First draft: Prepared for Public Health Foundation of India, comments welcome!

Can food alone resolve "malnutrition"?: Stunting, open defecation, and the urgency a of policy response

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A child's height is one of the most important indicators of her well-being. Height reflects the accumulated total of early-life health, net nutrition, and disease. Because problems that prevent children from growing tall also prevent them from growing into healthy, productive, smart adults, height predicts adult economic outcomes (Vogl, 2012) and cognitive achievement (Spears, 2011).

Researchers studying height have long been puzzled by a paradox: Among developing countries, differences in average height are not very well explained by differences in income (Deaton, 2007). In particular, children in India are shorter, on average, than children in Sub-Saharan Africa, even though Indians are richer on average.

What could explain this paradox? Because addressing widespread stunting is a health and economic policy priority, understanding determinants of children's height is important. In a recently released working paper (Spears, 2013 "How much international variation in child height can sanitation explain?" available online at http://riceinstitute.org/wordpress/research/?did=13), I explore evidence for one possible explanation: open defecation. More than a billion people worldwide defecate openly without using a toilet or latrine. India, with some of the world's worst stunting, also has one of the very highest rates of open defecation: more than half of the Indian population does not use any toilet or latrine.

Evidence in the medical and epidemiological literature has documented that germs in feces can stunt children's growth. This is in part due to diarrhea, and possibly in part due to enteropathy (Humphrey, 2009): chronic changes in the lining of the intestines (Korpe and Petri, 2012) that make it harder for the body to use nutrients. Well-identified econometric papers have also shown a causal link from sanitation to child height. For example, in a paper coauthored with Jeffrey Hammer about an experiment done in partnership with the World Bank Water and Sanitation Program and the government of Maharashtra, we find that a program that promoted rural sanitation also caused children to grow taller (Hammer and Spears, 2012). Therefore, the new working paper (Spears, 2013) asks the quantitative, accounting question: how big is the effect of sanitation on child height? Big enough to account for important differences?

Open defecation around the world

Are the countries where many people defecate openly the same countries where the most children are stunted, and the average child is shortest? Yes, as demonstrated in the graph

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below. Cross-country differences in sanitation linearly explain 54 percent of the international variation in average child height.

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Each circle in this graph is a collapsed round of a Demographic and Health Survey, therefore, each represents one country in one year. The size of the circles is proportionate to the population of the country in that year. For example, the three largest circles at the bottom-right of the graph represent India in 1992, 1998, and 2005 – the three years when India had a DHS survey. One striking fact is that India's circles fall on the trend line. Indian children are very short by international standards, but are exactly as short as widespread open defecation in India predicts.

Further analysis in the paper suggests that the association between child height and open defecation is not merely due to some other coincidental factor. It is not accounted for by GDP or differences in governance, female literacy, breastfeeding, or other forms of infrastructure such as availability of water or electrification. Because changes over time within countries have an effect on height similar to the effect of differences across countries, it is safe to conclude that the effect is not a coincidental reflection of fixed genetic differences or slowly changing cultural practices. Ongoing follow-up research with coauthors suggests a similar association between change over time in sanitation and change over time in child height within Cambodia and within Bangladesh.

