Wealth and Health of Children in India

A State-Level Analysis

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What are the relationships between wealth and children's health in India's states that are as populous as many other countries? Presenting a state-level analysis of the association between state net domestic product per capita and three children's health indicators, this paper describes how these relationships differ in the last two rounds of the National Family Health Survey. It finds evidence that the cross-sectional relationships between aggregate wealth and children's health indicators are positive, yet the association was less steep in the mid-2000s than in the late 1990s. It also finds a negative relationship between growth in SNDP per capita and improvement in state-level children's health indicators. These findings are consistent with the hypothesis that the kinds of investments which improve health may lead to economic growth, rather than vice versa.

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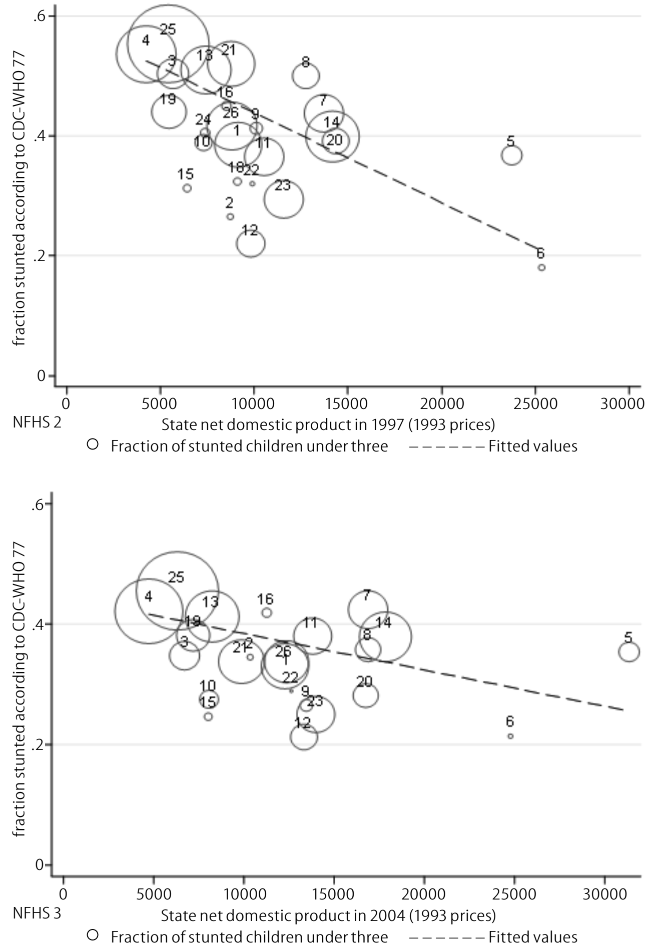
There is much interest, both among researchers and policymakers, in understanding relationships between aggregate income and health. In 1975, Preston described a strong, log-linear relationship between country-level mortality and income, suggesting that cross-country wealth is strongly associated with health, but that this relationship is less steep at higher levels of wealth. Although mortality is a particularly meaningful measure of the health of a population, health is, of course, multidimensional. Height is emerging as another important measure of health; it predicts life span, cognitive ability, and productivity. Preston's famous cross-country correlation between mortality and wealth contrasts with the puzzling result from Deaton (2007b) that average height across countries, another important measure of population health, does not correlate with gross domestic product (GDP) per capita.

This paper asks what relationships between wealth and health look like in India, a nation whose states are as populous as many other countries. We present a simple analysis of state-level children's health indicators and state-level measures of aggregate income, and describe how these relationships seem to be changing in recent years. We have analysed children's health indicators because they have received less attention in macro-level analyses of wealth and health, and because they are particularly low in India.

This paper adds a state-level analysis of the relationship between income and three children's health indicators to the literature. In addition to infant mortality, a widely used measure of children's health, this analysis also uses height as a health outcome of interest. Height is increasingly used, particularly by economists, as a marker of early life health. Height tells us about children's experiences of nutrition and disease (Steckel 2009), particularly from conception to age two. Due to the association between height and early life health, height is highly predictive of welfare later in life – taller people live longer, more productive, and healthier lives (Deaton 2007b). In India, as in many other countries, variation in children's height is strongly predictive of their cognitive achievement (Spears 2012).

