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# Increasing socioeconomic inequality in childhood undernutrition in urban India: trends between 1992–93, 1998–99 and 2005–06

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This article examines the trends and pattern in socioeconomic inequality in stunting, underweight and wasting among children aged <3 years in urban India over a 14-year period. We use three successive rounds of the National Family Health Survey data conducted during 1992–93, 1998–99 and 2005–06. The selected socioeconomic predictors are household wealth and mother's education level. We use principal component analysis to compute a separate wealth index for urban India for all three rounds of the survey. We have used descriptive statistics, concentration index and pooled logistic regression to analyse the data. The results show that between 1992–93 and 2005–06, the prevalence of childhood undernutrition has declined across household wealth quintiles and educational level of mothers. However, the pace of decline is much higher among the better-off socioeconomic groups than among the least-affluent groups. The result of pooled logistic regression analysis shows that the socioeconomic inequality in childhood undernutrition in urban India has increased over the study period. The salient findings of this study call for separate programmes targeting the children of lower socioeconomic groups in urban population of India.

**Keywords** Concentration index, pooled logistic regression, socioeconomic inequality, undernutrition, urban India

## KEY MESSAGES

- The prevalence of undernutrition among children aged <3 years has declined over the period in urban India, but the current level is still high.
- The decline in the prevalence of childhood undernutrition was higher among the richest wealth quintile compared with the poorest wealth quintile and among the most educated mothers compared with uneducated mothers.
- Socioeconomic inequality in childhood undernutrition has increased in urban India over the last two decades.
- Urban India needs dedicated policies to tackle the higher burden of childhood undernutrition among poor socioeconomic groups.

## Introduction

The 'urban advantage' over rural areas in utilization of maternal and child healthcare (MCH) services, maternal mortality and childhood mortality in developing countries is well-documented, and childhood nutritional status is no exception to this. Several studies have clearly demonstrated that urban children are better nourished and less likely to be stunted and underweight than their rural counterparts (Von Braun *et al.* 1993; Ruel *et al.* 1998; Menon *et al.* 2000; Ruel 2000; Sahn and Stifel 2003; Smith *et al.* 2005; Fotso 2006). This advantage is mainly attributed to a well-equipped urban healthcare system with better geographical accessibility—which facilitates public health interventions, such as campaigns to control epidemic diseases, vaccination and maternal and child health programmes—compared with rural areas (Fotso *et al.* 2007). Apart from an improved healthcare system, urban areas also offer greater availability of food, better housing, electricity, water, sanitation and transportation facilities compared with rural areas (Garrett and Ruel 1999). In addition, urban and rural population differ in terms of education, economic status, employment opportunities and other socio-cultural aspects that have important bearing on child health (Defo 1996; Lalou and Legrand 1997; Sastry 1997).

Meanwhile, there is a growing argument that the 'urban health advantage' is diminishing in developing countries with their rapidly changing urban population (Harpham 2009). At the beginning of the 21st century, total urban population of the world surpassed rural population—about 52% (3.6 billion) of the world population now lives in urban areas (United Nations 2012). This growth is mostly concentrated among developing countries. The explosive growth in urban population of developing countries is largely due to poverty led massive rural to urban migration and natural increase. Accompanying this phenomenon is increasing urban poverty. As a result, global poverty has become an urban phenomenon in recent years. The absolute number of urban poor has increased in the last 15–20 years at a rate faster than in rural areas (Ravallion 2007).

In developing countries, a considerable proportion of urban population has unmet needs of housing, education, health and employment. Due to lack of investment in public utilities, most of the urban dwellers have inadequate provision of water, sanitation, drainage, garbage collection, health and education services (Mitlin 2000). A significant majority of the urban poor resides in informal settlements and slums which are usually overcrowded, devoid of basic amenities and surrounded by hazardous environment (Harpham 2009; Matthews *et al.* 2010). In conclusion, the social and health services and livelihood opportunities in urban centres have not kept pace with their rapidly growing population in many of the developing countries (Fotso *et al.* 2007; Montgomery 2009). Unhealthy living conditions together with poverty have worsened the health susceptibility of marginalized urban sub-groups more than the rest of the urban dwellers in the developing countries (Madhiwalla 2007; UN-HABITAT 2011).

Recent studies have noted large socioeconomic disparities in child health and the utilization of MCH services in urban population of developing countries. The gap between urban poor and non-poor in the utilization of maternal healthcare services has increased in many developing countries (Shah *et al.* 2009; Zhao *et al.* 2009; Matthews *et al.* 2010). Similarly, child and maternal mortality among slums dwellers is much higher than non-slums dwellers (African Population and Health Research Centre 2002; Bartlett 2003; IIPS and ORC Macro 2007; Ziraba *et al.* 2009). Childhood nutritional status is no exception to this. Newly assembled evidence from developing countries indicates that the locus of poverty and malnutrition is gradually shifting from rural to urban areas, as the number of urban poor and undernourished are increasing more rapidly than the rural ones (Haddad *et al.* 1999; Bitran *et al.* 2005). Using Demographic and Health Survey datasets from 10 developing countries, a study has shown that the socioeconomic gradient in childhood stunting is indeed higher in urban areas (Menon *et al.* 2000). Another study from sub-Saharan African countries has also documented similar findings (Fotso 2006). The poor childhood nutritional status among the urban poor is mainly attributed to their dismal living conditions, income constraints and price barriers which limit the advantage that poor can reap from better food supply in urban areas (Van de Poel *et al.* 2007).

Similar to other developing countries, there is evidence of an urban divide in income, living conditions and health status in India (Madhiwalla 2007; Topalova 2008). Recently, a few studies have also noted enormous and growing disparities in use of MCH services between economic groups of urban areas of the country (Gupta *et al.* 2008; Pathak and Mohanty 2010; Pathak *et al.* 2010; Kumar and Mohanty 2011a). However, little is known about such disparity in childhood undernutrition in urban India. A study provides a synoptic view of socioeconomic disparity in childhood malnutrition in urban India (Arokiasamy *et al.* 2012). Another study examines the poor/non-poor gap in childhood undernutrition in India between two points of time and concluded that the gap in childhood undernutrition was higher between urban poor and non-poor (Kumar and Mohanty 2011b). However, these studies have not evaluated the pattern of socioeconomic inequality in childhood undernutrition in urban India across time. Moreover, the conclusions drawn by Kumar and Mohanty (2011a,b), depend only on rich/poor ratio and they have not taken account of mother's education which is an important measure of inequality in child health. Empirical evidence suggests that maternal education is more important than paternal education, socioeconomic status and health services availability in explaining the differentials in child health outcomes, including childhood nutrition (Martin *et al.* 1983; Young *et al.* 1983; Frost *et al.* 2005; Abuya *et al.* 2011).

This study examines socioeconomic inequality in childhood undernutrition in urban India over the period of 1992–2006. Though the average prevalence of stunting—an indicator of childhood undernutrition—among urban children is lower than rural children—40% in urban areas compared with 51% in rural areas (IIPS and ORC Macro 2007)—this lower prevalence cannot warrant for lower socioeconomic gradient in childhood undernutrition in urban India. Due to rapid urbanization in recent decades, India, like many other developing countries, is now facing numerous problems arising due to mounting number of urban poor living in abysmal conditions (Office of Registrar General and Census Commissioner, Census of India 2011). According to the Urban Poverty in India report

[The Ministry of Housing and Urban Poverty Alleviation (HUPA), Government of India and United Nations Development Program 2009], ~26% of total urban population in India lives below the poverty line. Moreover, the ratio of urban poverty in some of the populous states is higher than that of rural poverty (NSSO 2001).

This study, therefore, aims to examine the trends and patterns of childhood undernutrition across household economic status and maternal education in urban India using all three rounds of the National Family Health Survey (NFHS) conducted during 1992–93, 1998–99 and 2005–06. We focus on childhood undernutrition because it is one of the major public health problems in India. The burden of malnourished children in India is among the highest in the world and virtually twice that of sub-Saharan African countries. Nearly, 60 million Indian children are estimated to be underweight in the country (Aadir and Guilkey 1997; Gragnolati *et al.* 2005; FOCUS 2006). In addition, childhood malnutrition is sensitive to poverty and its associated attributes, such as low income, poor education, poor living environment and housing, inadequate access to food, to safe water and to healthcare services (ACC/SCN 1997; UNICEF 1998; Gopalan 2000; Pen and Bacalloa 2002). Moreover, the Millennium Development Goal-1 exclusively calls for reduction in the proportion of underweight children under 5 years of age.

