Open defecation in rural India, 2015-2016: Levels and trends in the NFHS-4

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Abstract

The Government of India's NFHS-4 offers the best new data on open defecation in rural India to be released in over a decade. Although open defecation has become less common than it was ten years ago, it is still highly prevalent, with more than half of rural households reporting open defecation rather than toilet or latrine use. On average, change has been slow, even during the period of the Swachh Bharat Mission.

Introduction

Reducing open defecation is an urgent policy priority: it kills thousands of children each year, and stunts the growth and development of those who survive. As a result, the UN has included the elimination of open defecation globally by 2030 among its Sustainable Development Goals. The Government of India has set an even more ambitious schedule: the Swacch Bharat Mission (SBM) aims to end open defecation by October 2019.

According to the WHO and Unicef's Joint monitoring report, more than half of open defecation that occurs anywhere in the world occurs in *rural* India (JMP, 2017). According to the 2011 Census, 90% of Indian households that lack a toilet or latrine are rural households. Although life in rural India is changing quickly in many respects, Census and other data sources suggest that latrine adoption is proceeding slowly. In this commentary, we investigate patterns of rural open defecation using the newly released National Family Health Survey-4 (NFHS-4), a large-scale nationally representative survey collected between January, 2015 and November, 2016. The NFHS is conducted as a collaboration between the International Institute of Population Sciences, ICF International, and the Ministry of Health and Family Welfare of the Government of India.

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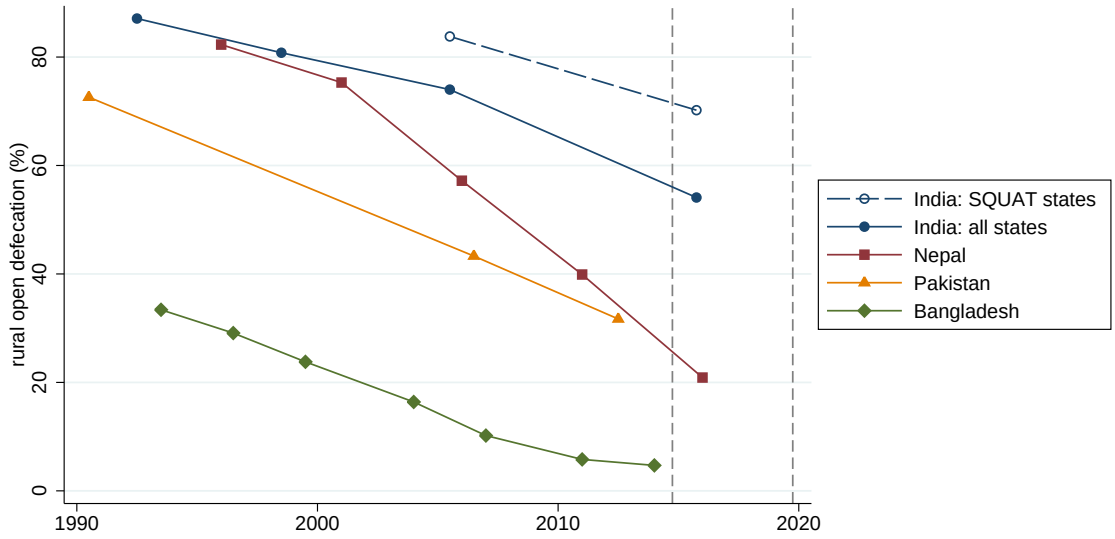
Studying the NFHS-4 offers special advantages over other data sources. High among this is that the NFHS is part of an international health monitoring program called the Demographic and Health Surveys (DHS), which are widely regarded as high quality data. These internationally comparable surveys ask the same questions in many countries around the world. Results from the NFHS-4 are therefore readily comparable to evidence from other countries.

