Early Childhood Health and Development in India: A Review of the Evidence and Recommendations for the Future

ABSTRACT  This paper documents temporal trends and interstate and intrastate disparities in child health and cognitive ability in India, and reviews the theoretical and empirical literature on policy interventions that may help ameliorate these gaps. We show that despite rapid improvements in early childhood health across much of India over the past three decades, many areas still experience persistently high rates of infant mortality, low rates of child immunization, and low levels of child academic achievement. We outline a series of interventions with a strong theoretical and empirical evidence base for improving physical and cognitive development of young children in these areas, including improved nutrition and sanitation, parental stimulation, and caretaker focus on cognitive and emotional development of the child. We then describe various challenges that must be overcome before these interventions can be carried out successfully, as other market failures and issues of state capacity are often present. We conclude by recommending that as India scales up programs aimed at early childhood health and development, it must (a) collect extensive data to understand where programs should be deployed in order to maximize their impact and (b) perform rigorous program evaluations to ensure that interventions which have been shown to work in more favorable settings are also successful in the Indian context.

Keywords: Child Health and Development, India, Policy

JEL Classification: I1, O
1. Introduction

Children’s experiences in utero and in early life can have large, long-lasting impacts that translate into health and economic well-being in adulthood (Almond and Currie 2011; Currie and Vogl 2013; Heckman 2006, 2007). Microeffects have also been shown to extend to the macrolevel, for example, in robust international associations between health in early life and economic indicators such as GDP per capita (Weil 2014). These findings suggest that policies that bolster the survival and development of infants and young children have more than just an ethical imperative: when implemented well, they generate large economic returns. Still, despite the growing academic consensus, policy makers in low-income countries have been slow to shift their focus to this issue, resulting in insufficient funding and regulatory oversight for programs that improve the welfare of young children (Britto, Engle, and Super 2013).

With regard to child health, India’s story over the past decade has largely been one of success in reducing infant mortality and encouraging healthy growth through immunization and supplementation. Infant mortality has fallen from 66 deaths per 1,000 live births in 2000 to 39 deaths per 1,000 live births in 2014, and DPT immunization rates have increased from 58 percent to 83 percent during the same time period.

Yet progress has been uneven. Both the level and the rate of improvement of child health in India remain widely unequal. Infant mortality rates (IMRs) in Uttar Pradesh and Madhya Pradesh are more than four times those of Kerala, while the gap between the most and least vaccinated states is more than 40 percentage points. Even within states, there exist stark disparities. IMRs of children born in rural areas are more than 1.5 times those of their urban counterparts. Similarly, the difference between the most and least vaccinated districts “within” states is almost always greater than 30 percentage points.

Of course, greater economic development should help improve many of these outcomes. Figure 1 shows state-level infant mortality and immunization rates as a function of (log) state income per capita. There is a clear relationship between the level of economic development and infant mortality and immunization rates. However, almost equally striking is the amount of variation in performance among states with similar levels of income. This variation suggests that, at least for intermediate stages of growth, economic development is not a panacea; there is an important role for government programs and policies to improve early childhood outcomes (and by extension later-life outcomes) among its citizens.
These statistics pose a natural question: How can governments help to remediate disadvantage and reduce the inequalities of early childhood that translate to wide gaps in achievement and well-being in adulthood? With regard to health, the best tools for fighting these inequalities are well known: access to vital micro and macronutrients, immunization from life-threatening diseases, access to clean water and local sanitation, and prevention and rapid treatment of infectious diseases. These tools must be combined with strategies that prioritize the so-called “last mile”—getting effective interventions to the (often disenfranchised) populations that need them most but get them at rather high marginal costs. This is where the most work is still needed, to stimulate consumer demand and bolster the incentives of local agents to provide high-quality health and nutrition services.

While the survival and health of young children is paramount, cognitive and non-cognitive skills (which are not perfectly correlated with child
health) are often more strongly associated with economic outcomes in adulthood. In this regard, the picture in India is fuzzier. While there is some nationally representative evidence on spatial patterns of cognitive development in later childhood in India (ages 5 and up), the country is lacking a comprehensive data source for skill and capability development at early ages (below age 3, for instance). These data are important to assess where the geographic disparities in skill deficits at early ages are most important.

The importance of addressing under-investment in early childhood development was highlighted by a recent series in *The Lancet*. The authors suggest that 53 percent of the under-five-year olds in South Asia are at risk of “not reaching their development potential” (Black et al. 2016). To combat these deficits, governments must employ a rapid scaling-up of interventions focused on “nurturing care,” or “a stable environment that is sensitive to children’s health and nutritional needs, with protection from threats, opportunities for early learning, and interactions that are responsive, emotionally supportive, and developmentally stimulating” (Britto et al. 2016). Nutrition and health interventions are affordable starting points to implement these policies more broadly (Richter et al. 2016).

In recent years, the Indian government has spearheaded early childhood education initiatives, guided by the emphasis given to this topic in the Eleventh Five Year Plan (2007–12) and subsequently by the Right of Children to Free and Compulsory Education Act in 2009. These commitments from the central government—along with several high-profile initiatives to support them—establish a set of national priorities related to early childhood development. Such initiatives include the delivery of preschool education through the Integrated Child Development Services (ICDS); community-based child development support through Accredited Social Health Activists (ASHAs); and the Rajiv Gandhi National Crèche Scheme (RGNCS).

These programs have the potential to become vital components of a holistic set of national policies that promote early childhood development. In this paper, we highlight three critiques of the status quo and point to potential solutions that have proven successful in other contexts (covered in detail in Section 4). The critiques are as follows. First, policy implementation, which is largely administered by individual states in India, has thus far been inadequate. Second, empirically sound evaluation of pilot

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1. Of course, these correlations are conditional on survival. More work is necessary to determine what part, if any, of these correlations comes from selection bias.
initiatives is needed to identify the highest return policy levers and weed out low-return programs. Third, even successful pilots may flounder when brought to scale; this problem may be particularly salient given India’s complex political and institutional environment. We thus emphasize the need for proper monitoring and evaluation of at-scale initiatives through purposeful investment in data gathering and analysis, while also adjusting program implementation to take into account provider incentives and stimulation of public demand.

The remainder of the paper is organized as follows. Section 2 provides some background on the current status of and recent trends in child health and development in India, with special attention given to the inequality in these measures across Indian states (and between districts within states). Section 3 describes a theoretical framework for health and skill formation in childhood, through which we identify key elements of good policy making for the early advancement of children. Section 4 reviews the relevant literature in public health and economics for successful interventions aimed at reducing inequities in child health and early skill development, discusses the potential scalability of these interventions in the Indian context, and recommends next steps for public policy. Section 5 concludes the paper.

2. The State of Child Health in India

In this section, we use data from several large, nationally representative surveys to characterize both the current state of early childhood health in India and variation in these outcomes by gender, urbanity, and state. There are three key findings. First, Indian infant mortality and immunization rates have improved considerably since 1980. By 2013, the Indian IMR had dropped to one-third of its 1980 level and DPT immunization rates increased from 16 percent in 1984 to 83 percent in 2013. However, there is substantial heterogeneity across and within Indian states in both immunization and infant mortality. For instance, in 2013, IMRs in Kerala were similar to those of Mexico, while IMRs in Madhya Pradesh were slightly higher than Ethiopia’s. Additionally, all states have severe rural-to-urban disparities in infant mortality but much smaller gaps in immunization rates. Finally, there is also large variability in childhood cognitive outcomes across states: while 99 percent of 8 to 11 year olds in Kerala can recognize letters, the same is true for only 76 percent of 8 to 11 year olds in Uttar Pradesh. The following sub-sections describe these findings in greater detail.
2.1. Measurement of Early Childhood Health Outcomes

We study changes over time and differences across space in Indian early childhood health outcomes and Indian early childhood health investments. To summarize early childhood health outcomes, we use infant mortality, which has several advantages as a measure of early childhood health. First, saving the lives of young children is an inherently important policy outcome. Second, IMRs can be objectively measured through surveys (vital registration records from hospitals, for example, would not be as representative for this purpose since many deaths do not occur in hospitals). Third, IMRs are at least moderately correlated with many other early childhood health outcomes of interest. Fourth, IMRs are widely measured across the developing and developed world, allowing for the Indian experience to be placed in an international context.

As a proxy for early childhood health investments, we use the percentage of 12 to 23 month olds receiving all appropriate DPT, measles, polio, and BCG (tuberculosis) vaccinations. Immunization rates were chosen because they are easily and objectively measured (most survey enumerators examine an individual’s immunization card); they are highly correlated with other outcomes of interest; and they provide large payoffs in terms of reduced mortality, improved later-life health, and human capital accumulation. While it would be beneficial to have data on other forms of household-based investments such as time spent playing (stimulation), providing a varied diet to the child etc., such data is not available to us.

Table 1 shows the pair-wise correlations between state-level IMRs, full vaccination rates, percentage of institutional births, percentage of mothers receiving an antenatal checkup, percentage of children receiving Vitamin A supplementation, and percentage of children experiencing stunting (less than –2 standard deviations below average height-for-age). The correlations for stunting are for a subset of 19 states with sufficient data. Infant mortality is moderately correlated with all major outcomes of interest in the expected direction, although no correlations are significant. Vaccination rates are highly and significantly correlated with all other measures of child investment and improved maternal/neonatal care.