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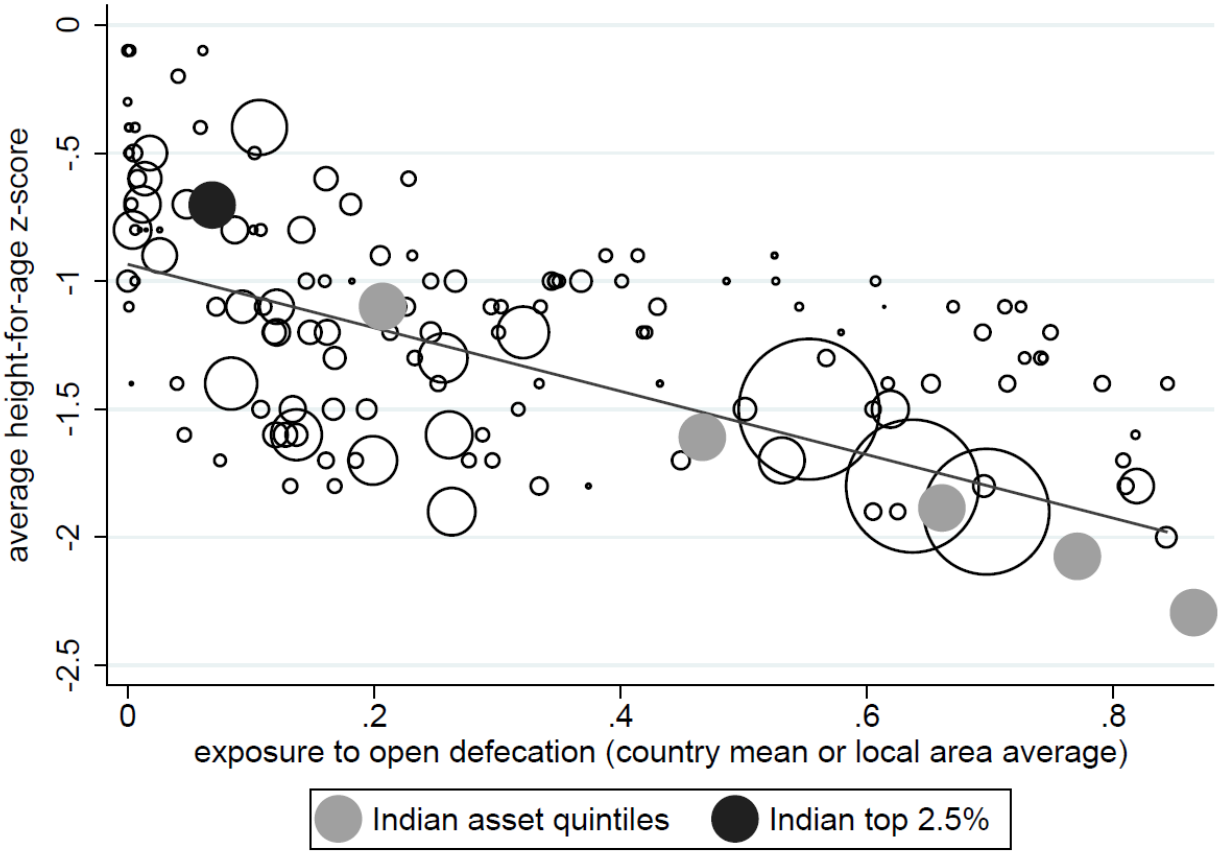
Why are rich Indian children too short?

Stunting is common even among relatively well-off families in India (Tarozzi, 2008). This suggests that private goods – such as food we eat, or curative medical treatment – may not be enough for healthy child development.

The graph below plots the same country averages again, and adds 6 dots from subsets of the 2005 Indian DHS. The grey dots are the five wealth quintiles into which the DHS splits households according to their assets. The black dot is a sample I constructed, following Tarozzi, to be the top 2.5% of Indian children: living in urban houses with their own toilets, with educated mothers, and with a range of assets. For each of the six dots I computed the average child height for age score and the open defecation that they are locally exposed to – that is to say, the fraction of households in their local survey area ("PSU") who practice open defecation.



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Strikingly, the wealth group dots fall on a line very close to the international line. Indeed, rich Indian children are too short, but this graph suggests that it is no puzzle: they are just about as short as predicted based on the level of open defecation to which they are exposed (due to other households' behavior).

