Working Paper 249

Income, Income Inequality and Mortality

An empirical investigation of the relationship in India, 1971-2003

K S James
T S Syamala

ISBN 978-81-7791-105-3

Institute for Social and Economic Change (ISEC) is engaged in interdisciplinary research in analytical and applied areas of the social sciences, encompassing diverse aspects of development. ISEC works with central, state and local governments as well as international agencies by undertaking systematic studies of resource potential, identifying factors influencing growth and examining measures for reducing poverty. The thrust areas of research include state and local economic policies, issues relating to sociological and demographic transition, environmental issues and fiscal, administrative and political decentralization and governance. It pursues fruitful contacts with other institutions and scholars devoted to social science research through collaborative research programmes, seminars, etc.

The Working Paper Series provides an opportunity for ISEC faculty, visiting fellows and PhD scholars to discuss their ideas and research work before publication and to get feedback from their peer group. Papers selected for publication in the series present empirical analyses and generally deal with wider issues of public policy at a sectoral, regional or national level. These working papers undergo review but typically do not present final research results, and constitute works in progress.

INCOME, INCOME INEQUALITY AND MORTALITY

AN EMPIRICAL INVESTIGATION OF THE RELATIONSHIP IN INDIA, 1971-2003

K S James and T S Syamala*

Abstract

This study aims to understand the nuances behind the often-celebrated relationship between income and mortality in the context of India. The income-life expectancy relationship is non-linear in nature, with mortality responding sharply in the earlier years and rather slowly in the latter years. The regression analysis between per-capita income and the Gini-Coefficient with mortality for different decades revealed that the income-mortality relationship has been weaker in the 1970s but became stronger in the 1980s and the 1990s. In the 1990s, the relationship was mainly confined to the 0-4 and 70+ age groups. In addition, during the 1990s, besides income, the income inequality measure (Gini Coefficient) became an important predictor of mortality. The multi-level analysis also proved nearly the same pattern. The income-mortality relationship in India is limited to the childhood years. The income inequality measure also matters more in the case of childhood mortality. The study also looks at the pathways through which income or income inequality can influence mortality. Nevertheless, it is found that neither the access to care nor the bad health habits can explain this relationship completely. Perhaps, there is a need for further deep investigation into the relationship to understand the pathways through which it operates in India.

Introduction

The most frequently cited correlate of mortality is the socio-economic living standards measured either at the household level or at aggregate level. The evidence of significant quantitative association between economic status and health measures is abundant from the different countries of the world, whether developed or developing (Smith 1999). At the same time, considerable debate persists on the relative importance of income in determining the health status of the people, particularly in developing countries. In recent years, with the diffusion of medical technologies in developing countries, the general perception is that mortality is, increasingly, being disassociated from economic factors (Preston 1976), despite the fact that most micro-level studies invariably bring out the clear association between livings standards and mortality[1].

The standard argument put forward as a reason for this relationship, at least in the context of developed countries, is that it is a mere manifestation of easy access to care. The poor people are denied health care due to lack of purchasing power or they are able to access only poor quality services. If access to care is the reason for this relationship, it can be addressed, perhaps, with appropriate policies to improve access to health services (Deaton 2002). However, much of the public health literature did not accept this view (Deaton 2002, Cutler *et al,* 2006). Deaton (2002) summarises the findings of various studies on the importance of access to care in the following words: "While the public health literature contains sound arguments that differential access to medical care is not the root of the gradient, the literature probably assigns too little weight to the effectiveness of medical care itself and

---

* Professor and Head, and Associate Professor, Population Research Centre, Institute for Social and Economic Change, Dr V K R V Rao Road, Nagarabhavi, Bangalore – 560 072.

[1] In India, all the large-scale surveys conducted in recent years, three rounds of National Family Health Survey (NFHS), district level Reproductive and Child Health Survey (RCH) and the NSSO data on morbidity, reveal an inverse relationship between standard of living and mortality.

beyond that to the possibility that widening gradients are related to life saving bursts of technical progress" (Deaton 2002, P: 18).

Another possible argument for the observed relationship between income and mortality is that it is a reflection of bad health-related behaviour of the poor people. Health related behaviour such as use of tobacco, smoking, consumption of alcohol etc., is generally found to be higher among the socio-economically backward sections of the population in many countries. However, the studies have also indicated that such behaviour can explain only a part of the income-mortality gradient (Deaton 2002).

Despite significant differences, many developing countries have recently experienced vast improvement in life expectancy without commensurate increase in per capita income. This has led to the argument that non-income factors play a crucial role in mortality transition in developing countries. Contrary to this, Preston (1980) found a significant association between life expectancy and income level even in developing countries. He has measured income in terms of the national income of the country, which he argued is the best single indicator of the living standards in a country. The study showed that considerable improvement in life expectancy during 1930 to 1960 could be attributed to the improvement in the socio-economic standards. The income-mortality relationship is explained in terms of improvement in food supply and the resultant increase in the health of the population.

In the mid-70s, researchers began to doubt whether national income continued to play any role in determining population health in industrialised countries. Since then a few studies have recorded evidence from the poor countries that the income-mortality relationship is strong only in countries with low per capita income. The issue of concern here was the nature of the relationship between income and health. Some of the studies have argued that the income-health relationship is best characterised as a linear gradient of risk, with each higher level of income associated with better health and lower morality (Marmot *et al*, 1991; Adler *et al*, 1993). However, a few other studies argued the income-health relationship to be non-linear with income beyond the median level having diminishing effect on health (Backlund *et al*, 1996; House *et al*, 1990). It appeared that at a certain level of development, increase in income had little effect on national life expectancy (Preston, 1975).

Of late, it has also been argued that economic reform, which is the leading cause of accelerated economic growth and increase in per capita income, is adversely affecting the status of the people (Prasad and Sathyamala 2006). This has been argued in the case of India and China by other authors as well (Cutler *et al,* 2006). They have attributed the slow decline in mortality in both the countries in the 1990s to their economic reform policies. In other words, it is argued that economic reforms and the consequent high growth of income widened income inequality in the country. This widening inequality had an adverse impact on the general health of the people.

Over the years, there has been debate over the role of income as a determinant of population health. This paved way for further studies to focus less on individual income and health measures and more on distribution of economic and health benefits across different social and economic groups within and across societies. The major findings of some of the studies were that better health outcomes are positively correlated not only with absolute levels of income but also with equitable distribution of income within society (Wilkinson, 1990; Kaplan *et al*, 1998; Ken Judge, 1995). The studies summarised that mortality rates are no longer related only to per capita economic growth, but are related, instead, to the scale of income inequality in each society. Studies conducted in the United States and Britain have come out with evidence supporting the income inequality hypothesis.

Most of the studies on income, income inequality and mortality are conducted in the western countries and very little is known about this relationship in the context of developing countries. While studies have provided conflicting evidence of income-mortality relationship within developing countries, the income inequality-mortality relationship remains completely unknown. This study, therefore, looks at the income, income inequality and mortality relationship in India using data from 1971 to 2003. A broad trend in in Per-capita Income (PCI) and Income Inequality (Gini coefficient) in different States of India is given in Appendix IX.

The major objective of this study is to examine the income and income inequality relationship with mortality in different states in India over the last three decades. It also tries to find out how the income-mortality relationship changes over the period and how far the inequality measure mediates this relationship. Further, the study looks at the pathways through which the relationship operates in India. The Mortality is analysed separately for broad age groups because the relationship is different across these broad classifications.

Data and Methodology

The data for the study comes from age-specific death rates for different states in India on an annual basis since 1971 available from the Sample Registration System (SRS). The SRS provides death rate for every five-year age group up to 70 years. For convenience, the age-specific mortality in the five-year age group is collapsed into six broad categories using appropriate population weights.

The Per-capita Income data comes from the Central Statistical Organisation (CSO) for the same period at constant prices. However, the CSO changes the base period of the income data from time to time. The data from 1980-81 to 2002-03 is available with the same base year, 1993-94, from the EPW Research Foundation. The data from 1970-71 to 1978-79, available for the 1980-81 base period, is converted into the 1993-94 base year by splicing.

Another problem in comparing the data on income with mortality is that while income data is provided for a financial year, the mortality data is available on a calendar-year basis. We have compared the income data for 1970-71 to death rate of 1970 and followed a similar pattern for all the years.

The income-inequality measure considered for the analysis is the Gini index computed from the National Sample Survey Organisation (NSSO) consumption expenditure data. For previous years, the Gini index is taken from the World Bank (1997). However, the data are not available for Punjab and Haryana separately for the past. Hence, the same level of inequality is assumed for both states for earlier years. The recent inequality index is drawn from the Economic Review. The data from NSSO on consumption expenditure used for estimating the Gini index is not available on an annual basis. Hence, for those years where data are not available we have assumed nearly the same inequality level of the succeeding or preceding years, whichever is nearest.

Multilevel model

We utilised the linear multilevel modeling approach to address the relationship between income, income-inequality and mortality more thoroughly (Goldstein 2003; Raudenbush and Bryk 2002). We conceptualised the data as a three-level structure of "cells" of death rates at level-1, with time at level-2, and within states at level-3 (Subramanian 2005; Subramanian *et al,* 2003). The cells are based on a cross-tabulation of 15 age categories × 2 gender categories (male/female) × 2 categories of place of residence (urban/rural) for each period. For every state, we observed repeated measures on the outcome (mortality rate) and for every cross-section (within a state) we observed death rates based on a combination of age, gender and place of residence. Consequently, the baseline model that we specified for the analysis is as follows:

$$y_{ijk} = b_0 + b^t t_{jk} + \boldsymbol{ß x}_{ijk} + (v_{0k} + u_{0jk} + e_{0ijk}) \quad (1)$$

where, y_{ijk} is the logged death rate for cell i in time j in state k; $\boldsymbol{x}$ is a vector of categorical cell-level predictors (*i.e.*, age, sex, and place of residence); t is a continuous variable time (centered around year 1985). Three random terms are specified in the models (1): v_{0k}, u_{0jk} and e_{0ijk}; v_{0k} is the random displacement for state k in mortality rate, u_{0jk} is the random effect associated with time j in state k, and e_{0ijk} is the level-1 residual for each cell i in time j in state k.

