

# Sanitation and Stunting

*How much international variation in child height can open defecation explain?*

A child's height is one of the most important indicators of her well-being. Height reflects the accumulated total of early-life health and diseases. Because problems that prevent children from growing tall also prevent them from growing into healthy, productive, smart adults, height predicts adult economic outcomes.

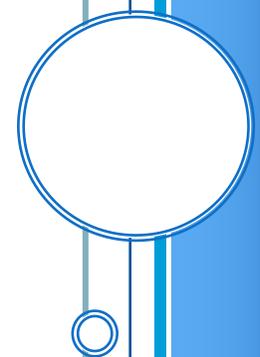
Researchers studying height have long been puzzled by a paradox: Among developing countries, differences in average height are not very well explained by differences in income. In particular, children in India are shorter, on average, than children in Sub-Saharan Africa, even though Indians are richer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

**Open defecation explains 54% of international variation in child height.** In contrast, GDP only explains 29 percent. The association between sanitation and stunting is not driven by wealth, genetics, or other coincidental differences.

**Stunting is important for cognitive achievement and economic productivity.** In India, taller children are much more likely to be able to read and do math. This correlation is partially determined by early-life exposure to sanitation.

**Open defecation can statistically account for the India-Africa child height gap.** If the low sanitation coverage in Indian data is statistically adjusted to match the greater sanitation coverage in Africa, the average height of Indian children "increases" by at least as much as the India-Africa gap. Sanitation is an especially urgent threat in India because high population density increases exposure to open defecation.



## Open defecation explains cross-country differences in child height



Are 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 figure above. Cross-country differences in sanitation explain 54 percent of the variation in average child height.

Each circle in this graph 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.

Statistics verify 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, or other forms of infrastructure such as availability of water or electrification.

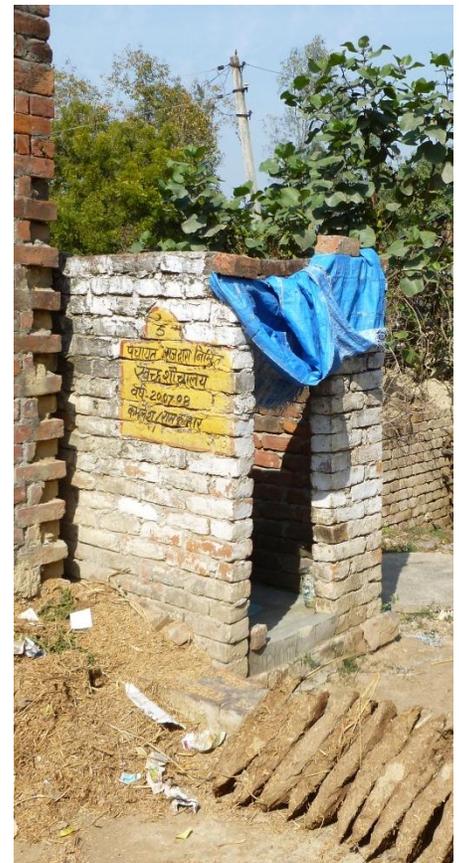
Because changes over time within countries have an effect on height similar to the effect of differences across countries, it is safe to conclude that the effect is not a coincidental reflection of fixed genetic differences.

### Data Source: DHS Surveys

The data used in this analysis come from Demographic and Health Surveys, such as India's National Family Health Survey. DHS surveys are funded by USAID and are among the highest-quality internationally comparable data sources on health in developing countries. Learn more about DHS surveys at [www.measuredhs.com](http://www.measuredhs.com).

## Why would sanitation matter for height?

A child's height reflects a combination of her genetic potential and the extent to which her early-life health and nutrition allow her to reach that potential. In richer countries, genetics is a relatively more important determinant of differences in heights; in poorer countries net nutrition and the disease environment matter. Because open defecation introduces germs from feces into the environment, poor sanitation makes growing children sick. This is why the link between open defecation and child height is even stronger in high population density places like India: children are more likely to encounter germs from other people's feces.