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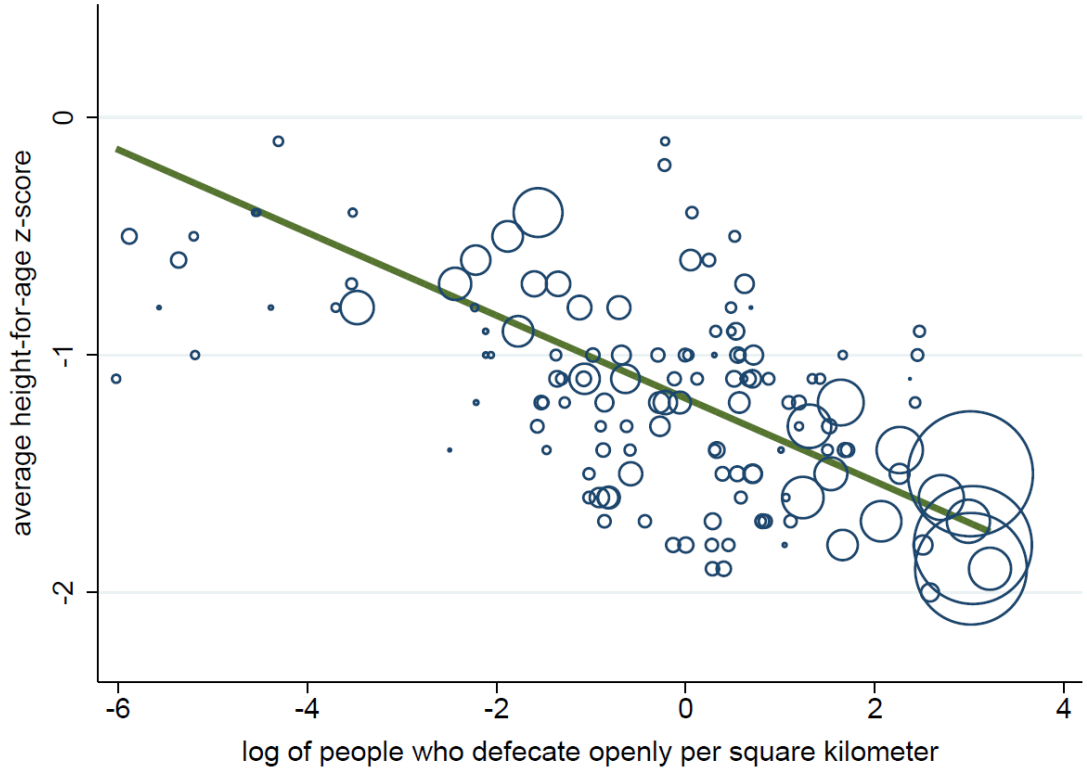
Good toilets make good neighbors

If open defecation is indeed keeping children from growing to their genetic potentials – rather than merely being coincidentally correlated with height – we would expect open defecation to be more important for health outcomes where children are more likely to encounter whatever fecal germs are introduced into the environment. This means that population density should matter: living near neighbors who defecate openly is more threatening than living in the same country as people who openly defecate far away.

The graph below confirms that this is the case: child height is even more strongly associated with the average number of people per square kilometer in a country who practice open defecation. The density of open defecation per square kilometer, in this simple linear graph, can account for 64% of international variation in child height.



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The graph plots the same 140 country years as before, and again the three large circles represent India. Once again, stunting among Indian children is no surprise: they face a double threat of widespread open defecation and high population density.

The next graph reflects a similar exercise across Indian states, looking within India's most recent DHS survey. Because each circle is now drawn using data from *part* of a DHS survey instead of an entire DHS

