



HAL
open science

Adult education and child mortality in India: the influence of caste, household wealth, and urbanization.

Archana Singh-Manoux, Aline Dugravot, George Davey Smith, Malavika Subramanyam, S. V. Subramanian

► To cite this version:

Archana Singh-Manoux, Aline Dugravot, George Davey Smith, Malavika Subramanyam, S. V. Subramanian. Adult education and child mortality in India: the influence of caste, household wealth, and urbanization.. *Epidemiology*, Lippincott, Williams & Wilkins, 2008, 19 (2), pp.294-301. 10.1097/EDE.0b013e3181632c75 . inserm-00275805

HAL Id: inserm-00275805

<https://www.hal.inserm.fr/inserm-00275805>

Submitted on 25 Jan 2011

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Adult education and child mortality in India: the influence of caste, household wealth, and urbanization

Archana Singh-Manoux^{1,2,3*}, Aline Dugravot¹, George Davey Smith⁴, Malavika Subramanyam⁵, S. V. Subramanian⁵

¹ Santé publique et épidémiologie des déterminants professionnels et sociaux de la santé INSERM : U687, IFR69, Université Paris Sud - Paris XI, Université de Versailles-Saint Quentin en Yvelines, Hôpital Paul Brousse 16, av Paul Vaillant Couturier 94807 VILLEJUIF, FR

² Department of Epidemiology and Public Health University College of London (UCL), 1-19 Torrington Place London WC1E 6BT, GB

³ Centre de Gériologie Assistance publique - Hôpitaux de Paris (AP-HP), Hôpital Sainte-Perine, FR

⁴ University of Bristol GB

⁵ Department of Society, Human Development and Health Harvard School of Public Health, Boston, MA, US

* Correspondence should be addressed to: Archana Singh-Manoux <archana.singh-manoux@inserm.fr >

Abstract

Objective

To examine the association between adult education and child mortality, and to explore the influence of other socioeconomic markers - caste, household wealth and urbanization - on this association.

Methods

Data were drawn from the 1998–1999 Indian National Family Health Survey from 26 states on 66367 children aged 5 or under. Adult education, head of household and spouse, was categorized into 0, 1–8, and 9 or more years of schooling. Logistic regression was used to estimate associations between measures of education and child mortality in analysis adjusted for other socioeconomic markers. Effect modification by caste, household wealth and urbanization was assessed by fitting an interaction term with education.

Results

Compared to those with no education, 9 or more years of education for the head of household (OR=0.54; 95% CI=0.48–0.62) and the spouse (OR=0.44; 95% CI=0.36–0.54) was associated with lower child mortality in analyses adjusted for age, sex and state of residence. Further adjustments for caste and urbanization attenuated these associations slightly and substantially when adjustments were made for household wealth. Nevertheless, in fully adjusted models, nine or more years of education for the head of household (OR=0.81; 95% CI=0.70–0.93) and the spouse (OR=0.75; 95% CI=0.60–0.94) remained associated with child mortality. There was no effect modification by caste, household wealth and urbanization of the association between adult education and child mortality.

Conclusion

Our results suggest that adult education has a protective association with child mortality in India. Caste, household wealth and urbanization do not modify or completely attenuate this association.

MESH Keywords Censuses ; Child Mortality ; Child, Preschool ; Educational Status ; Effect Modifiers (Epidemiology) ; Female ; Health Surveys ; Humans ; Income ; India ; epidemiology ; Infant ; Infant Mortality ; Infant, Newborn ; Logistic Models ; Male ; Social Class ; Socioeconomic Factors ; Urbanization

Research into health inequalities has established socioeconomic circumstances as important determinants of health.^{1–4} Different indicators of socioeconomic position (SEP) are seen to measure different aspects of social stratification and are associated with measures of health in slightly different ways.^{5–8} Education, income and occupational position are considered to be the standard markers of SEP and are widely used in health inequalities research.⁶ The role of education is often seen to be less important than markers of adult SEP.^{7,9,10} As most of the evidence on health inequalities comes from the developed world,^{1–5,7,8,11} there is little systematic evidence on the role played by education in developing countries. Recent work on Korean data suggests that education is a strong predictor of mortality,^{12,13} probably due to its stronger link with occupational position and material well being in Korea compared to western countries.¹⁴ This 'antecedent' role of education,^{15,16} linking it to future life chances is likely to be particularly manifest in developing countries.

The purpose of the present analysis is to examine the association between adult education and child mortality in India. Article 45 of the Indian Constitution ensures "provision for free and compulsory education" till the age of 14 years but it is widely reported that many adults in India have received no education.¹⁷ Higher level of adult education has been shown to be associated with lower child mortality in India,^{17–20} and other developing countries.^{21–23} However, it is unclear whether education remains associated with child mortality in India after taking into consideration the influence of other markers of socioeconomic disadvantage, here assessed via household wealth and urbanization. Caste is a traditional measure of social position in India and differs from other indicators in that it is both endogenous and

hereditary.²⁴ ²⁵ Caste continues to be linked to socioeconomic disadvantage despite the affirmative action program in India that reserves government jobs and seats in educational institutes for the disadvantaged castes.²⁶ Thus, there are the expected associations between caste and poor health in India.²⁵ ²⁷ Material factors, measured here as household wealth, have been shown to be important for child health in India and other developing countries.²⁸ ²⁸–³⁰ Finally, the concentration on poverty³¹ and the lack of access to healthcare in rural areas ³² makes urbanization an important variable to consider when examining the benefits of education to child health. Our aim in this paper is to examine first the association between adult education and child mortality in analysis adjusted for other socioeconomic markers and then to explore whether these markers act as effect modifiers of the association between adult education and child mortality.