All the 2013 data on state and district immunization rates were collected from the District Level Household and Facility Survey IV (DLHS) and the Annual Health Survey (AHS) 2012–13 state reports. The 2013 data on infant mortality was collected from the Indian Census Sample Registration System 2013 Statistical Report. All 1993 data on infant mortality and immunizations were collected from the 1992–93 Demographic Health
**Table 1.** State-level Correlations between Key Outcomes of Interest

<table>
<thead>
<tr>
<th>Infant Mortality</th>
<th>% Fully Vaccinated</th>
<th>% Institutional Deliveries</th>
<th>% Antenatal Check-up</th>
<th>% Receiving Vitamin A</th>
<th>% Stunting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infant mortality</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% fully vaccinated</td>
<td>-.1537</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% institutional deliveries</td>
<td>-.2555</td>
<td>.4096**</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% antenatal check-up</td>
<td>.1728</td>
<td>.6583***</td>
<td>.6243***</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>% receiving vitamin A</td>
<td>-.2778</td>
<td>.5436***</td>
<td>.7107***</td>
<td>.6346***</td>
<td>1</td>
</tr>
<tr>
<td>% stunting</td>
<td>.29</td>
<td>-.4216*</td>
<td>-.7843***</td>
<td>-.5662***</td>
<td>-.7462***</td>
</tr>
</tbody>
</table>

Source: 2012 India Human Development Survey (IHDS).
Note: *p < .1, **p < .05, ***p < .001
Survey (DHS). The DHS and DLHS are large, nationally representative surveys of Indian population health with an emphasis on reproductive and early childhood outcomes.

Finally, as a proxy for child cognitive development, we use a rudimentary reading, writing, and math test given to children aged 8 through 11 in the 2012 India Human Development Survey (IHDS), India’s only national panel dataset collected by the National Council of Applied Economic Research (NCAER). Despite the amount of attention paid to early childhood physical health interventions and measurement, there has not been a commensurate focus on early childhood cognitive and socio-emotional outcomes. This gap in knowledge is important: A large number of studies from across the developed and developing worlds have shown that cognitive and non-cognitive developmental outcomes are closely linked with adult labor market productivity. Indeed, the wide disparities found in this study based on a much cruder measure of child cognitive development suggest that much more work in this area is needed.

2.2. Aggregate Trends in Indian Early Childhood Health

Indian early childhood health care and health outcomes have improved markedly over the past 30 to 40 years. Figure 2 shows trends in Indian infant mortality and Indian immunization rates relative to other large developing countries using data collected by the World Bank. Infant mortality has fallen from 142 deaths per 1,000 live births in 1974 to 39 deaths per 1,000 live births in 2014. Similarly, the proportion of children receiving the DPT immunization has increased from 16 percent in 1984 to 84 percent by 2014. However, despite these advances, Indian IMRs remain more than three times those of China and 1.7 times those of Indonesia, leaving considerable room for improvement.

Figure 3 shows the current ratio of rural-to-urban Indian IMRs and immunization across Indian states. As pictured, there are stark disparities in IMRs between rural and urban areas: the rural IMR is 25–75 percent greater than the urban rate in most Indian states and more than double the urban rate in a small number of states in the northeast. Saikia et al. (2013) suggest that much of this gap can be explained by the higher levels of maternal education and wealth in urban areas rather than better provision of health care per se. Thus, development programs aimed at increasing rural standard of living may also work to decrease rural-to-urban early childhood health disparities.
FIGURE 2. Changes in Infant Mortality and Immunization Rates among Selected Developing Countries over Time

Infant Mortality Rate (1970–2014)

Year


Pct. 12–23 Month Olds with DPT Imm. (1984–2014)

Year


Source: Data on infant mortality and DPT immunization rates from World Bank.
FIGURE 3. Ratio of Rural to Urban Infant Mortality and Immunization Rates by State

**Panel A**

Ratio of Rural to Urban Infant Mortality Rate

**Panel B**

Ratio of Rural to Urban Immunization Rates

(\% of 12–33 Month Olds with All Immunizations)

Sources: Infant mortality data from the 2013 Indian Census State Sample Registration Statistical Report and immunization data from the District Level Household and Facility Survey IV (DLHS) and the Annual Health Survey (AHS) 2012–13 state reports.

Notes: In Panel B state reports were not available for Gujarat and Jammu & Kashmir. These maps are not to scale and may not depict authentic boundaries.
In contrast to infant mortality, rural-to-urban differences in immunization rates, while present, appear smaller. Indeed, in some states, such as Andhra Pradesh, Odisha, and Tamil Nadu, immunization rates in rural areas have reached or surpassed those of urban areas. These results suggest that although Indian government’s action has been partially successful in closing the immunization gap between rural and urban regions, they have been less successful in closing the gap in outcomes, at least as proxied through the IMR. Understanding why this is the case is an important area for future research.

Finally, Figure 4 illustrates the ratio of male-versus-female IMRs across states. In most states, male IMRs are 5–10 percent lower than

FIGURE 4. Ratio of Male-to-Female Infant Mortality Rates by State

Sources: 2013 Indian Census State Sample Registration Statistical Report.
Note: This map is not to scale and may not depict authentic boundaries.

2. It is important to note that since we create ratios of variables measured on different scales, it is difficult to compare the magnitude of urban–rural disparities across variables. However, the fact that some regions have reached parity between rural and urban areas for immunization rates, while only one state has done so for IMRs, suggests that this larger gap is not simply an artifact of how we chose to display the data. The decline in rural–urban immunization gaps has also been documented in Singh (2013).
female rates. Although these disparities are smaller than the rural–urban gap, unlike the rural–urban disparity, these differences likely cannot be explained by differences in mothers’ socioeconomic status or access to health facilities. Understanding the extent to which preference for males leads to higher IMRs for females is an area of highly important ongoing research. Male and female infant immunization rates were only available for a subset of states surveyed in the 2012–13 DLHS, but these data show roughly equivalent immunization rates between boys and girls.

2.3. State-level Variation in Early Childhood Health

India has enormous regional variation in standards of living, culture, language, and gender equality. Thus, it is perhaps unsurprising that there is also substantial state-level heterogeneity in early childhood investments and health outcomes. Figure 5 shows infant mortality and immunization rates at the state level in 2013. In general, the south and northwest of the country have relatively low IMRs while the north and northeast have higher rates. The extent of spatial variation is quite striking: Kerala has approximately the same IMR as Mexico (12 deaths per 1,000 live births), while Madhya Pradesh has a rate similar to Ethiopia (54 deaths per 1,000 live births). There is a similar degree of state-level variation among immunization rates, but much less spatial correlation.

Figure 6 shows state IMRs after adjusting for state GDP per capita. There are two main things to note. First, even after controlling for state GDP, there still exists a large amount of interstate variation in both IMRs and immunization rates. Second, although a number of states under or over-perform their predicted values based on GDP per capita, the rough geographic disparities in infant mortality and immunization rates remain.

3. The ratio between male and female IMRs in Kerala and Goa is particularly low because the overall IMRs are extremely low. In absolute terms, the difference between the Keralan male and female IMRs is only 3 deaths per 1,000 live births.

4. Some of the low immunization rates reported in DHLS IV are surprising, especially those of Tamil Nadu (56 percent). Indeed, the 2009 UNICEF coverage survey recorded immunization rates more than 20 percentage points higher than the DLHS IV estimates. However, early reports from the National Family Health Survey IV (2016) also found relatively low (though still 13 percentage points higher than in the DLHS report) immunization rates and a decrease of similar magnitude since 2005. Thus, although the DLHS reports of immunization rates in Tamil Nadu appear inexplicably low, the directionality of the trend over time appears to agree with other data sources.
FIGURE 5. 2013 Infant Mortality and Immunization Rates by State

Panel A
2013 Infant Mortality Rate (Deaths per 1,000 Live Births)

Panel B
2012 Percent 12–23 Month Olds with All Immunizations

Sources: Infant mortality data from the 2013 Indian Census State Sample Registration Statistical Report and immunization data from the District Level Household and Facility Survey IV (DLHS) and the Annual Health Survey (AHS) 2012–13 state reports.

Notes: In Panel B of the above figure, state reports were not available for Gujarat and Jammu & Kashmir.
These maps are not to scale and may not depict authentic boundaries.
Sources: Infant mortality data from the 2013 Indian Census State Sample Registration Statistical Report and immunization data from the District Level Household and Facility Survey IV (DLHS) and the Annual Health Survey (AHS) 2012–13 state reports.

Notes: The above GDP-adjusted figures show the residuals of an OLS regression of the outcome variable on log GDP/capita. These residuals were then normalized such that the value for the state with the lowest value was set equal to 0.

In Panel B of the above figure, state reports were not available for Gujarat and Jammu & Kashmir.

These maps are not to scale and may not depict authentic boundaries.
Figure 7 shows how infant mortality and vaccination rates have changed at the state level between 1993 and 2013. There are several important takeaways. First, infant mortality fell dramatically in almost all Indian states during this time frame with the exception of Jammu and Kashmir. Second, this decrease was especially prominent in the north and Tamil Nadu, with reductions of 40 to 55 deaths per 1,000 live births—a remarkable public health accomplishment. Third, vaccination rates also increased throughout much of the country, but these gains were particularly pronounced in the north. Indeed, several wealthier states, including Tamil Nadu, Maharashtra, and Haryana, saw only small gains or small falls in immunization rates over this time period.

The relative stagnation of immunization rates in India’s higher income states is not well understood. Dasgupta et al. (2014) found in a correlational analysis that the districts experiencing immunization-rate declines in nine higher income states were more likely to be urban and less likely to have a higher proportion of Scheduled Castes/Scheduled Tribes. However, much more research is required to understand why immunization gains may have stopped in India’s wealthier states, especially because early data from the 2015–16 DHS suggests that this trend has continued in the years since 2012.

Broad-based gains in both infant mortality and immunization rates, especially in the poorest regions of India, suggest that various factors including economic growth and government initiatives have been relatively successful over the past few decades in improving investments in child health and child health outcomes. However, despite these improvements, large parts of the country still remain plagued by high IMRs and nonuniversal vaccination, reminding us that much work still lies ahead.