In model (1) the regression and variance parametres take on the following interpretations: b_0 (associated with a constant, x_{0ijk}, which is a set of 1s, and therefore, not written) is the average logged mortality rate for referenced individuals (which is mortality rate of rural males in the 0-4 years age group in 1985) across all states over the entire study period; b is a vector of regression coefficients associated with the vector of cell-level predictors; and b^t estimates the average linear trend in mortality over time. No substantial improvement was noticeable for alternative (less parsimonious) specifications of time (including non-linear and a saturated specification with a dummy variable for each period). The random effects, v_{0k}, u_{0jk} and e_{0ijk}, are assumed to be identically, independently and normally distributed with mean zero and variances, s^2_{v0}, s^2_{u0}, and s^2_{e0}, respectively. The parameter s^2_{v0} represents the variation between states in mortality rate based on age, sex, place of residence and after accounting for the average changes in mortality over time; s^2_{u0} represents the between-time (within state) variation in mortality or the unobserved heterogeneity associated with time, and s^2_{e0} represents the residual variation at the cell level. The presence of more than one residual term (or the structure of the random part more generally) distinguishes the multilevel model from the standard linear regression models or analysis of variance models (Goldstein 2003). The underlying random structure (variance-covariance matrix, represented as ?) of the model specified in model (1) is typically specified as: $Var[v_{0k}] \sim N(0, s^2_{v0})$; $Var[u_{0jk}] \sim N(0, s^2_{u0})$; $Var[e_{0ijk}] \sim N(0, s^2_{e0})$; and $Cov[v_{0k}, u_{0jk}, e_{0ijk}] = 0$. Model (1) is usually referred to as the "random-intercepts" or "variance components" model, since it allows us to partition variation according to the different levels, with the variance in y_{ij} being the sum of $s^2_{v0} + s^2_{u0} + s^2_{e0}$.

In order to address time factor, we extended Model 1 to include a time-varying predictor associated with per capita income in the fixed part of the model:

$$y_{ijk} = b_0 + b^t t_{jk} + \boldsymbol{ß x}_{ijk} + b^{PCI} PCI_{jk} + (v_{0k} + u_{0jk} + e_{0ijk}) \qquad (2a)$$

where, b^{PCI} estimates the average linear effect of PCI_{jk} (the logged per capita income at time j in state k) on changes in mortality. We also tested an alternative specification, where instead of specifying states as a random effect (v_{0k}), we included them as a fixed effect, giving us the following two-level multilevel Model (2b):

$$y_{ij} = b_0 + b^t t_j + \boldsymbol{ß x}_{ij} + b^{PCI} PCI_j + \boldsymbol{ß}^{st} \boldsymbol{st}_j + (u_{0j} + e_{0ij}) \qquad (2b)$$

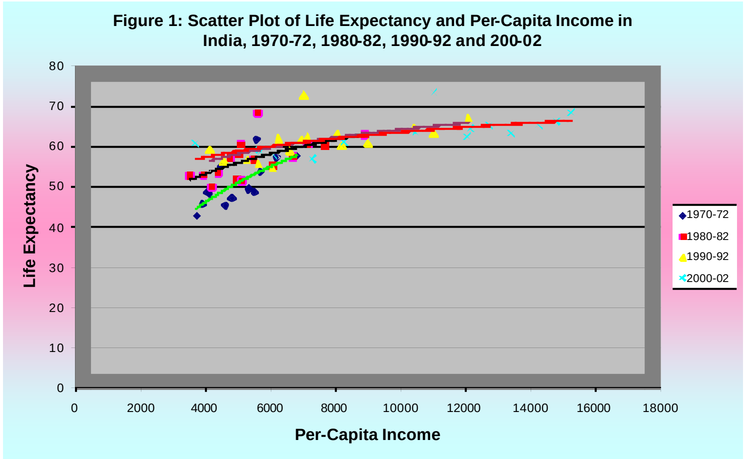
where, $\boldsymbol{st}_j$ is a vector of dummy variables for j-1 states, and $\boldsymbol{ß}^{st}$ is a vector of regression coefficients associated with it. The results associated with b^{PCI} were not sensitive to the alternate model specification. We present both the results. Model 2 was then extended to include an interaction variable between the logged state per capita income (PCI_{jk}) and age categories in the fixed part of the model to address aim (2):

$$y_{ijk} = b_0 + b^t t_{jk} + \boldsymbol{ß x}_{ijk} + ß^{age} age_{ijk} + b^{PCI} PCI_{jk} + ß^{agepci} [age_{ijk} . PCI_{jk}] + (v_{0k} + u_{0jk} + e_{0ijk}) \qquad (3)$$

where, age_{ijk} is a vector of dummy variables for i-1 age categories, and $ß^{age}$ is a vector of regression coefficients associated with it. The vector of interaction parameters is given by $ß^{agepci}$ and is associated with vector of interaction variables $[age_{ijk} . PCI_{jk}]$. Model 3 was also tested with state as a fixed effect. Models similar to 2a, 2b and 3 were specified for testing the relationship between state income inequality and mortality decline. State income inequality was also logged. The coefficients reported are Maximum Likelihood estimates, derived by using the Iterative Generalized Least Squares algorithm as implemented with MlwiN (Goldstein 2003; Rasbash *et al*, 2004).

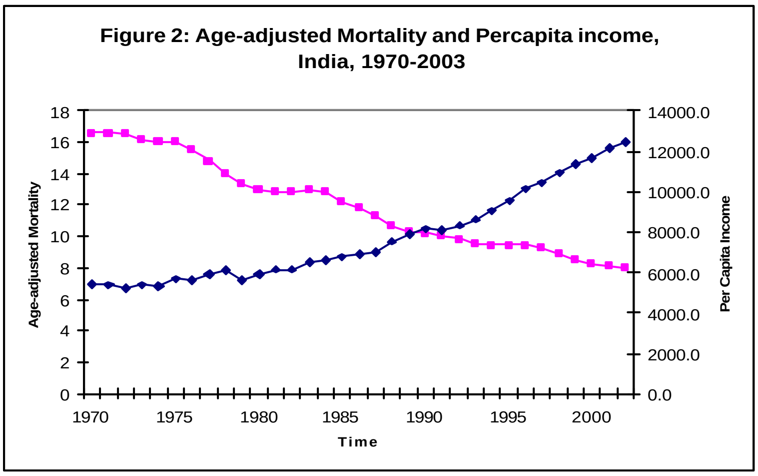
Income-Mortality Pattern

As a first step, we have plotted the relationship between income and life expectancy for four periods (Figure 1). A logistic curve is also fitted on the scatter plot between income and life expectancy for all the four periods. The graph is similar to the one drawn by Preston (1976) for different countries and is also known as the Preston Curve.



In general, the graph indicates that the life expectancy gap across the states in India has narrowed in the last three decades. For instance, the curve in 1970-72 is far steeper than the curve for the two recent decades (1990-92 and 2001-03). It looks like that the relationship between income and life expectancy has shifted, and the relationship has weakened over the period.

The relationship between life expectancy and income, as reflected in the shape of the curve, suggests a non-linear pattern. The relationship also has become very weak by 2001-03. However, if one analyses individual state patterns, the relationship appears to be strong. For instance, the current per-capita income of Uttar Pradesh is almost similar to the per-capita income of Punjab in the 1970s. A comparison of life expectancy also shows nearly the same picture. The current life expectancy in Uttar Pradesh is 59, almost same as that of Punjab in the early 1970s (58), indicating a perfect relationship between income and mortality between these two states.

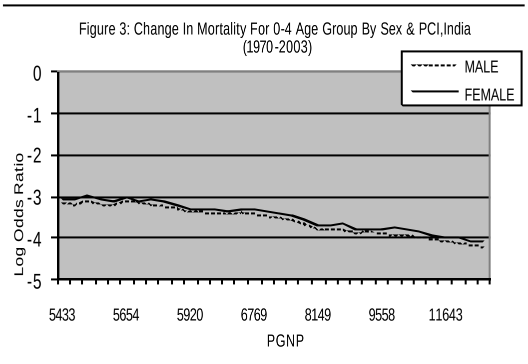


The non-linear relationship between income and mortality is also clear in Figure 2, which plots age-adjusted mortality with per-capita income and time at the national level. The per-capita income of India has been growing faster since the 1990s, but the pace of decline in mortality has been slower, perhaps because mortality level is already low. Similarly, although per-capita income growth was slow prior to 1990 there was a faster decline in mortality.

Life expectancy and age-adjusted mortality are summary indicators and, as such, often conceal wide variations across different age groups in mortality. Perhaps, mortality in all age groups may not respond to income similarly. For instance, the relationship of income with adult mortality is rather complex while that of child mortality is commonly observed. Hence, the relationship between mortality and income using summary mortality indicators may be misleading.