We combine data from a variety of sources in the late 1990s and the mid-2000s to document cross-sectional associations between state net domestic product (SNDP) per capita and three measures of children's health – the average height for age z-score of children under three; the fraction of children stunted, or less than two standard deviations below the reference mean; and infant mortality. We find evidence that the relationship between aggregate income and the children's health indicators was less steep in the mid-2000s than in the late 1990s. Finally, we find a negative relationship between growth in SNDP per capita and improvement in state-level child height or infant mortality, but a positive correlation between children's health in the late 1990s and economic growth between the two surveys that we rely on. These findings are consistent with Deaton (2007a), who also finds that levels of health correlate with future economic growth. They suggest that the kinds of investments that are needed for good health may promote economic growth. For policymakers interested in improving health in India, this study suggests a need to look beyond measures of overall economic performance to specific ways of improving children's health, particularly in very early life when they are most vulnerable to health insults.

Figure 1: State-Level Relationships between Fraction of Under Three Who Are Stunted and SNDP Per Capita in NFHS 2 and NFHS 3



Size of circle proportional to approximate population of children under six.

Background

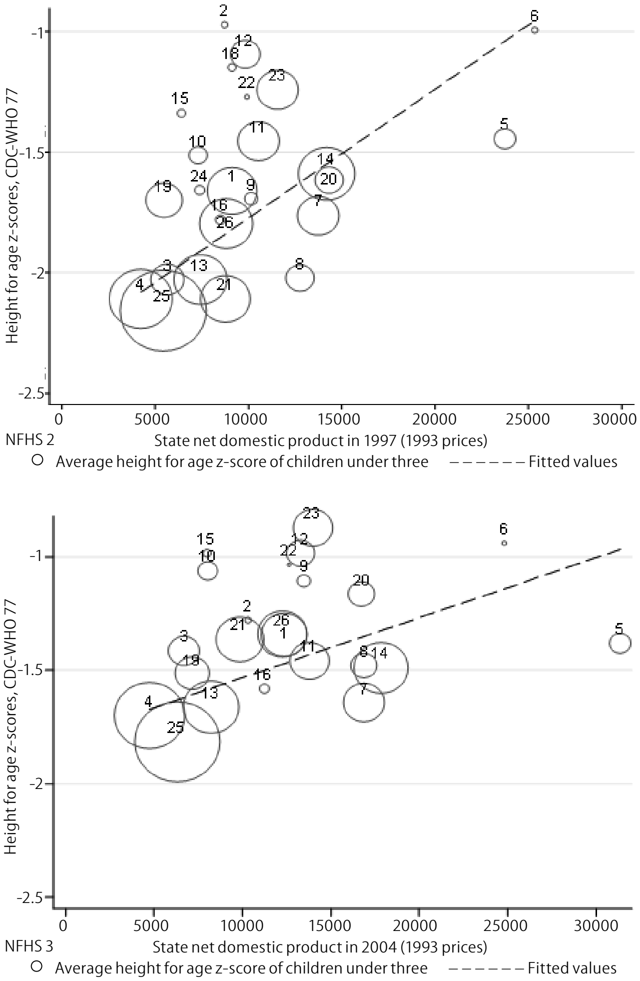
Prior studies present mixed results on the relationship between aggregate income and aggregate health, which depend both on the indicator used and the time and place studied. Prichett and Summers (1996) document a relationship of infant mortality and income per capita using cross-country data from the late 20th century. Fogel (2004) and others have suggested that in resource-constrained settings, there is a strong association between income and stature. However, Deaton (2007b) finds no relationship between height and GDP per capita in a sample of developing countries, and Bozzoli et al (2009) find no association between adult heights and GDP per capita in a sample of European countries.

