

Short communication (2,500 words, including notes but excluding abstract and cover page)

Access to water does not explain exceptionally common open defecation in India

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Abstract

Open defecation is exceptionally common in India. According to Joint Monitoring Programme data, 60 percent of all people worldwide who defecate in the open live in India. In policy discussions, one commonly cited candidate explanation for the puzzle of Indian open defecation despite economic growth is access to water. We report two analyses, comparing internationally and within India, which suggest the same conclusion: exceptional open defecation in India is not, in general, able to be explained by lack of access to water, on average. Internationally, India has much more open defecation than cross-country trends would predict for its level of water access, and four of every five countries with worse access to water have lower levels of open defecation. Within rural India, in data from the 2011 Census of India, almost half of households with piped water in the home defecate in the open. Open defecation rates between households with water near and water far are very similar, and this slight difference is entirely accounted for by differences in asset wealth: at the same level of wealth, open defecation has no association with this difference in water access, on average.

Keywords: open defecation, India, water access, behavior, census

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Introduction

Open defecation is exceptionally widespread in India. Indeed, open defecation is increasingly a problem concentrated in India: according to Joint Monitoring Programme data, 60 percent of all people worldwide who defecate in the open live in India, a fraction which has been increasing for several years. Within India, 90 percent of open defecation is rural, rather than urban. This is a puzzle because Indians have been experiencing economic growth and falling poverty, and most countries that are poorer than India have lower rates of open defecation – in many cases, much lower. Why is open defecation so exceptionally persistent in rural India?

One frequently cited candidate explanation for this Indian exceptionalism is limited access to water. It is commonly suggested by commentators, policy-makers, and others in India's sanitation sector that open defecation remains common because people do not have access to water to flush or clean latrines. For example, the then Minister of Drinking Water and Sanitation said in 2014 that "Out of every [350,000] toilets built, 10,000 are used... Lack of water is the main problem" (Telegraph, 2014). An opinion article in the Indian newspaper *Business Standard* writes "water and maintenance are the key challenges" (Das Gupta, 2014). Another on CNN suggests "an absence of adequate toilets *and water facilities* is as much the reason for this..." (Khullar, 2014; emphasis added). The opinion that water access accounts for Indian open defecation is commonly raised in the authors' discussions with policy-makers about sanitation in India.

In this note, we present evidence that, on average, worse access to water cannot account for widespread open defecation in India. Both in international comparisons and in analysis of census data within India, simple statistical comparisons are incompatible with any straightforward understanding of water as a special driver of India's uniquely widespread and persistent open defecation. Although we cannot claim that none of the over 100 million households in India where open defecation is practiced are influenced by access to water, nothing in the data we study suggests that unusual water shortfalls can account for the aggregate outcome. Although we do not resolve or explain the puzzle of exceptional Indian open defecation, we contribute to understanding this important issue.

Evidence from international comparisons

If India's extreme levels of open defecation could be explained by access to water, then we would expect to see an international trend in the association between water and open defecation, and we would expect this trend to predict Indian open defecation, given its access to water. Moreover, we would expect to see more open defecation in the many countries with worse access to water than India.

Figure 1 shows that none of these expectations hold true. Within each plot, each circle is a country in the 2012 Unicef and WHO Joint Monitoring Programme data. Circles are sized proportionately to countries' populations, so the large circles are India and China, and India is labeled. Graphs are presented for total populations and rural populations, by the percent of people with access to "improved" water and with water "piped on premises" of their homes, as classified by the JMP.

According to these data, 90.7 percent of people in rural India have access to improved drinking water,² this implies that a minimum of 86 percent of the rural people who defecate in the open in India have improved drinking water.³

The quadratic trend lines plotted alongside the country-level data reflect only correlations, not any causal effect. But in every case there is much more open defecation in India than would be predicted by any international trend, as is visible in the vertical distance between India and the trend lines. In comparison with many developing countries, access to improved water is relatively good in India, *prima facie* evidence that access to water is unlikely to explain why open defecation in India is particularly bad. Circles to the left of India's reflect the many countries with worse access to water.