## Materials and methods

### Data

Data for this study comes from three successive rounds of the NFHS of India conducted during 1992–93, 1998–99 and 2005–06. For convenience, we refer to the period between 1992–93 and 1998–99 as 1992–99, between 1998–99 and 2005–06 as 1998–2006 and between 1992–93 and 2005–06 as 1992–2006. The NFHS is large scale household survey conducted across the states and union territories of India. The multiple rounds of the survey are conducted by the International Institute for Population Sciences (IIPS), Mumbai with a collaborative assistance from several national and international organizations. The main purpose of the survey is to provide reliable estimates of fertility, infant and childhood mortality, nutritional status of children, use of MCH services, at national level, state level and across urban and rural residence.

All three rounds of the survey adopted multi-stage sampling design—two-stage sampling design in rural areas and three-stage in urban areas. The sampling design remained similar in all three rounds of the survey which allow a comparison with the estimates of the consecutive rounds (Mishra *et al.* 2004; Ram and Roy 2004). The details of sampling design and sample size estimation are given in the reports of various rounds of the NFHS (IIPS and ORC Macro 1995, 2000, 2007). The NFHS collected data using different interview schedules—household schedule and eligible women/individual schedule. The contents of the schedule remained similar in all the three rounds of the survey. The household response rate was 96% in the first round, 98% each in the second and third rounds of the survey; the individual response rate was 96% each in the first and second rounds, while it was 94% in the third round of the survey.

### Outcome variable

We used anthropometric data on height-for-age, weight-for-age and weight-for-height *z*-scores to assess the childhood undernutrition. We focused on all three indicators since, together, they provide a complete picture of chronic and acute undernourishment among children. Moreover, there is controversy in selection of a single indicator—some studies (Nandy and Miranda, 2008) suggests height-for-age (stunting), whereas another (Deaton and Drèze, 2009) suggests weight-for-age (underweight) as a best indicator to capture overall childhood undernutrition.

To estimate all the three indicators, we adopted US National Centre for Health Statistics (US-NCHS) international reference population as recommended by the World Health Organization (WHO) (Dibley *et al.* 1987a,b). We used US-NCHS reference population due to its comparability in all three rounds. We could not use the new reference population of the WHO (WHO Multicenter Growth Reference Study Group 2006) because it was not available in the first and second round of the NFHS. According to the WHO guidelines, a child with height-for-age *z*-score less than −2 standard deviations is classified as stunted. Similarly, a child with weight-for-age *z*-score of less than −2 standard deviations is classified as underweight and a child with weight-for-height *z*-score of less than −2 standard deviations is classified as wasted. All three rounds of the NFHS provide information on anthropometric indicators with varying age group of children. For example, NFHS-1 collected information from children below 4 years of age and NFHS-2 collected information from children below 3 years of age, whereas NFHS-3 collected information from children below 5 years of age. Therefore, to make the estimates comparable, we restricted our analysis to the children <3 years of age only. Hence, the final analytical sample size (after excluding flagged and missing cases) for stunting was 5920, 6771, 8875; for underweight was 7547, 6771, 8875 and for wasting was 5942, 6868 and 8875 during NFHS-1, NFHS-2 and NFHS-3, respectively.

### Predictor variables

Household wealth and mother's level of education are main predictor variables in the study. It is well established that socioeconomic factors such as lower levels of household wealth and mother's level of education are important causes of childhood undernutrition (UNICEF 1998). The various pathways through which maternal education promotes child nutritional status, as suggested by the literature, include the acquisition of health knowledge, adherence to recommended feeding practices for children and increased command over resources (Frost *et al.* 2005).

In the absence of data on income and expenditure in NFHS, this study used household wealth index as a proxy for household's economic status. The wealth index computed based on the economic proxies, such as housing quality, household amenities, consumer durables and size of land holding (Montgomery *et al.* 2000; Filmer and Pritchett 2001; Rutstein and Johnson 2004; Vyas and Kumaranayake 2006; Gwatkin *et al.* 2007; O'Donnell *et al.* 2008). The third round of the NFHS computed a wealth index using principal component analysis (PCA) and the index is divided into five

quintiles—poorest, poorer, middle, richer and richest. But, the first two rounds of the survey computed standard of living index based on arbitrary scoring of the economic proxies, and the index was divided into three categories—low, medium and high. Therefore, in this study, a separate wealth index (divided in five quintiles) for urban area is computed using PCA for all three rounds of the survey and based on selected economic proxies of households. This is done to make the wealth index comparable over the years. The index is divided into five quintiles (20% each)—poorest, poorer, middle, richer and richest.

Mother's level of education is computed using the information on number of years of schooling and divided into four categories—uneducated (0 year of schooling), primary (1–5 years of schooling), secondary (6–12 years of schooling) and >secondary (>12 years of schooling). Grouping of years of schooling into level of education is standard practice to classify maternal education from health survey data (Subramanyam *et al.* 2010).

We control a list of socio-demographic variables in the analysis, which in previous studies, have been found to be significantly associated with childhood undernutrition in India. These controlled variables are—sex of the child (male; female), age of the child (<12 months; 12–23 months; ≥24 months), birth order and preceding birth interval (first order; ≤24 months; >24 months), size of the child at birth (large; average; small), mother's age at birth of the child (≤19 years; 20–29 years; ≥30 years), father's education (uneducated; primary; secondary; >secondary), use of antenatal care services (yes; no), child is fully immunized (no; yes), breastfeeding status (duration in months), caste (scheduled caste/scheduled tribe; other backward castes; others), religion (Hindu; Muslims; others), mother's exposure to media (no; yes), current working status of mother (no; yes); months of the survey and region of the country (north; east; central; northeast; west; south). The region is classified following the regional classification of NFHS (IIPS and ORC Macro 2007).

### Statistical analysis

Bivariate analysis is carried out to examine the level and trends in stunting, underweight and wasting across the household wealth quintiles and mother's level of education. Chi-square test is used to examine the significant association between undernutrition and socioeconomic indicators.

Concentration index (CI) is used to measure socioeconomic inequality in childhood undernutrition in urban India over time. The CI for undernutrition is defined with reference to the concentration curve, which plots cumulative percentage of undernourished children ($y$-axis) against cumulative percentage of the children ranked by household wealth, beginning with the poorest and ending with the richest quintile ($x$-axis). In such a case, when all the children, irrespective of their economic status '$x$', have exactly the same '$y$', the concentration curve will be a 45° line (line of equality), running from the bottom left-hand corner to the top right-hand corner. If '$y$' takes higher values among poorer people, the concentration curve will lie above the line of equality. The opposite is true if the '$y$' takes a lower value. Greater the distance of the curve from the line of equality, greater is the economic inequality in '$y$' (O'Donnell *et al.* 2008). The CI is a measure of this inequality. It is defined as twice the area between the concentration curve and the line of equality (Wagstaff and Doorslaer 2004). The value of CI varies between −1 and +1. Its value is negative when the concentration curve is above the diagonal, and positive when the curve is below the diagonal. If there is no inequality (the concentration curve coinciding with the diagonal), the value of CI is zero. A negative value implies that childhood undernutrition is concentrated among the poor population, whereas a positive value indicates the opposite condition. A value of 0 implies that the undernutrition is equally distributed across the socioeconomic groups. The aforesaid methodology is used to estimate the CI for all the three rounds of the NFHS. We used factor score of household wealth, obtained from the PCA, to estimate CI across household economic status. The CI for mother's level of education is based on mother's years of schooling (Sastry 2004).

Wagstaff (2005) has shown that in case of the dichotomous outcomes (like those used in this article) the lower and upper bounds for CI can depend on the mean values of the variables. This implies that the extent of inequality as measured by the CI can get affected considerably if the mean of the outcome variable changes from one survey round to the other. One solution to address this problem is to normalize the CI or to divide it by the reciprocal of the mean. We compute both, the regular and normalized CIs (dividing by the reciprocal of the mean) and find similar pattern over time. Therefore, we use the CIs as they are, without normalizing them. Our argument is backed by a previous study which finds similar pattern in regular and normalized CIs when analysing economic inequality in childhood malnutrition and mortality in India (Chalasani 2012).

In this study, all the three outcomes (stunting, underweight and wasting) are binary in nature (i.e. 1 = if stunted, 0 = otherwise), therefore, binary logistic regression is used. In the regression analysis, we use pooled data of all three rounds of the NFHS to examine the interaction effect of time (survey period) with household wealth and mother's level of education. The pooled regression analysis is adjusted for the selected covariates. The results of the logistic regression analysis are presented in terms of predicted probabilities to avoid the complexity in interpretation of interaction terms in the regression models. The exposure variables are tested for possible multi-collinearity using variance inflation factors test before putting them into pooled logistic regression analysis. The analyses presented in the subsequent sections have been carried out in STATA 10.0.