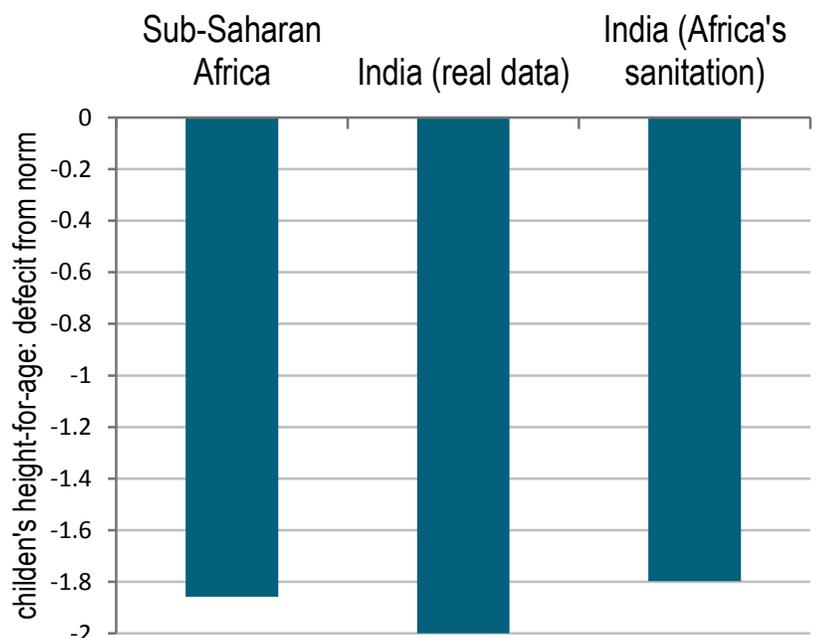
## An "Asian Enigma": Could open defecation explain the height gap between India and Sub-Saharan Africa?

Households in India are less poor, on average, than households in Sub-Saharan Africa, but children are shorter. Stunting is common even among relatively well-off families in India. However, widespread Indian stunting is not due to genetics: Indian babies who move to developed countries in early life grow much taller.

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. The graph to the right shows that sanitation differences are sufficient to completely explain this gap.

Of course, because Indian households are richer, Indian children should be *taller* than African children. Moreover, even with African levels of open defecation, children in both regions would be too short.

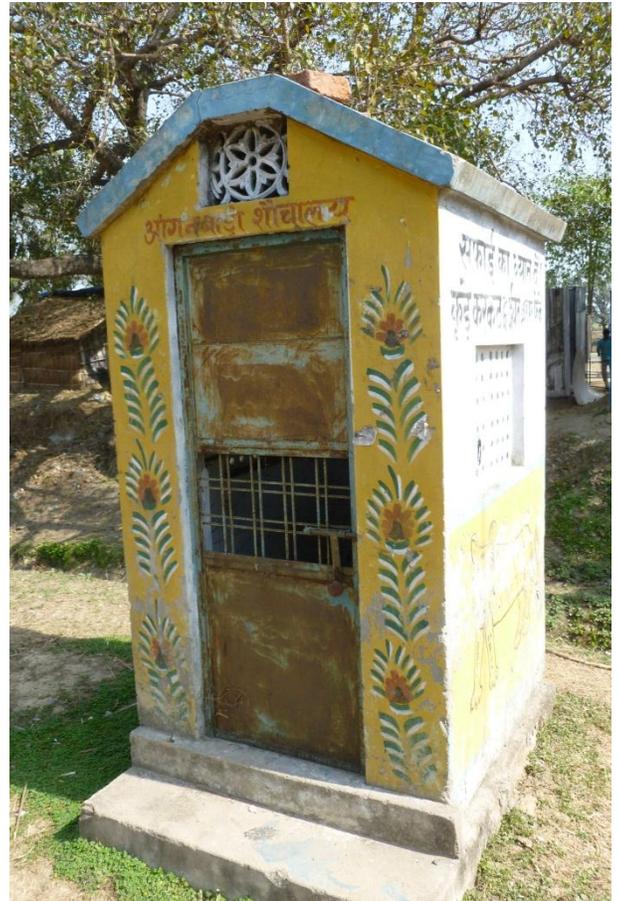
**Average child height in rural India and Africa**



## Latrines spillover: Open defecation matters for everybody

When one household's behavior impacts others, economists call the situation a "spillover." Open defecation causes negative spillovers because germs from one person's feces, released into the environment, can make other people sick.

Sanitation spillovers are one reason why even relatively well-off Indian children are shorter than international norms for healthy children recommend: even if everybody in their family uses a latrine or toilet, they are exposed to germs by other people's behavior. In light of the importance of sanitation for stunting – and the outcomes that height predicts such as economic productivity – this means that ending open defecation is a policy priority for everybody in countries like India where it is widespread.



### Interested in all the details? Learn more!

This brief is primarily based on a research paper by Dean Spears: "How much international variation in child height can sanitation explain?" The full paper, with the details of all computations and conclusions, is available online at [www.riceinstitute.org](http://www.riceinstitute.org).

Prior research by other scholars made this study possible. You can learn more by reading:

Angus Deaton. 2007. "Height, health, and development." *PNAS*.

Jean Humphrey. 2009. "Child undernutrition, tropical enteropathy, toilets, and handwashing." *The Lancet*.

Dean Spears. 2012. "Height and cognitive achievement among Indian children." *Economics and Human Biology*.

Alessandro Tarozzi. 2008. "Growth reference charts and the nutritional status of Indian children." *Economics and Human Biology*.

[www.riceinstitute.org](http://www.riceinstitute.org)