Mortality Pattern by Broad Age groups

In order to understand the income-mortality relationship more closely, we have plotted broad age group mortality first against per-capita income and later against time. The graph is presented only at the all-India level. There are significant variations in the pattern of mortality transition across the states, some of which will be depicted subsequently. For more clarity, the death rate is converted into log odds ratios. Figures 3 and 4 present the 0-4 age group's death rate plotted against per-capita income and time in India.



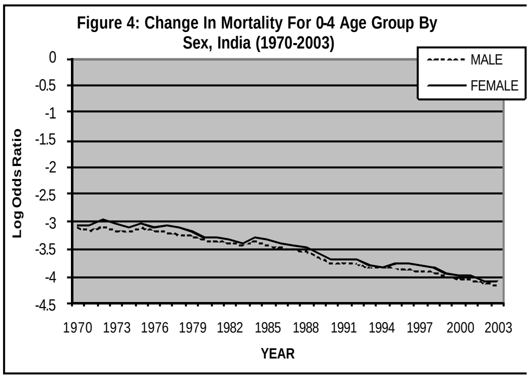


Figure 3 indicates that there had been faster decline in child mortality in the beginning but slowed down towards the end. Perhaps, one possible explanation is that at the initial level of economic development, a smaller increase in income responds more positively to a decline in mortality than at higher levels of economic development. Similar changes were also observed with time and mortality (Figure 4). It is, therefore, difficult to predict whether the decline is merely due to the time factor (technological improvement) or whether socio-economic development measured in terms of per-capita income also plays a crucial role in reducing mortality. The figures also show female disadvantage in mortality throughout the period and the magnitude does not significantly vary across time.

As against this, mortality in the 5-14 and 15-34 age groups depicts a slow decline in the past and a faster decline in recent years (Figures 5 – 8). This is particularly true in the early adult years (15-34 age group), where adult mortality shows an increasing trend during the second half of the 1980s to first half of the 1990s. This trend is similar in the two graphs depicted by per-capita income and time. It indicates that income plays only marginal role in mortality transition in the adult age group. As against the gender pattern observed in the 0-4 age group, a narrowing trend in the gender differentials in mortality in recent years is apparent in the 5-14 and 15-34 age groups.

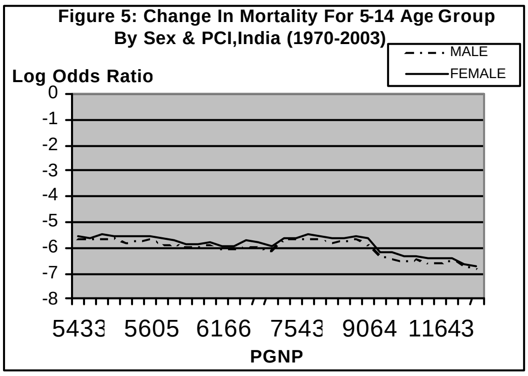


Figure 5: Change In Mortality For 5-14 Age Group By Sex & PCI,India (1970-2003)

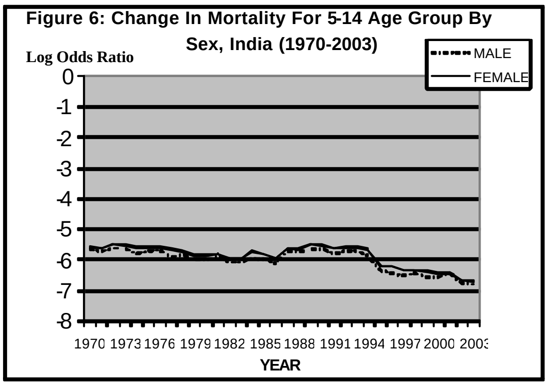


Figure 6: Change In Mortality For 5-14 Age Group By Sex, India (1970-2003)

The late adult mortality (35-59 years) pattern, depicted in Figures 9 and 10, shows lower mortality for females throughout the period. In recent years, the gap has further widened in for females. The trend recorded in late adult mortality coincides with the early adult mortality pattern and early old age mortality (60-69 years depicted in Figures 11 and 12). Hence, it is difficult to predict the effect of per-capita income on the decline of mortality for these age groups from the current analysis. The mortality trend, on the contrary, in the 70 years and above age group is in line with the 0-4 age group's mortality pattern (Figures 13 and 14). There has been a steady decline in mortality in the 70 years and above age group throughout the period.

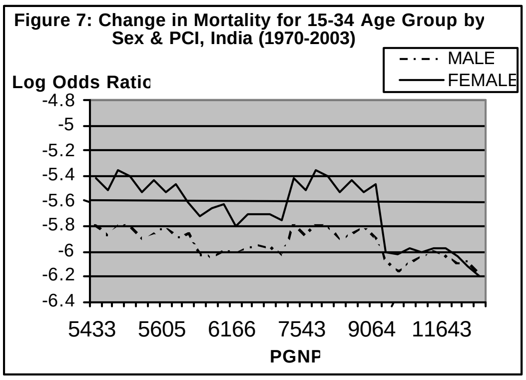


Figure 7: Change in Mortality for 15-34 Age Group by Sex & PCI, India (1970-2003)

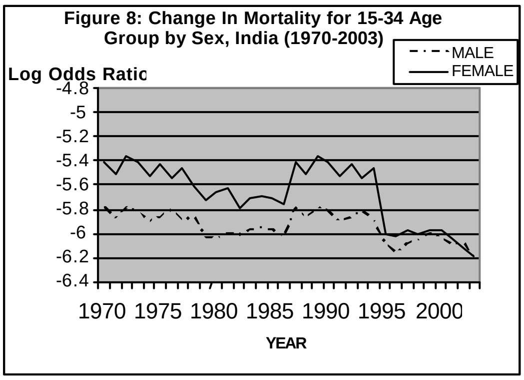


Figure 8: Change In Mortality for 15-34 Age Group by Sex, India (1970-2003)

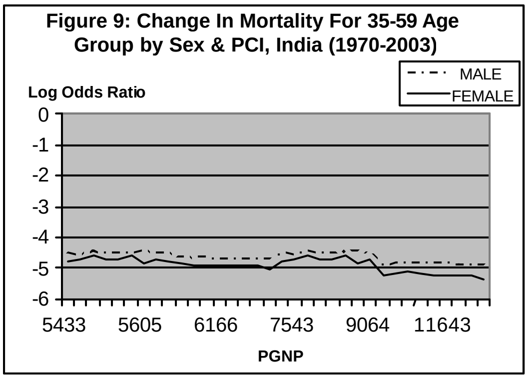


Figure 9: Change In Mortality For 35-59 Age Group by Sex & PCI, India (1970-2003)

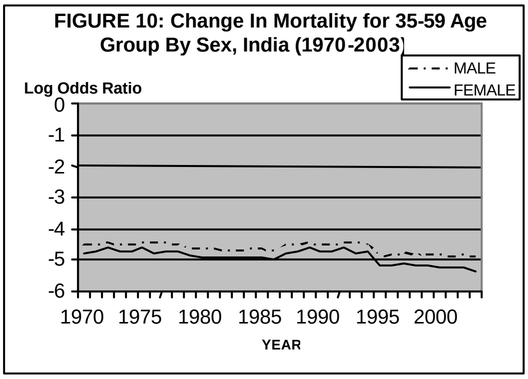


FIGURE 10: Change In Mortality for 35-59 Age Group By Sex, India (1970-2003)

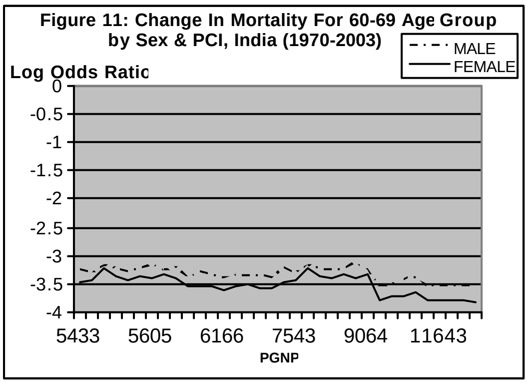


Figure 11: Change In Mortality For 60-69 Age Group by Sex & PCI, India (1970-2003)

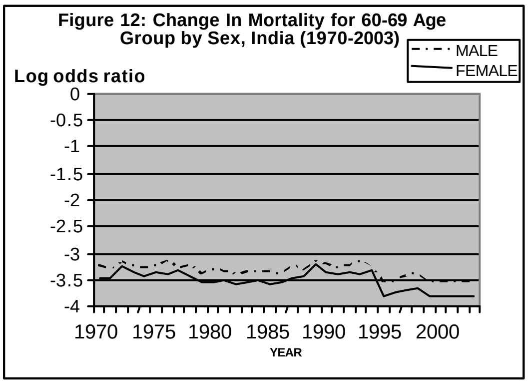


Figure 12: Change In Mortality for 60-69 Age Group by Sex, India (1970-2003)

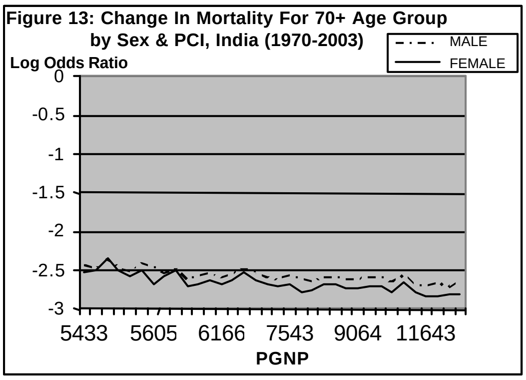


Figure 13: Change In Mortality For 70+ Age Group by Sex & PCI, India (1970-2003)