Methods

Data are drawn from the nationally representative cross-sectional 1998–1999 Indian National Family Health Survey (NFHS).³³ The data were obtained by face-to-face interviews with the head of the household, conducted in one of the 18 Indian languages, in the respondent's own home. Information was obtained on a range of health, demographic, and socioeconomic measures for each member of the household. Data on all measures for all the members of the household, deceased or alive, came from interviews with head of the household. This method of data collection is economical and has been shown to be accurate when compared to self-reported data in India.³⁴ The survey response rate ranged from 89% to almost 100%, with 24 of the 26 states having a rate of more than 94%.³³ The 1991 census list of wards served as the sampling frame. The census wards were stratified according to geographic region, size, % of males working in the non-agricultural sector, % belonging to the disadvantaged castes, and female literacy. A subset of these variables, depending on the state under consideration, was used to list wards. Subsequently, wards were selected with probability proportional to size based on the 1991 Census. These wards formed the primary sampling unit (PSU) which were villages or groups of villages in rural areas, and wards or municipal localities in urban areas (N=3211). The households to be interviewed were then selected with equal probability from the household list in each PSU using systematic sampling, for further details see <http://www.nfhsindia.org/>.

Mortality

The respondent to the household survey was asked about the number of living resident members of the household and the number who had died in the 2 years preceding the survey (1997–1998). For each deceased household member, information was obtained on gender and age at death. Child mortality was considered to be death by the age of 5 for the analysis reported in this paper. Thus, mortality was an outcome even though it was estimated from a cross-sectional survey. Such indirect methods of mortality assessment have been used in demographic studies, and their suitability is widely accepted.³⁵

Measures of SEP

Education was measured as years of schooling and was available for the head of household (male in 90% of cases) as well as the spouse (female in 90% of cases). The years of schooling were categorized into three groups: no schooling (0 years of schooling), primary and lower secondary (1–8 years) and higher secondary (9 years or more) education. Thus, the top category (9 years or more) reflects education till the age of 14.

Caste was based on the head of household's self-identification as belonging to a scheduled caste, scheduled tribe, other backward class, other caste, or no caste group.²⁷ At the bottom of the hierarchy are the low-status castes (scheduled castes) and indigenous groups (scheduled tribes). Scheduled castes are the lowest castes in the traditional Hindu caste hierarchy (e.g., "untouchables" or Dalits), and as a consequence experience intense social and economic segregation and disadvantage. Occupationally, most scheduled castes are landless agricultural laborers or are engaged in what were traditionally considered to be ritually polluting occupations like cleaning toilets, removing dead animals, working with leather, and cremating the dead. Scheduled tribes consist of approximately 700 tribes that tend to be geographically isolated and have limited economic and social interaction with the rest of the population. They are ethnically distinct and live in physical isolation from other caste groups. "Other backward class" comprises a diverse collection of "intermediate" castes that are considered low in the traditional caste hierarchy but clearly above scheduled castes and tribes. "Other caste" is the default residual group (i.e., persons who do not belong to a scheduled caste, scheduled tribe, or other backward class) that enjoys higher status in the caste hierarchy. Groups for whom caste was not likely to be applicable (e.g., Muslims, Christians, or Buddhists) and participants who did not report any caste affiliation in the survey were classified under "no caste".

Household wealth was measured by household assets and material possessions. These included consumer durables (clock/watch, ceiling fan, bicycle, radio, television, sewing machine, refrigerator, motorcycle/car), characteristics of the dwelling (toilet facilities, source of drinking water, electricity, number of rooms, separate kitchen, cooking fuel used) and landownership. Asset ownership indices have been used in many previous studies as a reliable and valid proxy measure for wealth and standard of living.³⁶ The NFHS standard-of-living index was adapted using "proportionate possession weighting"³⁷ to yield a weighted standard-of-living index. The weights for each item were derived on the basis of the proportion of households owning the particular item. Thus, for example, if 40 of 100 households in the sample owned a radio, then a radio would get a weight of 60 (100–40). Weights for each item were summed into a linear index and households were allocated a final household wealth score. These were then converted into quintiles for the analysis.

Urbanization was characterized by the number of residents and the urban or rural nature of the neighborhood. Households were classified as being located in a large city (population ≥ 1 million), small city (population 100 000 to 1 million), town (population ≤ 100 000), or village and rural area.