Should we expect to find an association between SNDP per capita and children's health indicators in Indian states? Vanneman and Dubey (2011) calculate high within-state measures of inequality, which suggest that even in rich states, poor children may be deprived. However, there is some evidence from periods before the one we study that such a relationship may exist. Coffey (2013) finds that for state cohorts born in India between 1970 and 1983, there is a robust relationship between SNDP per capita in a cohort's year of birth and the cohort's adult height. Claeson et al (2000) point out that there was a state-level relationship between income and infant mortality in India from the 1970s to 1990, but that improvements in the infant mortality rate (IMR) seem to depend more on things such as nutrition and reproductive health interventions designed to target the neonatal period than income.

There is a proliferation of recent work making sense of India's economic growth (Subramanian 2009; Kohli 2012; Bhagwati and Panagariya 2013). As Kohli (2006) points out, at an average annual growth rate of about 6% over the last quarter century, "there is no denying that the Indian economy in recent decades has been one of the world's fastest growing economies" (1251). However, scholars disagree about the relationship between economic growth and improvements in health. Some suggest that economic growth is the key to poverty reduction (Bhagwati and Panagariya 2013), but others have observed that economic growth has not led to commensurate improvements in social welfare in India, and particularly not in health (Drèze and Sen 2013). Deaton and Drèze (2002) observe that rates of decline in child mortality in India do not match the unprecedented rates of economic growth, and Claeson et al (2000) point out that infant mortality declines in India have been quite slow compared to other countries. A related study suggests that declines in child malnutrition measured by anthropometric measures such as height and weight have also been slow (Radhakrishnan and Ravi 2004).

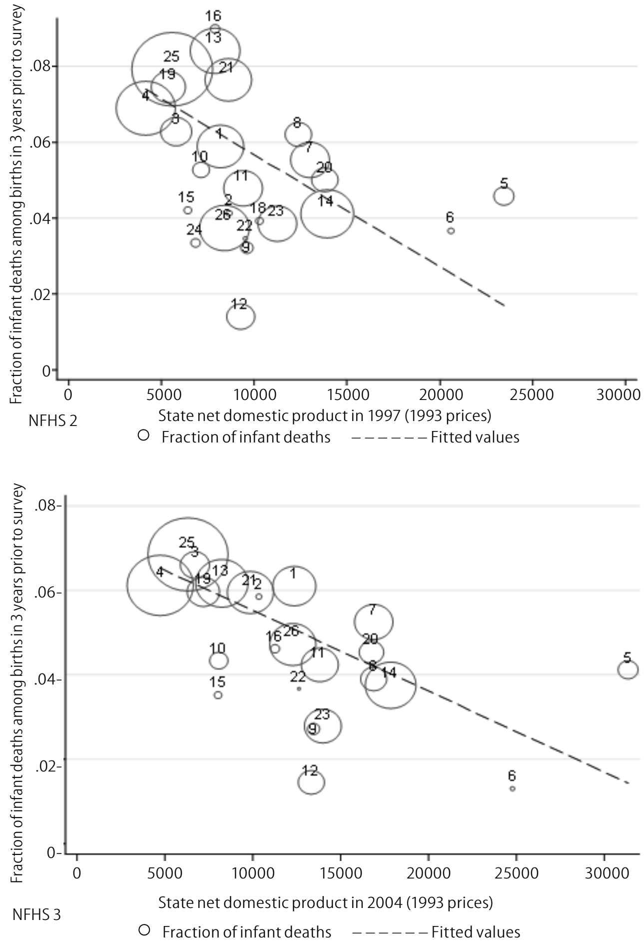
Prior studies have explored associations between aggregate measures of income and health in India. James and Syamala (2010) document an association between rising incomes in India and longer life expectancies; they also find that this association is weaker in later periods. Subramanyam et al (2011) regress individual-level binary indicators for children's anthropometric faltering on economic growth in that child's state in the 6.5 years before the survey; they do not find evidence that growth predicts these indicators of anthropometric faltering. Subramanian and Subramanyam (2011) show that states with more of an increase in per capita income between 1992 and 2005 experienced less of a

Figure 2: State-Level Relationships between Height for Age Z-Scores of Children Under Three and SNDP Per Capita in NFHS 2 and NFHS 3



Size of circle proportional to approximate population of children under six.