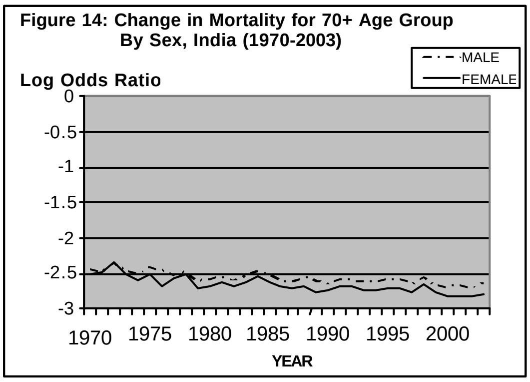


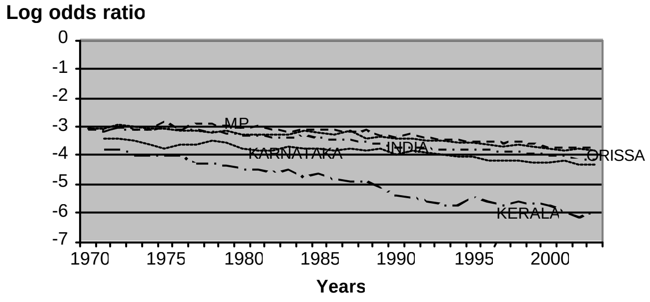
Figure 14: Change in Mortality for 70+ Age Group By Sex, India (1970-2003)

Overall, the child and adult mortality patterns signify faster rate of decline in the past and slow decline in the recent years. Adult mortality shows slower decline in the past and faster decline in recent years. However, the role of income in the decline of mortality in both groups cannot be clearly established. Perhaps, it is true that income does not matter for all the age groups. However, before coming to this conclusion, there is a need to undertake an analysis that is more comprehensive.

State level Variation in Mortality Pattern

In order to present a general idea of the differential pattern of decline in mortality across states in India, we plotted a graph depicting log odds ratio of 0-4 mortality over the period for four states along and at the all-India level. Figure 15 presents the change in the log odds ratio of 0-4 mortality in Kerala, Karnataka, Orissa and Madhya Pradesh and all-India. The states are arbitrarily chosen. Two states are in the advanced demographic transition and the other two in the early transition.

Figure 15: Change in Mortality (0-4 age group) for Four States and all India, 1970-2003



Not only that mortality levels differ among states but the trend of decline also varies. It is clear that while a drastic reduction of mortality is observed in Kerala in the early 1990s, an upward movement of mortality is visible in other three states. Hence, an analysis of the mortality pattern should also necessarily bring out the state-level differentials.

Statistical Analysis

The graphic presentation of data reveals some broad patterns of the income-mortality relationship across different age groups in India. It also shows the importance of time, representing technological changes. In this section, we examine the relationship between macroeconomic characteristics associated with changes in per capita income and changes in income inequality and decline in mortality in India. The per capita income mortality relationship is specifically examined over time after controlling age, sex and place of residence. The analysis specifically examines the income-mortality relationship in different age groups. Similarly, the income-inequality relationship is also examined over time, after controlling age, sex and place of residence. The income-inequality measure used in the analysis is the Gini coefficient.

Ordinary Least Square (OLS) model

As a first step, we carried out a simple OLS regression between per-capita income and Gini with mortality in different age groups. The result of the analysis carried out for each decade separately is presented in Table 1. The per capita income and Gini have been converted into log values.

Table 1: OLS regression coefficient of log of per-capita income (LN-PCI) and log of Gini Index (LN-GINI) on Mortality in different periods across states in India

YEAR	1970-79		1980-89		1990-2003		1970-2003	
AGE-GROUP	LN-PCI	LN-GINI	LN-PCI	LN-GINI	LN-PCI	LN-GINI	LN-PCI	LN-GINI
0-4	-58.71	30.01	-37.54*	18.48	-15.14*	17.76*	-42.54*	-24.08
5-14	-6.67	2.61	3.50*	-6.53	-6.54*	-6.22*	-2.26*	-0.77
15-34	-3.69	1.06	2.98*	-5.24	-4.14*	-5.41*	-1.36*	-1.51
35-59	-8.64	6.28	8.06*	-20.13	-11.73*	-10.28	-3.99*	-0.53
60-69	-41.25	38.61	27.23*	-66.59	-39.84*	-26.49	-13.31*	6.20
70+	-45.18	-49.27	-21.69	10.62	-6.80	84.43*	-31.07*	-21.84

* Significant at less than 0.05 level

The table brings out some interesting patterns for discussion. It seems that the per-capita income has not been a significant factor in mortality change in the earlier decade (1970s) as against the common understanding that the income-mortality relationship is strong at higher levels of mortality. Perhaps, it indicates that the mortality change in India was mainly due to import of medical technology rather than improvement in socio- economic conditions. On the contrary, the pattern of income-mortality relationship altered significantly in India during the 1980s and the 1990s. In the 1980s, in almost all the age categories, income shows a significant impact except for the 70 years and above group. However, interestingly, only for childhood and very old age (70+) group, the relationship showed a negative sign. For all other age groups, income had a significant positive impact on mortality. This shows that for the older adults income affects mortality adversely indicating the onset of epidemiological transition from infectious diseases to degenerative diseases that affect the rich equally. However, this explanation may not hold well in case of younger age group (5-14). The possible reasons for the adverse effect of income on mortality in this age group may purely be a cohort effect. As infant and child mortality is generally high among the poor, those who have survived beyond age five among the poor may be relatively healthier leading to lower mortality among them in the future. Surprisingly, the pattern again changed in the 1990s and early 2000s and income shows a negative significant relationship with mortality in almost all age groups during this period. It may be an indication that as epidemiological transition advances, it affects all sections irrespective of income. Nevertheless, a change in life style may be necessary to limit the bad effect of epidemiological transition. Thus, although the immediate effect of degenerative diseases may be on the rich, the subsequent effect will be universal but adverse to the poor.

It is also interesting to see that income inequality shows a high positive association with mortality in childhood and very old (70+) mortality in the 1990s and early 2000. While income remains important, the changes that occurred during this period show the importance of the inequality pattern on mortality, but inequality nearly remained insignificant in the earlier decades. Since the 1990s, the Indian economy has been growing at a rapid pace and it might have worsened the inequality situation in the country. The significant association of inequality and mortality since the 1990s may be a reflection of the bad effect of higher economic growth and the resultant inequality on health. The recently held National Family Health Survey-3 also showed near stagnancy in the nutritional levels of children and women in India during the rapid economic transformation period (International Institute for Population Sciences (IIPS) and Macro International 2007.)

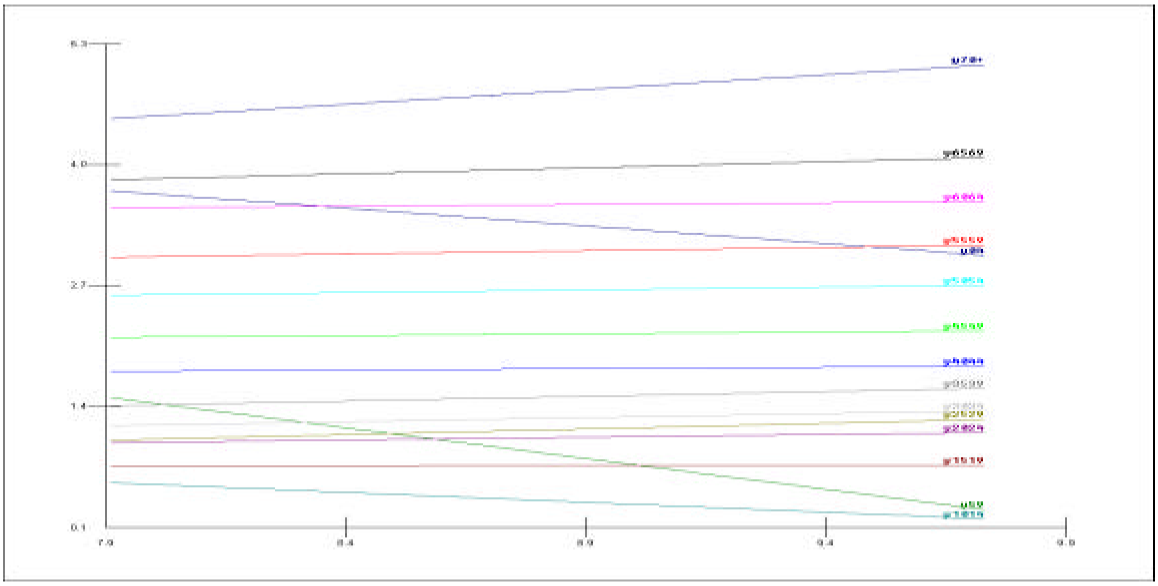
Income and Mortality Estimation

For a detailed investigation of the income-mortality relationship over the period, we have estimated different models. As a first step, per capita income and mortality has been analysed using both fixed effect and random effect models (see Appendix I and II).

The SRS data used for the analysis is a type of repeated observations, so fixed and random effect models are used in the analysis. In the time series data the observations are not independent. In such cases, we can use the repetition to get better estimates. In the typical OLS estimates, the pooled data would give biased estimates. The fixed and random effect models take into account the repetition and therefore it is possible to control fixed or random individual differences.