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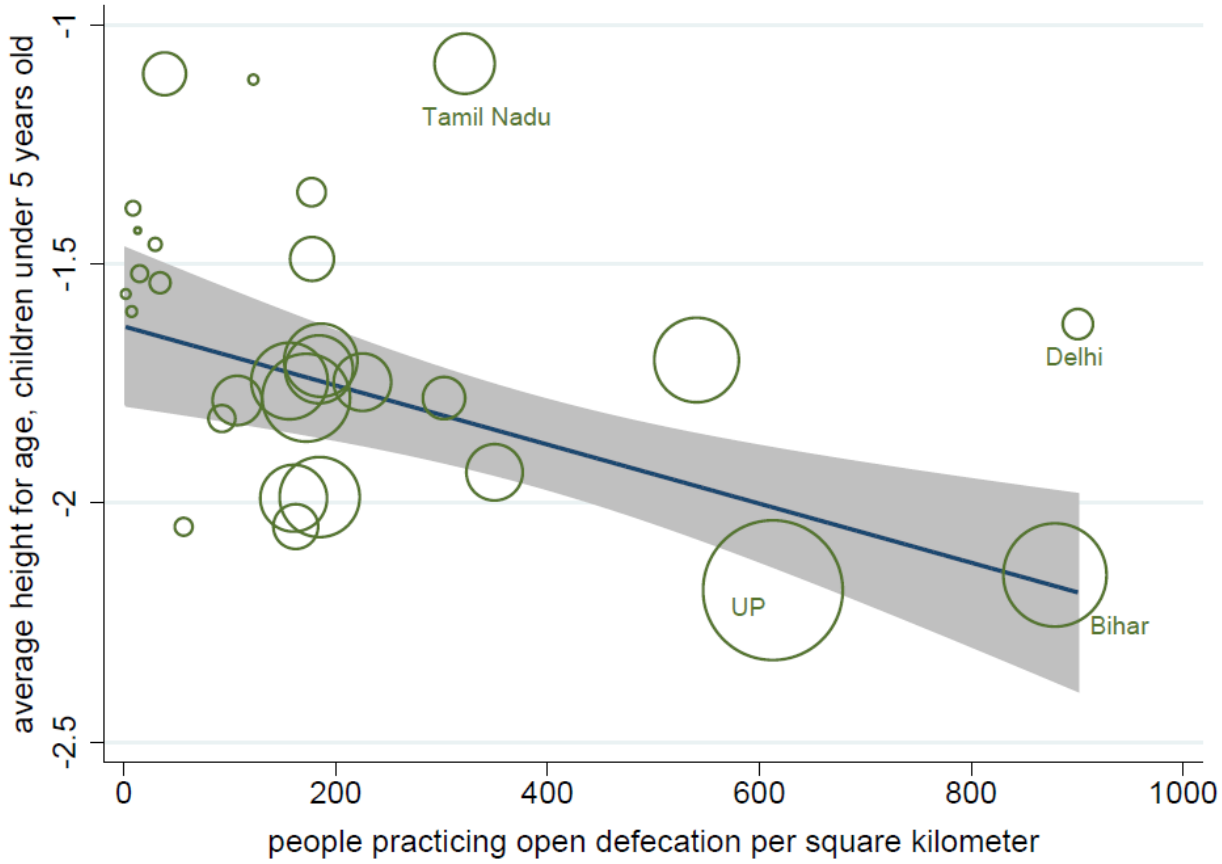
survey, averages are noisier than in the cross-country picture and the fit of the line will be less perfect. Nevertheless, a downward slope is clear: Indian states with more open defecation per square kilometer have shorter children. This suggests that Uttar Pradesh and Bihar are urgent targets for improving children's disease environment.



Source: Vyas and Spears (2013) from NFHS-3; © and used here with permission

An "Asian enigma"?: Height differences between India and Africa

Households in India are less poor, on average, than households in Sub-Saharan Africa, but children there are shorter (Ramalingaswami, et al, 1996). However, widespread Indian stunting is not due to genetics: Indian babies who move to developed countries in early life grow much taller (Proos, et al 1992).

Because of the effect of open defecation on stunting, we can estimate how tall Indian children hypothetically *would be* if exposed to the better sanitation profile in Africa. Decomposition results in the paper – in the spirit of Blinder-Oaxaca – show that sanitation differences are able to completely account for this gap. Constructing a counterfactual sample of children's heights

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in India's most recent DHS weighted to match the exposure to open defecation in a set of pooled DHS surveys from Sub-Saharan Africa can eliminate the India-Africa gap.

This suggests that sanitation is very important, but it isn't everything important. For example, in joint work with Diane Coffey and Reetika Khera (2013), we show that children of women in India with lower social status grow less tall, identifying the consequences of intrahoushold rank by taking advantage of special properties of rural joint Indian families. Because these children are in the same household, they presumably are exposed to essentially the same sanitation environment. Other dimensions of inequality are correlated with height in India: gender, birth order (Jayachandran and Pande 2011), and caste (although, since this is a "perspectives" article, I will wonder if open defecation sites tend to be nearer to low caste homes, which appears to be the case in some villages I have visited, and which cannot be tested with DHS data).

Although I am not an expert on either of these issues, I understand that breastfeeding is not ideally practiced in India, and that many children's diets are importantly lacking in animal fats and proteins (note, however, unless one believes these practices have changed importantly over the past 20 years, they cannot account for the within-country, that is fixed effects, sanitation and stunting link). Further, because Indian households are richer, Indian children would be expected to be *taller* than African children, beyond merely eliminating the gap – which is all open defecation statistically appears to do. Moreover, even matching African levels of open defecation, children in both regions would be much too short. All of this said, sanitation appears to be important enough to merit a serious and urgent policy response.

