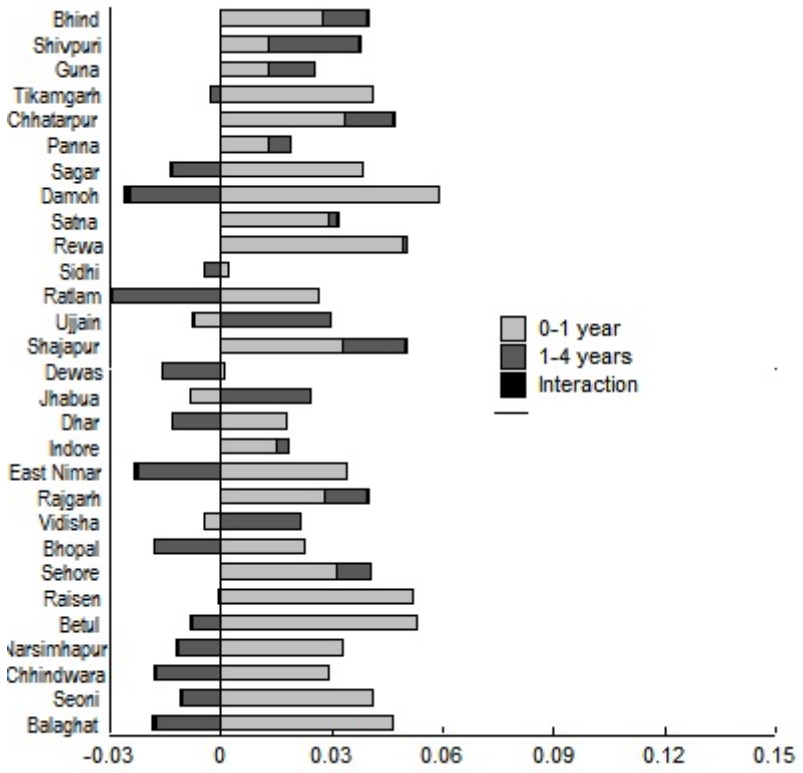

Figure 7*Figure 7:* *Decomposition of the change in the probability of survival in the age group 0-5 years in the districts of Madhya Pradesh during 1991-2001.*