We note, however, that the NFHS data on open defecation has one important weakness: the NFHS asks about sanitation behavior at the ***household*** level,[1] rather than the ***individual*** level, which, when combined with data on population density, is the indicator that is most relevant for health.[2] The difference between a household-level question and an individual-level question is important in the Indian context because there are many households in which some people use the latrine while others defecate in the open (Coffey et al., 2014). This is especially true of government-provided latrines: the SQUAT survey found that government-provided latrines are more likely to be used by only some household members compared to privately constructed latrines (Coffey and Spears, 2017). Asking about household-level behavior therefore underestimates the prevalence of open defecation.

Despite the fact that the question asked by the NFHS underestimates person-level open defecation, the release in January 2018 of household-level data from the NFHS-4 nevertheless provides an important opportunity to deepen our understanding of the levels and trends of rural open defecation. In short, we unfortunately find that the NFHS-4 offers little evidence that the decline in open defecation in rural India has accelerated radically in recent years, despite the high profile efforts of the Swacch Bharat Mission which began in October, 2014. Although households are more likely to report latrine or toilet use than before, change has been slow, and familiar regional patterns remain.

Figure 1: Rural open defecation in South Asian DHS rounds



Source: Demographic and Health Surveys. Vertical lines indicate the beginning and end of the SBM.

How much open defecation is there in rural India?

Figure 1 compares household-level rural open defecation estimates from the NFHS-4 to estimates from India's three prior DHS surveys, and to estimates from DHS surveys collected in other South Asian countries, including Nepal, Pakistan, and Bangladesh. It finds that open defecation is more common, and has declined more slowly, in India than in these other countries. In contrast with rural India, where about 55% of households report defecating in the open or using what is called a "dry latrine"[3], open defecation has been almost eliminated from Bangladesh and has recently declined rapidly in Nepal.

The top, dashed line of figure 1 restricts the NFHS-4 data to the four[4] "focus states" in the 2013-14 SQUAT survey (Bihar, Madhya Pradesh, Rajasthan, and Uttar Pradesh), which were the subject of our prior work in this journal (Coffey et al., 2014). The SQUAT survey focused on these states because over 40% of India's rural population lives in these states and because the fraction of households that did not have a toilet or latrine was around 80% in each of these states in the 2011 Census. The NFHS-4, from 2015-2016, finds that open defecation remains very high – above 70% – in the rural areas of these four states.

Table 1 presents further details on the prevalence of open defecation in rural India. The first column shows data from the 2005-06 NFHS-3 for comparison. The other columns report our estimates of the prevalence of open defecation in rural India from the NFHS-4. In addition to showing results for India as a whole (column 2), we compute results for three sub-populations, presented columns 3, 4, and 5: the four SQUAT focus states, Uttar Pradesh, and Bihar.

Panel A reports the percentages of rural households that defecate in the open, that use a pit latrine, that use a latrine with a tank, and that use a toilet that flushes into a sewer. Comparing the 2005-6 data to the 2015-16 data, we see a decline of about 20 percentage points in household-level open defecation (from about 75% to about 55%). Most of the change appears to come from increased use of latrines with tanks, which are more expensive than pit latrines. As we have discussed previously in this journal, pit latrines are a safe, affordable sanitation option that is widely used in other developing countries (Coffey et al., 2017). In India, however, and especially in the SQUAT focus states, pit latrines are relatively rare. Instead, people either use an expensive latrine that is connected to a very large tank or they defecate in the open. This is because by avoiding pit latrines, rural Indians avoid the need to empty a latrine pit. Even though emptying a pit latrine is a common occurrence in other developing countries, it is problematic in India