Covariates

Besides age and sex of the children, we also used information on the state in which they lived. State refers to the administrative groupings within India. Data used in the analyses come from all the 26 states (Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Delhi, Goa, Gujarat, Haryana, Himachal Pradesh, Jammu and Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Orissa, Punjab, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal) that existed in 1998–1999.

Statistical analysis

A two-level multilevel logistic regression model,³⁸ with individuals at level-1 and the local area, here the PSU, at level-2, was used throughout to account for clustering at the level of the PSU. The effect for clustering was tested using the likelihood ratio test. The null hypothesis was that the random intercept variance is equal to zero and the alternative hypothesis was that it is 'greater' than zero; the resulting p-value was then halved.³⁸

We examined the association between the five measures of SEP and child mortality in analysis first adjusted for age and sex (Model I) and then also adjusted for state (Model II). State is treated as a separate covariate as there are substantial socioeconomic and mortality differences between the states and we wanted to remove this confounding influence on the association between SEP and child mortality. Given the fact that the sex ratio is unfavorable for females in India,³⁹ we tested gender differences in the association between measures of SEP and child mortality by fitting an interaction term between each SEP and sex using the likelihood-ratio test. A lack of observed gender differences allowed us to combine male and female children for further analysis.

Subsequent analyses were pursued only for the two measures of education: education of head of household and education of spouse. The purpose of these analyses was twofold: to examine whether the age, sex and state adjusted association (Model A) between adult education and child mortality survives adjustment (Model B) for caste, household wealth and urbanization, separately and then all together; and then to examine whether caste, household wealth and urbanization act as effect modifiers of the association between adult education and child mortality. Effect modification was tested by fitting an interaction term, on a multiplicative scale, between the measure of education and first caste, then household wealth and finally urbanization. The models were fitted using the NLMIXED procedure of the SAS software by maximizing an approximation to the likelihood integrated over the random effects.⁴⁰ The method for approximating the integral was adaptive Gauss-Hermite quadrature. A dual quasi-Newton algorithm was used to carry out the maximization.

Results

Overall, there were no differences between male and female children (data not shown but available from authors), leading us to combine them in the analyses. Data on 9044 children (Table 1) were excluded due to missing values on the measures of education. Child mortality in the excluded group (3.5%) was not significantly different ($p=0.98$) from those included in the analysis (3.5%). Data on both measures of adult education were missing for 7172 children; the mortality in this group was 3.6%. Only a third of the children overall were under 1 year of age but they made up a large proportion of the dead; both in the missing data (73.2%) and those included in further analysis (73.4%). Overall, 66367 children were included in the analysis presented in this paper; details are presented in Table 1 . For 26.3% of children the head of household had 9 or more years of education, the corresponding figure for the spouses' education was 11.1%; 65.3% of spouses had no schooling whatsoever. Over 60% of children were from the backward classes (scheduled caste, scheduled tribe and other backward caste) a third (33.3%) were from the upper classes, represented in the table by "other caste". Nearly three quarters of all children (74.4%) lived in villages.

Table 2 shows the association between adult education and the three other measures of SEP. The median years of education for the head of household shows it to be closely linked to caste, household wealth and the measure of urbanization. For the spouse the association was clearly graded for the measure of urbanization but only evident for household wealth in the top quintile. The median years of education of the spouse was zero in all caste groups. The 66367 children included in the analysis came from 38833 households, with every household contributing a mean of 1.7 children. The deaths among the children occurred in 2144 households, 92.8% of these households reported only one death. The variance estimates for the PSU suggested there was clustering of deaths at the PSU level (p value for all models was less than 0.001).

The association between all the measures of SEP used in this study and child mortality is presented in Table 3 . The interaction term for sex was always greater than $p=0.05$, indicating there was no strong evidence that the association between measures of SEP and child mortality differed as a function of the sex of the child. Model 1 was adjusted for the effect of age and sex and took account the clustering at the PSU level; model 2 was further adjusted for the confounding effects of state. In fully adjusted models (Model 2), 9 years or more of

education for the head of household had a protective association with child mortality (OR = 0.54; 95% confidence interval (CI) = 0.48–0.62), the same was true for spouse's education (OR = 0.44; 95% CI = 0.36–0.54). The reference category for analysis using caste as a measure of SEP was the "scheduled caste" group. The "other backward caste" (OR = 0.85; 95% CI = 0.75–0.97) and the "other caste" group (OR = 0.70; 95% CI = 0.61–0.80) had lower child mortality compared to the scheduled caste group. The association between household wealth and child mortality was finely graded with the lowest mortality in the wealthiest group (OR = 0.27; 95% CI = 0.22–0.32). Finally, urbanization was also associated with child mortality. Compared to children who lived in villages, mortality was lower among town (OR = 0.64; 95% CI = 0.54–0.75), small city (OR = 0.49; 95% CI = 0.37–0.64) and large city dwellers (OR = 0.56; 95% CI = 0.44–0.72).