Ending open defecation in India: Next steps for policy-makers

Open defecation is everybody's problem. It is the quintessential "public bad" with negative spillover effects even on households that do not practice it. Because early life health shapes adult cognitive achievement and productivity, it is a priority for economic policy and health policy both.

Therefore, officials in Block Development Offices, district Vikas Bhavans, state capitals, and offices in Delhi must make eliminating open defecation a top priority. This means much more than merely building latrines; it means achieving widespread latrine use. In particular, the newly elected government of Uttar Pradesh, already hailed for its dynamism and innovation, has a special opportunity to distinguish itself by turning around the situation confronting the new officeholders: one of the world's most threatening combinations of widespread child stunting and high rates of open defecation per square kilometer.

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Talk about stunting

Stunting is often referred to as "malnutrition." Sometimes in policy debates, this is taken to imply that the solution is to provide more food. Food is very important, and I look forward to a day when nobody has to feel hungry because they cannot access enough to eat. But what these results suggest is that the disease environment is an important cause of "malnutrition," too. If so, then far from merely a concern of infrastructure specialists, open defecation would a priority for health and nutrition policy – and for children's well-being and the productivity of the next generation of workers. Talking about "stunting" instead of "malnutrition" when what we really mean is "short children" could clarify discussion and avoid prejudicing policy solutions (Waterlow, 2011).

Motivate latrine use

Latrines only make people healthier if they are used for defecation. They do not if they are used to store tools or grain, or provide homes for animals, or as a source of repurposable building materials. Any policy response to open defecation must take seriously the thousands of latrines that the government has funded that sit unused (at least as toilets) in rural India. Perhaps surprisingly, giving people latrines is not enough.

It is especially appropriate that we are discussing open defecation at the Public Health Foundation of India, because sanitation is the classic public good. Because other people benefit from my using a toilet, when I am trading off my own costs and benefits, I may not be as motivated as I socially should be to dispose of my feces safely if I do not consider the "external" effects on other people.

Of course, this economic calculus is not the only barrier to latrine use, and may not even be the most important. Many people, for example, will explain that they believe that "going to the fields" is healthy (even if "the field" is actually pretty close to somebody's house). People around the world have differing concepts of what "cleanliness" entails. More research – quantitative and qualitative – is urgently needed about what can motivate and limit latrine use.

In contrast, there is little mystery surrounding the forces that have an interest in latrine construction. Moving money for government construction – apparently the local definition of the word "*vikas*" in some places where I have traveled – will always have a constituency among the contractors and others who can benefit from it. It would be a shame if any increased financial investments in sanitation by the government served only to attract the attention of district and block officials who would otherwise find diverting funds from a different program more lucrative, without actually solving the problems of motivating latrine use. A carefully implemented and sufficiently large *ex post* incentive, given conditional on actual latrine use, could be a more effective use of funds.

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Collect useful data

The Indian Government's Ministry of Drinking Water and Sanitation has long demonstrated an admirable commitment to open access to administrative data and figures: for years, they have made freely available on the internet district-level and even village-level counts of latrines constructed under their scheme. Few programs have made a similarly commendable effort.

In general, the data input into this system are not "collected" by surveyors in the way that DHS or census data is. Instead, the data are submitted as administrative records by the government agents whose job it is to implement sanitation policy. Thus, latrine counts are reported by the people who are responsible for creating latrines. This limits the usefulness of the data, not only for research, but also for the government's own management of its programs.

There is a conceptually simple and well-tested solution, successfully put into practice every day by academic, government, and private organizations throughout India and around the world: survey data. The government could create an independent team of surveyors – accountable only to decision-makers and only for accurate information – who go to a randomly selected sample of places to learn about sanitation coverage and latrine use, in an ongoing pattern. Data would be credible and constantly updated for administrators' information. It is true that there may not be numbers reported every year for every locality, but a carefully constructed sample could produce useful information about a sufficient range of places.

"Better data about latrines" may seem an unlikely answer to the question "how can policy address stunting among Indian children?" But widespread open defecation is a policy emergency about which there may be more puzzles than solutions. Without information, policy-makers can become detached from the problems that they are trying to solve. An accurate database for ongoing research and decision-making is a first step.

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