Most countries with *worse* access to water than India also have *better* sanitation, in this case meaning lower open defecation. There are 178 countries with information on open defecation and water access in the JMP data. Of the 78 that have fractions with improved water than India, 68 countries (87 percent) have lower open defecation than India; of the 44 that have less piped water, 36 countries (82 percent) have lower open defecation than India. Because most open defecation in India is rural, it also is useful to examine rural parts of countries. Of 90 countries with less access to improved water among rural people, 78 (87 percent) have lower rural open defecation rates. Finally, of 47 countries with worse rural piped water than India, 38 (81 percent) have lower rural open defecation rates.

Another approach is to compare fractions of people, rather than fractions of countries. According to these data 48.3 percent of people in India defecate in the open, but only 21.2 percent of all people who live in countries with lower levels of access to improved water than India defecate in the open. Only 21.5 percent of the people who live in countries with worse access to piped water than India defecate in the open. These international data offer no evidence to suggest that access to water can explain open defecation in India.

Evidence from the 2011 Census of India

We have seen that access to water, as recorded by JMP data, cannot account for India's open defecation exception internationally. In this section, we consider the variation in open defecation that water access can or cannot explain *within* India. We use data from the Government of India's 2011 census.⁴

These data have two advantages for our analysis. First, they were collected by and are in wide use by the Government of India, and are widely considered the definitive available data on sanitation in India. Second, unlike the JMP they provide information on *where* water is available relative to a household, splitting households into three categories: those with water piped into the home, those with water near the home, and those with water far from the home (labeled "away" by the census). One disadvantage

² Note that this JMP measure is for *drinking* water which is a more binding constraint than is needed. If 90.7 of people in rural India have access to improved drinking water; some *larger* fraction will have access to water usable for flushing and cleaning toilets that may not be of high enough quality to drink.

³ Assume that all 9.3% without improved drinking water defecate in the open. $(65.0-9.3)/65.0 = 0.857$.

⁴ This data is available to researchers in a 1 percent sample, for analysis at a census data center at Jawaharlal Nehru University.

of these data is that they record household-level open defecation, rather than person-level latrine use, as distinct from latrine ownership.

We concentrate on rural India, because this is where 92 percent of households recorded as defecating in the open in these data live. We have census data on 1,677,653 rural households, of which 67 percent are recorded to defecate in the open. Among the rural households in our data, 35 percent have water access within their premises, 43 percent have water near their premises, and 22 percent have water away from their premises.

Simple summary statistics suggest that access to water is not an important determinant of open defecation. Fully 46.6 percent of rural households with access to water *on their premises* defecate in the open. In the JMP country level data, in only 12 percent of countries does a fraction of *all* rural people defecate in the open that is as high as this fraction of people who defecate in the open among people in rural India with water on their premises. Among the rural residents of these 21 high open-defecation countries in the JMP data, only 8 percent have piped water and 56 percent have improved water.

Among rural households in the Indian census without water on their premises, 80.7 percent of those with water far away defecate in the open, compared with 77.6 percent of those with water near their homes. Although we cannot verify census enumerators' classifications of households, this small 3 percentage point difference further suggests that open defecation behavior is not substantially shaped by access to water.

Table 1 elaborates upon this initial impression. Each column in the table presents a simple linear probability regression for an indicator for a household's open defecation on indicators for water being near the home and water being in the home, with water far away as the omitted category for comparison. Columns 1 and 2 pool rural and urban India, with an indicator for rural residence added in column 2. Over a quarter of the small increase in open defecation for households with water far rather than near is already accounted for by the difference between rural and urban India.

Columns 3, 4, and 5 return the focus to rural India. As we have seen, households with access to water nearby are only 3 percentage points less likely to defecate in the open than households with water far away. However, there is no reason to believe that this difference reflects a causal effect of access to water. Households with worse access to water are also poorer, on average.

The census data include measures of household asset ownership that we use to construct an imperfect accounting for relative household wealth and poverty (Filmer and Pritchett, year). We separate households into mutually exclusive categories based on their ownership of sets of assets. We construct two separate sets of categories, for robustness:

- Wealth bins A are 128 intersecting categories of formal house construction, electrification, and ownership of a bicycle, a TV, and a mobile phone.
- Wealth bins B are 381 intersecting categories of ownership of a radio, a bicycle, a TV, a mobile phone, a scooter or motorcycle, a laptop computer, and a car.