Table 1: Levels of open defecation in rural India

	(1)	(2)	(3)	(4)	(5)
sample:	all states	all states	SQUAT focus states	Uttar Pradesh	Bihar
year:	2005-6	2015-16	2015-16	2015-16	2015-16
Panel A: Where do rural households dispose of their feces? (reported as a % of households)					
open defecation	74.6	54.8	70.2	70.1	73.6
pit latrine	10.9	17.9	8.7	7.5	7.7
latrine with tank	13.6	25.5	20.3	21.5	17.8
flush toilet to sewer	0.8	1.6	0.6	0.8	0.5
Panel B: Households that defecate in the open, among rural households with characteristic (%)					
has TV	52.2	38.1	46.3	48.4	35.9
does not have TV	84.3	73.9	82.2	80.7	81.9
has mobile phone	32.5	51.5	67.7	68.3	71.6
Hindu	78.2	58.4	72.4	74.3	74.6
Muslim	59.5	39.1	54.5	44.3	68.5
water on premises	52.8	33.4	41.2	51.1	62.2
improved water access	73.6	54.5	69.5	69.9	73.4
Panel C: Count of persons who defecate in the open (millions; see note below about assumption)					
all rural households	595	500	264	110	75
has TV	139	192	64	28	7
does not have TV	465	307	199	81	68
has mobile phone	24	434	236	101	68
water on premises	47	54	11	2	2
improved water access	491	441	241	106	74

Sources: 2005-6 data are from the NFHS-3; 2015-16 data are from the NFHS-4
Note: SQUAT focus states are Bihar, Madhya Pradesh, Rajasthan, and Uttar Pradesh. Columns 2-5 assume a total rural population of 912 million. Column 1 assumes a total rural population of 800 million. Results in panel C assume that all members of a household have the same sanitation behavior – they all either use a latrine or defecate in the open. All columns use DHS sampling weights.

because it is believed that only people from untouchable castes can empty a latrine pit (Coffey and Spears, 2017). The NHFS-4 finds that pit latrines are more common in 2015-16 than they were in 2005-6, but that they are less common than latrines with tanks that can be emptied mechanically or infrequently.

Panel B of Table 1 reports the fraction of households within various categories (for example, households that have a TV) that defecate in the open. Several patterns, each suggested by prior research on open defecation in India,[5] emerge from the NFHS-4 data. First, these data provide evidence that open defecation is not driven by poverty: it is common even among households that own assets such as TVs and mobile phones. Second, open defecation in rural India is robustly correlated with religion, as originally explored by Geruso and Spears (2018): Hindu households are more likely to report open defecation than Muslim households in each of these samples, despite the fact that Muslim households are poorer, on average. Third, open defecation in India is not a result of lack of access to water: about a third of households that have water on the premises defecate in the open.

Panel C uses the NFHS-4 data to estimate the count of persons who defecate in the open in rural India. These estimates must be treated with care because, as we discussed above, the NFHS asks about household behavior, rather than individual behavior. Therefore, in computing the number of people who defecate in the open, we must assume that what a household reports is true for every

member of that household. This assumption leads us to underestimate open defecation behavior. Despite this, the number of people who still practice open defecation is staggering: the results in Panel C find that at least 500 million rural Indians defecated in the open in 2015-16.

Change during the SBM period?: January 2015 through November 2016

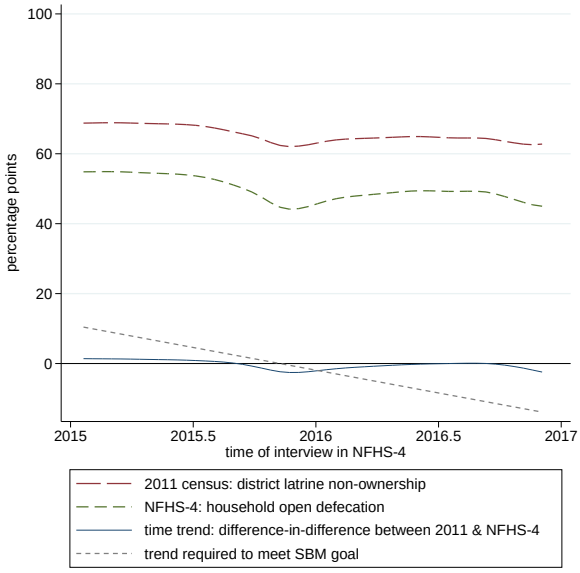
Ordinarily, researchers implicitly interpret a DHS survey as though it were representative of a country in a particular year. The NHFS-4, however, collected a large sample of approximately 600,000 households, and was conducted over a period of two years. The 23-month span of the NFHS-4 occurred within the first half of the Swacch Bharat Mission. Indeed, the 23 months of data collection amount to 38% of the total 60 months of the SBM. As a result, we can compare households that were interviewed earlier in the survey with households that were interviewed later in the survey to learn something about SBM's progress over the period of the survey.