Figure 3: State-level Relationships between Infant Mortality among Children Born in the Three Years before the Survey and SNDP Per Capita in NFHS 2 and NFHS 3



Size of circle proportional to approximate population of children under six.

decrease in child underweight prevalence in the poorest wealth quintile.

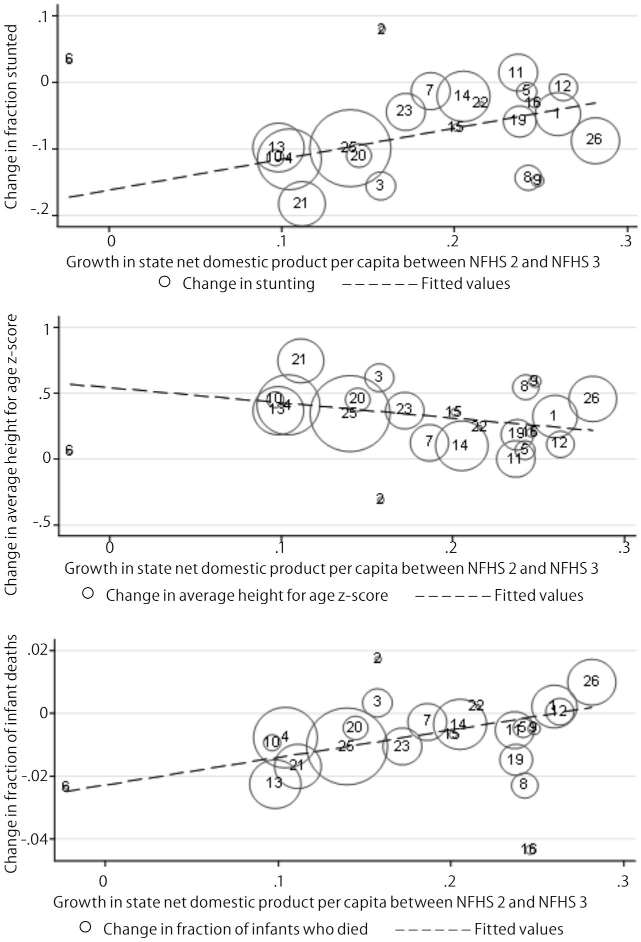
Data and Methods

This analysis combines data from several sources. Children's height and infant mortality are taken from the second (1998) and third (2005) rounds of the National Family Heath Survey (NFHS) (IIPS 1998, 2007). These surveys are representative at the state level. Children's height is measured in height for age z-scores according to the 1977 Centers for Disease Control and Prevention (CDC)-World Health Organisation (WHO) standard. Only the heights of children under three were used; although the NHFS 3 measured the height of children up to five, the NFHS 2 measured only the heights of children under three. When considering the association between children's heights and SNDP per capita, we use both the fraction of children stunted and the average height for age z-score of children in the state as outcome variables. Both these are important indicators of early life health in a population. The fraction of children stunted – that is, the fraction whose height for age z-scores are less than -2 standard deviations below the reference population – is a widely used measure of population health (Adair and Guillkey 1997; Wamani et al 2005). However, Spears (2012) shows that taller children are more likely to be able to read across the distribution of Indian heights, and that the relationship is approximately linear. Therefore, it makes sense not only to use the fraction stunted, which collapses height information into a binary variable, but also the height for age z-scores themselves. The infant mortality variable is the state-wise fraction of children born alive in the three years before the survey date who died before their first birthday.

SNDP per capita data are taken from the Economic and Political Weekly Research Foundation's *Domestic Products of States of India* (EPWRF 2009). We use SNDP per capita from 1997 and 2004, one year before each survey. The base prices are from 1993.