Columns 4 and 5 each control for one of these semi-parametric wealth indicators as a set of fixed effects. This is equivalent to estimating the average association between water access and open defecation within these wealth categories. In both cases, there is no longer any indication of a difference in open defecation between households with water far from their home and households with water near to their home, which suggests that the (very small) apparent difference was merely a spurious reflection of differences in socioeconomic status. These coarse wealth controls cause the coefficient on access to water on premises to reduce by one-third, suggesting that further accounting for different properties of these households may further reduce this apparent open defecation advantage of those with piped water.

Figure 2 presents a graphical depiction of this result. The horizontal axis ranks households by one measure of wealth, from richest to poorest, using wealth bins A.⁵ The overlapping of the lines for water near and water far indicate that, at the same level of asset wealth, this extra access to water makes *no difference* to household open defecation, on average. We note that even among the asset-richest rural households on the left side of the graph, open defecation is very common in comparison with other developing countries.

Conclusion

Two analyses, comparing internationally and within India, suggest the same conclusion: exceptionally widespread open defecation in India is not able to be explained, in general, by any average lack of access to water. Internationally, India has much more open defecation than any international trend would predict for its level of water access, and most countries with worse access to water have much lower levels of open defecation. Within rural India, in census data, many households with piped water in the home defecate in the open. Open defecation rates between households with water near and water far are very similar, and this slight difference is entirely accounted for by differences in asset wealth: at the same level of wealth, open defecation has no association with this difference in water access. Certainly there are dimensions of access to water that these data do not fully capture – such as average hours of water availability from pipes – but we interpret this data as sufficient to shift a burden of proof onto any analyst who claims that water access can account for India’s exceptional open defecation.

If water access cannot explain Indian open defecation, it is beyond the scope of this short communication to do so. We refer the reader to a recent epidemiological study in Orissa by Barnard, *et al* (2013), who conclude that “the most common reason reported for not using a latrine was that people prefer open defecation. Open defecation is a cultural practice that is deeply engrained in communities in India.” Recent social science research that explores these themes in India includes Coffey, *et al* (2014), Coffey, *et al* (2015), and Teltumbde (2014).

⁵ Each household is assigned the midpoint rank (among the 1,677,653 rural households) when the 128 asset ownership bins are ranked by fraction of households defecating in the open. Therefore, although the lines in the figure slope upwards by construction, each household is categorized with others only according to its asset ownership. Vertical distances are therefore similar to fixed effects regression estimates within asset bins.

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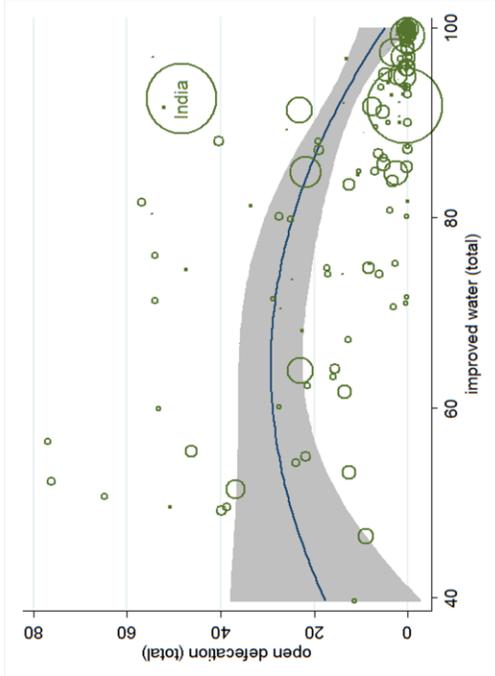
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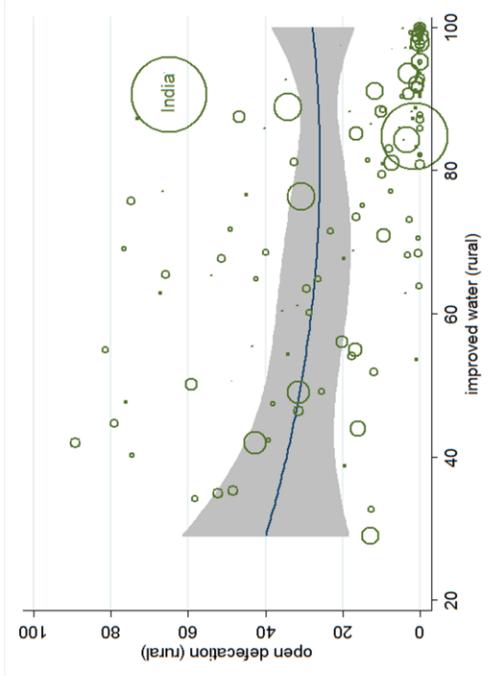
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Figure 1: International comparisons of sanitation by water access, JMP 2012