Such a strategy offers the unique advantage of asking the same survey question at different points of time. However, it also offers the risk that places where the survey visited early could be different, on average, from places where the survey visited late. We will therefore have to interpret any apparent time trend carefully. We account for differences across places, in part, by matching each rural household in the NFHS-4 with the fraction of rural households in its district that were reported to not own any toilet or latrine in the 2011 Census.

Figures 2 and 3 compare open defecation rates among households interviewed by the NFHS-4 at different times. Figure 2 studies all of rural India, where figure 3 studies only the four SQUAT focus states. In both of these figures, an observation is a household, and the horizontal axis is the time at which a household was interviewed. Similar methods are used for creating both figures – we focus our discussion first on the findings of figure 2.

The dashed line labeled "NFHS-4" — the second from the top in both figures — plots how household-level average open defecation (as reported in the NFHS-4) is different among households interviewed at different times. It has a downward slope, which means that households interviewed towards the end of the survey were less likely to report defecating in the open than households interviewed at the beginning of the survey. One way to think about this line is to imagine what it would look like if there were a very rapid reduction in open defecation

Figure 2: 2015-2016 time trends in rural open defecation: all India

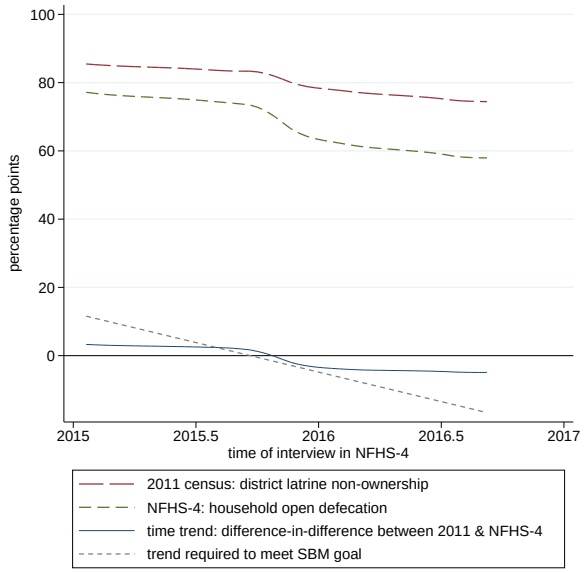


across the country over the two years during which the NFHS-4 were collected: then, we would expect the line to have a steep downward slope. Does the slope we see reflect rapid national improvement in open defecation?

Unfortunately, we cannot interpret the slope of the NFHS-4 line as *only* reflecting change over time in average open defecation across India because the places interviewed later in the survey might have been different, on average, from the places interviewed earlier in the survey. That is exactly what the line with long dashes labeled "2011 Census" — the top line in both figures — indicates. This line is computed by matching each household to the percent of rural households in its district that did not own a latrine according to the 2011 Census. This line can be thought of as a measure of place-specific differences in sanitation that all were measured in the same year and that existed before the SBM. The 2011 Census line slopes down, indicating that places with more latrine non-ownership in 2011 tended to be interviewed earlier by the NFHS-4 than places with less latrine non-ownership in 2011. So, much of the slight downward slope in open defecation in the NFHS-4 line is probably due to pre-existing differences in sanitation across places. This means that the NFHS-4 line probably *overstates* the decline in open defecation over this period.