Finally, we linearly interpolate between the 1991 and 2001 Censuses to estimate the under-six population of each state in 1998, and between the 2001 and 2011 Censuses to estimate the child population in each state in 2005. The population of children under six in Jammu and Kashmir was not available for 2001, so for the 1998 population we interpolated backwards, assuming the same linear rate of growth as that from

Figure 4: Relationship between Growth in SNDP Per Capita and Change in Child's Health Outcomes between NFHS 2 and NFHS 3



Size of circle proportional to average of 1998 and 2005 under six population.

1 = Andhra Pradesh, 2 = Arunachal Pradesh, 3 = Assam, 4 = Bihar and Jharkhand, 5 = New Delhi, 6 = Goa, 7 = Gujarat, 8 = Haryana, 9 = Himachal Pradesh, 10 = Jammu and Kashmir, 11 = Karnataka, 12= Kerala, 13= Madhya Pradesh and Chhattisgarh, 14 = Maharashtra, 15 = Manipur, 16 = Meghalaya, 17 = Mizoram, 18 = Nagaland, 19 = Odisha, 20 = Punjab, 21 = Rajasthan, 22 = Sikkim, 23 = Tamil Nadu, 24 = Tripura, 25 = Uttar Pradesh and Uttarakhand, 26 = West Bengal.

between 2001 and 2011. We use these child population figures to weight the observations in both the graphs and the regression analyses.

Three new states – Chhattisgarh, Uttarakhand, and Jharkhand – were formed between the two rounds of the NFHS. To facilitate comparison, we create population figures and weighted SNDP per capita figures for 2005 that combine Chhattisgarh and Madhya Pradesh, Uttarakhand and Uttar Pradesh, and Jharkhand and Bihar.[1] The analysis uses states for which there is both NFHS data and SNDP per capita data.

Results

State-Level Associations between Income and Children's Health

A state-level analysis suggests strong associations between children's height and SNDP per capita, and infant mortality and SNDP per capita. Figure 1 (p 65) shows that in both the NFHS 2 and the NFHS 3, there is an inverse relationship between the fraction of children stunted in a state, and the SNDP per capita of that state. Figure 2 (p 66) likewise shows state-level relationships between average height for age z-scores and SNDP per capita in both the NFHS 2 and the NFHS 3.[2] Figure 3 (p 66) plots, for NFHS 2 and NFHS 3 separately, the fraction of infants in each state who died in the three years before the survey against SNDP. We find positive and significant associations in these cross-sections, but it seems that the relationship is weaker in the NFHS 3 than the NFHS 2.

Changing Magnitude of the Relationship between Income and Children's Health

What are the magnitudes of these relationships in the two surveys? In the NFHS 2, a Rs 5,000 difference in SNDP per capita is associated with a difference of 1.5 infant deaths per 1,000. Using the same states as were available for NFHS 2, the same difference in real net domestic product per capita in NFHS 3 was associated with only a difference of 1 infant death per 1,000. In NFHS 2, a Rs 5,000 difference is associated with a 7 percentage point difference in stunting prevalence, but in NFHS 3, this difference in SNDP per capita was associated with a 3 percentage point difference in stunting prevalence. Finally, in NFHS 2, a Rs 5,000 difference in SNDP per capita was associated with more than a quarter of a standard deviation difference in the average height for age z-score of children under three. The comparable figure for the NFHS 3 was a 0.13 standard deviation difference in the average height for age z-score of children under three.