Table 4 presents results of further analysis on education of the head of household and child mortality. Model A accounted for clustering at the PSU and was adjusted for age, sex, and state (Model 2 in Table 3). Subsequently, this model was adjusted for caste, household wealth and urbanization, individually and then all together (Model B) in order to remove the mediating or the confounding effect of these measures of SEP. The interaction term was used to assess effect modification by caste, household wealth or urbanization on the association between education of head of household and child mortality. Nine years or more of education for the head of household was associated with lower child mortality in analysis adjusted for all covariates and caste (OR = 0.58; 95% CI = 0.51–0.66). The interaction term ($p=0.15$) provided no strong evidence that the association between education for head of household and child mortality was different in the five caste groups examined. Similar results were obtained in analyses adjusted for household wealth (OR = 0.80; 95% CI = 0.69–0.91) or urbanization (OR = 0.58; 95% CI = 0.51–0.66). The interaction term for household wealth ($p=0.54$) or urbanization ($p=0.54$) did not suggest these measures modified the association between head of household and child mortality. In analyses adjusted for covariates in Model A plus caste, household wealth and urbanization, nine years or more of education for the head of household was associated with 19% lower child mortality (OR=0.81; 95% CI = 0.70–0.93).

Table 5 repeats the analysis reported in Table 4 using the measure of education for the spouse. Nine years or more of education had a protective effect on child mortality in analyses adjusted for caste (OR = 0.47; 95% CI = 0.38–0.58), for household wealth (OR = 0.74; 95% CI = 0.59–0.92) or for urbanization (OR = 0.51; 95% CI = 0.41–0.63). The results for spousal education differ from that of head of household in that even 1–8 years of education had a protective association with child mortality in analyses adjusted for caste (OR = 0.73; 95% CI = 0.65–0.83), household wealth (OR = 0.87; 95% CI = 0.77–0.99) or urbanization (OR = 0.74; 95% CI = 0.65–0.83). The association between spouse's education and child mortality was similar in different caste ($p=0.54$), household wealth ($p=0.34$) and urbanization ($p=0.54$). Nine years or more of education for the spouse was associated with 25% (OR=0.75; 95% CI = 0.60–0.94) lower child mortality when adjustments were made simultaneously for caste, household wealth and urbanization.

A composite measure of education, constructed using the average of the two measures, shows 9 or more years of education to be associated with lower child mortality in analysis adjusted for age, sex and state (OR=0.42; 95% CI=0.35–0.51) and also when adjustments were made for other measures of SEP (OR=0.77; 95% CI =0.63–0.94).

Discussion

The purpose of the present analyses was twofold. First, to examine whether there remains an association between adult education and child mortality after adjustments for other sources of socioeconomic disadvantage in India. Our results show that for both measures of adult education used in the study; that of head of the household and the spouse, nine or more years of education was associated with lower child mortality. These effects were not completely attenuated when adjustments were made simultaneously for the influence of caste, household wealth and urbanization; leading us to conclude that adult education may continue have an association with child mortality after removing the mediating or confounding influence of other markers of SEP. A note of caution to say that it is not possible to infer an independent effect of one factor simply because a residual association remains after adjustment for potential confounders, since measurement error in strongly correlated confounders will almost guarantee such a residual effect.⁴¹ It is also likely that education influences household wealth and location of residence (urbanization), in that they are on the causal pathway between education and health outcomes, in which case adjustment for them constitutes over-adjustment.

Second, we examined whether there was any effect modification of the association between adult education and child mortality by markers of socioeconomic disadvantage, here caste, household wealth and urbanization. The goal of this analysis was to allow conclusions to be drawn about public policies on education. If education was to be beneficial, here examined in terms of health outcomes like child mortality, only for the already advantaged then it cannot be used to improve population health. For instance, the existence of an interaction between education and caste could suggest that adult education did not have an equally protective effect on child mortality in all the caste groups. This is certainly plausible. Indian society is highly stratified by caste and although caste does not rigidly determine one's occupation in contemporary India, it is highly correlated with socioeconomic disadvantage.²⁶ Lower caste groups have been shown to have poorer health²⁵ and higher mortality.²⁷ Our results for the interaction term suggest that the association between adult education and child mortality was similar in different caste groups. We checked this further by examining this association in analysis stratified by caste.

These results (not shown but available from authors) support those obtained using the interaction term, higher education was indeed associated similarly with lower child mortality within all caste groups. The implication for India, and perhaps for groups that have traditionally faced socioeconomic disadvantage elsewhere, is that education matters for health outcomes.

In examining the role of adult education, we chose to study it in the context of three different measures of SEP - caste, household wealth and urbanization. There are important differences between these measures. Caste is a measure of social stratification which is generally unchanging throughout the lifecourse. Household wealth is important to consider as there have been results showing material factors explain away the association between education and child mortality.^{28–30} Finally, urbanization is an important measure, this large an effect is likely to be unique to developing or poor countries. However, these variables are not interchangeable and show the complex sources of socioeconomic disadvantage in India. Any public health message on the benefits of education needs to consider some of these other markers of SEP. In our data household wealth appears to be the strongest explanatory factor, even though none of the three measures considered individually or simultaneously completely attenuated the association between education and mortality. It is also important to note that we did not observe any effect modification of the association between adult education and child mortality in these data. Thus, the education level of adults in the household is equally beneficial for child mortality outcomes in different caste and wealth groups, and in urban and rural neighborhoods.