## Results

### Trends in childhood undernutrition in urban India

The overall prevalence (%) of childhood undernutrition has declined in urban India during 1992–2006 (Figure 1). The prevalence of stunting is 40, 36 and 31% in 1992–93, 1998–99 and 2005–06, respectively. The corresponding figures for the prevalence of underweight are 44, 38 and 37%. The prevalence of wasting has declined from 18% in 1992–93 to 13% in 1998–99 but further increased to 17% in 2005–06.

A trend, similar to what has been witnessed at aggregate level, emerges when we examine the prevalence of stunting and underweight across wealth quintiles and mother's level of education. In other words, the prevalence of both, stunting and underweight, during this period has declined across wealth and educational categories (Table 1). For instance, among the richest wealth quintile, the prevalence of stunting has dropped from 29% in 1992–93 to 19% in 1998–99 and further to 16% in 2005–06. Among the poorest wealth quintile, the prevalence has declined from 55% in 1992–93 to 52% in 1998–99, to 46% in 2005–06. The trends remain more or less similar across other wealth quintiles. Examining the prevalence of undernutrition by mother's level of education also provides similar patterns of decline. For instance, the prevalence of underweight has declined from 57% in 1992–93 to 52% in 1998–99 and further to 49% in 2005–06 among the uneducated mothers. Similarly, the prevalence among the most educated mothers (>secondary) has declined from 23% in 1992–93 to 20% in 1998–99 and to 18% in 2005–06. The prevalence of wasting has decreased between 1992–93 and 1998–99 but increased between 1998–99 and 2005–06 across household wealth and mother's level of education.

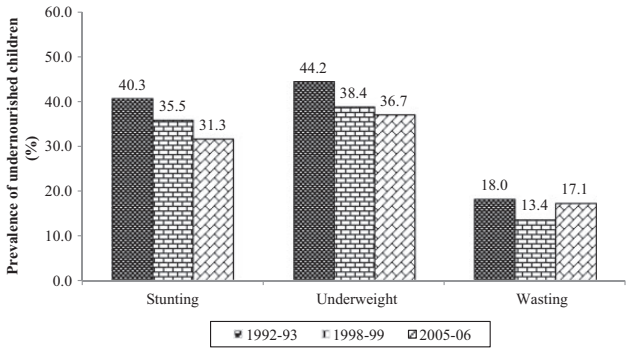


**Figure 1** Trends in proportion of stunting, underweight and wasting among children below 3 years of age in urban India, 1992–2006.

Though the prevalence of childhood undernutrition has declined across wealth quintiles and maternal education, the decline is higher among better-off socioeconomic groups than among the least-affluent groups during 1992–2006. During the period, the decline in the prevalence of stunting is 17% among the poorest wealth quintile compared with 46% among the richest wealth quintile; 22% among uneducated mothers compared with 39% among the most educated mothers. The prevalence of underweight among the poorest wealth quintile has declined by only 12% compared with 35% among the richest wealth quintile. Similarly, the decline is only 14% among uneducated mothers compared with 21% among the most educated mothers. A similar pattern of changes in the prevalence is observed in the case of wasting as well.

Table 1 also suggests that there is a stark difference in the prevalence of stunting, underweight and wasting within socioeconomic groups. For instance, the prevalence of stunting is 46% among the poorest compared with 16% among the richest wealth quintile in 2005–06. Similarly, ~42% children of uneducated mothers are stunted compared with 14% of the most educated mothers. A similar difference is observed for underweight and wasting as well. The pattern also remains similar over time.

## Trends in socioeconomic inequality in childhood undernutrition in urban India

Table 2 shows the extent of socioeconomic inequality (measured by CI) in stunting, underweight and wasting during 1992–2006. In general, the result of CI shows pro-poor

**Table 1** Percentage of children below 3 years of age who were undernourished by household wealth and education level of mother in urban India, 1992–2006

| | Prevalence (%) of stunting | | | % change during 1992–2006 | Prevalence (%) of underweight | | | % change during 1992–2006 | Prevalence (%) of wasting | | | % change during 1992–2006 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1992–93 | 1998–99 | 2005–06 | | 1992–93 | 1998–99 | 2005–06 | | 1992–93 | 1998–99 | 2005–06 | |
| Household wealth | (222.3)[a] | (331.5)[a] | (402.6)[a] | | (350.5)[a] | (451.9)[a] | (427.2)[a] | | (23.9)[a] | (64.2)[a] | (41.6)[a] | |
| Poorest | 55.3 | 51.8 | 45.7 | 17.4 | 60.3 | 56.1 | 53.2 | 11.8 | 21.9 | 16.9 | 21.6 | 1.4 |
| Poor | 45.2 | 40.4 | 37.4 | 17.3 | 51.2 | 47.0 | 41.4 | 19.1 | 21.1 | 16.2 | 17.5 | 17.1 |
| Middle | 41.8 | 37.1 | 34.1 | 18.4 | 45.5 | 40.0 | 40.0 | 12.1 | 17.0 | 13.7 | 19.2 | −12.9 |
| Rich | 33.5 | 30.1 | 24.8 | 26.0 | 35.8 | 31.3 | 28.7 | 19.8 | 17.5 | 11.2 | 14.5 | 17.1 |
| Richest | 29.4 | 19.1 | 15.9 | 45.9 | 29.7 | 21.4 | 19.2 | 35.4 | 13.5 | 9.3 | 12.7 | 5.9 |
| Ratio: lowest to highest | 1.9 | 2.7 | 2.9 | | 2.0 | 2.6 | 2.8 | | 1.6 | 1.8 | 1.7 | |
| Mother's level of education | (332.6)[a] | (326.8)[a] | (354.8)[a] | | (383.5)[a] | (361.4)[a] | (416.8)[a] | | (26.1)[a] | (30.8)[a] | (47.3)[a] | |
| Uneducated | 52.9 | 49.3 | 41.5 | 21.6 | 57.1 | 52.0 | 49.3 | 13.7 | 20.0 | 15.5 | 21.2 | −6.0 |
| Primary | 42.7 | 40.3 | 37.7 | 11.7 | 45.4 | 45.1 | 41.3 | 9.0 | 20.3 | 14.5 | 17.9 | 11.8 |
| Secondary | 31.7 | 29.8 | 29.3 | 7.6 | 36.9 | 32.6 | 34.2 | 7.3 | 16.8 | 12.7 | 16.4 | 2.4 |
| >Secondary | 23.2 | 17.8 | 14.1 | 39.2 | 23.0 | 19.6 | 18.1 | 21.3 | 11.7 | 10.0 | 11.1 | 5.1 |
| Ratio: lowest to highest | 2.3 | 2.8 | 2.9 | | 2.5 | 2.7 | 2.7 | | 1.7 | 1.6 | 1.9 | |

*Notes:* Figures in parentheses are the Chi-square statistics; $\chi^2$ test applied for each variable. Level of significance: $^aP < 0.01$.

**Table 2** Concentration index (95% confidence interval) showing the trends in socioeconomic inequality in childhood undernutrition in urban India, 1992–2006

| | 1992–93 | | 1998–99 | | 2005–06 | | % changes during 1992–2006 |
|---|---|---|---|---|---|---|---|
| | CI | SE | CI | SE | CI | SE | |
| Household wealth | | | | | | | |
| Stunting | −0.14 (−0.16, −0.12)a | 0.009 | −0.17 (−0.10, −0.15)a | 0.009 | −0.18 (−0.20, −0.16)a | 0.009 | 28.6 |
| Underweight | −0.15 (−0.16, −0.13)a | 0.008 | −0.17 (−0.19, −0.16)a | 0.008 | −0.19 (−0.21, −0.18)a | 0.009 | 26.7 |
| Wasting | −0.08 (−0.11, −0.14)a | 0.018 | −0.14 (−0.18, −0.11)a | 0.019 | −0.09 (−0.12, −0.06)a | 0.014 | 12.5 |
| Mother's level of education | | | | | | | |
| Stunting | −0.18 (−0.20, −0.16)a | 0.009 | −0.18 (−0.20, −0.16)a | 0.009 | −0.19 (−0.21, −0.17) | 0.009 | 5.6 |
| Underweight | −0.17 (−0.19, −0.15)a | 0.009 | −0.19 (−0.21, −0.17)a | 0.009 | −0.18 (−0.20, −0.17)a | 0.008 | 5.9 |
| Wasting | −0.09 (−0.13, −0.06)a | 0.018 | −0.12 (−0.15, −0.08)a | 0.019 | −0.11 (−0.14, −0.08)a | 0.014 | 22.2 |

*Notes:* The CI for mother's education is based on mother's completed years of schooling; [a]$P < 0.01$.

condition in childhood undernutrition over the time. The inequality in childhood undernutrition has increased significantly across household wealth over time. For instance, the value of CI for stunting has increased from −0.14 in 1992–93 to −0.17 in 1998–99 and to −0.18 in 2005–06. For underweight, the value of CI has increased from −0.15 in 1992–93 to −0.17 in 1998–99 and to −0.19 in 2005–06. In the case of wasting, the inequality has initially increased then decreased afterwards. A similar pattern can be observed from the concentration curves presented in Figure 2. Extent of inequality in childhood undernutrition is higher across the mother's level of education but the pattern remains more or less stagnant over the period of 1992–2006. For instance, the value of CI for stunting is −0.18 in 1992–93, −0.18 in 1998–99 and −0.19 in 2005–06. The inequality in childhood undernutrition increases from 13 to 29% for household wealth and from 6 to 22% for mother's education during 1992–2006.

