

Open Defecation

Evidence from a New Survey in Rural North India

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Despite economic growth, government latrine construction, and increasing recognition among policymakers that open defecation constitutes a health and human capital crisis, it remains stubbornly widespread in rural India. We present evidence from new survey data collected in Bihar, Haryana, Madhya Pradesh, Rajasthan and Uttar Pradesh. Many survey respondents' behaviour reveals a preference for open defecation: over 40% of households with a working latrine have at least one member who defecates in the open. Our data predict that if the government were to build a latrine for every rural household that lacks one, without changing sanitation preferences, most people in our sample in these states would nevertheless defecate in the open. Policymakers in India must lead a large-scale campaign to promote latrine use.

We are very grateful for helpful comments from readers of a draft of this paper. The paper reflects the views only of its authors personally, and not necessarily those of reviewers or of any organisation. A more detailed and complete working paper version is available online at squatreport.in.

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1 Introduction

Most people who live in India defecate in the open. Most people worldwide who defecate in the open live in India. Open defecation has dire consequences: it kills babies, impedes the physical and cognitive development of surviving children, and reduces the human capital of India's workforce. Open defecation is associated with significant negative externalities: it releases germs into the environment which harm the rich and the poor alike – even those who use latrines.

As the rest of the world steadily eliminates open defecation, this behaviour stubbornly persists in India. Indeed, with 67% of rural households and 13% of urban households defecating in the open (Census 2011), India now accounts for 60% of the world's open defecation (for more information, see WHO and UNICEF 2014). Moreover, open defecation in India is particularly threatening for health because the population density is so high: Figure 1 (p 44) shows that no country has even half the average density of open defecators per square kilometre as does India.

Our study focuses on sanitation in rural India for several reasons. First, open defecation is far more common in rural India than in urban India. Second, about 70% of the Indian population live in rural areas. Indeed, 89% of households without a toilet in the 2011 Census were in rural areas. Finally, improving rural sanitation poses particular challenges. India has seen decades of government spending on latrine construction and sustained economic growth, but rural open defecation has remained stubbornly high.

Why do people in rural India defecate in the open in such large numbers? Answering this question requires understanding the behaviour of hundreds of millions of people. We asked people in 3,235 rural households in five north Indian states where they defecate and what they think about it. We are aware of no prior study that is similarly broadly representative of sanitation views and behaviours in India (for related prior evidence in the context of sanitation projects, see Arnold et al 2010; Patil et al 2013).

The central claim of our paper is that people in the states that we study display a “revealed preference” for open defecation. Economists identify a decision-maker's revealed preference from what he chooses out of a set of alternatives. This use of the word “preference” differs from everyday language because it says nothing explicitly about people's likes and dislikes. Instead, the principle of revealed preference holds

Figure 1: Open Defecators Per Square Kilometre (2012)

Source: UNICEF-WHO Joint Monitoring Programme.

that a decision-maker's choice among his options reveals a "preference" that can be usefully applied to predict his future choices, and used to simulate the effects of policy changes.

Sanitation behaviour is, in fact, the result of two decisions (Cameron et al 2013). First is a household-level decision about whether or not to own a latrine. Second is a person-level decision about whether or not to use a latrine, among people who have access to one. We sometimes combine these two household-level and person-level decisions when we write about "demand for latrine use" or "preference for open defecation". This does not mean that members of the same household always agree: indeed, coexistence of open defecation and latrine use within the same household is a central observation of this paper. Yet, the two decisions are closely related, and choosing not to build a latrine is associated with the likelihood of using one.

Of course, these decisions are only in part shaped by what people "like"; they are also shaped by a variety of other personal and social forces, all of which are captured in economists' concept of "preference" revealed by a person's behaviour.¹ Since we are primarily interested in revealed preference – in order to predict the effect of policy changes – this paper has little to say about any ultimate historical, cultural, or social roots of the preference that we document. Moreover, we do not believe this preference is immutable – indeed, we personally hope the opposite.

Our claim that survey respondents display a revealed preference for open defecation relies on three central observations. As we will show later, households in India rarely build the types of inexpensive latrines widely used by poor households to reduce open defecation and save infant lives in Bangladesh, south-east Asia, and sub-Saharan Africa. We present the finding that many people in households that own working latrines nevertheless defecate in the open, and that government-provided latrines are especially unlikely to be used.

A demographic model applied to our survey data (detailed in a later section) predicts that if the government were to build a latrine for every household in Bihar, Madhya Pradesh (MP), Rajasthan and Uttar Pradesh (UP), without changing anybody's preferences, most rural people in our sample would still defecate in the open. In short, we find that many people have a revealed preference for open defecation, such that merely

providing latrine "access" without promoting latrine use is unlikely to importantly reduce open defecation.

The findings of our survey have clear implications for sanitation policy in India: programmes must concentrate on behaviour change and promoting latrine use. Amidst repeated calls for ambitious government latrine construction schemes by prominent policymakers and opinion leaders, we conclude that our findings may be surprising to some readers.