It is widely accepted that among adults, education influences health through material, psychosocial and behavioral pathways.^{30,42} Research on child mortality suggests parental education is associated with better child care, better health care utilization and higher value being placed on children;⁴³ with greater autonomy⁴⁴ and discipline¹⁷ also seen to be important mechanisms through which maternal education influences child health. Our objective in this paper was not to separate out the effects of maternal and paternal education; these data do not really lend themselves to that exercise. The data were collected in interviews with the head of the household and the precise biological link with the child is not known. The head of household was male in 90% of the cases. For 91.6% of the children where the head of household had no education (N=24237), the spouse also did not have any education. However, only 51.2% of the heads of household did not have an education when the spouses did not have an education (N=43328). This implies that nearly half the reference group in the analysis on education of the spouse, the group with no education (N=43328), was made up of children where the head of household had some education. Despite this 'contamination' of the reference category, education of the spouse was associated with lower child mortality. This suggests that female education has a stronger association with child mortality outcomes, with even 1 to 8 years of education showing some protective effect.

There are obvious caveats to conclusions drawn in the paper. The child mortality rates in our sample are lower than the national statistics for India published by UNICEF (http://www.unicef.org/infobycountry/india_statistics.html) The UNICEF figures for the probability of dying between birth and five years of age expressed per 1,000 live births for 2003 in India was 87. Our figures are roughly 35 per 1000, suggesting that the most disadvantage groups are not fully represented in our sample. It is also possible that the mortality reported in this survey was influenced by recall bias. The recall of the age of the child that had died might not be accurate. It is for this reason that we did not separate out infant and child mortality in our analyses, assuming that the recall bias is not large enough to influence the results for mortality between the ages of 0 and 5 to a meaningful degree. We were not able to examine cause specific mortality and it is possible that education has a stronger link with some causes of death compared to others. Thus, generalizations cannot be made for all causes of child mortality. Furthermore, the two year time frame for mortality does not allow us to capture the year to year instability in mortality, likely to be prevalent in developing countries. Nevertheless, it is highly unlikely that the general pattern of results between adult education and child mortality varies from one year to the next. Finally, the analytical strategy chosen in this study does not allow causal inferences to be made either about the role of education or about the pathways through which education influences health.⁴⁵ Nevertheless, recent careful analysis of US data shows that education does have a "causal" impact on mortality among adults and the effect might be larger than previously estimated.⁴⁶

A necessary prerequisite to reducing health inequalities is being able to ascertain the relative importance of different factors that underlie these inequalities. There appears to be a general consensus regarding the importance of education to both economic development and health leading the United Nations to declare the years 2005–2014 to be the "Decade for Education for Sustainable Development" (http://portal.unesco.org/education/en/ev.php-URL_ID=23279&URL_DO=DO_TOPIC&URL_SECTION=201.html). India, like many other developing countries, is ridden with multiple inequalities and it is often difficult to identify one factor that could substantially improve survival chances among children. We show that education has an association with child mortality outcomes even after some of the complex sources of social advantage and disadvantage are taken into account. Education is different from other markers of SEP as it is in a realm of public policy, with governments setting targets for the population. Nine years of education is a modest goal and coincidentally this is what Article 45 of the Indian Constitution guaranteed for all in India over 50 years ago.

Acknowledgements:

Financial support

AS-M is supported by a "Chaire d'excellence" award from the French Ministry of Research and a "European Young Investigator Award" from the European Science Foundation. SVS is supported by the National Institutes of Health Career Development Award (NHLBI 1 K25HL081275).

References:

1. Fox AJ. Health inequalities in European countries. Aldershot Gower Publishing Company Limited; 1989;
2. Townsend P, Davidson N, Whitehead M. Inequalities in Health: The Black Report and the Health Divide. London Penguin Books; 1992;
3. Lynch JW, Kaplan GA, Shema SJ. Cumulative impact of sustained economic hardship physical, cognitive, psychological, and social functioning. *N Engl J Med*. 1997; 337: (26) 1889 - 1895
4. Kitagawa EM, Hauser PM. Differential Mortality in the United States: A Study in Socioeconomic Epidemiology. Cambridge Harvard University Press; 1973;
5. Bartley M, Sacker A, Firth D, Fitzpatrick R. Understanding social variation in cardiovascular risk factors in women and men: the advantage of theoretically based measures. *Soc Sci Med*. 1999; 49: (6) 831 - 845
6. Galobardes B, Shaw M, Lawlor DA, Lynch JW, Davey Smith G. Indicators of socioeconomic position (part 1). *J Epidemiol Community Health*. 2006; 60: (1) 7 - 12
7. Davey Smith G, Hart C, Hole D. Education and occupational social class: which is the more important indicator of mortality risk?. *J Epidemiol Community Health*. 1998; 2: (3) 153 - 60
8. Geyer S, Hemstrom O, Peter R, Vagero D. Education, income, and occupational class cannot be used interchangeably in social epidemiology. Empirical evidence against a common practice. *J Epidemiol Community Health*. 2006; 60: (9) 804 - 810
9. Agardh E, Ahlbom A, Andersson T. Socio-economic position at three points in life in association with type 2 diabetes and impaired glucose tolerance in middle-aged Swedish men and women. *Int J Epidemiol*. 2007; 36: (1) 84 - 92
10. Daly MC, Duncan GJ, McDonough P, Williams DR. Optimal indicators of socioeconomic status for health research. *Am J Public Health*. 2002; 92: (7) 1151 - 1157
11. Beebe-Dimmer J, Lynch JW, Turrell G, Lustgarten S, Raghunathan, Kaplan GA. Childhood and adult socioeconomic conditions and 31-year mortality risk in women. *Am J Epidemiol*. 2004; 159: (5) 481 - 490
12. Khang YH, Lynch JW, Kaplan GA. Health inequalities in Korea: age- and sex-specific educational differences in the 10 leading causes of death. *Int J Epidemiol*. 2004; 33: (2) 299 - 308
13. Khang YH, Kim HR. Explaining socioeconomic inequality in mortality among South Koreans: an examination of multiple pathways in a nationally representative longitudinal study. *Int J Epidemiol*. 2005; 34: (3) 630 - 637
14. Son M. Commentary: why the educational effect is so strong in differentials of mortality in Korea?. *Int J Epidemiol*. 2004; 33: (2) 308 - 310
15. Singh-Manoux A, Clarke P, Marmot M. Multiple measures of socio-economic position and psychosocial health: proximal and distal measures. *Int J Epidemiol*. 2002; 31: (6) 1192 - 1199
16. Singh-Manoux A. Commentary: Modelling multiple pathways to explain social inequalities in health and mortality. *Int J Epidemiol*. 2005; 34: (3) 638 - 639
17. Basu AM, Stephenson R. Low levels of maternal education and the proximate determinants of childhood mortality: a little learning is not a dangerous thing. *Soc Sci Med*. 2005; 60: (9) 2011 - 2023
18. Bang AT, Bang RA, Baitule SB, Reddy M, Deshmukh MD. Effect of home-based neonatal care and management of sepsis on neonatal mortality: field trial in rural India. *Lancet*. 1999; 354: (9194) 1955 - 1961
19. Kravdal O. Child mortality in India: the community-level effect of education. *Popul Stud (Camb)*. 2004; 58: (2) 177 - 192
20. Das Gupta M. Death clustering, mother's education and the determinants of child mortality in rural Punjab, India. *Popul Stud (Camb)*. 1990; 44: 489 - 505
21. Caldwell J, McDonald P. Influence of maternal education on infant and child mortality: levels and causes. *Health Policy Educ*. 1982; 2: (3-4) 251 - 267
22. Majumder AK, May M, Pant PD. Infant and child mortality determinants in Bangladesh: are they changing?. *J Biosoc Sci*. 1997; 29: (4) 385 - 399
23. Mosley WH, Chen LC. An analytical framework for the study of child survival in developing countries. 1984. *Bull World Health Organ*. 2003; 81: (2) 140 - 145
24. Dumont L. *Homo Hierarchicus: The Caste System and Its Implications*. London, England Weidenfeld & Nicholson; 1970;
25. Mohindra KS, Haddad S, Narayana D. Women's health in a rural community in Kerala, India: do caste and socioeconomic position matter?. *J Epidemiol Community Health*. 2006; 60: (12) 1020 - 1026
26. Deshpande A. Caste at Birth? Redefining disparity in India. *Review of Development Economics*. 2001; 5: 130 - 144
27. Subramanian SV, Nandy S, Irving M, Gordon D, Lambert H, Davey Smith G. The mortality divide in India: the differential contributions of gender, caste, and standard of living across the life course. *Am J Public Health*. 2006; 96: (5) 818 - 825
28. Desai S, Alva S. Maternal education and child health: is there a strong causal relationship?. *Demography*. 1998; 35: (1) 71 - 81
29. Frenzen PD, Hogan DP. The impact of class, education, and health care on infant mortality in a developing society: the case of rural Thailand. *Demography*. 1982; 19: (3) 391 - 408
30. van Oort FV, van Lenthe FJ, Mackenbach JP. Material, psychosocial, and behavioural factors in the explanation of educational inequalities in mortality in The Netherlands. *J Epidemiol Community Health*. 2005; 59: (3) 214 - 220
31. Ghosh M. Agrarian structure and rural poverty in India. *Journal of Contemporary Asia*. 1998; 28: 175 - 184
32. Borah BJ. A mixed logit model of health care provider choice: analysis of NSS data for rural India. *Health Econ*. 2006; 15: (9) 915 - 932
33. International Institute of Population Sciences. National Family Health Survey 1998-99. 2000; Mumbai, India International Institute of Population Sciences; Ref Type: Report
34. Mohan D, Neufeld K, Chopra A, Sethi H. Agreement between head of household informant and self-report in a community survey of substance use in India. *Drug Alcohol Depend*. 2003; 69: (1) 87 - 94
35. Hill K. Approaches to the measurement of childhood mortality: a comparative review. *Popul Index*. 1991; 57: (3) 368 - 382
36. Filmer D, Pritchett LH. Estimating wealth effects without expenditure data--or tears: an application to educational enrollments in states of India. *Demography*. 2001; 38: (1) 115 - 132
37. Gordon D, Pantazis C. *Breadline Britain in the 1990s*. Aldershot; United Kingdom Ashgate Publishing; 1997;
38. Snijders TAB, Bosker RJ. *Multilevel analysis. An introduction to basic and advanced multilevel modeling*. London Sage Publications Ltd; 1999;
39. Sharma DC. Widespread concern over India's missing girls. Selective abortion and female infanticide cause girl-to-boy ratios to plummet. *Lancet*. 2003; 362: (9395) 1553 -
40. SAS. SAS OnlineDoc®. Version 8. 2007; Ref Type: Internet Communication
41. Phillips AN, Davey Smith G. How independent are "independent" effects Relative risk estimation when correlated exposures are measured imprecisely. *J Clin Epidemiol*. 1991; 44: (11) 1223 - 1231
42. Ross CE, Wu C-L. The links between education and health. *American Sociological Review*. 1995; 60: 719 - 745
43. Caldwell JC. Education as a factor in mortality decline. An examination of Nigerian data. *Population Studies*. 1979; 33: 395 - 413
44. Bourne KL, Walker GM. The differential effect of mothers' education on mortality of boys and girls in India. *Population Studies*. 1991; 45: 203 - 219
45. Kaufman JS, Maclehorse RF, Kaufman S. A further critique of the analytic strategy of adjusting for covariates to identify biologic mediation. *Epidemiol Perspect Innov*. 2004; (1) 4 -
46. Lleras-Muney A. The relationship between education and adult mortality in the United States. *Review of Economic Studies*. 2005; 72: 189 - 221