Finally, Figure 8 shows the level of inter-district variation in vaccination rates within the same state. Each point on the graph represents a specific district, with the Y-axis reflecting the percent of 12 to 23 month olds fully vaccinated in that district and the X-axis standing for the state in which the district is located. This figure shows huge intra-state variation in immunization rates; even lower performing states such as Uttar Pradesh and Arunachal Pradesh have some districts with more than 70 percent of children vaccinated, while higher performing states such as Kerala and West Bengal have

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5. Changes for the newly formed states were computed by subtracting the full average of the 1993 state from which the new state was formed with the 2013 average of just the new state.

6. Districts with less than 10 children surveyed were not included.
FIGURE 7. Changes in Infant Mortality and Immunization Rates by State between 1993 and 2013 (Percentage)

Panel A
Change in Infant Mortality Rate between 2013 and 1993

Panel B
Change in Percent 12–23 Months Olds with All Immunizations (1993–2012)

Sources: Infant mortality data from the 2013 Indian Census State Sample Registration Statistical Report and immunization data from the District Level Household and Facility Survey IV (DLHS) and the Annual Health Survey (AHS) 2012–13 state reports. Infant mortality and immunization data for 1993 are from the 1993 Demographic and Health Survey (DHS).

Notes: In Panel B of the above figure, state reports were not available for Gujarat and Jammu & Kashmir. These maps are not to scale and may not depict authentic boundaries.
districts where fewer than 50 percent of 12 to 23 month olds have received full immunization. This high level of variation both between states and between districts within states has been documented by Rammohan and Awofeso (2015). The authors show that district education levels, income per capita, and access to health facilities (for DPT vaccinations only) are highly correlated with district-level differences, but they do not report how much variance is left unexplained after accounting for these factors.

2.4. **State-level Variation in Child Cognitive Ability**

The earlier sections summarized the current state of physical child health. While decreasing infant mortality, improving child nutrition, and increasing access to medical facilities for children is of first-order policy importance,
recent research has also emphasized the significance of early childhood cognitive and emotional development for later-life outcomes. However, unlike child physical health, nationally representative data on the state of early childhood cognitive and non-cognitive development in India is lacking.

In this sub-section, we summarize the largest known nationally representative survey of child ability in India. In 2004 and 2012, the NCAER IHDS tested more than 11,000 eight to eleven year olds across India on math, reading, and writing skills. Figure 9 summarizes the 2012 state-level averages in reading and math scores. A respondent is assigned a reading score on a scale of 0 to 4, where 0 means the student does not recognize letters, 1 is for students who recognize letters but not words, 2 means the student can read words but not sentences, 3 signifies the student can read sentences but not paragraphs, and 4 indicates that a student can read paragraphs. Across Indian states, average scores range from just above 3 (can read sentences) to less than 2 (can only read words). Scores are highest in the northwest and Kerala, and lowest in the north and southeast. There also appears to be a high spatial correlation in scores.

We see a largely similar pattern for math scores. In math, a score of 0 means the student cannot recognize numbers, a score of 1 is for students who recognize numbers but who cannot subtract, a score of 2 means the student can subtract but not divide, and a score of 3 indicates that the student can divide. Again, across Indian states, average scores range from around 1 (student can only recognize numbers) to 2 (student can subtract), and state-level variation is high: scores are likewise highest in the northwest and Kerala, and lowest in the north. Andhra Pradesh and Tamil Nadu were found to perform much better on math than reading.

A different (and perhaps more intuitive) way to examine these data is to analyze the percentage of students who have attained the most basic level of proficiency by state. Figure 10 shows the percentage of 8 to 11 year olds who can recognize letters and numbers in most Indian states. Here, the degree of state-level variation in reading and math ability is especially stark: 76 percent of 8 to 11 year olds in Uttar Pradesh can recognize letters compared with 99 percent in Kerala and 96 percent in Andhra Pradesh. Similarly, only 69 percent of students can recognize numbers in Uttar Pradesh, compared with 99 percent in Kerala and 95 percent in Andhra Pradesh. These findings

8. The ASER Centre also provides India-wide testing of 5–14 year olds but only in rural districts.
9. State-level averages were computed for all states with 100 or more observations.
FIGURE 9. Average Math and Reading Scores of 8 to 11 Year Olds by State

Panel A
Avg. Math Score (0–3 Scale) (IHDS–2012)

Panel B
Avg. Read Score (0–4 Scale) (IHDS–2012)

Source: Data on math and reading scores from the 2012 India Human Development Survey (IHDS).

Notes: The scale in the panels of the above figure represents the range of possible scores on the math and reading tests provided to 8–11 year olds in the 2012 IHDS. Students in the math and reading test receive 3 and 4 questions of increasing difficulty, respectively, and their score is the total number of questions they get right. The values on the map are the mean scores for students in each Indian state with at least 100 respondents. All states with fewer than 100 respondents were dropped. These maps are not to scale and may not depict authentic boundaries.
FIGURE 10. Proportion of 8 to 11 Year Olds by State Who Can Recognize Numbers and Letters

Panel A
Recognize Numbers (IHDS–2012)

Panel B
Recognize Letters (IHDS–2012)

Source: Data on math and reading scores from the 2012 India Human Development Survey (IHDS).
Notes: The scale in the panels of the above figure represents the range of possible scores on the math and reading tests provided to 8–11 year olds in the 2012 IHDS. Students in the math and reading test receive 3 and 4 questions of increasing difficulty, respectively, and their score is the total number of questions they get right. The values on the map are the mean scores for students in each Indian state with at least 100 respondents. All states with fewer than 100 respondents were dropped. These maps are not to scale and may not depict authentic boundaries.
are especially surprising given that almost all test-taking 8 to 11 year olds in the survey stated that they attended school.

Finally, Figure 11 conveys the relationship between state IMRs in 2005 and state math scores in 2012 (the relationship is nearly identical for reading scores). There is a strong negative relationship: the higher a state’s 2005 IMR, the lower its children’s math scores (correlation of –0.58). Obviously this relationship is not causal, but the strong correlation does provide evidence that low levels of development may lead to both higher infant mortality and lower scores in school.

2.5. The Need for Better Measurement of Early Childhood Cognitive and Non-cognitive Skills

These data on childhood math and reading ability provide a window into both the absolute and state-level variation in core skills across India, but it is unclear whether these differences are caused by deficiencies in the
education system, different levels of income, variability in physical health, gaps in early childhood cognitive/non-cognitive development, or other factors entirely. Therefore, the disparities found here call out for more exploration. Although we have detailed data on many potential contributors to these disparities, one important area where data is almost nonexistent is cognitive and non-cognitive skills among children in early childhood (0 to 3 years).

To amend this information gap, we recommend that the Indian government sponsor a nationally representative survey aimed at providing a comprehensive understanding of the state of early childhood development. One potential survey is the Multiple Indicator Cluster Survey (MICS) developed by UNICEF (Aslam et al. 2014). MICS has been carried out in many developing countries over the past decade and includes modules on child physical health, child developmental ability, parental caretaking activities, and maternal health. MICS only focuses on children under 5, but the study could be adapted for older ages. Implementing this type of survey in India would provide important insight into the types of barriers that lead to large regional disparities in childhood learning and ultimately in long-term labor-market outcomes.

3. Theoretical Considerations and a Framework

The process of health and human capital accumulation throughout childhood is a complex one—a combination of the capabilities that children are born with (so-called “endowments”); investments in children made by parents, caregivers, local communities, and government; and adverse as well as positive experiences that affect child development. Understanding how these elements interact over the course of childhood to determine adult health and skill capabilities (and, in turn, economic outcomes) is crucial to developing sound policies that achieve high returns while remaining cost-effective.

In this section, we review a theoretical framework for health and skill formation in childhood, with an eye toward identifying the key elements of good policy that arise. The basis for this theory has played an important role in academic research for decades (Becker and Lewis 1973; Behrman 1997; Behrman, Pollak, and Taubman 1982; Grossman 1972; Rosenzweig and Schultz 1983), but recent works by Heckman et al. (2010), Cunha and Heckman (2007), Heckman and Mosso (2014), and Heckman, Pinto, and Savelyev (2013) have developed a formal mathematical structure specific to the analysis of early childhood development, which has made strides toward estimating the framework’s parameters (Aizer and Cunha 2012; Cunha, Heckman, and Schennach 2010).
3.1. A Framework for Childhood Health and Skill Formation

The process of health and human capital accumulation begins at conception. Even before birth, children are endowed with “stocks” of health and skills. These stocks are multidimensional. For example, health might include pulmonary, cardiovascular, and immune function. Skill generally refers to cognitive function as well as non-cognitive capabilities, such as grit, conscientiousness, and adaptability. These endowments capture the variation in initial states observed in the population. For example, some children have robust immune systems while others are predisposed to illness. Similarly, some children are naturally gifted when it comes to cognitive functions while others have lesser natural ability. These endowments surely have a genetic component, driving a correlation in the characteristics (and corresponding outcomes) of parents and children.

Stocks of health and skills in this model can be thought of in the same way as capital in a standard model of economic growth: they depreciate over time; they can be augmented through investment; and they are prone to exogenous shifters, or “shocks,” which are out of the child’s control.

Endowments form the initial stocks, which then evolve from period to period, starting at gestation and continuing through birth, early and late infancy, the toddler years, childhood, adolescence, and finally, adulthood. During gestation, prenatal investments (for example, maternal nutrition, decisions regarding smoking and alcohol consumption, prenatal checkups), shocks (for example, illness episodes, traumatic events), and depreciation shift initial stocks. The resulting stocks of health and skills at birth are then taken as inputs into a similar process in the next period, early infancy. Here, the stock continues to evolve as parents devote their material resources and time to the infant.