2 Context and Survey Methodology

2.1 The International Context

This paper is far from the first to emphasise the importance of latrine use, and to point beyond policies of latrine construction (Mehta and Movik 2011; O'Reilly and Louis 2014). Many of our conclusions will be familiar to sanitation professionals who have struggled for years to promote behaviour change in India and worldwide (Bartram et al 2012; Galbraith and Thomas 2009; Perez et al 2012; Ghosh and Cairncross 2014; Venkataramanan 2013). Yet, the magnitude of resistance to

Table 1: Open Defecation in the International Context, 2012 JMP Data

Country	% Open Defecation	% Shared or Unimproved	% Improved Sanitation	GDP Per Capita
India (2011 Census)	49.8			
India (JMP)	48	16	36	5,050
Southern Asia*	38	20	42	4,666
Sub-Saharan Africa*	25	45	30	3,171
Pakistan	23	29	48	4,360
Haiti	21	55	24	1,575
Low-income countries*	21	42	37	1,569
Ghana	19	67	14	3,638
Senegal	17	31	52	2,174
Zambia	16	41	43	2,990
Swaziland	14	29	57	5,912
Kenya	13	57	30	2,109
Southern Asia without India*	12	31	57	-
Nicaragua	10	38	52	4,254
Democratic Republic of Congo	9	60	31	451
Republic of Congo	8	77	15	5,631
Uganda	8	58	34	1,134
Malawi	7	83	10	739
Cameroon	6	59	45	2,551
Myanmar	5	18	77	-
Bangladesh	3	40	57	2,364
Burundi	3	50	47	737
Rwanda	3	33	64	1,379
Gambia	2	38	60	1,565
Vietnam	2	23	75	4,912
China	1	34	65	10,771

* Categories are defined by the World Bank; low-income includes countries with gross national income per capita, calculated using the World Bank Atlas method, of \$1,035 or less in 2012 (World Bank 2014).

Sources: Distribution of the population into each sanitation category (% of population) from WHO and UNICEF (2014).

India figures from Census 2011 from Government of India (2012), and relate to proportion of households not having a toilet in their house and not using a public toilet. Per capita GDP PPP figures from World Bank (2014).

latrine use in rural north India might surprise even experts: we find that even among the demographic subgroups in our survey who are most likely to use a toilet, open defecation is still more common than among the populations of some of the poorest countries in the world.

Table 1 (p 44) reports the fraction of people who defecate in the open according to UNICEF-WHO Joint Monitoring Programme (JMP) data for a set of countries and regions that we have selected for illustration. Open defecation is much more common in India than it is in many of the poorest countries of the world such as the Democratic Republic of the Congo, Malawi, Burundi and Rwanda – to say nothing of richer countries that are still much poorer than India, such as Kenya and Bangladesh.

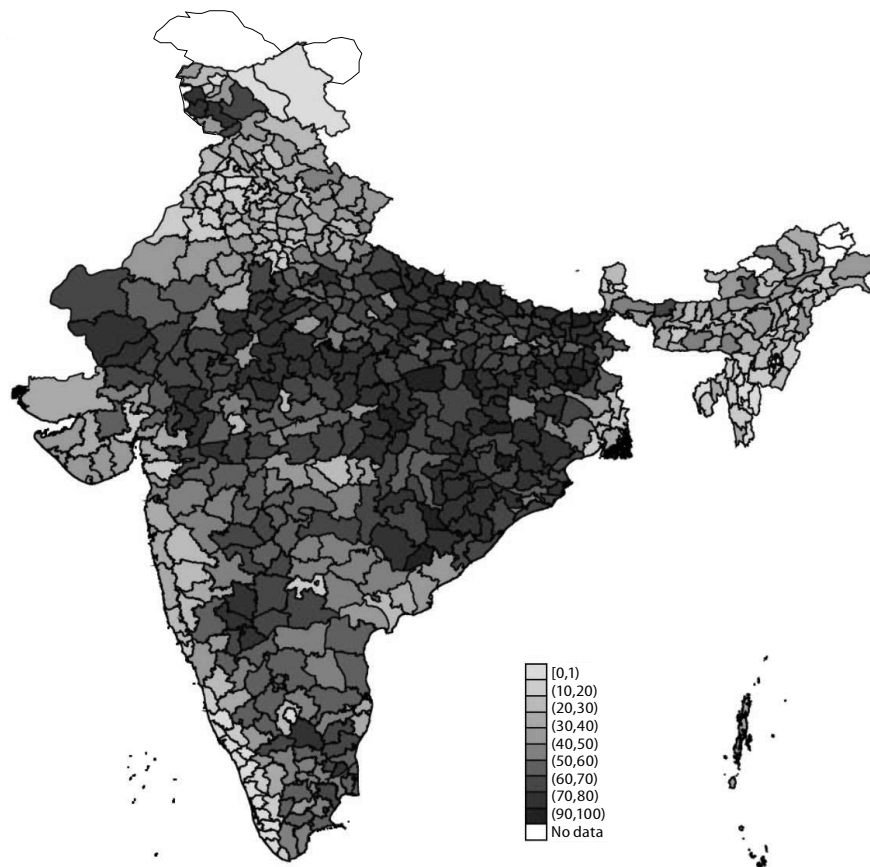
The statistics in Table 1 are important to our analysis because even the subgroups within our rural Indian sample that are *most likely* to use latrines report higher rates of open defecation than the JMP does for many of these countries. For example, we will see that the fraction of males *in households that own latrines* who defecate in the open in our sample is greater than the percentage of all people in sub-Saharan Africa or Haiti who defecate in the open, latrine owners or not. A larger fraction of females in our sample *in households that own latrines* defecate in the open than do people in Zambia, Swaziland, or Kenya, to say nothing of the lower rates of open defecation in some deeply impoverished countries.