One way of thinking about this is that the average household interviewed by the NFHS-4 in 2016 was between 3 and 4 percentage points less likely to report

Figure 3: 2015-2016 time trends in rural open defecation: SQUAT focus states



defecating in the open than the average household interviewed in 2015. But, the average household interviewed in 2016 lives in a district that had 2 to 3 percentage points less latrine non-ownership in the 2011 census than the average household interviewed in 2015. So, it may be that the average decline in open defecation in rural India was at a rate of about 1-2 percentage points a year.

The line marked "time trend" at the bottom of the figure is computed by subtracting each point on the NFHS-4 line from each point on the 2011 census line. When estimated in this way, the time trend has a negative slope, but it is not particularly large: it is about 1.8 percentage points per year. Both figures also compare the "time trend" line with a dotted line that shows how steep the negative slope would have to be to meet the SBM's 2019 goal. The slope of the dotted line is steeply negative: the decline in open defecation from 2015 to 2016 would have needed to be 13 percentage points per year to be on pace for the SBM. Within the four SQUAT focus states, the decline in open defecation that would have been needed for the SBM to be on pace is even greater: 17 percentage points per year. The decline estimated by the "time trend" line in figure 3 was about 7 percentage points in these states. Although 7 percentage points per year is slower than what would be needed to meet the SBM, if this pace represents a change in individual-level behavior (rather than latrine ownership), it would nevertheless be an important improvement. However, we will see below that this estimate is sensitive to accounting for differences in households' economic status; moreover, this decline in open defecation is not a switch into pit latrines.

As a double-check of this method of estimating the decline of rural open defecation, we also compute an estimate of the time trend in open defecation using linear regression. When we regress household open defecation on the date of the NFHS-4 interview, controlling for district-level latrine non-ownership in the 2011 census, we estimate a similar trend to what is estimated above: a linearized, annualized rate of decline in open defecation of 1.7 percentage points per year in 2015 and 2016, for the full rural sample. This estimate is quantitatively robust to also controlling for households' asset ownership (1.5 percentage points per year) or asset ownership interacted with religion categories (about one percentage point per year). Because asset wealth would have increased in India over this period, these controls let us ask if the decline in open defecation exceeded what the data would predict from economic progress alone. The size of these 2015-2016 trends is similar to the size of the average, annualized decade-long decline that would have reduced open defecation in rural India from 74.6% in the NFHS-3 to 54.8% in the NFHS-4.

In contrast with the full-rural-India sample, in the SQUAT focus states sub-sample these regression controls make a larger difference to the estimated rate of decline. Controlling only for district-level latrine non-ownership in the 2011 Census, regression finds a linearized 6.2 percentage point decline per year, matching figure 3. However, this estimate falls to 1.4 percentage points per year if households' asset wealth is included, or 1.5 if asset wealth and religion are both accounted for. Therefore, part of the downward slope in the NFHS-4 line in figure 3 reflects the fact that richer households tended to be interviewed later by the DHS in these states. For example, rural households in these states interviewed by the NFHS-4 a year later were about seven percentage points more likely to have electricity.

Another important fact about the decline in rural open defecation in SQUAT focus states is that it is not a switch into pit latrines of the sort that the SBM is building. Instead, it is a switch into large, expensive tanks, commonly called "septic tanks" in rural India, even when they are simply large brick rooms, built underground to hold feces. The increase in septic tank use (2.8 percentage points per year) slightly exceeds the decrease in open defecation (1.5 percentage points per year) with controls for households assets and religion.[6] Thus, the change from 2015 to 2016 in reported household-level pit latrine use in the SQUAT focus states is not statistically different from zero.[7]