There are several key features in the model that deserve mention. First, the levels of stocks coming into a given period may impact the effectiveness of investments during that period. For example, an infant with a weak immune system (a low stock of immunity) may benefit greatly from supplementation with Vitamin A, which helps boost the body’s natural immune response. An infant with a more robust immune system may still benefit from Vitamin A but less so than the weaker infant. As we highlight below, this interaction between stocks and investments is absolutely critical to elucidate for the purposes of good policy making.

Second, the stocks of health and skills may directly impact each other, and one stock may also affect the productivity of investments in the other. For example, investing time in a child’s socio-emotional development may
yield the greatest returns for children with the highest stocks of health. In other words, it may be difficult to teach socio-emotional skills to a sick child. Third, as a corollary of the last point, certain investments may affect both health and skill stocks. For example, antimalarial treatment will certainly improve a child’s health if she is sick with malaria, but it may also have indirect impacts on cognitive function and other capabilities.

Finally, inherent in the capital-like dynamics of the model is the idea that health and skill stocks are linked over time, and the extent of this linkage depends on the way in which particular stocks and investments interact (and potentially how this interaction changes over the course of childhood). If, for example, investments have the highest returns for children with higher endowments, then children with low initial stocks may find it difficult or impossible to catch up to their better-endowed peers, despite consistent targeted investments. On the other hand, if early remediation of poor endowments is possible, then catch-up should also be possible.

3.2. Policy Implications

The theoretical framework described earlier is important because it gives us a lens through which to evaluate policies for early childhood development in attempting to target the highest impact interventions. Implicit in our discussion is a motivation to reduce inequalities that stem from health and human capital formation in childhood. This entails implementing policies that remediate outcomes for disadvantaged children as well as protect against further disadvantage. Several significant lessons emerge from this framework.

3.3. Timing Matters

The evolution of stocks plays a central role in the model. The fact that one period’s “outputs” of health and skills are taken as the next period’s “inputs” generates the potential for long-run consequences of temporary investments or one-time shocks. For the purposes of policy making, it is therefore critical to understand how much the timing of investments can matter at different points in time in this model, because their impact determines the long-run returns to the intervention. In particular, we would like to know when children with low stocks of health and skills are most receptive to investments.

While we still have much to learn about these parameters, recent research has made some significant strides, combining detailed data on many dimensions of stocks of health and skills over time with rigorous structural estimation techniques (Cunha, Heckman, and Schennach 2010;
Heckman and Mosso 2014). This research shows that there are substantial differences in the way in which stocks and investments interact at different ages. In particular, very early in life, say from in utero to age 2, investments and stocks of health and human capital are highly substitutable, that is, if a child is disadvantaged at birth, or faces a large shock early in life, it is relatively “easy” to remedy the disadvantage. Later in childhood, however, stocks and investments become less substitutable, or even complementary to each other, within a given time period; that is, beginning at some point in childhood, skill starts to beget skill. However, the exact point at which this change occurs is open to debate. Early work on the importance of the first 1,000 days of life suggested that early life nutritional or health deficits were extremely difficult to overcome (Martorell, Khan, and Schroeder 1994). Yet more recent work has found that growth even up to age 8 can still have beneficial effects on adolescent outcomes (Georgiadis et al. 2016). Although the effects of growth on long-term cognitive achievement for children of different ages remain an ongoing debate, there remains a consensus that early life investments have especially strong effects. Therefore, even if investing in disadvantaged adolescents is ethically desirable, it may be highly inefficient economically.10

Perhaps the easiest way to understand this set of results is through an example. An attentive care provider may be able to ameliorate cognitive disadvantage for a very young child by providing intensive time inputs, a specialized curriculum, and material resources such as toys and play activities, while even a very high quality teacher may not have the same effect on a teenager who has done poorly in school throughout her life. Put another way, later in childhood, high-quality inputs might best serve those with high baseline abilities.

This changing extent of substitutability over childhood suggests two crucial lessons related to timing: to remediate disadvantage, the highest return investments are those made very early in life, and investments late in childhood are more productive if the stocks of health and skills are already higher. The latter insight implies a “dynamic complementarity” between early and late investments: the greater the level of early investment (and thus the larger the early stocks of health and skills), the more productive later investments become.

10. It should be noted that the timing of this investment remains in disequilibrium—it is likely that shifting even large quantities of resources to early childhood investments and away from later childhood inputs would not equalize the marginal returns to additional investment, at least in the Indian context.
3.4. Crowding Out and Complementarity in Investments

There are likely many potential policy levers focused on early childhood development at a government’s disposal. What sub-set of these is most appropriate for a given population is a question that the theory is largely silent about. But one insight regarding multiple interventions that does come from the model is the potential for both crowding out and complementarity.

Crowding out implies that in a given period, investments that act in very similar ways on the same dimensions of the human capital stock are likely to substitute for one another.

There is some empirical evidence to back up this idea. For example, Rossin-Slater and Wüst (2015) study the long-term impacts of two early life programs in Denmark: high-quality preschool childcare and home visitation by a trained nurse. The researchers find that the two programs, intervening at slightly different times in the child’s early life (infancy and around age 3), effectively act as substitutes for one other in terms of generating positive long-term outcomes such as educational attainment and family income. Adhvaryu et al. (2015) and Gunnsteinsson et al. (2014) find strikingly similar results among much poorer populations in Mexico and Bangladesh, respectively.

On the other hand, complementarity suggests that investments that act to augment human capital stocks in different ways may have stronger effects when deployed together than they would have in isolation. There are two remarkable recent examples of this from settings that could not be more disparate: 19th-century Boston and present-day rural India. Alsan and Goldin (2015) examine the impact of water and sewerage infrastructure in historical Boston. They find that changes in clean water and sewerage infrastructure alone had no effect on IMRs (which, in the late 1800s, were comparable to present-day developing countries). But in parts of Boston that happened to get both interventions, there was a marked impact on mortality, suggesting that the two interventions were highly complementary. Duflo et al. (2015) produced similar evidence of improvements in diarrheal disease from an evaluation of an integrated water and sanitation improvement program in rural Odisha, which offered piped water as well as latrines to village households.

3.5. Parental Involvement

Thus far, we have focused on how the stocks of health and human capital evolve over time as they face shocks, depreciate, and are augmented via investments. While the first two factors—shocks and depreciation—may be considered exogenous (out of the control of children and other relevant decision-makers), the last factor, investment, is certainly endogenous: how
much parents, communities, and governments invest in children is an active
decision, likely governed by preferences, budget constraints, characteristics
of the child, local economic opportunities, and prevailing cultural norms
(Becker and Lewis 1973; Behrman 1997; Rosenzweig and Schultz 1983).

Parents—mothers in particular—are often the primary caretakers of
infants and young children and thus play a pivotal role in children’s early
lives (Adhvaryu and Nyshadham 2014; Almond and Mazumder 2013).
Accordingly, they act both as a source of investment of time and material
resources as well as an important mediator of other investments. For exam-
ple, parents decide how much time to devote each day to their children;
how much and what to feed them; how much to spend on preventive and
curative health care; whether and how early to enroll them in school; how
much after-school tutoring they receive; and a whole host of other decisions,
which, when aggregated, determine the level of total investment in the child.
In many cases, parents also determine access to, and the effectiveness of,
community or government programs aimed at helping children.

With some care, the theoretical framework laid out previously can be
expanded to allow for such investment decisions to be analyzed. This
extended theory links parental preferences and budget constraints to the
amount they choose to invest in their children, and ultimately to the stocks
of child health and human capital on which we have focused in this section.
The main lesson emerging from this model of parental decision-making and
the empirical studies that aim to test its predictions is that, depending on the
context, parents can both augment and undo the impacts of interventions
targeting children (Almond and Mazumder 2013). Though the evidence
is mixed, studies in low-income settings tend to demonstrate a propensity
to reinforce interventions with additional parental investment (Adhvaryu
and Nyshadham 2014; Adhvaryu, Fenske, and Nyshadham 2014; Datar,
Kilburn, and Loughran 2010; Grantham-Mcgregor et al. 1991, 1997), while
studies in higher income settings generally reveal the opposite (Bharadwaj,
Eberhard, and Nielson 2010). The reinforcing or compensatory effects need
to be accounted for to understand the full impacts of policies targeting dis-
advantaged children in each particular setting.

4. Evidence on Early Childhood Development Programs

This section provides a summary of effective interventions shown to reduce
infant mortality, combat malnutrition, and promote child development. The
key takeaways from this section are twofold. First, while interventions such
as micronutrient supplementation, improving food security, and strengthening public health infrastructure are essential in the continuing fight against childhood mortality and malnutrition, we emphasize the importance of a role for stimulation and home visitation, which have been shown to be effective along with traditional malnutrition-based interventions in improving child development. Second, the delivery of these interventions is crucial. While there is plenty of evidence on what works with regard to improving child health and development, it is important to note that what works in the laboratory or in theory might not work in real life. With that in mind, we can broadly think of problems of take-up or lack of effectiveness of proven theories as coming from demand- or supply-side constraints. In this sense, the problems nations face in improving early childhood health are not entirely different from the challenges in improving education; hence, understanding the role of market failures in terms of supply and demand is crucial for making progress in this arena.