According to this, income does not have significant impact on mortality. Both fixed effect and random effect models do not bring out the association between income and mortality. On the contrary, all other factors considered for the analysis like age, state, place of residence etc., were important for mortality reduction. It is surprising because per-capita income has been found to be an important predictor of mortality since the 1980s according to the OLS regression analysis. Perhaps the lack of association between income and mortality may be because income does not influence mortality of all age groups. To correct this and in order to investigate further, the relationship between age categories and changes in state per capita income and mortality we have introduced an interaction effect between different age groups and per capita income. The interaction effect is to find out the effect of age on mortality on income. As is clear from Figure 16 income-mortality relationship is strong in the two age groups of 0-4 and 5-9 years. It is important because child mortality (0-4 age group death) is considered as an index of the health status of a society. Thus, income still has a strong effect on the under-5-year mortality and to some extent on the 5-9 years age group. For other age groups, however, the relationship remains insignificant. (Detailed tables are presented in Appendix III and IV)

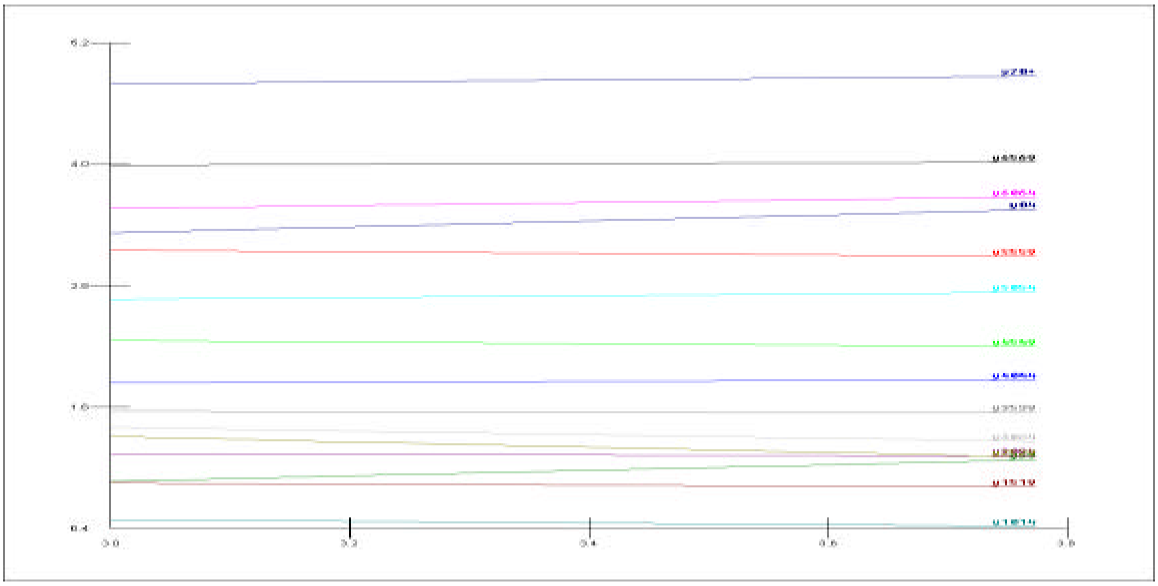
Figure 16: Predicted relationship between log mortality (y -axis) and state per capita income (x-axis) for different age categories, specifying state as random effects



Income Inequality and Mortality Estimation

After carefully analysing the income-mortality relationship, we have examined the income inequality-mortality relationship. In this case too, the first attempt was to estimate the effect of change in state income inequality predicting changes in mortality, conditional on age, sex, place of residence and changes in state per capita income using both fixed effect and random effect models. The results from analysis are presented in Appendix V and VI. As in the case of income-mortality relationship, the income inequality was also found to be insignificant in explaining mortality changes.

Figure 17: **Predicted relationship between log mortality (y-axis) and state income inequality (x-axis) for different age categories, specifying state as random effects**



However, other variables included in the model are significant. Perhaps it also indicates that the inequality effect may not be universally true for all age groups. In order to test this hypothesis we introduced the interaction terms between age-specific death rates and the income-inequality measure (Gini coefficient). We did not find an association between changes in state income inequality and changes in mortality. The results from the analysis is presented in Figure 17 and Appendix VII and VIII.

It is clear that an increase in state income inequality predicts decline in mortality only for the under-5 age group. There is a positive association between state income inequality and mortality decline in the 5-9 years age group when we specify state as a random effect. However, this slop is not significantly different from that of 0-4 in the model when we specify state as a fixed effect. No relationship was observed for other age groups.

On the whole, the analysis shows that income-mortality and income inequality-mortality relationship is strong for the childhood years in India. For other age groups, income does not seem to have a significant impact on mortality. This finding seems to be in line with the public health discourse in India, particularly on the impact of modern medicines in controlling mortality in the country as against improvement in socio-economic conditions. However, for the childhood years, generally, income and public health measures matter more than medical technology.

While it is interesting that income-mortality relationship is still strong in the country, at least for the childhood years, it is also important to ask why that is so. In other words, how does income affect morality in the Indian context? While the income inequality argument has been very dominating in recent years to understand the income-mortality relationship (Wilkinson 1990; Deaton 2002), the accessibility argument has been prominent, often in the case of developing countries. In addition, it is also often argued that the poor face several health risks due to smoking, chewing substances that affect health, alcohol consumption etc.

Role of Health Accessibility

One of the important arguments put forward to explain the relationship between income and mortality is the differences in the access to health care facilities between the rich and the poor. However, studies carried out from several parts of the world reveal that even with equal access, income-mortality relationship persists (Deaton 2002). Several issues have to be considered in determining accessibility to health facilities. Physical accessibility is important because it determines the ease with which the people are able to get treatment for any illness. However, mere physical accessibility may not help the poor in receiving health care because they might be excluded due to financial inaccessibility. It is often reported by different surveys in India that direct as well as indirect costs govern in accessing medical care (Mahal *et al,* 2001).

There had also been criticism from many quarters overemphasizing medical facility for achieving the desired health goals. Public health studies emphasise the limits of medicine in bringing about improvement in health (Deaton, 2002). Even in India, Kerala had achieved a good health record much before the advent of modern medical facilities. The mortality transition in Kerala dates back to the beginning of the 20th Century and is mainly due to public health measures rather than medial technological interventions (Panikar and Soman, 1984).

The district-level survey conducted as part of the Reproductive and Child Health Project in 2002-04 provides information on the physical accessibility to health facilities. The economic living standard of the surveyed households is also provided and classified into three categories (poor, middle and rich) based on the assets and amenities each household possesses. We have computed the accessibility of government health facility in rural areas for different economic groups. Table 2 presents the accessibility of different government health facilities by the standard of living index in India.

Table 2: Percentage distribution of Households with Distance to the Nearest Government Health Facilities by Standard of Living Index in Rural Areas, India, 2002-04

Stand of Living	Distance to the PHC		
	<2 Km	2-5 Km	6 and above
Low	4.4	33.6	62.0
Medium	5.2	37.6	57.3
High	6.1	38.5	55.3
Distance to the CHC			
Low	2.4	15.3	82.3
Medium	2.6	18.9	78.6
High	3.3	21.3	75.4
Distance to the Govt. dispensary			
Low	3.0	18.6	78.5
Medium	3.6	21.8	74.7
High	4.3	24.9	70.9
Distance to the Govt. Hospital			
Low	2.0	12.2	85.8
Medium	2.1	15.0	83.0
High	2.8	17.1	80.1
Distance to any govt. facility			
Low	5.8	36.3	57.9
Medium	6.3	38.8	54.9
High	6.9	39.9	53.2

Source: Computed from the District Level Household Survey conducted in India during 2002-04.

It shows that physical accessibility of the different levels of hospitals is not significantly different for households with different economic living standards. The accessibility of any facility for majority of the population is a matter of concern in India. For a large majority of the population a government health facility is available only beyond 6 km away from home. It is difficult to believe that the lack of accessibility to government health care facility is matched by a private care facility nearby.

With distance increasing, the poor may get affected more than the rich in terms of financial accessibility. Thus, on the whole, it is clear that accessibility is an issue but does not seem to suggest that the income-health relationship can be explained only in terms of accessibility as the poor and rich are nearly equally affected by the accessibility issue.

Role of Health Habits

Another possible explanation for the income-mortality relationship is the health habits of the poor. Unhealthy practices like smoking, drinking alcohol and chewing of tobacco etc., are considered more common among the poor than the rich. The income-mortality relationship is also a reflection of these bad practices. However, studies found no clear-cut findings to establish convincingly that the habits of the poor are responsible for their bad health (Deaton 2002).

The National Family Health Survey (NFHS) conducted in 2006 collected the information on some of the health habits of adult females in the age group 15-49 years and males in the age category of 20-54 years. The survey also provides information on the standard of living of the household in a five-point scale. Tables 3 and 4 provide information on the percentage of males and females who smoke, drink alcohol and use tobacco by standard of living index.

Table 3: Percentage of females reporting alcohol use, smoking and use of tobacco by Wealth Index, India 2006

Background characteristics	Percentage Smoke	Percentage drink	Percentage use other forms of tobacco	Percentage either smoke, drink or chew tobacco	Percentage who smoke, drink and chew tobacco
Wealth Index					
Poorest	3.3	6.2	19.2	23.8	0.2
Poorer	2.1	2.3	13.3	16.1	-
Middle	1.2	2.0	9.3	11.7	-
Richer	0.5	0.8	6.3	7.3	-
Richest	0.2	0.5	3.1.	3.7	-
Total	**1.4**	**2.2**	**9.8**	**11.9**	**-**

Source: Computed from National Family Health Survey data 2006.

It is clear that a higher percentage of the poor have bad health habits. However, the data also bring out the fact that the bad health habits are comparatively very less among females in India. As such, its impact on the health of the children will be negligible. The observed relationship between income and health was primarily limited to the childhood years. Hence, it will be difficult to conclude that poor health habits are the main reasons for the income-mortality relationship in the country.