Figure 4: Districts in 2016 resemble 2011

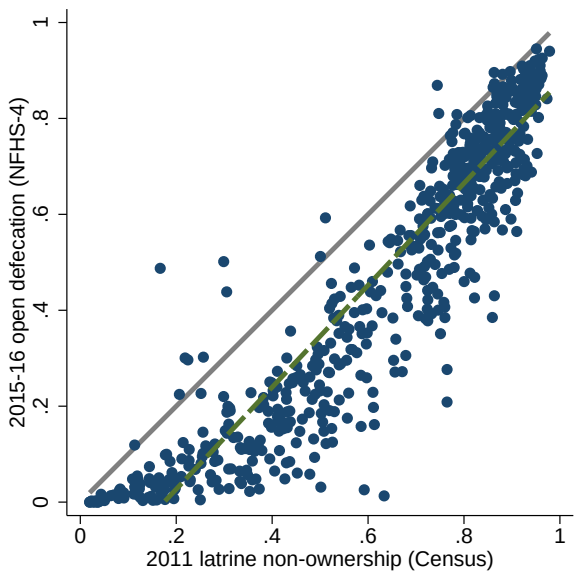


Figure 4 offers a further visualization of our finding that the patterns of open defecation in 2015-2016 resemble what was true in 2011. The figure shows that district-level open defecation computed from the NFHS-4 is highly predictable based on district-level latrine non-ownership in the 2011 Census.[8] The fact that the line is below the 45-degree line means that open defecation decreased overall, but the correlation between past and present is 93%. Regional patterns of open defecation that were present in 2011 are similar in the NFHS-4.

Conclusion

These results from the NFHS-4 likely do not surprise readers familiar with the challenges posed by open defecation in rural India. Nevertheless, they are important: they are the most credible nationally-representative estimates to be released in nearly a decade. These new numbers encourage readers and policymakers to be interpret cautiously suggestions that open defecation in rural India has changed radically in the last few years. If the average decline in rural open defecation from December 2016 to October 2019 proves to be similar to what the NFHS-4 indicates it was from January 2015 through November 2016, then about half of rural Indians will still be defecating in the open at the end of the Swacch Bharat Mission. Careful reflection and new approaches to encouraging latrine use are needed.

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Notes

[1]In each country, including India, the DHS questionnaire asks "What kind of toilet facility do members of your family usually use?"

[2]The number of persons who defecate in the open in a given area is a useful indicator of a person's exposure to fecal germs. If population growth is high enough, it may be the case that even though the *percentage* of households that defecate in the open is decreasing, exposure to fecal germs remains similar to what it was 10 years ago. It is difficult to quantify exposure to fecal germs in rural India because the government does not publish urban and rural population density separately.

[3]54.1% of rural Indian households report open defecation in the NFHS-4; our estimate of 54.8% includes "dry latrines," a practice that is decreasingly common in which household members defecate in a slab in or near the home or home compound and the feces are carried away daily, often by a Dalit.

[4]The SQUAT survey also interviewed households in Haryana, but this was a contrast state rather than a focus state, because households in Haryana are richer, on average, than in the focus states.

[5]See Coffey and Spears (2017) for a detailed account of the causes and consequences of open defecation in India.

[6] If regression is used without the asset and religion controls, but only controlling for the 2011 census, the 6.2 percentage point per year trend in open defecation estimated by regression closely matches a 6.6 percentage point increase in reported use of large tanks.

[7]In fact, regression with controls suggests that reported pit latrine use slightly *decreased* over this time period in these states, relative to the change in asset wealth. The confidence interval of the trend includes zero if assets and religion are not controlled for, so only the 2011 Census is, but is below zero (meaning pit latrine use slightly declined) if these are controlled for. The robust conclusion is that there was essentially no important increase in pit latrine use in the rural NFHS-4 in these states from over 2015 and 2016, relative to asset wealth.

[8]The figure excludes two outlier districts from Jammu & Kashmir where the Census data appear to be inaccurate.