## Multivariate analysis

The findings of the descriptive analysis and concentration indices suggest that the socioeconomic inequality in childhood undernutrition in urban India has either widened or stagnated over the time. However, it is worth noting here that these findings may be biased as they are yet to be adjusted for other socio-demographic determinants that may have strong influence on childhood undernutrition. To examine the magnitude of changes in childhood undernutrition across household wealth quintiles and mother's education level over the period of 1992–2006, we run the binary logistic regression on pooled dataset of all three rounds of the NFHS. In the models, we examine the effect of interaction terms—one between the survey period and household wealth and the other between the survey period and mother's level of education—after adjusting for sex of the child, age of the child, birth order and preceding birth interval, size of the child at birth, mother's age at birth of the child, father's education, use of antenatal care services, full child immunization, breastfeeding, caste, religion, mother's exposure to media, current working status of mother, months of the survey and region of residence. The coefficients of the interactions are presented in Table A1. The results show that the interaction term of survey year and household wealth is statistically significant for stunting and underweight. Similarly, the interactions between the survey year and mother's level of education are significant for stunting and underweight, though level of the significance is not even across all the interaction terms. In the case of wasting, the interaction terms are significant inconsistently with household wealth and insignificant with mother's level of education.

We have presented the results of this analysis in terms of predicted probability of being undernourished of the urban children by household wealth and mother's level of education. Our multivariate analysis confirms the result of bivariate analysis indicating that the probability of being stunted and underweight has declined significantly ($P < 0.01$ for each of the indicators) in urban areas between 1992 and 2006, however, the probability of wasting stagnated ($P < 0.05$) during the same period (Figure 3).

The interactionage effect (in terms of predicted probability) of survey periods and household wealth and survey periods and mother's level of education on being stunted, underweight and wasted in urban India during 1992–2006 are presented in Tables 3, 4 and 5, respectively. We find a clear gradient in the association between the socioeconomic status and the probability of being undernourished. For instance, the probability of stunting is 0.418 among children of the poorest wealth quintile, 0.325 among poor quintile, 0.275 among middle quintile, 0.215 among richer quintile and 0.136 among the richest quintile in 2005–06. Similarly, the probability of being stunted is 0.390 among the children of uneducated mothers, 0.326 among the children of primary educated mothers, 0.238 among the children of secondary educated mothers and 0.124 among the children of the most educated mothers. A similar result is observed for underweight and wasting. Moreover, this pattern remained similar over the period.

The percentage change in the predicted probabilities of undernutrition across the household wealth and mother's education is presented in Figure 4a and b. During 1992–2006, in urban areas, the decline in the prevalence of stunting is about twice as high (40%) among the richest wealth quintile than the poorest quintile (22%) (Figure 4a). In case of underweight, the decline is 32% among the richest wealth quintile compared with 18% among the poorest wealth quintile during the same period. The corresponding decline for wasting is 17 vs 2%. Across the education level of mothers, the percentage decline in probability of stunting is 36% among

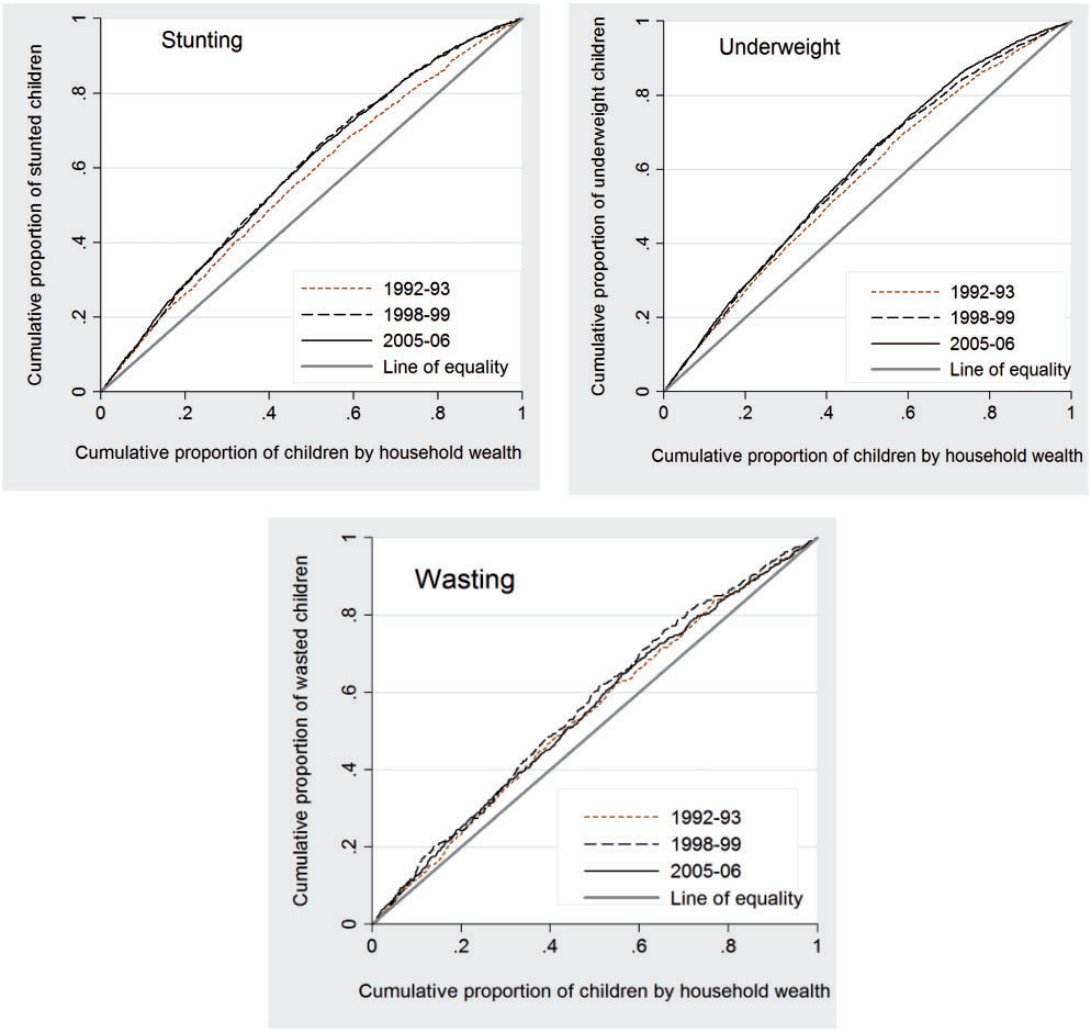


**Figure 2** Concentration curves showing inequalities in childhood undernutrition by economic status of population in urban India, 1992–2006.

the most educated compared with 24% among uneducated mothers during 1992–2006 (Figure 4b). A similar pattern is observed for underweight. However, for wasting, the probability has increased among both, uneducated (–17%) and the most educated mothers (–10%) during the period. The findings clearly show that the inequality in childhood undernutrition across household wealth and mother's education has increased over the period after adjusting for other confounders.

## Discussion

In this study, we have examined the trends and pattern of socioeconomic inequality in childhood undernutrition among children aged <3 years in urban India between 1992–93 and 2005–06. The socioeconomic factors are household wealth and mother's level of education. During the study period, there is a constant decline in prevalence of stunting and underweight. The proportion of wasted children first registers a decline and then an increase. This has resulted in a net decline, though minimal, in the prevalence of wasting over the study period. The decline in the prevalence of undernutrition may be a combined effect of rapid economic growth with the implementation of the New Economic Policy in early 1990s, improved living conditions and maternal and child health interventions and programmes implemented during the period, but the data do not permit us to assess the programme effect on the decline in the prevalence of undernutrition among urban children in India. Though the prevalence of undernutrition has decreased over the study period, it is worth noting here that the current prevalence of stunting and underweight among children of urban India is still considerably higher than the average level of undernutrition in many of the South-East Asia and most of the African countries (UNICEF 2006).