Given our earlier findings on the immense heterogeneity in health outcomes across states and even districts within states, it should be noted that it is inadvisable to impose a “one size fits all” policy when it comes to improving early childhood health. Further, as Section 3 points out, the timing of these interventions is crucial for maximum efficacy. Therefore, if policy makers want the highest return on their investments, it is important to target policies in the most vulnerable places, and for children in specific age groups. Finally, policies are rarely evaluated at scale and those in the early childhood health space are no exception. These are salient issues to keep in mind when considering what policies to create, how and when to implement them, and what the effects of these policies might look like when scaled up in the long run. In this section, we first review the evidence about what works for child physical health and overall child development (cognitive and non-cognitive aspects) before addressing implementation and take-up issues.11

4.1. Child Survival and Physical Health

While India has made strides in reducing infant mortality over the last few decades, neighboring countries such as Sri Lanka and China still lose far fewer children in the first year of life. In fact, Sri Lanka and China’s IMRs in 2014 (8.4 and 9.2 per 1,000 live births, respectively) were less than the

11. One important caveat to the discussion below is that many aspects of a child’s environment matter for child health and development; given space constraints, we cannot review them all thoroughly. For example, our review does not focus on issues such as women’s education, empowerment, and domestic violence.
average IMR in high-income, non-OECD countries (10.2). In India, as is true around the world, a significant portion of deaths under the age of 5 is driven by neonatal mortality (death within the first month of life). This is important as the causes of neonatal and infant mortality can be quite variable, leading to different policy prescriptions. For example, recent work by Chen, Oster, and Williams (2016) finds that while the United States lags behind other developed nations in infant mortality, it actually has an advantage in terms of neonatal mortality. Such findings lead to sharper policy prescriptions, which rely on detailed analyses of the causes of neonatal and infant/child mortality.

However, since most deaths in India do not occur at a hospital, obtaining reliable information and representative data on cause of death over time has been challenging. A study published in *The Lancet* in 2010 (Million Death Study Collaborators 2010) provides some of the first analyses of neonatal cause of death by using nationally representative data collected as part of the Sample Registration System, covering about 1.1 million homes in India. According to this study, the top three causes of neonatal mortality in India, explaining about 78 percent of all deaths within the first month of life, were (a) prematurity and low birth weight, (b) neonatal infections, and (c) birth asphyxia and trauma. For deaths occurring after the first month of life and before 60 months, the main causes (explaining about 50 percent of deaths) were pneumonia and diarrheal diseases. Each of these five causes is eminently preventable. As the study concludes, “Our results suggest that almost half of India’s neonatal deaths are caused by birth asphyxia and birth trauma, sepsis, pneumonia and tetanus—conditions that can be avoided by increases in delivery care and postnatal care.”

Darmstadt et al. (2005) conduct a review of interventions that demonstrate strong evidence for reducing neonatal deaths. Examples of such interventions include folic acid supplementation, clean delivery practices, food supplementation, kangaroo mother care for low birth weight infants (Bera et al. 2014; Samra, Taweel, and Cadwell 2014; Suman Rao, Udani, and Nanavati 2008), and vaccinations. There is ample evidence that these individual interventions work: for example, a meta-analysis of studies that examine the efficacy of the tetanus toxoid immunization (aimed at lowering deaths due to neonatal infections) found that two properly timed doses for pregnant women can reduce neonatal deaths by a staggering 94 percent (Blencowe et al. 2010). In a *Lancet* review, Black et al. (2008) focus on the link between maternal and child nutrition and mortality. They find effective interventions to include promotion of breastfeeding, micronutrient supplementation (including multiple instances of micronutrient supplementation during pregnancy), and food supplementation for populations with
insufficient food. Studies suggest that pregnant mothers and young children particularly benefit from increased protein intake (Puentes et al. 2016; Stevens et al. 2015). Supplementary nutrition for women and infants in the United States (the WIC program) has been shown to be effective in decreasing the incidence of low birth weight, especially among vulnerable populations (Bitler and Currie 2005). It is also clear that improving health facilities, and access to facilities, can help with child survival. Access to high-quality medical care such as neonatal intensive care units has been found to reduce neonatal and infant deaths among a subset of extremely vulnerable infants in many countries (Almond et al. 2010; Bharadwaj, Loken, and Neilson 2013).

We next move on to a predominant cause of death during childhood, diarrheal diseases. One of the most effective ways to curb this disease is to provide access to clean water and waste management. In developing countries, the burden of diarrheal disease is often the greatest in urban areas, whereas problems such as food insecurity and lack of antenatal care tend to be more prominent in rural areas. The centerpiece of the fight against diarrheal deaths in the developing world (including India) currently is the use of Oral Rehydration Therapy (ORT) with Oral Rehydration Salt (ORS), along with exclusive breastfeeding and zinc supplementation. While knowledge of ORT with ORS is high in India, effective use is still low (Lakshminarayanan and Jayalakshmy 2015).

However, preventing diarrhea from occurring in the first place should be the underlying policy goal. Infrastructure investments by the government to combat open defecation would likely yield high returns by lowering the burden of this disease. Such investments would not only decrease diarrheal deaths but might also reduce the incidence of stunting (Spears, Ghosh, and Cumming 2013). While the provision of clean water is a major part of the fight against diarrhea (a meta-analysis by Fewtrell et al. [2005] finds water quality interventions to be incredibly important), sewage systems in urban areas can be complementary in reducing infant mortality. A recent study by Alsan and Goldin (2015) concluded that a combination of clean water and sewerage provision dramatically reduced infant mortality in Massachusetts between 1880 and 1915. However, it is important to note that simply increasing investments in public health infrastructure alone cannot be the solution. Building toilets and sewers is obviously crucial, but if children are not informed about the importance of behaviors like washing their hands after using a toilet, the returns to these basic investments will fall short. Thus, developments in infrastructure and access to clean water need to be coupled with campaigns such as the Global Handwashing Day to have the most impact.

While there are undoubtedly short-term benefits to these interventions in terms of child health and reductions in mortality, studies have also
considered their long-run effects. Research in economics has looked at the long-term impacts of micronutrient supplementation, strengthening food security, and access to advanced health facilities. Two examples of the long-lasting impacts of micronutrients come from Adhvaryu et al. (2014) and Gunnsteinsson et al. (2014). The first found that exposure to iodine in the form of iodized salt in the 1930s led to increased educational attainment and better labor market outcomes in the United States. The second study discovered that exposure to Vitamin A supplementation for infants in Bangladesh reduced the risk of harm done by exposure to such environmental events as typhoons. This is an important result since developing countries like India tend to also suffer disproportionately from climate- and environment-related shocks. With regard to supplemental feeding programs, Hoynes, Schanzenbach, and Almond (2016) as well as Aizer et al. (2014) found positive impacts of safety net programs such as food stamps and welfare payments in the United States on later-life health and labor market outcomes. Finally, Bharadwaj, Loken, and Neilon (2013) showed that access to neonatal intensive care units in Chile and Norway increased cognitive performance in school many years later.

Conditional on surviving the early years, one of the most pervasive problems facing many developing countries, and India in particular, is the issue of childhood malnutrition often measured by stunting (height for age below 2 SD). Stunting and its correlates (apart from mortality, which we have already mentioned above) are well studied, are associated with lower cognitive abilities (Lewit and Kerrebrock 1997), are a likely driver of later-life obesity and related diseases (Eckhardt 2006), and might increase malaria-related deaths (Shankar 2000). Nearly half of all Indian children under age 5 are estimated to be stunted (UNICEF). Many of the strategies outlined previously such as supplemental and complementary feeding, vitamin supplementation, and lowering the burden of diseases like diarrhea are also thought to be effective in combating stunting (Bhutta et al. 2008).

4.2. Child Development

While micronutrients, supplemental feeding, and investments in public health infrastructure are all important tools in the fight against childhood mortality and malnutrition, it is also essential to focus on overall child development as measured by the inter-related domains of cognitive–language, sensory–motor, and social–emotional skills and capabilities. As Section 2 points out, we know less about where childhood cognitive disparities lie in Indian populations, but they are likely correlated with disparities in mortality. A *Lancet* series on early childhood development identifies four important risk
factors among children under age 5 in least developed countries (some of which are also risk factors for mortality): stunting, inadequate cognitive stimulation, iodine deficiency and iron deficiency, and anemia (Grantham-McGregor et al. 2007). Hence, there is considerable overlap between factors that matter for neonatal and child survival and those that affect child development (conditional on survival). Engle et al. (2007) discuss evidence on how interventions that reduce malnutrition, iodine deficiency, and iron deficiency improve behavior, cognitive skills, and motor development. In this subsection, we therefore focus on strategies that have been shown to work for improving a child’s cognitive and non-cognitive skills, but are not directly aimed at decreasing malnutrition and micronutrient deficiency.

The best-known example of such studies focused on developing countries is the Jamaica experiment (Grantham-McGregor et al. 1991). The Jamaica intervention randomized 129 stunted Jamaican children between the ages of 9 and 24 months into three treatment arms and a control group. The treatments were: (a) psychosocial stimulation, (b) nutritional supplementation, and (c) both psychosocial and nutritional supplementation. Working with community health workers, the psychosocial component comprised weekly one-hour play sessions at home, which lasted two years. The main idea behind the play sessions was to improve the quality of time that mothers spent with their children. The broad set of results from multiple papers that analyze the short- and long-run consequences of the Jamaica intervention agree that stimulation and stimulation plus nutritional supplementation are most important for realizing long-term gains in cognitive functioning and other adult outcomes (Gertler et al. 2014; Grantham-McGregor et al. 1994, 1997; Walker et al. 2011). Perhaps the most important insight from these studies is that nutritional supplementation alone is not effective in helping children build skills. In fact, a 20-year follow-up of the original program participants by Gertler et al. (2014) found that on average, participants who received the stimulation intervention had 42 percent higher earnings later in life.12

The results from the Jamaica intervention align with several other papers, including a review by Baker-Henningham and Boo (2010) of over 25 studies in low-income and middle-income countries that focus on early childhood

12. It must be stressed here that (a) wider replication of stimulation programs is needed in order to fully claim validity in the Indian context and (b) studies have found long-run and intergenerational consequences of macronutrition, underscoring that intervention has potentially high returns. For example, Hoddinott et al. (2013) found evidence of a long-run economic effect for men exposed to nutritional supplementation alone before age 3. Behrman et al. (2009) show that the children of women exposed to this same program are significantly less underweight than the children of women from the control group.
stimulation through parenting interventions. The authors concluded, “Early stimulation interventions are effective in improving child and maternal outcomes and these benefits are likely to be sustained over the long term.” This sentiment is again echoed in an excellent review by Schodt et al. (2015) of interventions largely focusing on home visitation programs in Latin America. 