Table 1

Characteristics of the study population in relation to indicators of socioeconomic position.

	Included in the analysis (N=66367)		Missing data (N=9044)	
	N (%)	dead %	N	dead %
Education: head of household				
no schooling	24237 (36.5)	4.3	844 (9.3)	3.8
1–8 years	24674 (37.2)	3.7	472 (5.2)	2.5
9 years or more	17456 (26.3)	2.1	254 (2.8)	2.8
Missing data			7474 (82.6)	3.5
Education: spouse				
no schooling	43328 (65.3)	4.2	204 (2.3)	2.0
1–8 years	15697 (23.7)	2.6	74 (0.8)	2.7
9 years or more	7342 (11.1)	1.5	24 (0.3)	0
Missing data			742 (96.7)	3.5
Caste				
Scheduled caste	12048 (18.2)	4.0	1512 (16.7)	4.0
Scheduled tribe	9830 (14.8)	4.7	1120 (12.4)	4.9
Other backward caste	18836 (28.4)	3.5	2470 (27.3)	3.6
No caste	3539 (5.3)	3.7	540 (6.0)	2.2
Other caste	22114 (33.3)	2.7	3402 (37.6)	2.9
Household wealth				
Poorest quintile	14391 (21.7)	5.2	1723 (20.8)	5.1
Second quintile	13692 (20.6)	4.5	1607 (20.8)	4.8
Third quintile	12300 (18.5)	3.6	1657 (20.6)	3.3
Fourth quintile	13134 (19.8)	2.5	1936 (21.2)	3.2
Top quintile	12850 (19.4)	1.4	2121 (16.7)	5.1
Urbanization				
Village	49385 (74.4)	4.0	6557 (72.5)	3.6
Town	7783 (11.7)	2.4	1030 (11.4)	3.5
Small city	3427 (5.2)	1.9	545 (6.0)	2.4
Large city	5772 (8.7)	1.5	912 (10.1)	3.2

Table 2Adult education and caste, household wealth and urbanization[†]

	Years of education of head of household	Years of education of spouse
	Median (Mean)	Median (Mean)
Caste		
Scheduled caste	2.5 (3.8)	0 (1.4)
Scheduled tribe	3.0 (4.0)	0 (2.1)
Other backward caste	4.0 (4.7)	0 (2.1)
No caste	4.0 (4.2)	0 (2.4)
Other caste	6.0 (6.2)	0 (3.4)
Household wealth		
Poorest quintile	0 (2.2)	0 (0.5)
Second quintile	2.0 (3.4)	0 (1.0)
Third quintile	4.0 (4.5)	0 (1.9)
Fourth quintile	6.0 (5.8)	0 (2.9)
Top quintile	10.0 (9.1)	6 (6.1)
Urbanization		
Village	3.0 (4.1)	0 (1.6)
Town	7.0 (6.8)	2.0 (4.2)
Small city	8.0 (7.2)	4.0 (4.5)
Large city	9.0 (8.1)	5.0 (5.7)

[†] Analysis on complete cases, N = 66367.

Table 3

Associations between measures of socioeconomic position and child mortality (0–5 years).