Table 4: Percentage of males reporting alcohol use, smoking and use of tobacco by Wealth Index, India 2006

Background characteristics	Percentage Smoke	Percentage drink	Percentage use other forms of tobacco	Percentage either smoke, drink or chew tobacco	Percentage who smoke, drink and chew tobacco
Wealth Index					
Poorest	43.7	40.6	53.2	78.6	13.9
Poorer	40.5	33.9	46.7	72.8	10.3
Middle	36.1	33.1	38.7	66.8	8.3
Richer	29.8	28.9	33.5	59.4	6.6
Richest	22.3	26.9	24.2	49.2	4.3
Total	**33.5**	**32.0**	**37.9**	**63.9**	**8.0**

Source: Computed from National Family Health Survey data 2006.

Conclusion

This study aims to understand the nuances behind the often-celebrated relationship between income and mortality in India. The empirical estimation of this relationship is also largely motivated by the long series of data on mortality and income available for every major state in India since 1971. The age-specific mortality rate for rural and urban areas separately by gender available from the Sample Registration System (SRS) is used for the analysis. The per-capita income data for the states for the same period is derived from the Central Statistical Organisation (CSO). We have used multilevel fixed effect and random effect models to understand the relationship.

The graphic presentation of the data showed that the income-life expectancy relationship is non-linear in nature with mortality responding sharply in the earlier years and rather slowly in the latter years. However, it was difficult to establish a one-to-one correspondence between income and mortality through a graphic depiction because this relationship is also confounded by time (technological improvement) and many other factors. Hence, a multivariate framework became essential to predict the association between income and mortality.

The Ordinary Least Square regression analysis (OLS) between per-capita income, Gini Coefficient of income distribution and mortality for different decades revealed that the income-mortality relationship had been weak in the 1970s but became stronger in the 1980s and, to some extent, in the 1990s. In the 1990s, the relationship has been observed mainly for the 0-4 and 70-plus age group. In addition, during the 1990s, other than income, the income inequality measure (Gini coefficient) has also become an important predictor of mortality.

The multilevel analysis also proved nearly the same pattern. The income-mortality relationship in India is limited, basically, to the childhood years. For the other age group the income-mortality relationship does not seem to matter much. The income inequality matters more in the case of childhood mortality. This is expected because the epidemiological transition from infectious diseases to degenerative diseases in the country would have reduced the income-mortality relationship for adult age groups.

The study looks into the impact of accessibility to health care and bad health habits as possible explanations for the income-mortality relationship. However, it was found that at least in the case of physical accessibility to governmental health facility, the income level did not seem to matter much in rural areas. Bad habits like smoking, chewing tobacco and alcohol consumption were found to be more prevalent among the poor sections of the population and comparatively less prevalent among women. As such, its impact on childhood mortality will be negligible. Although access to care and bad baits are important in mediating the relationship between income and mortality, they may not be able to explain the income-mortality relationship in India.

On the whole, the analysis reveals that the income-mortality relationship is mainly restricted to childhood years. Not only income, but also income distribution seems to matter in mortality transition at least in recent years in the country.

References

Adler, N, T Boyce, M Chesney, S Folkman and L Syme (1993). Socioeconomic Inequalities in Health: No Easy Solution. *JAMA,* 269 (24):3140-45.

Backlund D, P D Sorlier and N J Johnson (1996). The Shape of the Relationship between Income and Mortality in United States: Evidences from the National Longitudinal Mortality Study. *Annals of epidemiology,* 6 (1):12-23.

Cutler, David, Angus Deaton and Adriana Lleras-Muney (2006). The Determinants of Mortality. *Journal of Economic Perspectives,* 20 (3): 97–120.

Deaton, Angus (2002). Policy Implications of the Gradient of Health and Wealth. *Health Affairs,* 21 (2): 13-30.

Deaton, Angus and Christina Paxson (2001). Mortality, Income, and Income Inequality Over Time in Britain and the United States. *NBER Working Paper No. 8534*. Cambridge MA, USA: National Bureau of Economic Research.

Fuchs, V (1974). Some Economic Aspects of Mortality in Developing Countries. In M Perlaman (eds), *The economics of health and medical care*. New York: John Wiley.

Goldstein, H (2003). *Multilevel statistical models*. London: Arnold. (3rd edition)

House J, R Kessler, A R Herzog, R Mero, A Kinney and M Breslow (1990). Socioeconomic Status and Health. *Milbank Quarterly,* 68:383-411.

International Institute for Population Sciences (IIPS) and Macro International (2007). *National Family Health Survey (NFHS-3) 2005-06: India: volume 1.* Mumbai: IIPS.

Kaplan G A, E Pamuk, J W Lynch, R O Cohen and J L Balfour (1996). Income Inequality and Mortality in the United States: Analysis of Mortality and Potential Pathways. *BMJ,* 312 (7037): 999-1003.

Ken Judge (1995). Income distribution and life expectancy: A Critical Appraisal. *BMJ,* 311 (7015):1282-85.

Mahal A, A S Yazbeck, D H Peters and G N V Ramana (2001). The Poor and Health Service Use in India. *HNP Discussion Paper*. Washington, DC: The World Bank.

Marmot M G, D G Smith and S Stansfeld (1991). Health Inequalities Among British Civil Servants: The Whitehall II study. *Lancet,* 337 (8754): 1387-93.

Panikar, P G K and C R Soman (1984). *Health Status of Kerala - Paradox of Economic Backwardness and Health Development*. Trivandrum: Centre for Development Studies.

Prasad, Sujata and C Sathyamala (eds) (2006). *Securing Health for All: Dimensions and Challenges*. New Delhi: Institute for Human Development.

Preston, S H (1975). The Changing Relation between Mortality and the Overall Level of Economic Development. *Population Studies*, 29 (2): 231-48.

Rasbash, J *et al* (2004). *A user's guide to MLwiN version 2.0*. London: Centre for Multilevel Modeling, Institute of Education.

Raudenbush, S and A Bryk (2002). *Hierarchical linear models: applications and data analysis methods*. Thousand Oaks: Sage Publications.

Subramanian, S V *et al* (2005). Racial Disparities in Context: A Multilevel Analysis of Neighborhood Variations in Poverty and Excess Mortality among Black Populations in Massachusetts. *American Journal of Public Health*, 95 (2): 260-65.

Subramanian, S V, K Jones and C Duncan (2003). Multilevel Methods for Public Health Research. In I Kawachi and L F Berkman (eds), *Neighborhoods and Health*. Oxford University Press: New York.

———— (2001). Multilevel Perspectives on Modeling Census Data. *Environment and Planning,* 33 (3): 399-417.

Wilkinson R G (1990). Income Distribution and Mortality: A "Natural" Experiment. *Sociology of Health and Illness,* 12 (4): 391-412.

World Bank (1997). *India: Achievements and Challenges in Reducing Poverty*. Washington D C: The World Bank.

Appendix I: Estimated random effect model (using state as random effect) between change in log per capita income and mortality across states in India from 1971-2003

PARAMETER	ESTIMATE	S. ERROR (U)
Constant	3.459*	0.300
Year 1985	-0.018*	0.001
Female	-0.134*	0.005
Urban	-0.345*	0.005
Age 5-9	-2.462*	0.014
Age 10-14	-2.989*	0.014
Age 15-19	-2.621*	0.014
Age 20-24	-2.323*	0.014
Age 25-29	-2.241*	0.014
Age 30-34	-2.115*	0.014
Age 35-39	-1.888*	0.014
Age 40-44	-1.581*	0.014
Age 45-49	-1.209*	0.014
Age 50-54	-0.738*	0.014
Age 55-59	-0.318*	0.014
Age 60-64	0.182*	0.014
Age 65-69	0.565*	0.014
Age 70+	1.386*	0.014
Lpcnsdp	**-0.008**	**0.034**
Lgini		

Appendix II: Estimated fixed effect model (using state as fixed effect) between change in log per capita income and mortality across states in India from 1971-2003

PARAMETER	ESTIMATE	S. ERROR (U)
Constant	3.36*	0.297
Year 1985	-0.018*	0.001
Female	-0.134*	0.005
Urban	-0.345*	0.005
Age 5-9	-2.462*	0.014
Age 10-14	-2.989*	0.014
Age 15-19	-2.621*	0.014
Age 20-24	-2.323*	0.014
Age 25-29	-2.241*	0.014
Age 30-34	-2.115*	0.014
Age 35-39	-1.888*	0.014
Age 40-44	-1.581*	0.014
Age 45-49	-1.209*	0.014
Age 50-54	-0.738*	0.014
Age 55-59	-0.318*	0.014
Age 60-64	0.182*	0.014
Age 65-69	0.565*	0.014
Age 70+	1.386*	0.014
Log per capita income (LPI)	**0.009224**	**0.034**
Assam	0.142*	0.023
Bihar	0.104*	0.033
Gujarat	-0.006	0.024
Haryana	-0.216*	0.026
Karnataka	-0.119*	0.022
Kerala	-0.551*	0.022
Maharashtra	-0.153*	0.026
Madhya Pradesh	0.114*	0.022
Orissa	0.134*	0.024
Punjab	-0.309*	0.029
Rajasthan	-0.040*	0.022
Tamil Nadu	-0.010	0.023
Uttar Pradesh	0.187*	0.024
West Bengal	-0.102*	0.025

Appendix III: Estimated random e effect model (using state as random effect) between change in log per capita income and age on mortality across states in India from 1971-2003