Therefore, for all three dependent variables, the magnitude of the association between wealth and health seems to be smaller in NFHS 3 than NFHS 2. The regressions in Table 1 test the hypothesis that the relationships between wealth and children's health are weaker in the later survey than the earlier one. Table 1 shows the results of a pooled regression of a state and survey round-specific child health indicator on SNDP per capita in that round and state, plus an indicator for the observation being from NFHS 3 and the interaction of the survey round with SNDP per capita.[3] As expected, for stunting and infant mortality, there is a positive coefficient on the interaction

Table 1: SNDP Per Capita (Thousands of Rupees) Is More Weakly Associated with Health in NFHS 3 Than NFHS 2

Dependent Variable	(1) Fraction of Children Under 3 Who Are Stunted	(2) Average Height for Age z-Score of Children Under 3	(3) Infant Deaths of Children Born in the 3 Years before the Survey
SNDP per capita	-0.0148 (0.00399)	0.0532 (0.0127)	-0.00296 (0.000753)
NFHS 3	-0.139 (0.0519)	0.499 (0.177)	-0.0119 (0.00957)
SNDP per capita X NFHS 3	0.00876 (0.00483)	-0.0268 (0.0166)	0.00104 (0.000880)
	p=0.07	p=0.11	p=0.25
c	0.584 (0.0404)	-2.295 (0.125)	0.0863 (0.00810)
n (states)	46	46	46
R^2	0.46	0.24	0.43

In the regressions in this table, there are two observations for each state. One observation uses data from the NFHS 2 and the other uses data from the NFHS 3. Coefficients are estimated using ordinary least squares regression, and observations are weighted using the under six populations of each state in the year of the relevant survey round. Heteroskedasticity-robust standard errors are shown in parentheses.

term, and for height there is a negative sign. This means that in the later round of the survey, the relationship between SNDP and children's health variables was less steep.

Inverse State-Level Relationship between Growth Income and Health Improvements

Figure 4 (p 67) shows relationships between growth in SNDP per capita and changes in children's health outcomes between the two surveys. Growth in SNDP per capita is calculated as the ratio of the difference between SNDP per capita 2005 and 1998 to SNDP per capita in 1998.

The top panel shows the difference in fraction of children stunted, the middle panel shows the difference in the average height for age z-score, and the bottom panel shows the difference in the fraction of children born in the three years before the survey who died as infants between NFHS 2 and NFHS 3. The fitted lines for each of these graphs, weighted by the average population of the state in the two time periods, have negative slopes for the top and bottom panels, and a positive slope for the middle panel. These fitted lines suggest that states which experienced more economic growth witnessed less of a decline in stunting prevalence and infant mortality. The same story emerges when looking at height for age z-scores – on average, states that experienced more economic growth saw less of an increase in height for age z-scores. Table 2 shows the raw data used to construct these graphs.

The surprising inverse relationship between change in SNDP per capita and improvement in children's health outcomes are quite precisely estimated. Table 3 presents the results of regressions of the difference in the three child health variables on the growth in SNDP per capita. The *p*-value for the coefficient on growth in SNDP per capita in the regression using change in stunting as a dependent variable is less than 0.01, as is the *p*-value for the coefficient in the regression using change in infant mortality as the dependent variable. In the regression using change in average height for age z-scores, the *p*-value is about 0.10. Considering the small sample of states, these *p*-values suggest a very low probability that the negative relationship between growth in wealth and improvement in children's health described here are due to chance alone.