Like national average, the prevalence of underweight has also declined across the household wealth quintiles and educational level of mothers in urban India during 1992–2006, but the pace of decline is much higher among better-off socioeconomic groups compared with the least affluent groups. The current prevalence of childhood undernutrition is considerably higher among the children belonging to the lowest wealth quintiles and uneducated mothers than their counterparts. These findings indicate persisting socioeconomic disparities in childhood undernutrition in urban India. Our finding is in tune with

previous studies which have noted significant socioeconomic disparities in the use of MCH services and the prevalence of infant mortality in urban India (Gupta *et al.* 2008; Pathak and Mohanty 2010; Kumar and Mohanty 2011a,b). The higher prevalence of undernutrition, particularly of stunting and underweight, among the children of the poorest wealth quintile could be explained by their poor living conditions, detrimental environmental conditions which are more susceptible to infectious diseases, low affordability to purchase the quality foods and low level of utilization of healthcare services. These conditions may lead to insufficient physical growth, poor nutritional status and frequent attacks of infectious diseases like diarrhoea which may propel the risk of underweight among the children belonging to lower socioeconomic groups (Caulfied *et al.* 2004).

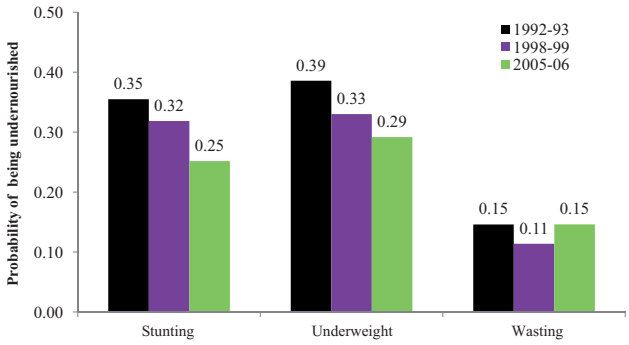


**Figure 3** Predicted probability of being stunted, underweight and wasted among children below 3 years of age in urban India, 1992–2006. *Notes:* The probabilities are based on regression analysis and models have been adjusted for household wealth, mother's education, sex of the child, age of the child, birth order and preceding birth interval, size of the child at birth, mother's age at birth of the child, father's education, use of antenatal care services, immunization status of the child, breastfeeding status, caste, religion, mother's exposure to media, current working status of mother, months of survey and region of the country.

Inequality in childhood undernutrition across the levels of maternal education is similar to that of household wealth. The level of childhood undernutrition is higher among children of illiterate mothers compared to those born to highly educated mothers. The low level of undernutrition among the children of the most educated mothers may reflect, in part, the health advantages conferred by their higher economic status (Mosley and Chen 1984). Along with improving household income, the effect of maternal education may also be channelized through mother's increasing health knowledge, greater access to and use of healthcare services, better and nutritious feeding practices and mother's decision making control within the household (Miller and Rodgers 2009; Aslam and Kingdon 2010).

The results of the multivariate analysis show that the socioeconomic inequality in childhood undernutrition has widened over the study period. Inequality across household wealth has progressively increased between 1992–93 and 2005–06. Economically better-off households have experienced a greater decline in the prevalence of stunting and underweight compared with the households of the poorest quintile. These findings suggest that the economically better-off households have benefited more from the economic growth and ongoing maternal and child health interventions compared to poor households during 1992–2005 (Subramanyam *et al.* 2010). The inequality in childhood undernutrition is also growing across mother's level of education. The decline in the prevalence of stunting and underweight is higher among the children of the most educated mothers compared with the children of uneducated mothers during 1992–2006. Thus, mother's education appears as a probable factor underlying socioeconomic inequality in childhood undernutrition—either through 'selection effects' or through 'causal effects', whereby mother's schooling provides her with the knowledge, means and ability to raise healthy children (Caldwell 1979).

The pattern of socioeconomic inequality in stunting and underweight remains similar during 1992–2006. However, we

**Table 3** Predicted probabilities (95% confidence interval) of stunting among children below 3 years of age across household wealth and mother education in urban India, 1992–2006

| | 1992–93 | | 1998–99 | | 2005–06 | |
|---|---|---|---|---|---|---|
| | PP | 95% CI | PP | 95% CI | PP | 95% CI |
| Household wealth | | | | | | |
| Poorest | 0.534 | (0.499, 0.569) | 0.505 | (0.474, 0.535) | 0.418 | (0.390, 0.447) |
| Poor | 0.434 | (0.403, 0.466) | 0.397 | (0.369, 0.426) | 0.325 | (0.300, 0.352) |
| Middle | 0.369 | (0.340, 0.400) | 0.326 | (0.300, 0.354) | 0.275 | (0.252, 0.299) |
| Rich | 0.300 | (0.273, 0.329) | 0.276 | (0.252, 0.302) | 0.215 | (0.194, 0.237) |
| Richest | 0.228 | (0.206, 0.252) | 0.176 | (0.157, 0.196) | 0.136 | (0.121, 0.153) |
| Mother's level of education | | | | | | |
| Uneducated | 0.513 | (0.490, 0.536) | 0.479 | (0.454, 0.504) | 0.390 | (0.365, 0.415) |
| Primary | 0.414 | (0.376, 0.453) | 0.387 | (0.355, 0.419) | 0.326 | (0.294, 0.360) |
| Secondary | 0.262 | (0.243, 0.282) | 0.263 | (0.247, 0.280) | 0.238 | (0.224, 0.253) |
| >Secondary | 0.194 | (0.165, 0.228) | 0.154 | (0.131, 0.179) | 0.124 | (0.107, 0.143) |

PP, predicted probabilities; CI, confidence intervals.

*Notes:* The probabilities are based on regression analysis and models have been adjusted for sex of the child, age of the child, birth order and preceding birth interval, size of the child at birth, mother's age at birth of the child, father's education, use of antenatal care services, immunization status of the child, breastfeeding status, caste, religion, mother's exposure to media, current working status of mother, months of survey and region of the country.

**Table 4** Predicted probabilities (95% confidence interval) of underweight among children below 3 years of age across household wealth and mother education in urban India, 1992–2006

| | 1992–93 | | 1998–99 | | 2005–06 | |
|---|---|---|---|---|---|---|
| | PP | 95% CI | PP | 95% CI | PP | 95% CI |
| Household wealth | | | | | | |
| Poorest | 0.583 | (0.554, 0.613) | 0.541 | (0.510, 0.572) | 0.480 | (0.451, 0.509) |
| Poor | 0.474 | (0.446, 0.503) | 0.435 | (0.407, 0.465) | 0.369 | (0.342, 0.396) |
| Middle | 0.403 | (0.376, 0.430) | 0.345 | (0.318, 0.373) | 0.316 | (0.291, 0.341) |
| Rich | 0.315 | (0.290, 0.340) | 0.280 | (0.255, 0.305) | 0.248 | (0.225, 0.272) |
| Richest | 0.244 | (0.224, 0.266) | 0.198 | (0.184, 0.213) | 0.166 | (0.149, 0.184) |
| Mother's level of education | | | | | | |
| Uneducated | 0.534 | (0.513, 0.555) | 0.493 | (0.468, 0.518) | 0.463 | (0.438, 0.489) |
| Primary | 0.426 | (0.393, 0.460) | 0.425 | (0.392, 0.458) | 0.355 | (0.321, 0.390) |
| Secondary | 0.308 | (0.290, 0.326) | 0.271 | (0.254, 0.288) | 0.278 | (0.263, 0.294) |
| >Secondary | 0.199 | (0.172, 0.228) | 0.143 | (0.121, 0.168) | 0.140 | (0.122, 0.160) |

PP, predicted probabilities; CI, confidence intervals.

*Notes:* The probabilities are based on regression analysis and models have been adjusted for sex of the child, age of the child, birth order and preceding birth interval, size of the child at birth, mother's age at birth of the child, father's education, use of antenatal care services, immunization status of the child, breastfeeding status, caste, religion, mother's exposure to media, current working status of mother, months of survey and region of the country.

**Table 5** Predicted probabilities (95% confidence interval) of wasting among children below 3 years of age across household wealth and mother education in urban India, 1992–2006

| | 1992–93 | | 1998–99 | | 2005–06 | |
|---|---|---|---|---|---|---|
| | PP | 95% CI | PP | 95% CI | PP | 95% CI |
| Household wealth | | | | | | |
| Poorest | 0.185 | (0.161, 0.213) | 0.135 | ((0.113, 0.158) | 0.181 | (0.160, 0.203) |
| Poor | 0.161 | (0.140, 0.184) | 0.136 | (0.118, 0.156) | 0.170 | (0.151, 0.191) |
| Middle | 0.131 | (0.113, 0.152) | 0.111 | (0.095, 0.129) | 0.163 | (0.145, 0.182) |
| Rich | 0.135 | (0.116, 0.156) | 0.098 | (0.084, 0.115) | 0.138 | (0.121, 0.157) |
| Richest | 0.114 | (0.098, 0.132) | 0.072 | (0.060, 0.086) | 0.095 | (0.082, 0.113) |
| Mother's level of education | | | | | | |
| Uneducated | 0.170 | (0.154, 0.187) | 0.135 | (0.119, 0.151) | 0.187 | (0.169, 0.207) |
| Primary | 0.148 | (0.124, 0.176) | 0.132 | (0.112, 0.154) | 0.185 | (0.160, 0.213) |
| Secondary | 0.131 | (0.117, 0.146) | 0.099 | (0.089, 0.111) | 0.142 | (0.131, 0.154) |
| >Secondary | 0.093 | (0.073, 0.128) | 0.073 | (0.058, 0.092) | 0.109 | (0.093, 0.127) |

PP, predicted probabilities; CI, confidence intervals.