PARAMETER	ESTIMATE	S. ERROR(U)
Constant	6.74*	0.365
Year 1985	-0.017*	0.001
Female	-0.133*	0.005
Urban	-0.346*	0.005
Age 5-9	-0.002	0.310
Age 10-14	-4.467*	0.309
Age 15-19	-6.019*	0.307
Age 20-24	-6.2*	0.307
Age 25-29	-6.664*	0.306
Age 30-34	-6.243*	0.307
Age 35-39	-6.141*	0.306
Age 40-44	-5.207*	0.306
Age 45-49	-4.9*	0.306
Age 50-54	-4.616*	0.306
Age 55-59	-4.291*	0.306
Age 60-64	-3.485*	0.306
Age 65-69	-3.939*	0.306
Age 70+	-4.755*	0.306
Log percapita income (LPI)	-0.381*	0.041
LPI x Age 5-9	-0.280*	0.035
LPI x Age 10-14	0.167*	0.035
LPI x Age 15-19	0.386*	0.035
LPI x Age 20-24	0.441*	0.035
LPI x Age 25-29	0.503*	0.035
LPI x Age 30-34	0.469*	0.035
LPI x Age 35-39	0.484*	0.035
LPI x Age 40-44	0.412*	0.035
LPI x Age 45-49	0.420*	0.035
LPI x Age 50-54	0.441*	0.035
LPI x Age 55-59	0.452*	0.035
LPI x Age 60-64	0.417*	0.035
LPI x Age 65-69	0.512*	0.035
LPI x Age 70+	0.699*	0.035

Appendix IV: Estimated fixed effect model (using state as fixed effect) between change in log per capita income and age on mortality across states in India from 1971-2003

PARAMETER	ESTIMATE	S. ERROR(U)
Constant	6.636*	0.363
Year 1985	-0.018*	0.001
Female	-0.133*	0.005
Urban	-0.346*	0.005
Age 5-9	-0.003	0.310
Age 10-14	-4.465*	0.309
Age 15-19	-6.018*	0.307
Age 20-24	-6.199*	0.306
Age 25-29	-6.663*	0.306
Age 30-34	-6.244*	0.307
Age 35-39	-6.141*	0.306
Age 40-44	-5.207*	0.306
Age 45-49	-4.899*	0.306
Age 50-54	-4.616*	0.306
Age 55-59	-4.291*	0.306
Age 60-64	-3.485*	0.306
Age 65-69	-3.94*	0.306
Age 70+	-4.756*	0.306
Log per capita income (LPI)	-0.363*	0.042
LPI x Age 5-9	-0.2809*	0.035
LPI x Age 10-14	0.167*	0.035
LPI x Age 15-19	0.386*	0.035
LPI x Age 20-24	0.441*	0.035
LPI x Age 25-29	0.503*	0.035
LPI x Age 30-34	0.469*	0.035
LPI x Age 35-39	0.484*	0.035
LPI x Age 40-44	0.412*	0.035
LPI x Age 45-49	0.420*	0.035
LPI x Age 50-54	0.441*	0.035
LPI x Age 55-59	0.452*	0.035
LPI x Age 60-64	0.417*	0.035
LPI x Age 65-69	0.512*	0.035
LPI x Age 70+	0.699*	0.035
Assam	0.142*	0.023
Bihar	0.102*	0.033
Gujarat	-0.006	0.024
Haryana	-0.216*	0.026
Karnataka	-0.12*	0.022
Kerala	-0.552*	0.022
Maharashtra	-0.152*	0.026
Madhya Pradesh	0.114*	0.022
Orissa	0.133*	0.024
Punjab	-0.308*	0.029
Rajasthan	-0.040	0.022
Tamil Nadu	-0.009	0.023
Uttar Pradesh	0.186*	0.024
West Bengal	-0.101*	0.025

Appendix V: Estimated random effect model (using state as random effect) between change in income inequality and mortality across states in India from 1971-2003

PARAMETER	ESTIMATE	S. ERROR(U)
Constant	3.393*	0.359
Year 1985	-0.018*	0.001
Female	-0.141*	0.005
Urban	-0.335*	0.005
Age 5-9	-2.467*	0.014
Age 10-14	-2.986*	0.014
Age 15-19	-2.611*	0.014
Age 20-24	-2.314*	0.014
Age 25-29	-2.234*	0.014
Age 30-34	-2.112*	0.014
Age 35-39	-1.887*	0.014
Age 40-44	-1.585*	0.014
Age 45-49	-1.212*	0.014
Age 50-54	-0.738*	0.014
Age 55-59	-0.319*	0.014
Age 60-64	0.182*	0.014
Age 65-69	0.569*	0.014
Age 70+	1.397*	0.014
Log of per capita income	-0.006	0.035
Lgini	**0.013**	**0.052**

Appendix VI: Estimated fixed effect model (using state as fixed effect) between change in income inequality and mortality across states in India from 1971-2003

PARAMETER	ESTIMATE	S. ERROR(U)
Constant	3.227*	0.359
Year 1985	-0.018*	0.001
Female	-0.141*	0.005
Urban	-0.336*	0.005
Age 5-9	-2.467*	0.014
Age 10-14	-2.986*	0.014
Age 15-19	-2.611*	0.014
Age 20-24	-2.314*	0.014
Age 25-29	-2.234*	0.014
Age 30-34	-2.112*	0.014
Age 35-39	-1.887*	0.014
Age 40-44	-1.585*	0.014
Age 45-49	-1.212*	0.014
Age 50-54	-0.738*	0.014
Age 55-59	-0.319*	0.014
Age 60-64	0.182*	0.014
Age 65-69	0.569*	0.014
Age 70+	1.397*	0.014
Lgini	**0.026**	**0.052**
Assam	0.172*	0.031
Bihar	0.112*	0.035
Gujarat	-0.007	0.025
Haryana	-0.218*	0.026
Karnataka	-0.120*	0.022
Kerala	-0.555*	0.023
Maharashtra	-0.158*	0.027
Madhya Pradesh	0.113*	0.022
Orissa	0.137*	0.024
Punjab	-0.311*	0.029
Rajasthan	-0.041	0.022
Tamil Nadu	-0.014	0.023
Uttar Pradesh	0.189*	0.024
West Bengal	-0.100*	0.025
Lpcnsdp	0.014	0.035

Appendix VII: Estimated random effect model (using state as random effect) between change in income inequality and age on mortality across states in India from 1971-2003

PARAMETER	ESTIMATE	S. ERROR(U)
Constant	2.482*	0.428
Year 1985	-0.018*	0.001
Female	-0.140*	0.005
Urban	-0.336*	0.005
Age 5-9	-2.386*	0.344
Age 10-14	-1.756*	0.345
Age 15-19	-1.501*	0.343
Age 20-24	-1.255*	0.341
Age 25-29	-0.441	0.342
Age 30-34	-0.577	0.342
Age 35-39	-0.885*	0.342
Age 40-44	-0.755*	0.342
Age 45-49	-0.014	0.342
Age 50-54	-0.071	0.341
Age 55-59	0.891*	0.341
Age 60-64	0.682*	0.341
Age 65-69	1.399*	0.341
Age 70+	2.048*	0.341
lpcnsdp	-0.006	0.035
Log of Gini	**0.284***	**0.087**
lgini.y5	-0.024	0.102
lgini.y1	-0.365*	0.103
lgini.y1	-0.330*	0.102
lgini.y2	-0.314*	0.101
lgini.y2	-0.533*	0.102
lgini.y3	-0.456*	0.101
lgini.y3	-0.297*	0.101
lgini.y4	-0.246*	0.102
lgini.y4	-0.356*	0.102
lgini.y5	-0.198	0.101
lgini.y5	-0.359*	0.101
lgini.y6	-0.149	0.101
lgini.y6	-0.246*	0.101
lgini.y7	-0.194	0.101

Appendix VIII: Estimated fixed effect model (using state as fixed effect) between change in income inequality and age on mortality across states in India from 1971-2003

PARAMETER	ESTIMATE	S. ERROR(U)
Cons	2.319*	0.428
Time 1985	-0.018*	0.001
Female	-0.140*	0.005
Urban	-0.336*	0.005
y5-9	-2.386*	0.344
y10-14	-1.756*	0.345
y15-19	-1.5*	0.343
y20-24	-1.255*	0.341
y25-29	-0.440	0.342
y30-34	-0.576	0.342
y35-39	-0.884*	0.341
y40-44	-0.754*	0.342
y45-49	-0.013	0.342
y50-54	-0.071	0.341
y55-59	0.891*	0.341
y60-64	0.682*	0.341
y65-69	1.4*	0.341
y70+	2.049*	0.341
Lgini	**0.297***	**0.086**
lgini.y5	-0.025	0.102
lgini.y1	-0.365*	0.103
lgini.y1	-0.330*	0.102
lgini.y2	-0.314*	0.101
lgini.y2	-0.533*	0.102
lgini.y3	-0.456*	0.102
lgini.y3	-0.297*	0.101
lgini.y4	-0.247*	0.102
lgini.y4	-0.356*	0.102
lgini.y5	-0.199	0.101
lgini.y5	-0.359*	0.101
lgini.y6	-0.149	0.101
lgini.y6	-0.246*	0.101
lgini.y7	-0.194	0.101
Assam	0.172*	0.031
Bihar	0.112*	0.035
Gujarat	-0.006	0.025
Haryana	-0.218*	0.026
Karnataka	-0.120*	0.022
Kerala	-0.554*	0.023
Maharashtra	-0.158*	0.027
Madhya Pradesh	0.113*	0.022
Orissa	0.137*	0.024

Appendix IX: Trends in Per-capita Income (PCI) and Income Inequality (Gini coefficient) in different States of India