Table 2: Growth in SNDP Per Capita and Change in Children's Health Indicators

State	Growth in State Net Domestic Product Per Capita	Change in Average Height-for-Age z-Score	Change in Stunting Prevalence	Change in Infant Deaths Per 1000	Average of 1998 and 2005 Estimated Child Population
Andhra Pradesh	0.34	0.32	-0.048	0.0022	99,84,902
Karnataka	0.32	0.00	0.015	-0.0054	71,61,167
West Bengal	0.31	0.45	-0.087	0.0100	1,11,76,108
Kerala	0.30	0.11	-0.007	0.0005	37,05,529
Meghalaya	0.30	0.20	-0.031	-0.0435	4,74,410
Himachal Pradesh	0.29	0.59	-0.148	-0.0048	7,94,375
Haryana	0.27	0.54	-0.143	-0.0229	32,96,419
Delhi	0.25	0.07	-0.014	-0.0047	19,46,163
Odisha	0.25	0.18	-0.058	-0.0148	52,92,481
Sikkim	0.25	0.23	-0.032	0.0022	74,239
Gujarat	0.23	0.12	-0.013	-0.0027	74,19,451
Maharashtra	0.22	0.10	-0.021	-0.0036	1,34,80,187
Manipur	0.20	0.35	-0.067	-0.0068	3,17,220
Tamil Nadu	0.20	0.37	-0.044	-0.0106	71,99,027
Punjab	0.18	0.45	-0.110	-0.0046	31,45,939
Goa	0.17	0.05	0.033	-0.0235	1,43,375
Arunachal Pradesh	0.17	-0.31	0.080	0.0173	2,01,761
Assam	0.14	0.61	-0.156	0.0034	44,89,237
Bihar/Jharkhand	0.13	0.41	-0.115	-0.0077	1,98,39,579
Rajasthan	0.13	0.75	-0.183	-0.0168	1,03,53,058
Jammu and Kashmir	0.12	0.45	-0.113	-0.0093	15,11,944
Uttar Pradesh/ Uttarakhand	0.11	0.34	-0.099	-0.0106	3,14,05,377
Madhya Pradesh/ Chhattisgarh	0.04	0.37	-0.098	-0.0225	1,28,65,114

Table 3: Growth in SNDP Per Capita Is Associated with Less Improvement in Children's Health

Dependent Variable	(1) Change In fraction of children under 3 Who Are Stunted	(2) Change in Average height for Age z-Score of Children under 3	(3) Change in Infant Deaths of Children Born in the 3 Years before the Survey
Growth of SNDP per capita	0.465 (0.170)	-1.152 (0.733)	0.088 (0.030)
	$p=0.01$	$p=0.13$	$p<0.01$
c	-0.162 (0.028)	0.540 (0.123)	-0.023 (0.005)
n (states)	23	23	23
R^2	0.32	0.17	0.40

In these regressions, there is one observation per state. The dependent variable is the difference in the outcome variable between NFHS 3 and NFHS 2, and the independent variable is growth in SNDP per capita calculated by subtracting the difference in SNDP per capita in the two years and dividing by the initial value. Observations are weighted by the average of the 1998 child population of the state and the 2005 child population. Heteroskedasticity-robust standard errors are shown in parentheses.

For the outcome variables of fraction stunted and fraction born in the three years before the survey who died as infants, the results are robust to using per cent changes, rather than level changes. That is, if, instead of doing the analysis with the level difference in the outcome variable between NFHS 2 and NFHS 3, we do the analysis with the per cent change in these variables, we find similar results.

Discussion

Macroeconomic Conditions and Children's Health

What do the analyses described here suggest about the relationship between wealth and children's health in India? Part of the strong positive association can certainly be explained by that wealth allows people to afford better food, medical care and home environments. Societies that are richer can invest in public goods such as sanitation, vector control, and education. But the association between wealth and health outcomes was weaker in NFHS 3 than NFHS 2. Perhaps even more strikingly, states which improved their SNDP per capita did not see corresponding improvements in children's health, and some states that did not achieve economic growth did improve children's health indicators.

Why is economic growth associated with less improvement in children's health? This might be the case if states that were already healthier experienced more economic growth over the period under study. There is indeed a high correlation between state averages of children's health in 1998 and economic growth between the two rounds of the survey. The correlation between height for age in 1998 and economic growth between the two survey rounds was 0.4; comparable figures for stunting and infant death were -0.31 and 0.39. In addition to suggesting a reason for the negative relationship between economic growth and improvement in health indicators, these correlations provide suggestive evidence for the hypothesis, discussed by Deaton (2007a), that the kinds of public and private investments which create healthy populations also help promote economic growth.

Making Children's Health a Priority

These findings suggest that going forward, policymakers should work to improve children's health, rather than rely on economic growth to spur health improvement. Even in wealthy states such as Maharashtra, recent survey data finds deprivation on a number of indicators of children's health (IIPS-UNICEF 2012).

But to what types of interventions, then, should we turn? Deaton (2007b) suggests that good governance and women's education are likely to be two factors that both determine health conditions and promote economic growth. Investments in these areas are certainly needed in India, but they are long-term investments. What can be done to improve children's health in the short term?