*Notes:* The probabilities are based on regression analysis and models have been adjusted for sex of the child, age of the child, birth order and preceding birth interval, size of the child at birth, mother's age at birth of the child, father's education, use of antenatal care services, immunization status of the child, breastfeeding status, caste, religion, mother's exposure to media, current working status of mother, months of survey and region of the country.

do not find a clear trend in the case of wasting. Such inconsistent pattern can be understood in the light of the fact that wasting is an indicator of short-term nutritional disorder (Deaton and Drèze 2009) and likely to be affected by the illnesses and diseases just prior to the survey (IIPS and ORC Macro 2007). In this context, a study from Indian sub-continent has also indicated that the environmental changes from the winter to the monsoon season are responsible for significant loss of weight and lower weight-for-height *z*-scores, especially among children <3 years (Panter-Brick 1997).

This study addresses the socioeconomic inequality in childhood undernutrition in urban India for a period when the country was witnessing a rapid economic transformation following the introduction of the New Economic Policy in the early 1990s. It is now a well-established fact that the two decades (1990–2010) following the neo-liberal economic reforms in India have witnessed a dramatic increase in income inequality not only in rural areas but also in urban areas (Sarkar and Mehta 2010). Although the country has introduced and implemented several maternal and child health programmes during the same period to improve the health status of mothers and children, these schemes and interventions have not reached the poor, less educated and deprived strata of the society in an effective manner due to multiple reasons. Hence, it is not surprising to witness persistent and growing socioeconomic inequality in childhood undernutrition in urban India.

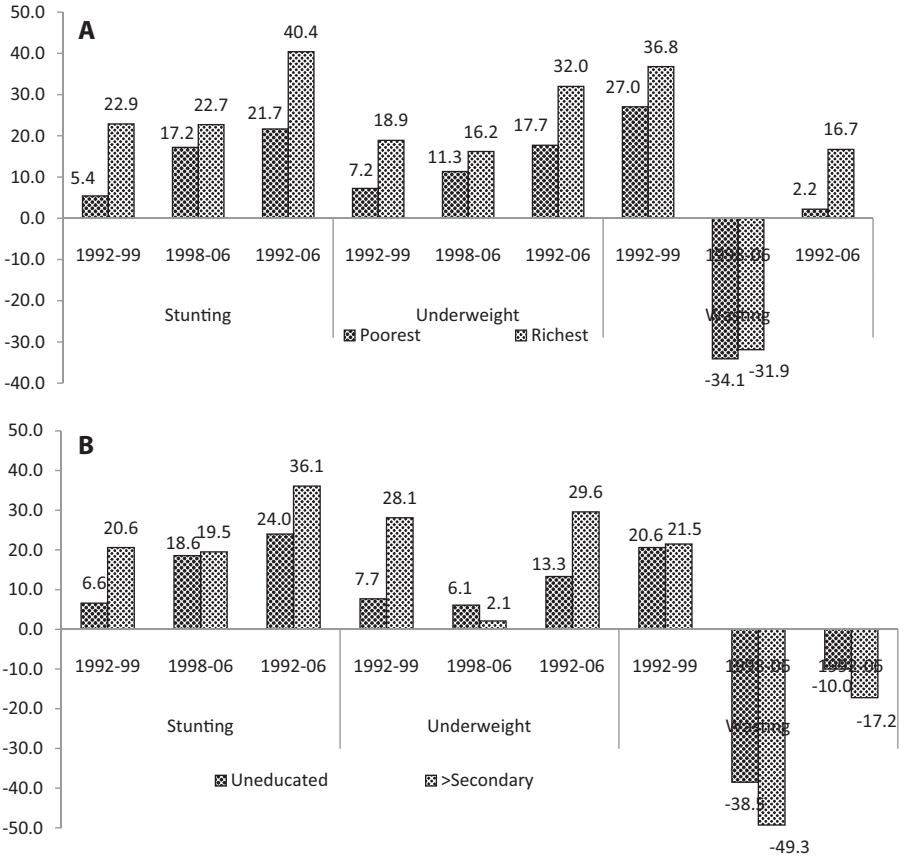


**Figure 4** (a) Percentage change in predicted probabilities of undernutrition among children below 3 years of age across household wealth in urban India, 1992–2006. (b) Percentage change in predicted probabilities of undernutrition among children below 3 years of age by mother's education level in urban India, 1992–2006.

The findings of the study may guide the existing health policies in the country. Acknowledging the greater health needs of rural population, the Government of India has launched a nationwide scheme—the National Rural Health Mission (2005–12)—with an aim to make architectural corrections in the public (government) healthcare system in rural areas and to ensure provision of high-quality health services to the rural masses in general, and the poor and the marginalized in particular. Unfortunately, the health needs of the urban population have been overlooked for a prolonged period probably under the impression that urban areas enjoy better availability and accessibility of health facilities than their counterparts in rural areas. This could have happened due to lack of systematic evidence on socioeconomic inequalities in health status in urban India. This study proposes to adopt a similar approach under the ongoing National Urban Health Mission to formulate a comprehensive health system response towards growing urban health needs of urban populations, particularly to the children belonging to the poorest socio-economic groups. In addition, the findings of the study also suggest the need for the expansion of the Integrated Child Development Services (ICDS) as the coverage of ICDS is highly inadequate in urban areas. According to the Department of Women and Child Development, Government of India (2005), there are only 360 urban ICDS projects catering to a huge population of ~90 million urban poor (Mirza 2009). Therefore, the government should plan further expansion of the ICDS in urban areas, particularly in the slums and poor areas of the cities. However, the expansion alone cannot bring about significant changes in the situation because the scheme suffers from multiple loopholes including rampant corruption (Gill and Taylor 2013). Therefore, the major challenge is to ensure accountability and transparency in its implementation. It may prove one of the major keys to narrow down the yawning gap in undernutrition between poor and non-poor children in urban India.

## Conclusions

This study concludes with the two key messages emerging from the analysis. First, though the proportion of undernourished children in urban India has declined over the period, the current level is still considerably high. Second, the socio-economic inequality in childhood undernutrition is increasing in urban India keeping the abysmal health condition of children belonging to the poor and deprived households. Based on the findings, the study suggests for specific policy, in line with those already in existence in rural India, to address

the high and increasing socioeconomic inequality in childhood malnutrition in urban India. As India is going to be overwhelmingly urban in next few decades, the salient findings of this study suggest the need for a multifaceted policy to improve the average health and to arrest the burgeoning socioeconomic inequality in childhood malnutrition in urban India.

## Limitations

This study examines trends in socioeconomic inequality in childhood undernutrition in urban India. The findings of the study are subject to certain limitations, which are described below. The first round of NFHS did not collect data from the state of Sikkim, thus the estimate from the first round may be a matter of caveat. Nevertheless, looking at the contribution of Sikkim in a national sample (0.05% in NFHS-2 and 0.04% in NFHS-3), we believe that our findings are not affected considerably and the estimates are comparable over the study period. Second, although multiple births are susceptible to poor child health outcomes, we have not accounted for them in this study considering the small number of such cases in the dataset.

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## References

Aadir LS, Guilkey DK. 1997. Age-specific determinants of stunting in Filipino children. *Journal of Nutrition* **127**: 314–20.

Abuya BA, Onsomu EO, Kimani JK, Moore D. 2011. Influence of maternal education on child immunization and stunting in Kenya. *Maternal and Child Health Journal* **15**: 1389–99.

ACC/SCN (Administrative Committee on Co-ordination/Sub-Committee on Nutrition). 1997. Nutrition and Poverty. In Papers from the SCN 24th Session Symposium in Kathmandu, March ACC/SCN Symposium Report, Nutrition Policy, Paper No. 16. World Health Organization, Geneva.

African Population and Health Research Centre. 2002. *Population and Health Dynamics in Nairobi's Informal Settlement*. Nairobi: African Population and Health Research Centre.

Arokiasamy P, Jain K, Goli S, Pradhan J. 2012. Health inequalities among urban children in India: a comparative assessment of empowered action group (EAG) and south Indian states. *Journal of Biosocial Science* **6**: 1–19.