States/Year	Gini coefficients				PCI			
	1970-71	**1983-84**	**1990-91**	**1999-2000**	**1970**	**1980**	**1990**	**2000**
ANDHRA PRADESH	28.09364	30.23848	30.01559	25.74976	4163	4604	6873	10195
ASSAM	NA	NA	21.20512	21.4992	4534	4636	5574	5943
BIHAR	27.657	26.60933	20.97428	21.9517	--	3539	4474	3798
GUJRATH	27.32074	26.4412	23.21736	25.35425	5919	6455	8788	12489
HARYANA	NA	28.10036	NA	25.305	6228	7514	11125	13848
KARNATAKA	29.25638	31.57375	29.53555	26.8184	4612	4943	6631	11939
KERALA	34.13295	34.90914	30.25416	28.2985	5444	5592	6851	10714
MAHARASTRA	28.50948	30.72213	31.53555	29.4888	5810	7102	10159	7195
MADHYA PRADESH	31.8411	29.74826	31.09391	25.99357	4768	5084	6350	7195
ORISSA	28.85117	27.43316	26.25226	24.9485	4093	4085	4300	5562
PUNJAB	NA	29.0088	NA	25.5654	6671	8442	11776	15071
RAJASTHAN	33.2989	33.83024	29.01362	22.58336	4119	4254	6760	8175
TAMIL NADU	31.07609	34.0609	29.59166	33.11934	5238	5266	7864	12994
UTTAR PRADESH	29.87202	29.93409	26.90478	26.20396	3870	4133	5342	5575
WEST BENGAL	27.9535	30.31079	29.17027	25.31512	--	4717	5991	9796

Recent Working Papers

187 Groundwater for Agriculural Use in India: An Institutional Perspective
Sarbani Mukherjee

188 Comparative Study of Traditional Vs. Scientific Shrimp Farming in West Bengal: A Technical Efficiency Analysis
Poulomi Bhattacharya

189 Urban and Service Delivery in Bangalore: Public-Private Partnership
Smitha K C and Sangita S N

190 Social Capital in Forest Governance Regimes
Sangita S N

191 Agriculture in Karnataka: A Historical View After the Fall of Serirangapatana
R S Deshpande and Malini Tantri

192 Personality Traits and Administrators
Anitha V

193 Sustainability of Indian Agriculture: Towards an Assessment
V M Rao

194 Emerging Development Issues of Greater Bangalore
G S Sastry

195 Rural Infrastructure Development Fund: Need for a Track Change
Meenakshi Rajeev

196 Emerging Ground Water Crisis in Urban Areas — A Case Study of Ward No. 39, Bangalore City
K V Raju, S Manasi and N Latha

197 In Pursuit of India's Export earning advantage: An Assessment of IT-Enabled Services Industry
Meenakshi Rajeev

198 A Patriarchal Link to HIV/AIDS in India
Skylab Sahu

199 Collective Action and Property Rights: Some Critical Issues in the Context of Karnataka
K G Gayathri Devi

200 State, Society and Inclusive Governance: Community Forests in Andhra Pradesh, Karnataka and Orissa
S N Sangita

201 Urban Poverty and Links with the Environment: An Exploration
K G Gayathri Devi

202 Groundwater Over-exploitation, Costs and Adoption Measures in the Central Dry Zone of Karnataka
Anantha K H and K V Raju

203 Changing Child Population: Growth, Trends and Levels in Karnataka
C M Lakshmana

204 Awareness About HIV/AIDS Among Karnataka Woment: An Analysis of RCH 2002-04 Data
K S Umamani

205 The Microfinance Promise in Financial Inclusion and Welfare of the Poor: Evidence from Karnataka, India
Naveen K Shetty

206 Structure of Central Himalayan Forests Under Different Management Regimes: An Empirical Study
Sunil Nautiyal

207 Poverty and Natural Resources: Measuring the Links (Some Issues in the Context of Karnataka)
K G Gayathri Devi

208 Federalism and Decentralisation in India: Andhra Pradesh and Tamil Nadu
V Anil Kumar

209 Capital, 'Development' and Canal Irrigation in Colonial India
Patric McGinn

210 Gender, Ecology and Development in Karnataka: Situation and Tasks Ahead
K G Gayathri Devi

211 Greenhouse Gases Emission and Potential Corbon Sequestration: A Case Study of Semi-Arid Area in South India
Lenin Babu and K V Raju

212 Emerging Trends in Managing Drinking Water – Case Studies of Coastal Villages in Karnataka
Manasi S, Latha N and K V Raju

213 Spatio-Temporal Analysis of Forests Under Different Management Regimes Using Landsat and IRS Images
Sunil Nautiyal

214 Traditional Knowledge System (Medicine): A Case Study of Arakalgud Taluk, Karnataka, India
B K Harish, K Lenin Babu

215 Tribal Movement in Orissa: A Struggle Against Modernisation?
Patibandla Srikant

216 Technological Progress, Scale Effect and Total Factor Productivity Growth in Indian Cement Industry: Panel Estimation of Stochastic Production Frontier
Sabuj Kumar Mandal and S Madheswaran

217 Fisheries and Livelihoods in Tungabhadra Basin, India: Current Status and Future Possibilities
Manasi S, Latha N and K V Raju

218 Economics of Shrimp Farming: A Comparative Study of Traditional Vs. Scientific Shrimp Farming in West Bengal
Poulomi Bhattacharya

219 Output and Input Efficiency of Manufacturing Firms in India: A Case of the Indian Pharmaceutical Sector
Mainak Mazumdar, Meenakshi Rajeev and Subhash C Ray

220 Panchayats, Hariyali Guidelines and Watershed Development: Lessons from Karnataka
N Sivanna

221 Gender Differential in Disease Burden: It's Role to Explain Gender Differential in Mortality
Biplab Dhak and Mutharayappa R

222 Sanitation Strategies in Karnataka: A Review
Veerashekharappa and Shashanka Bhide

223 A Comparative Analysis of Efficiency and productivity of the Indian Pharmaceutical Firms: A Malmquist-Meta-Frontier Approach
Mainak Mazumdar and Meenakshi Rajeev

224 Local Governance, Patronage and Accountability in Karnataka and Kerala
Anand Inbanathan

225 Downward Dividends of Groundwater Irrigation in Hard Rock Areas of Southern Peninsular India
Anantha K H

226 Trends and Patterns of Private Investment in India
Jagannath Mallick

227 Environmental Efficiency of the Indian Cement Industry: An Interstate Analysis
Sabuj Kumar Mandal and S Madheswaran

228 Determinants of Living Arrangements of Elderly in Orissa: An Analysis
Akshaya Kumar Panigrahi

229 Fiscal Empowerment of Panchayats in India: Real or Rhetoric?
M Devendra Babu

230 Energy Use Efficiency in Indian Cement Industry: Application of Data Envelopment Analysis and Directional Distance Function
Sabuj Kumar Mandaland S Madheswaran

231 Ethnicity, Caste and Community in a Disaster Prone Area of Orissa
Priya Gupta

232 Koodankulam Anti-Nuclear Movement: A Struggle for Alternative Development?
Patibandla Srikant

233 History Revisited: Narratives on Political and Constitutional Changes in Kashmir (1947-1990)
Khalid Wasim Hassan

234 Spatial Heterogeneity and Population Mobility in India
Jajati Keshari Parida and S Madheswaran

235 Measuring Energy Use Efficiency in Presence of Undesirable Output: An Application of Data Envelopment Analysis (DEA) to Indian Cement Industry
Sabuj Kumar Mandaland S Madheswaran

236 Increasing trend in Caesarean Section Delivery in India: Role of Medicalisation of Maternal Health
Sancheetha Ghosh

237 Migration of Kashmiri Pandits: Kashmiriyat Challenged?
Khalid Wasim Hassan

238 Causality Between Energy Consumption and Output Growth in Indian Cement Industry: An Application of Panel Vector Error Correction Model
Sabuj Kumar Mandaland S Madheswaran

239 Conflict Over Worship:A Study of the Sri Guru Dattatreya Swami Bababudhan Dargah in South India
Sudha Sitharaman

240 Living Arrangement Preferences of the Elderly in Orissa, India
Akshaya Kumar Panigrahi

241 Challenges and Pospects in the Measurement of Trade in Services
Krushna Mohan Pattanaik

242 Dalit Movement and Emergence of the Bahujan Samaj Party in Uttar Pradesh: Politics and Priorities
Shyam Singh

243 Globalisation, Democratic Decentralisation and Social Secutiry in India
S N Sangita and T K Jyothi

244 Health, Labour Supply and Wages: A Critical Review of Literature
Amrita Ghatak

245 Is Young Maternal Age A Risk Factor for Sexually Transmitted Diseases and Anemia in India? An Examination in Urban and Rural Areas
Kavitha N

246 Patterns and Determinants of Female Migration in India: Insights from Census
Sandhya Rani Mahapatro

247 Spillover Effects from Multinational Corporations: Evidence From West Bengal Engineering Industries
Rajdeep Singha and K Gayithri

248 Effectiveness of SEZs Over EPZs Structure: The Performance at Aggregate Level
Malini L Tantri

Price: Rs. 30.00 ISBN 978-81-7791-105-3

INSTITUTE FOR SOCIAL AND ECONOMIC CHANGE
Dr V K R V Rao Road, Nagarabhavi P.O., Bangalore - 560 072, India
Phone: 0091-80-23215468, 23215519, 23215592; Fax: 0091-80-23217008
E-mail: lekha@isec.ac.in; Web: www.isec.ac.in