While high-quality early childhood interventions have shown promising results in developing countries, some of the best evidence on this front actually comes from the developed world. While these are excellent studies, the different time period and context of these interventions are important to consider while thinking about translating these into the Indian context. The most well-studied intervention shown to have an impact on labor market (and other) outcomes is the Perry Preschool Project (Heckman et al. 2010). The Perry Preschool Project was an early childhood education initiative targeting disadvantaged African–American youth in Ypsilanti, Michigan, in the 1960s. The program—which started with 3-year-old children and lasted for two years—consisted of a two-and-a-half-hour preschool session on weekdays that focused on supporting a child’s cognitive and socio-emotional skills. This was supplemented by weekly home visits by teachers. While many studies estimate the rate of return of this program, Heckman et al. (2010) compute the impact using various econometric techniques that account for some of the compromises that occurred in the randomization protocol. Taking these into account, the rate of return is estimated to be between 7 percent and 10 percent. This rate of return includes not just the labor market return, but also the gains from access to this program on better health and reduced involvement in crime much later in life. Other studies of early childhood interventions in developed nations also find large benefits (see the Nurse Family Partnership Program [Olds 2006]; Chicago Child–Parent Study [Reynolds et al. 2001, 2002]; Head Start [Currie and Thomas 1995; Garces, Thomas, and Currie 2002]; and the Abecedarian Program [Barnett and Masse 2007]). While these interventions differ in the target population, the specifics of the interventions, and, importantly, in the age of enrollment and length of intervention, the broad lesson from these studies is that stimulation-based interventions in early childhood have very high returns.

4.3. Delivery of Interventions

While many of the previous interventions have proven powerful in improving child health and development, it is important to keep in mind the challenges of implementing initiatives in the field. This is a salient issue in developing
countries in particular, where multiple market failures may pose barriers to the take-up of what could be a very effective intervention.

A telling example of the failure to adopt effective technology due to suboptimal distribution policy comes from Adhvaryu (2014). Adhvaryu studies the take-up of artemisinin-based combination malaria therapy (ATC; effective in helping children and adults recover faster from malaria) in Tanzania and finds that while adoption is initially high, there is a steep drop-off two years after introduction. One of the major reasons for the decline appears to be misinformation about the effectiveness of ATC, perpetuated by misdiagnosis at the primary health care center. Hence, while effective in combating malaria, ATC was perceived by villagers to be less useful, perhaps since it was prescribed even when children and adults did not have malaria. Another example in the case of malaria is the low take-up of mosquito nets. While bed nets have obvious benefits, adoption has remained problematic. Cohen, Dupas, and Schaner (2015) find that short-run subsidies for bed nets promote long-term adoption, since subsidies allow individuals to learn about the product. A similar study in India by Tarozzi et al. (2014) involves giving microloans to promote the adoption of insecticide-treated bed nets. The research reports increased take-up, though the effects on health are mixed, likely due to low overall usage of the nets.

Further, consider the case of double-fortified salt. While the intervention seems rather simple—to fortify salt with iodine and iron (which directly tackles anemia, a major problem for children and women in India)—fortification alone guarantees neither take-up nor improved health outcomes. Banerjee, Barnhardt, and Duflo (2015) find that promoting the use of double-fortified salt through the use of information and incentives to sellers dramatically increases consumption in Bihar. Yet in a separate paper (Banerjee, Barnhardt, and Duflo 2016), they show that increased consumption of fortified salt does not lead to better health outcomes. Therefore, even improved take-up, resulting from efforts such as providing fortified salt for free, or through seller incentives, may not solve complex problems such as anemia. In contrast, Thomas et al. (2006) notes large positive impacts of direct iron supplementation (iron tablets distributed by a local health worker) and excellent compliance with the supplementation protocol. One of the reasons Banerjee, Barnhardt, and Duflo’s (2016) results may differ is due to the lower dosage of iron that is delivered through double fortification. Similar cautionary tales about “effective” health technology confronting take-up problems in the field appear in studies about cooking stoves aimed at reducing indoor air pollution (Hanna, Duflo, and Greenstone 2016; Miller and Mobarak 2014). In short, what works in the laboratory does not necessarily
work in the field since the adoption of new technologies is often a matter of learning, preferences, incentives, and costs. Understanding proper delivery of effective technologies is crucial to making progress on these issues.

4.4. Potential in the Indian Context

The examples we have focused on not only show policy makers what works but also why one should care about what works. From a policy perspective, it is useful to think about supply and demand issues for the delivery of effective early childhood investments. One broad approach to increasing the demand for health services is the use of conditional cash transfers. There is ample evidence from various developing countries that conditional cash transfers improve the take-up of preventive health services (Lagarde, Haines, and Palmer 2007) and result in better child health (Gertler 2004). An excellent example of the role of cash transfers comes from Macours, Schady, and Vakis (2008), which studies a large cash transfer program in Nicaragua and finds dramatic improvements in child development among the treated households. The findings suggest that the improvements in cognitive development are not due to the cash aspect of the program alone; the treated children are also more likely to receive stimulation at home. Such behavioral changes can have long-term impacts, even after the cash program ends. Banerjee, Duflo, Glennerster, and Kothari (2010) examine the role of conditional transfers in the take-up of immunization in India. They show that while improving the reliability of immunization camps improves attendance, coupling this reliability with small non-financial incentives nearly doubles the take-up. This is an important finding since it showcases how both demand- and supply-side constraints are extremely important in improving take-up of health services.

India has experimented with many cash transfers. In multiple studies of the Janani Suraksha Yojana (JSY), a large conditional cash transfer program aimed at increasing deliveries in institutions rather than at home, researchers have found increased take-up of institutional deliveries but conflicting evidence on improvements in health measures such as infant mortality and maternal mortality (Das, Rao, and Hagopian 2011; Lim et al. 2010; Powell-Jackson, Mazumdar, and Mills 2015; Randive, Diwan, and De Costa 2013). In fact, the JSY provides a perfect case study for why careful policy evaluation is essential before implementing an intervention at scale. The JSY is one of the largest conditional cash transfer programs in the world given its scope, but its rollout and lack of precise data on outcomes before and after threatens the reliability of results. Studies have to rely on quasi-experimental methods, and while this can be an effective tool, the results can be sensitive
to identification assumptions and it is harder to get at mechanisms and deeper
issues about implementation under quasi-experimental methods. While cash
transfers are popular for other health-related goals in India (especially to
promote gender equality through programs such as Apni Beti Apna Dhan,
Dhanlakshmi, and Devi Rupak), as the literature suggests, their evaluations
often result in mixed findings regarding effectiveness (Anukriti 2014; Sinha
and Yoong 2009). Careful implementation and sound evaluation is crucial
before implementing these schemes at scale.

On the supply side, Darmstadt et al. (2005) emphasize the delivery of
antenatal and postnatal care through family–community interventions. These
are interventions wherein components of antenatal and postnatal care, such
as home visitation, are provided by trained community health workers. The
interventions can be thought of as providing a suite of treatments rather
than any one specific treatment. In a follow-up *Cochrane* review, Lassi and
Bhutta (2015) analyze 26 randomized and quasi-randomized studies on the
effectiveness of such family–community interventions, including studies
done in India, cite tremendous promise and recommend scaling up these
types of interventions.

An important part of India’s community-based approach to health is the
ASHA model. ASHAs were formally included under the National Health
Mission in 2005 and the current number of ASHAs is around 860,000
(Ministry of Health and Family Welfare [MoHFW] India 2013). Despite
the emphasis on ASHAs, there has been little rigorous research done on
how best to improve this network. Recent work in economics has empha-
sized the recruitment of and incentives for government workers (Ashraf,
Bandiera, and Lee 2015; Dal Bó, Finan, and Rossi 2013; Das et al. 2015;
Muralidharan and Sundararaman 2011) in addition to incentives for commu-
nities as a whole (the PNPM Generasi program in Indonesia). For example,
Dal Bó, Finan, and Rossi (2013) discovered that offering a higher wage
attracts not only more qualified people to the government sector but also the
most motivated to engage in public service. An in-depth evaluation of the
PNPM Generasi program in Indonesia found that using incentivized block
grants was crucial in improving health indicators among young children
and pregnant mothers. One of the key features of the Generasi program
was the training of community health workers, which could have played an
important role in improving health outcomes. In addition, the communities
got to choose how they would improve on a pre-selected set of target health
indicators. Given the heterogeneity in health outcomes in India highlighted
in Section 2, allowing communities to choose how to focus grants might be
an important step forward.
Our stance is that research on the recruitment and incentive structures for ASHAs, as well as understanding whether mothers demand and trust information given by ASHAs would be incredibly useful in making policy decisions regarding how best to improve the functioning and service delivery of ASHAs. Improving neonatal and infant mortality requires a multipronged approach, but understanding the demand for and raising the quality and quantity of service delivery seems to be of great importance.