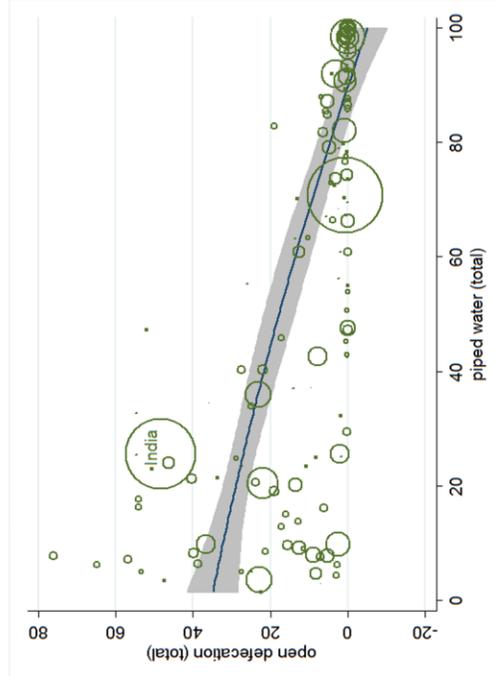
(a) improved water, rural & urban



(b) improved water, rural



(c) piped water, rural & urban



(d) piped water, rural

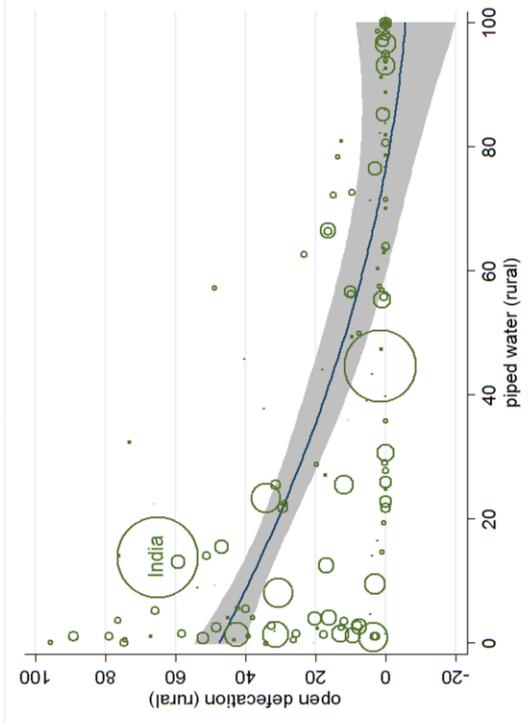
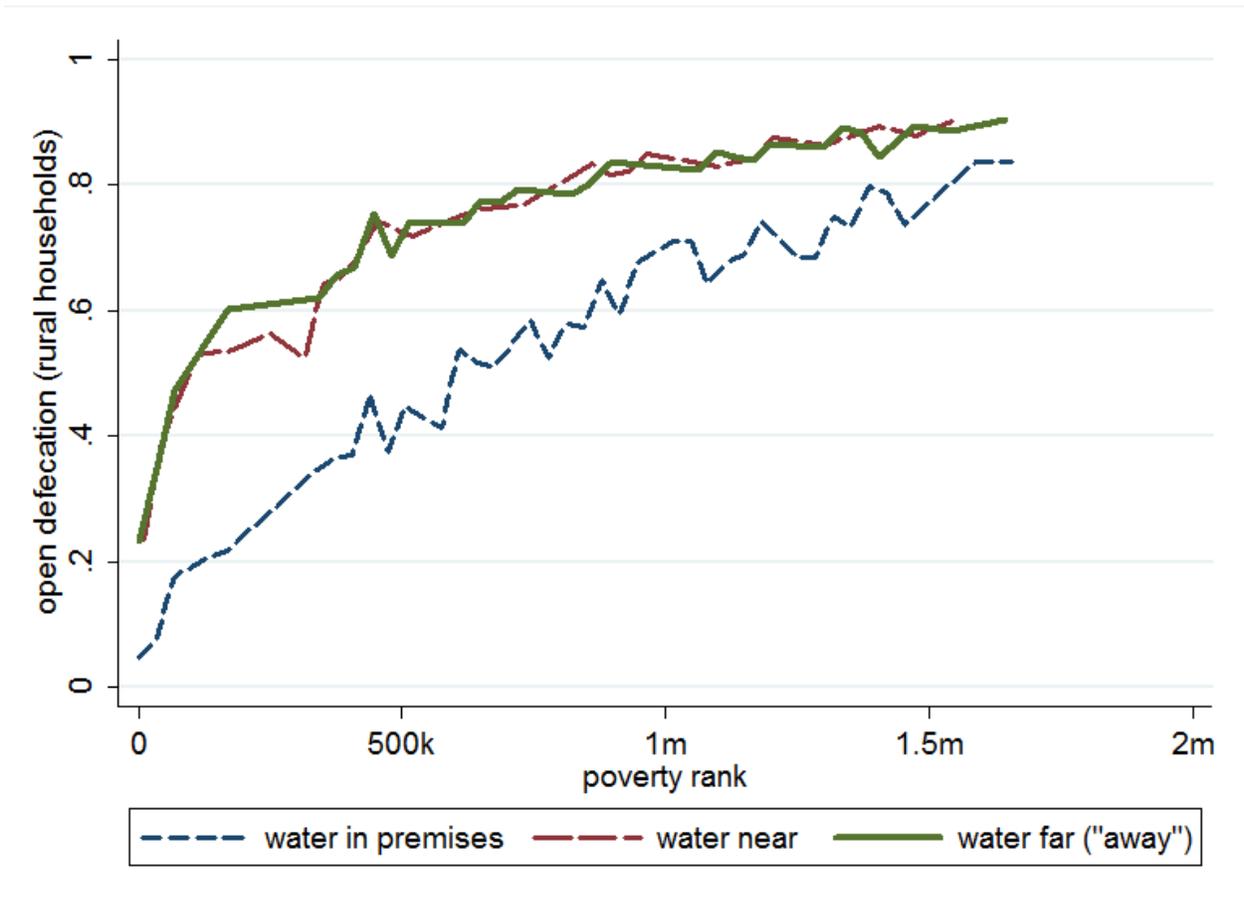


Figure 2: Rural open defecation by water access and wealth



Note: Observations are 1,677,653 rural households in the 5% sample of the 2011 Census of India. Poverty rank assigns each household the average rank, sorting by open defecation, in its bin of 128 intersecting categories of formal house construction, electrification, and ownership of a bicycle, a TV, and a mobile phone.

Table 1: Open defecation is not more likely when water is far rather than near

sample:	(1) rural & urban	(2) rural & urban	(3) rural	(4) rural	(5) rural
water far from home ("away")					
water near home	-0.0643*	-0.0473*	-0.0323*	-0.00194	-0.00378
	(0.0008)	(0.0008)	(0.0008)	(0.00381)	(0.00470)
water in home	-0.491*	-0.343*	-0.343*	-0.228*	-0.235*
	(0.0008)	(0.001)	(0.001)	(0.017)	(0.014)
urban		-0.433*			
		(0.001)			
wealth bins A				✓	
wealth bins B					✓
constant	0.750*	0.813*	0.807*	0.754*	0.757*
	(0.001)	(0.001)	(0.001)	(0.006)	(0.004)
<i>n</i> (households)	2,465,814	2,465,814	1,677,653	1,677,653	1,677,653

Note: OLS linear probability regressions; dependent variable is an indicator for household open defecation. Data are from the 1% sample of the 2011 Census of India. Robust standard errors in parentheses. Wealth bins A are 128 intersecting categories of formal house construction, electrification, and ownership of a bicycle, a TV, and a mobile phone. Wealth bins B are 381 intersecting categories of ownership of a radio, a bicycle, a TV, a mobile phone, a scooter or motorcycle, a laptop computer, and a car. All coefficients marked with * are statistically significantly different from 0 at a $p < 0.001$ level.