Aslam M, Kingdon G. 2010. Parental education and child health: understanding the pathways of impact in Pakistan. Centre for the Study of African Economies Working Paper Series (CSAEWPS) 2010-16. http://www.csae.ox.ac.uk/workingpapers/pdfs/2010-16text.pdf.

Bartlett S. 2003. Water, sanitation and urban children: the need to go beyond improved provision. *Environment and Urbanization* **15**: 57–70.

Bitran R, Giedion U, Valenzuela R, Monkkonen P. 2005. Keeping health in an urban environment: public health challenges for the urban poor. In: Fay M (ed). *The Urban Poor in Latin America*. Washington, DC: World Bank, pp. 179–95.

Caldwell JC. 1979. Education as a factor in mortality decline: an examination of Nigerian data. *Population Studies* **33**: 395–413.

Caulfied L, de Onis M, Blossner M, Black RE. 2004. Under-nutrition as an underlying cause of child deaths associated with diarrhoea, pneumonia, malaria, and measles. *American Journal of Clinical Nutrition* **80**: 193–8.

Chalasani S. 2012. Understanding wealth-based inequalities in child health in India: a decomposition approach. *Social Science and Medicine* **75**: 2160–2169.

Deaton A, Drèze J. 2009. Food and nutrition in India: facts and interpretations. *Economic & Political Weekly* **44**: 42–65.

Defo BK. 1996. Areal and socioeconomic differentials in infant and child mortality in Cameroon. *Social Science and Medicine* **42**: 399–420.

Dibley MJ, Goldsby JB, Staehling NW, Trowbridge FL. 1987a. Development of normalized curves for the international growth reference: historical and technical considerations. *American Journal of Clinical Nutrition* **46**: 736–48.

Dibley MJ, Staehling NW, Neiburg P, Trowbridge FL. 1987b. Interpretation of Z-score anthropometric indicators derived from the international growth reference. *American Journal of Clinical Nutrition* **46**: 749–62.

Filmer D, Pritchett LH. 2001. Estimating wealth effects without expenditure data-or tears: an application to educational enrolments in states of India. *Demography* **38**: 115–32.

FOCUS (Focus On Children Under Six). 2006. *Citizen's Initiative for the Rights of Children under Six, New Delhi*. http://www.righttofoodindia.org/data/rtf06focus reportabridged.pdf, accessed 15 February 2009.

Fotso JC. 2006. Child health inequities in developing countries: differences across urban and rural areas. *International Journal for Equity in Health* **5**: 9.

Fotso JC, Ezeh A, Madise N, Ciera J. 2007. Progress towards the child mortality millennium development goal in urban sub-Saharan Africa: the dynamics of population growth, immunization, and access to clean water. *BMC Public Health* **7**: 218.

Frost MB, Forste R, Haas DW. 2005. Maternal education and child nutritional status in Bolivia: finding the links. *Social Science and Medicine* **60**: 395–407.

Garrett JL, Ruel MT. 1999. Are determinants of rural and urban food security and nutritional status different? Some insights from Mozambique. *World Development* **27**: 1955–75.

Gill J, Taylor D. 2013. *Health and Health Care in India, National Opportunities, Global Impacts*. University College London School of Pharmacy.

Gopalan S. 2000. Malnutrition: causes, consequences, and solutions. *Nutrition* **16**: 556–8.

Gragnolati M, Shekar M, Dasgupta M, Bredenkamp C, Lee Y. 2005. India's undernourished children: a call for reform and action. *Health Nutrition, and Population (HNP) Discussion Paper*. Washington DC: World Bank.

Gupta M, Thakur J, Kumar R. 2008. Reproductive and child health inequities in Chandigarh Union Territory of India. *Journal of Urban Health* **85**: 291–9.

Gwatkin DR, Rutstein S, Johnson K *et al.* 2007. *Socio-economic Differences in Health, Nutrition, and Population Within Developing Countries: An Overview. Country Reports on HNP and Poverty*. Washington, DC: World Bank.

Haddad L, Ruel MT, Garrett J. 1999. Are urban poverty and undernutrition growing? Some newly assembled evidence. *World Development* **27**: 1891–904.

Harpham T. 2009. Urban health in developing countries: what do we know and where do we go? *Health and Place* **15**: 107–16.

International Institute for Population Sciences (IIPS), ORC Macro. 1995. *National Family Health Survey (NFHS-1), 1992-93: India*, Vol. I. Mumbai: IIPS.

International Institute for Population Sciences (IIPS), ORC Macro. 2000. *National Family Health Survey (NFHS-2), 1998-99: India*, Vol. I. Mumbai: IIPS.

International Institute for Population Sciences (IIPS), ORC Macro. 2007. *National Family Health Survey (NFHS-3), 2005-06: India*, Vol. I. Mumbai: IIPS.

Kumar A, Mohanty SK. 2011a. Intra-urban differentials in the utilization of reproductive healthcare services in India, 1992-2006. *Journal of Urban Health* **88**: 311–28.

Kumar A, Mohanty SK. 2011b. State of child health among poor and non-poor in urban India. *Genus* **69**: 1–19.

Lalou R, Legrand TK. 1997. Child mortality in the urban and rural Sahel. *Population: An English Selection* **9**: 147–68.

Madhiwalla N. 2007. Healthcare in urban slums in India. *The National Medical Journal of India* **20**: 113–4.

Martin LG, Trussell J, Salvail FR, Shah NM. 1983. Co-variates of child mortality in the Philippines, Indonesia, and Pakistan: an analysis based on hazard models. *Population Studies* **37**: 417–32.

Matthews Z, Channon A, Neal S *et al.* 2010. Examining the ''Urban Advantage'' in maternal health care in developing countries. *PLoS Medicine* **7**: e1000327.

Menon P, Ruel MT, Morris SS. 2000. Socio-economic differentials in child stunting are consistently larger in urban than rural areas: analysis of 10 DHS data sets. *Food and Nutrition Bulletin* **21**: 282–99.

Miller JE, Rodgers YV. 2009. Mother's education and children's nutritional status: new evidence from Cambodia. *Asian Development Review* **26**: 131–65.

Mishra VK, Roy TK, Retherford RD. 2004. Sex differentials in childhood feeding, health care, and nutritional status in India. *Population and Development Review* **30**: 269–95.

Mitlin D. 2000. Addressing urban poverty: increasing incomes, reducing costs, and securing representation. *Development in Practice* **10**: 204–15.

Montgomery MR. 2009. Urban poverty and health in developing countries. *Population Bulletin* **64**: 2.

Montgomery MR, Gragnolati M, Burke KA, Paredes E. 2000. Measuring living standards with proxy variables. *Demography* **37**: 155–74.

Mosley WH, Chen LC. 1984. An analytical framework for the study of child survival in developing countries. *Population and Development Review* **10**(Suppl.):25–45.

Nandy S, Miranda JJ. 2008. Overlooking undernutrition? Using a composite index of anthropometric failure to assess how underweight misses and misleads the assessment of undernutrition in young children. *Social Science and Medicine* **66**: 1963–6.

National Sample Survey Organization (NSSO). 2001. *Household Consumer Expenditure in India 1999–2000: Key Results*. New Delhi: National Sample Survey Organization.

O'Donnell O, Doorslaer EV, Wagstaff A, Lindelow M. 2008. *Analyzing Health Equity Using Household Survey Data: A Guide to Techniques and their Implementation. WBI Learning Resources Series*. Washington, DC: World Bank.

Office of Registrar General and Census Commissioner, Census of India. 2011. Provisional Population Totals Paper 2 of 2011 India Series-1 New Delhi, India.

Panter-Brick C. 1997. Seasonal growth patterns in rural Nepali children. *Annals of Human Biology* **24**: 1–18.

Pathak PK, Mohanty SK. 2010. Does the safe-motherhood program reach the poor in Uttar Pradesh, India? *Asian Population Studies* **6**: 173–91.

Pathak PK, Singh A, Subramanian SV. 2010. Economic inequalities in maternal health care: prenatal care and skilled birth attendance in India, 1992–2006. *PLoS One* **5**: e13593.

Pen AM, Bacalloa J. 2002. Malnutrition and poverty. *Annual Review of Nutrition* **22**: 241–53.

Ram F, Roy TK. 2004. Comparability issues in large sample surveys-some observations. In: Roy TK, Guruswamy M, Arokiaswamy P (eds). *Population, Health and Development in India-Changing Perspectives, International Institute for Population Sciences, Mumbai*. New Delhi, India: Rawat Publications, pp. 40–56.

Ravallion M. 2007. Urban poverty. *Finance and Development* **44**: 15–17.