The ICDS is India’s flagship program that has the potential to deliver high-quality child health and development services. The front-runner of these services is the *anganwadi* center (AWC). While an entire suite of early childhood services is provided at AWCs, the focus of this institution has largely been on supplemental nutrition, immunization, and other basic health and early preschool education needs. There is also clear potential to use AWCs as delivery centers for high-quality early childhood stimulation programs. However, a report by the Planning Commission on the effectiveness of ICDS on key health outcomes says, “Conclusive evidence of positive impact of ICDS is not available” (Planning Commission 2011). Furthermore, while early childhood care and education (ECCE) received national attention due to the Constitution Act of 2002, how the programs that were established are delivered or monitored is highly variable. While many agencies at the national and state level provide ECCE services, a report by the Ministry of Women and Child Development states, “There is no reliable data available about the actual number of children attending ECCE provisions and their breakup as per delivery of services/type of services.” For a program like ICDS that has been in place since 1975 and whose budget in the 2014–15 year was nearly US$2.2 billion, the lack of rigorous evaluations is a serious concern.

Similarly, while having immense potential, another important policy—the RGNCS for the children of working mothers—may not have proper evaluation processes in place. The RGNCS aims to provide precisely the types of services that we know work from other settings, such as early stimulation for children under age 3, supplementary feeding, and growth monitoring. According to the website of the Ministry of Women and Child Development, there are currently more than 21,000 such centers across India, and the program had a total budget allocation of just US$15 million in 2014–15. Considering that the number of births per year in India is around 27 million, even if only a tenth of infants and children needed services, the budget would only include about six cents per child per day. Since services such as stimulation typically last more than a year, the financial allocations for these kinds of services are woefully low. In an excellent review of various
child protection and child health programs in India, Das and Kundu (2014) report that only 0.02 percent of the total Union Budget is allocated to services that can be classified as “care and protection” for children—this includes schemes such as the RGNCS, Dhanlakshmi, and Integrated Child Protection Scheme (ICPS).

Perhaps it is not surprising then that a report by the Planning Commission in 2013 finds that these centers have low-quality infrastructure and training of crèche helpers as well as an inadequate flow of funds. The report, however, contains no information about whether the crèche program actually leads to greater child skills, nutrition, and the like. While documenting process is crucial and something that routinely seems to be done for such programs, recording impact is just as important. Multiple examples from the education sector have shown that typical inputs such as infrastructure and teacher pay are not always causally related with improved performance of students (Glewwe and Kremer 2006).

While studies such as the Jamaica intervention detailed previously reveal the incredible promise of investing early in children, these programs have largely not been scaled up in developing countries. Universal pre-K programs contain some of the same services. Several have been successful (Gormley et al. 2005) whereas others have shown mixed results in developed and developing countries (Baker and Milligan 2008; Berlinksi, Galiani, and Manacorda 2008; Bernal and Fernandez 2013; Blanden et al. 2016; Rosero and Oosterbeek 2011). Ongoing research is imperative for future policy making in this area. A version of the Jamaica program has been replicated by researchers in Colombia with scale in mind (Attanasio et al. 2015). This was achieved by training local female leaders who were already part of one of the largest welfare programs in the country. In the short term, the study finds impressive gains in cognition and receptive language among children. This program is now being tested in Odisha, relying on trained local women for delivery. While scaled-up interventions sound promising, a recent article by Attanasio, Cattan, and Krutikova (2016) identifies the key challenges in this process: (a) adapting programs to local contexts, (b) ensuring quality of provision, and (c) continued investment at later ages in childhood. The results from the Odisha study will be a good starting point for thinking about bringing high-quality early childhood stimulation programs up to scale in India. In a similar vein, Jed Friedman and co-authors from the World Bank and IFPRI are working on an evaluation of adding one additional *anganwadi* worker to AWCs. Experimental analysis of such programs is essential moving forward.

Budgets for child development in India absolutely need to be increased, but rigorous evaluations of what works in programs such as ICDS and
RGNCS must also be part of the equation. Analysts should also carefully consider the consequences of scaled-up programs and the possibility of overlap with other early childhood development (ECD) or household interventions (such as the Mahatma Gandhi National Rural Employment Guarantee Act [MGNREGA]). For example, does the work of RGNCS crowd out what ASHAs do or affect whether a child goes to an AWC? Are households that get benefits under MGNREGA more or less likely to take advantage of these schemes? It is these kinds of thoughtful questions that could lead to better programs that can have a real impact on Indian children.

5. Conclusion

There is growing consensus among researchers in developmental psychology, economics, epidemiology, nutrition, sociology, and a host of other disciplines that investing in children early in childhood has large, persistent returns to health and economic well-being. India has made significant progress in terms of reducing infant and child mortality and malnutrition in the past three decades. While there is much more to be done in terms of improving these basic measures of child health, we urge policy makers to take seriously the idea that focusing on overall child development, measured by socio-emotional and gross motor skills, is crucial. As we emphasize in this IPF paper, pairing nutritional supplementation with stimulation and cognitive interventions have been shown to be much more effective in raising development measures than nutritional interventions alone.

From a policy perspective, it is extremely important to consider how these interventions are delivered. We note many examples of theoretically sound and field-tested interventions failing when implemented at scale. The delivery of child development interventions is no less complicated than the delivery of basic educational services; yet research is severely lacking on how governments in developing countries can best provide these crucial services. While India has the basic ingredients needed to competently deliver child development services, policy makers ought to consider field-testing and rigorously evaluating the various schemes they implement. For example, the ASHA program, the RGNCS, and other conditional cash transfers aimed at improving child development should be implemented with a view to first evaluate and then scale-up. The anganwadi program is another example of an excellent vehicle that can deliver high-quality child development services; yet there is very little by way of empirically sound evaluations available to understand whether these centers are working efficiently.
There are two main takeaways from this article that we urge policy makers to consider. First, focus on further improving basic child health through interventions aimed at reducing malnutrition and infant mortality, but begin to focus as well on stimulation and home visitation programs. Second, while there is immense potential to deliver these interventions through ASHAs, AWCs, and crèche schemes, there is a great need to do rigorous empirical evaluations that inform how best to improve their functioning.

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I enjoyed this paper and thanks for the opportunity to comment on it. Early childhood investments in education and health are now widely acknowledged to be important worldwide. We have been learning extensively about their role in the United States and other countries in recent years but know little about their impact in India. The authors do a very good job of summarizing the findings from studies in this field. They also discuss Indian programs in some detail.

Let me try to be usefully critical on the present draft of the paper. I have two main sets of comments. The first is on the data used to describe trends on early childhood outcomes in India. The second relates to the question of how to do rigorous impact evaluation to understand which policies can be effective in improving early childhood outcomes in India.

The paper focuses on three main outcomes: infant mortality rates (IMRs), immunization, and cognitive outcomes for 8 to 11 year olds. The importance given to immunization is a bit puzzling because from 1990 to 2010 there was not much action on immunization while IMRs were steadily declining. Perhaps immunization is easier to track. It is much harder to observe nutrition and parental inputs, or similar determinants of early childhood development. But looking at the Figure 2 on immunization, you are roughly at the same level in 2010 as in 1995, and it seems to me that these are not central to the IMR decline. This reminds me of the important 1975 paper by Samuel Preston in which he shows that if you compare “before” and “after” the introduction of antibiotics, you find effects on longevity, but a longer historical analysis reveals that these mortality declines had been occurring for many decades before the introduction of antibiotics and were probably the result of other factors.

*To preserve the sense of the discussions at the India Policy Forum (IPF), these discussants’ comments reflect the views expressed at the IPF and do not necessarily take into account revisions to the conference version of the paper in response to these and other comments in preparing the final, revised version published in this volume. The original conference version of the paper is available on www.ncaer.org.*
The rural–urban and interstate disparities in IMRs are well presented. Urban IMRs are about half of the rural rates in many states. Given the rapid increases in urbanization in India, it may be useful to do some back of the envelope calculations to show how much of the overall IMR decline can be explained by a movement of the population from rural to urban areas. This would tell us how much of the decline we observe in the IMRs is simply a result of the urban–rural composition of the population and not attributable to specific policies aimed at improving child health. I also noticed that the rural–urban difference in immunization rates is really pretty small. So once again, it does not seem that immunization is an important part of the IMR story. It would be useful to get a better idea of why urban infant mortality is lower. The paper also shows that male–female infant mortality differences are not large. This is interesting because it suggests that interventions later in childhood could be critical for gender equality.

From infants, you jump to the cognitive abilities of 8 to 11 year olds using National Council of Applied Economic Research’s (NCAER) India Human Development Survey (IHDS). I wondered why you did not use more of the IHDS data to look at the ages in between. There is a lot of data on anthropometrics and nutrition intake in the NCAER data, and you could also exploit the IHDS panel to say more about how early childhood outcomes are related to those in later years. You suggest other surveys in the paper, but I think you could use the IHDS much more intensively than you do.

Let me now turn to the question of how we can build evidence on early childhood development to guide policy in India. Existing research in this area says intervene early, stimulate cognitive and non-cognitive, and target the areas with low stocks. The authors emphasize the need for rigorous studies on various policy interventions such as the Accredited Social Health Activist (ASHA) program. So what constitutes rigor in policy evaluation in this field?

There are two aspects of child development that make policies very difficult to evaluate using randomized experiments. First, the returns to any policy are non-linear and depend on the existing stocks of child health and education. Second, there are a number of complementary factors that determine the effectiveness of a policy. To elaborate, suppose I have just one background variable, along which children differ, and one possible policy. The question then is just a “yes” or “no” for that policy. I am in the perfect world for randomized trials. I just need to have a control and treatment group, I need to look at whether they match up on that one right-hand side variable, and since my answer is just whether I should go for this policy or not, I am in very good shape if I get a sizable treatment effect and my cost is reasonable.
What happens if I have two possible policies? I then need a factorial experiment with four treatment arms to estimate policy impact. I need places with both policies in place, only the first policy, only the second, and places with no policy in place. Now, go to three possible policies. The number of treatment arms expands exponentially. Once we allow for non-linearity in response, we also need to ensure that the initial stocks of the outcome we are interested in are the same in all the treatment and control arms. When we are thinking about whether we should spend more on the Integrated Child Development Services scheme, subsidized grains, or putting in more crèches, then all these policies are complementary and expensive, and using only randomized trials for looking at effects is really not going to work. We will probably need a better understanding of child physiology and use this in combination with innovative modeling and experiments.