	Deaths (%)	Model 1 adjusted for age, sex, [†] OR (95% CI)	Model 2 + adjusted for state [†] OR (95% CI)
Education: head of household			
no schooling	4.3	1	1
1–8 years	3.7	0.86 (0.78–0.94)	0.92 (0.84–1.02)
9 years or more	2.0	0.48 (0.43–0.55)	0.54 (0.48–0.62)
Education: spouse			
no schooling	4.1	1	1
1–8 years	2.6	0.62 (0.55–0.70)	0.70 (0.62–0.79)
9 years or more	1.5	0.36 (0.29–0.44)	0.44 (0.36–0.54)
Caste			
Scheduled caste	4.0	1	1
Scheduled tribe	4.7	1.21 (1.04–1.39)	1.15 (0.98–1.35)
Other backward caste	3.5	0.85 (0.75–0.97)	0.85 (0.75–0.97)
No caste	3.6	0.93 (0.75–1.16)	1.14 (0.91–1.43)
Other caste	2.6	0.65 (0.57–0.74)	0.70 (0.61–0.80)
Household wealth			
Bottom quintile	5.1	1	1
Second quintile	4.3	0.82 (0.73–0.92)	0.81 (0.72–0.91)
Third quintile	3.2	0.65 (0.57–0.74)	0.66 (0.58–0.75)
Fourth quintile	2.2	0.44 (0.38–0.50)	0.46 (0.40–0.54)
Top quintile	1.2	0.24 (0.21–0.29)	0.27 (0.22–0.32)
Urbanization			
Village	4.0	1	1
Town	2.4	0.58 (0.49–0.69)	0.64 (0.54–0.75)
Small city	1.9	0.46 (0.35–0.60)	0.49 (0.37–0.64)
Large city	1.5	0.38 (0.30–0.48)	0.56 (0.44–0.72)

[†] A random intercept was specified at the PSU (primary sampling unit) level in each model.

Table 4

Associations between education of head of household and child mortality in relation to other measures of socioeconomic position.

Education: head of household	Model A OR (95% CI)	Model B OR (95% CI)
	adjusted for age, sex, state [†]	+ adjusted for caste [†]
no schooling	1	1
1–8 years	0.92 (0.84 – 1.02)	0.95 (0.86 – 1.05)
9 years or more	0.54 (0.48 – 0.62)	0.58 (0.51 – 0.66)
Caste * education interaction		p = 0.15
	adjusted for age, sex, state [†]	+ adjusted for household wealth [†]
no schooling	1	1
1–8 years	0.92 (0.84 – 1.02)	1.05 (0.95 – 1.16)
9 years or more	0.54 (0.48 – 0.62)	0.80 (0.69 – 0.91)
Household wealth * education interaction		p = 0.54
	adjusted for age, sex, state [†]	+ adjusted for urbanization [†]
no schooling	1	1
1–8 years	0.92 (0.84 – 1.02)	0.95 (0.86 – 1.05)
9 years or more	0.54 (0.48 – 0.62)	0.58 (0.51 – 0.66)
Urbanization * education interaction		p = 0.54
	adjusted for age, sex, state [†]	+ adjusted for caste, household wealth & urbanization [†]
no schooling	1	1
1–8 years	0.92 (0.84 – 1.02)	1.06 (0.96 – 1.17)
9 years or more	0.54 (0.48 – 0.62)	0.81 (0.70 – 0.93)

[†] A random intercept was specified at the PSU (primary sampling unit) level in each model

Table 5Associations between education of spouse and child mortality in relation to other measures of socioeconomic position.[†]

Education: spouse	Model A OR (95% CI)	Model B OR (95% CI)
	adjusted for age, sex, state [†]	+ adjusted for caste [†]
no schooling	1	1
1–8 years	0.70 (0.62 – 0.79)	0.73 (0.65 – 0.83)
9 years or more	0.44 (0.36 – 0.54)	0.47 (0.38 – 0.58)
Caste * education interaction		p = 0.54
	adjusted for age, sex, state [†]	+ adjusted for household wealth [†]
no schooling	1	1
1–8 years	0.70 (0.62 – 0.79)	0.87 (0.77 – 0.99)
9 years or more	0.44 (0.36 – 0.54)	0.74 (0.59 – 0.92)
Household wealth * education interaction		p = 0.34
	adjusted for age, sex, state [†]	+ adjusted for urbanization [†]
no schooling	1	1
1–8 years	0.70 (0.62 – 0.79)	0.74 (0.65 – 0.83)
9 years or more	0.44 (0.36 – 0.54)	0.51 (0.41 – 0.63)
Urbanization * education interaction		p = 0.54
	adjusted for age, sex, state [†]	+ adjusted for caste, household wealth & urbanization [†]
no schooling	1	1
1–8 years	0.70 (0.62 – 0.79)	0.89 (0.79 – 1.01)
9 years or more	0.44 (0.36 – 0.54)	0.75 (0.60 – 0.94)

[†] A random intercept was specified at the PSU (primary sampling unit) level in each model.