Ruel M. 2000. Urbanization in Latin America: constraints and opportunities for child feeding and care. *Food and Nutrition Bulletin* **21**: 12–24.

Ruel M, Garrett J, Morris S *et al.* 1998. *Urban Challenges to Food and Nutrition Security: A Review of Food Security, Health, and Caregiving in the Cities. Food Consumption and Nutrition Division Discussion Paper 51*. Washington, DC: International Food Policy Research Institute.

Rutstein SO, Johnson K. 2004. *The DHS Wealth Index. DHS Comparative Reports no. 6*. Calverton, MD: ORC Macro, MEASURE DHS.

Sahn D, Stifel D. 2003. Urban–rural inequality in living standards in Africa. *Journal of African Economies* **12**: 564–97.

Sarkar S, Mehta BS. 2010. Income inequality in India: pre- and post-reform periods. *Economic & Political Weekly* **65**: 45–55.

Sastry N. 1997. What explains rural–urban differentials in child mortality in Brazil? *Social Science and Medicine* **44**: 989–1002.

Sastry N. 2004. Trends in socioeconomic inequalities in mortality in developing countries: the case of child survival in Sao Paulo, Brazil. *Demography* **41**: 443–64.

Shah MN, Bapat U, Das S, Barnett S, Costello A. 2009. Inequalities in maternity care and new-born outcomes: one-year surveillance of births in vulnerable slum communities in Mumbai. *International Journal for Equity in Health* **8**: 21.

Smith L, Rue M, Ndiaye A. 2005. Why is child malnutrition lower in urban than in rural areas? Evidence from 36 developing countries. *World Development* **33**: 1285–305.

Subramanyam MA, Kawachi I, Berkman LF, Subramanian SV. 2010. Socioeconomic inequalities in childhood undernutrition in India: analyzing trends between 1992 and 2005. *PLoS ONE* **5**: e11392.

The Ministry of Housing and Urban Poverty Alleviation (HUPA), Government of India, United Nations Development Program. 2009. *India: Urban Poverty Report 2009*. Oxford: Oxford University Press.

Topalova P. 2008. *India: Is the Rising Tide Lifting All Boats?* International Monetary Fund Working Paper, Asia and Pacific Department, WP/08/54.

United Nations. 2012. *World Urbanisation Prospects The Revision 2011*. New York: United Nations Department of Economic and Social Affairs, Population Division.

United Nations Human Settlements Programme (UN-HABITAT). 2011. *State of the World's Cities 2010/2011: Bridging the Urban Divide*. Nairobi, Kenya. UN-HABITAT.

United Nations International Children's Emergency Fund (UNICEF). 1998. *The State of the World's Children 1998*. New York: Oxford University Press.

United Nations International Children's Emergency Fund (UNICEF). 2006. *Progress for Children. A Report Card on Nutrition. UNICEF No. 4*.

Van de Poel E, O'Donnell O, Van Doorslaer E. 2007. Are urban children really healthier? Evidence from 47 developing countries. *Social Science and Medicine* **65**: 1986–2003.

Von Braun J, McComb J, Fred-Mensah B, Pandya-Lorch R. 1993. *Urban Food Insecurity and Malnutrition in Developing Countries: Trends, Policies, and Research Implications*. Washington, DC: International Food Policy Research Institute.

Vyas S, Kumaranayake L. 2006. Constructing socio-economic status indices: how to use principal components analysis. *Health Policy and Planning* **21**: 459–68.

Wagstaff A. 2005. The bounds of the concentration index when the variable of interest is binary, with an application to immunization inequality. *Health Economics* **14**: 429–32.

Wagstaff A, Doorslaer VE. 2004. Overall versus socioeconomic health inequality: a measurement framework and two empirical illustrations. *Health Economics* **13**: 297–301.

World Health Organization Multicenter Growth Reference Study Group. 2006. *WHO Child Growth Standards: Length/Height-for-age, Weight-for-age, Weight-for-length, Weight-for-height and Body Mass Index-for Age e Methods and Development*. Geneva: World Health Organization.

Young FW, Edmonston B, Andes N. 1983. Community-level determinants of infant and child mortality in Peru. *Social Indicators Research* **12**: 65–81.

Zhao Q, Kulane A, Gao Y, Xu B. 2009. Knowledge and attitude on maternal health care among rural-to-urban migrant women in Shanghai, China. *BMC Women's Health* **9**: 5.

Ziraba A, Madise N, Mills S, Kyobutungi C, Ezeh A. 2009. Maternal mortality in the informal settlements of Nairobi city: what do we know? *Reproductive Health* **6**: 6.

# Appendix

**Table A1** Regression coefficient (95% confidence intervals) showing the interaction effect of survey time and household wealth and survey time and mother education level on undernutrition among children below 3 years of age in urban India, 1992–2006

| | Stunting | Underweight | Wasting |
|---|---|---|---|
| Survey year and household wealth | | | |
| 1992–93 | | | |
| Poorest | | | |
| Poor | −0.18 (−0.37, 0.02)* | −0.19 (−0.37, −0.02)** | −0.05 (−0.29, 0.19) |
| Middle | −0.30 (−0.51, −0.09)*** | −0.35 (−0.54, −0.17)*** | −0.25 (−0.52, 0.01) |
| Rich | −0.39 (−0.62, −0.16)*** | −0.55 (−0.75, −0.34)*** | −0.17 (−0.46, 0.12) |
| Richest | −0.52 (−0.78, −0.25)*** | −0.63 (−0.86, −0.40)*** | −0.22 (−0.55, 0.11) |
| 1998–99 | | | |
| Poorest | | | |
| Poor | −0.21 (−0.40, −0.03)** | −0.17 (−0.32, 0.01)* | −0.01 (−0.25, 0.23) |
| Middle | −0.44 (−0.63, −0.24)*** | −0.47 (−0.67, −0.28)*** | −0.20 (−0.47, 0.06) |
| Rich | −0.54 (−0.76, −0.32)*** | −0.63 (−0.85, −0.42)*** | −0.26 (−0.55, 0.04)* |
| Richest | −0.82 (−1.07, −0.57)*** | −1.00 (−1.26, −0.75) ***. | −0.40 (−0.75, −0.06)** |
| 2005–06 | | | |
| Poorest | | | |
| Poor | −0.26 (−0.43, −0.09)*** | −0.29 (−0.46, −0.12)*** | 0.05 (−0.15, 0.26) |
| Middle | −0.42 (−0.60, −0.24)*** | −0.45 (−0.63, −0.27)*** | 0.08 (−0.14, 0.30) |
| Rich | −0.56 (−0.76, −0.36)*** | −0.64 (−0.84, −0.45)*** | −0.02 (−0.26, 0.22) |
| Richest | −0.84 (−1.08, −0.61)*** | −0.90 (−1.13, −0.68)*** | −0.08 (−0.36, 0.19) |
| Survey year and mother's level of education | | | |
| 1992–93 | | | |
| Uneducated | | | |
| Primary | −0.06 (−0.25, 0.14) | −0.05 (−0.22, 0.12) | 0.05 (−0.20, 0.30) |
| Secondary | −0.35 (−0.53, −0.18)*** | −0.10 (−0.26, 0.05) | 0.06 (−0.17, 0.28) |
| >Secondary | −0.25 (−0.66, −0.04)*** | −0.22 (−0.48, 0.05)* | −0.16 (−0.56, 0.24) |
| 1998–99 | | | |
| Uneducated | | | |
| Primary | −0.08 (−0.26, 0.10) | 0.04 (−0.24, 0.22) | 0.08 (−0.15, 0.32) |
| Secondary | −0.22 (−0.39, −0.05)*** | −0.09 (−0.26, 0.08) | −0.01 (−0.24, 0.22) |
| >Secondary | −0.42 (−0.72, −0.13)*** | −0.25 (−0.55, 0.05)* | −0.03 (−0.43, 0.38) |
| 2005–06 | | | |
| Uneducated | | | |
| Primary | −0.10 (−0.29, 0.10) | −0.25 (−0.44, −0.06)** | 0.13 (−0.10, 0.36) |
| Secondary | −0.10 (−0.27, 0.07) | −0.20 (−0.36, −0.03)** | −0.02 (−0.23, 0.18) |
| >Secondary | −0.29 (−0.56, −0.02)** | −0.61 (−0.87, −0.35)*** | −0.14 (−0.45, 0.18) |

***$P < 0.01$; **$P < 0.05$; *$P < 0.10$; number given in parenthesis is 95% confidence interval.

*Notes:* The models presented in the table have been adjusted for sex of the child, age of the child, birth order and preceding birth interval, size of the child at birth, mother's age at birth of the child, father's education, use of antenatal care services, immunization status of the child, breastfeeding status, caste, religion, mother's exposure to media, current working status of mother, months of survey and region of the country.