Bharat Ramaswami

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Like Rohini Somanathan, I too enjoyed reading the paper. I am a consumer of such research and not a producer of such research. But a happy consumer is not necessarily a satisfied consumer. So here is my wish list of what I would have liked. The first part of the paper is the data, followed by three major sections on the theoretical framework, its implications, the empirical findings, and the Indian context.

The theoretical framework models the outcome that initial and early life experience can have long-lasting and irreversible impacts. Of course, this is an important perspective, and the paper urges us to understand human capital in terms of stocks and investments and the substitutability between the two. I think that is a good point and it is not very hard to understand, and I presume the contribution of theory here is really to permit consistent and rigorous estimation of the extent of substitutability or complementarity at different points of time. Although the paper devotes a substantial discussion to the theoretical framework, I do not find the same amount of discussion in empirical findings. For instance, there is one important point at which I was confused, and here I quote the paper. There is a statement here that says, “… very early in life, say from ages 0 to 2, investments and stocks of health and human capital are highly substitutable.” What confused me was the word “say.” Does this mean that the empirical findings are not specific enough, and so is there a range of uncertainty here about when that substitutability ends or fades away? If so, what implications does that have for
policy? I think again from the point of view of a consumer of such research, I would have certainly liked to know what exactly the research says about this substitutability and what the range of uncertainty is about those findings.

Assuming that there is precise knowledge about substitutability, I found the policy discussions to be a little one-sided. Of course, I grant that the paper makes a solid case for investments in early childhood, but in the Indian context, what do we do about the large stock of children who are undernourished and understimulated? For instance, the research findings seem to imply that investments made at a later age may not make the stocks as productive as those made at an early age. But what about the productivity of the investment itself? What are the payoffs to that? That would be a useful and practical finding, and perhaps the paper does not want to go in that direction, but it is an important trade-off for us because we do have a large stock of children who are in that category. It is important even just to acknowledge the issue, because the whole emphasis in the literature has been on the first 1,000 days, but what happens after that, what happens to those who are already beyond their first 1,000 days, and where are we regarding that with respect to policy?

The second thing that occurred to me is that when we talk about empirical findings, the paper very rightly points out that various investments might be complementary or substitutable. While there is the possibility of crowding out, therefore, I did not understand whether there are some general lessons here that carry forward to policy. If every situation is specific, then of course we are at a very preliminary stage in knowledge generation, and it might be a little premature for us to talk about policy.

Similarly, I found the discussion in the paper about parental behavior, which I assume is the key to most interventions, to be fairly general and not specific enough. The paper says that additional parental investment in low-income settings tends to reinforce and augment interventions targeting children, while studies in higher income settings generally reveal the opposite. I think that is an intriguing statement, but what do we make of it and why does it happen? The question again, is whether our research is at a very preliminary stage or is there something that we can say about policy?

Finally, about the Indian context, I think the authors have very correctly pointed out that we need policy evaluations to be built into interventions at the pilot stage. When we want to scale an intervention, we need feedback mechanisms and monitoring. But, I wonder whether the paper is a little too dismissive of quasi-experimental methods. I say this because many of the programs are already in place, and quasi-experimental methods are pretty much all that we can do. It would have been useful to know from the paper
what the best evidence from quasi-experimental methods tells us about interventions relating to early childhood development. If the answer is nothing at all, then the paper should say so and try to explain why. If the answer is that we can learn something, then it would have been nice to know what that something was.

The last paragraph in the paper talks about the two main takeaways. The paper urges policy makers to consider not only interventions aimed at reducing malnutrition and infant mortality but also to focus on stimulus and home visitation programs. Second, the paper urges us to do rigorous empirical evaluations of Indian programs in the Indian context. I would say that these are really important takeaways, but the discussion that leads up to this message is much too slender as compared to the rest of the paper.

To summarize, as a consumer of this research I did learn a lot, but I would have liked the findings to be placed in different buckets for my own convenience, such as (a) what we know well, and what are the implications, (b) what is likely to be true but not fully definitive, and (c) what is perhaps speculative. I think that kind of a categorization would have helped me much more in knowing what to do about these fascinating and interesting findings reported in the paper.

General Discussion

T. N. Srinivasan suggested that the authors should convert their charts showing interstate comparisons into charts that rank states on unit-less measures, such as the percentage deviation for states’ rate relative to the all-India average, say on infant mortality. If the states are so ranked, it would turn out that the most morbid states relative to the average are the southern states, namely, Kerala, Tamil Nadu, and Andhra Pradesh, while the least morbid ones are the former BIMARU states (Bihar, Madhya Pradesh, Rajasthan, and Uttar Pradesh). So what was remarkable was the persistence of this situation over a long period of time.

Srinivasan then commented on Rohini Somanathan’s observations about the interdependency and nonlinearity of the complex relationships being discussed here. Precisely for this reason, he advocated a three-stage piloting-to-scaling-up process that has seen so much success in the Green Revolution and its aim of raising yields per hectare (Srinivasan and Katkar 2015). We knew that interventions providing increased irrigation and supplementary nitrogen, phosphorous, and potash could interact non-linearly with soil, seed, and climate to produce higher yields. But we did not simply implement one
scheme across the country. The intervention was broken up into three stages: first, working on the science at experimental stations to identify alternative combinations that showed the greatest promise; second, an intermediate stage where the farmer did the experimentation under real-life conditions; and third, randomized trials across the country. He suggested that a similar approach to childhood development needs to be adopted that can carefully observe the interaction between technology and public policy under conditions of uncertainty until we are sure of our policy design and can scale up the intervention with much greater confidence.

Adding a footnote to Srinivasan’s comment, Pranab Bardhan (Chair) remarked that the National Sample Survey (NSS) data also reveal that richer people are more often ill than poorer people. Hence, morbidity seems to vary systematically not only geographically but also in relation to expenditure groups. Achyuta Adhvaryu noted that the Demographic Health Survey (DHS) also showed the same results and suggested that this had to do with greater health awareness among richer and better educated populations. Bardhan suggested that greater access to health facilities is also likely to produce the same result. Srinivasan suggested that all of this came together in the state of Kerala.

Sandeep Sukhtankar wanted to hear from the authors how India fared on its overall expenditures on these programs in comparison with countries such as the United States, China, or Mexico.

Devesh Kapoor asked if the paper or the authors had explored the links between fertility changes and early childhood outcomes in India. Nirvikar Singh urged the authors to take a look at the World Bank’s analysis of Integrated Child Development Services (ICDS) undertaken some 10 years ago, which showed why ICDS was not working and how it could be made to work better.

Rohini Somanathan wondered if we should look at how interventions work or do not depending on whether they are built around visits to homes or to ICDS centers or other places where kids gather, particularly given that we are still not very often dealing with nuclear families in India. This went to the broader point mentioned by Bharat Ramaswami that the paper could reflect more on whether, how, and why the global research on early childhood development can apply to India. On cost-benefit, Somanathan suggested looking at the way states were spending money on such programs in the aggregate, as Sukhtankar had suggested. Also, in looking at complementarities, the paper could look at how the ICDS is run in different states—just as a feeding program despite the inclusion of many other elements, or supplemented by some of these other elements that can then shed
light on complementarities. This could be done for other programs and how they are implemented in different states.

Karthik Muralidharan flagged the issue of the enormous variation in outcomes across states, set against the morning’s comments by the keynote speaker, Amitabh Kant, who had emphasized the growing importance of policy at the state level. Even if a lot of the variation was due to income, Muralidharan recommended to the authors that they do a variance decomposition exercise for the variation in early childhood outcomes of interest, and after including income, see the residuals and assess how much the residuals could be shrunk by including more proximate observables with a possible impact on the outcomes, variables such as population density, sanitation status, public expenditures, etc. This would not be testing for causality but would still be an important exercise for the paper to do. It would help answer Preston curve type questions about interventions in health and education that could shift the curve upwards. Muralidharan’s second point reflected a bit of what Bharat Ramaswami and Rohini Somanathan had said about the disconnect in the paper, that all the data described are from India but the suggestions and policies are mostly from work done abroad. He suggested greater attention in the paper to programs designed and implemented in India, the thinking informing these programs, and their performance. This would be particularly important for the paper to have salience for an Indian policy audience, says the secretary of Women and Child Development in the Government of India.

Shekhar Shah recalled the paper presented by Shikha Jha and Bharat Ramaswami (2012) on food subsidies and the public distribution system (PDS) in India at the 2011 India Policy Forum (IPF) and the paper by Sonalde Desai and Reeve Vanneman (2015) on India’s Food Security Act in the 2014 IPF. He suggested that since part of the motivation for these large, expensive, very blunt interventions, such as the PDS and the Food Security Act is child nutrition, it would be useful for the paper to comment on them, perhaps outlining their opportunity costs.

Rohini Somanathan intervened to refer to the paper by Cutler and Miller (2005) on water quality, and its findings on clean water—based on filtration and chlorination—being responsible for nearly half the total mortality and two-thirds of the child mortality reductions in major US cities during the late 19th and early 20th centuries. Filtration and chlorination were jointly important in reducing mortality and were substitute technologies, though major cities had adopted filtration technologies first since they had been developed first, and so it appeared that filtration was more effective than chlorination. Her point was that we need to first look at the scientific
evidence before going into complementary and crowding out concerns at the national level. She suggested that the authors could also use the vast clinical evidence available for the Indian context in nutritional journals on, say, anaemia interventions, among other things.

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