There is increasing evidence that the first 1,000 days of life, that is, from the moment of conception to two years of age are extremely important for children's health, which is quite malleable (UNICEF 2013). The vast majority of child deaths occur in this window – indeed, more than 80% of the deaths of children born to women interviewed for NFHS 3 died before two years of age.[4] What is more, children's height, which we have used as an indicator of health in this analysis, is more or less set by the time that they are two years old (Waterlow 2011). Thus efforts to improve children's health need to be directed at very young children.

What are some promising interventions that could make a difference in the 1,000-day window? One place to start is to improve maternal health. Children spend most of the 1,000-day window dependent on their mothers for the nutrition they consume; they would spend about nine months in the womb, then, ideally, six months exclusively breastfeeding, and a year and a half breastfeeding and complementary feeding. And yet improvements to women's health and nutrition in India have been slow, and have lagged behind men's. Deaton and Drèze (2009) point out that both women's heights and their body mass index scores have been improving at slower rates than men's in India. Almost 20 years ago, Ramalingaswami et al (1996) suggested that poor women's health in India was worse than in other developing countries, including those in sub-Saharan Africa; unfortunately this continues to be true today. This is in part because of severe gender discrimination in India, where maternal and childcare are viewed narrowly as women's issues. For instance, Chattopadhyay (2012) shows that men are rarely involved in maternal care, which impedes access to care.

India Time Series

The EPW Research Foundation (EPWRF) has been operating an online database service christened as '**India Time Series**' (ITS), acronym as EPWRFITS, which can be accessed through the newly launched website **http://www.epwrfits.in**

Under the online data service, time series have been structured under various modules: (i) Financial Markets; (ii) Banking Statistics; (iii) Domestic Product of States of India; (iv) Price Indices; (v) Agricultural Statistics; (vi) Power Sector; (vii) Industrial Production; (viii) Finances of State Governments; (ix) Combined Government Finances; (x) National Accounts Statistics; (xi) Annual Survey of Industries; (xii) External Sector; and (xiii) Finances of the Government of India.

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Another promising area of intervention in the first 1,000 days is sanitation and hygiene. There is mounting evidence that diseases caused by poor sanitation and hygiene play an important role in both child mortality and child height in India (Spears 2013b, 2013c). Poor sanitation and hygiene lead to disease, and particularly gastrointestinal diseases. Not only do these diseases kill large numbers of children, they also stunt the growth and development of those who survive. And yet, as in the case of women's health, India lags far behind in providing basic sanitation. Sixty per cent of the people who openly defecate without a toilet or latrine live in India, and the country has done worse than Pakistan, Bangladesh, and much of sub-Saharan Africa in improving latrine coverage. Indeed, Spears (2013a) suggests that lack of sanitation coverage alone can explain the gap between the heights of Indian children and children in sub-Saharan Africa.

Our findings suggest that policymakers must look to specific interventions that reach mothers and very young children if they want to make faster progress on improving the abysmal state of children's health in India. As Indians' incomes grow, and they have a greater ability to afford food and basic medical care, factors such as women's health and sanitation are likely to be increasingly important reasons for differences in health across states in India and between India and the rest of the world. Enthusiasm for India's economic growth must be tempered by attention to specific ways of improving the poor health of children in the country.

NOTES

1 These figures are weighted by the 2001 populations of the states.

2 NFHS 1 was omitted from this analysis because heights were not measured in six largest states.

3 Nagaland and Tripura are omitted from these regressions because they did not have SNDP per capita information for 2005.

4 This figure does not include the large numbers of still births and miscarriages that are associated with poor women's health (Agarwal et al 1998).

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An author-title index for EPW has been prepared for the years from 1968 to 2012. The PDFs of the Index have been uploaded, year-wise, on the EPW website. Visitors can download the Index for all the years from the site. (The Index for a few years is yet to be prepared and will be uploaded when ready.)

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