2.2 Open Defecation in Rural North India

We report results from the SQUAT survey: a survey in rural north India about Sanitation Quality, Use, Access, and Trends. We conducted our survey in rural villages of five north Indian states in the “Hindi Heartland”. Four of these states were focus states, where rural open defecation is particularly common: Bihar, Madhya Pradesh, Rajasthan and Uttar Pradesh. One state, Haryana, was included as a potential “contrast state”, where households are richer, on average, and open defecation is less common. We will see, however, that Haryana primarily provides a contrast in wealth and latrine construction, not in sanitation preferences.

The district-level map in Figure 2 demonstrates that open defecation is particularly common in the region of our survey. These five states are home to 40% of the population of India, and to 45% of households in India without a toilet or latrine, according to the 2011 Census. At least 30% of *all people worldwide* who defecate in the open live in these five Indian states.² Our results, therefore, are relevant not merely to sanitation

Figure 2: Proportion of Population Defecating in the Open, 2011, India



Source: 2011 Census of India.

policy in India, but also to addressing much of the global sanitation challenge.

Table 2 summarises our sample, and contextualises it using the 2011 Census. Except for Haryana, which is much richer, the states where the survey was carried out have very high rural rates of household open defecation, ranging from 78% in Uttar Pradesh to 87% in Madhya Pradesh. Although all states showed a decline between 2001 and 2011 in the fraction of households defecating in the open, these were modest declines of between 2 and 5 percentage points in the four focus states.

Table 2: Sample and Sample Design, by States

	Our Survey (Sampled Districts)			2011 Census (State-Level Rural Data)		
	Districts	Households	Persons	OD %	% Change OD*	Change in OD* of Households**
Bihar	3	749	6,066	82.4	-3.7	30,47,547
Haryana	2	603	3,606	43.9	-27.4	-4,47,934
Madhya Pradesh	3	772	5,190	86.9	-4.2	22,63,646
Rajasthan	2	354	2,498	80.4	-5.0	15,18,427
Uttar Pradesh	3	757	5,427	78.2	-2.6	32,84,725
Combined	13	3,235	22,787	79.5	-4.6	96,66,412

* Percentage point change in the fraction of households defecating in the open, 2001-11.

** Change in the number of households defecating in the open, 2001-11.

The slow decline in household open defecation fractions in many states has not kept up with population growth, which has led to an increase in the count of those defecating in the open. As Table 2 shows, in all four of the survey's focus states, the number of households defecating in the open increased between 2001 and 2011. Based on census data, the

increase in the number of households defecating in the open was approximately equivalent to adding the population of the rural parts of about 30 average-sized districts – all defecating in the open – to these four states. Our sample therefore studies a region of India that, by this measure, is facing a growing sanitation challenge.

2.3 Sampling Strategy

We conducted interviews in 3,235 households in 13 districts in Bihar, Rajasthan, UP, MP and Haryana. As we asked about the defecation behaviour of each member of the household, we have data on 22,787 individual household members.

Our survey used a four-stage sampling strategy to select respondents:

Districts: Districts were purposively selected to match the state-level trend in rural household open defecation rates. That is, we considered eligible districts to be those districts in which the percentage point change in rural open defecation between the 2001 and 2011 Census rounds most closely matched the statewide percentage point change in rural open defecation.

Villages: We used as our sampling frame the list of villages prepared by the Government of India's District-Level Household & Facility Survey (DLHS-2). Villages were randomly selected using probability proportionate to population size sampling to ensure a representative sample within districts.

Households: Households were selected using a similar in-field randomisation technique to the one used in Pratham's Annual Status of Education Report survey.

Persons: Interviewers first completed a household roster with a knowledgeable member of the household. After completing the roster of household members, one person was selected to complete the individual interview privately with the interviewer.

Much more detail about our sampling strategy and our complete questionnaires are available in the working paper version of this paper, and online at <http://squatreport.in>. We used separate male and female questionnaires. The survey was especially designed to capture the sanitation beliefs and behaviours of men and women living in north Indian villages. We made special efforts to minimise social desirability bias, and other forms of bias in the responses; the working paper version of this paper outlines our approach in more detail.

3 Results

In this section, we present four sets of results. First, we note that people in rural India have an expensive concept of an acceptable latrine, and do not use the simple, affordable latrines that are very commonly used in other countries. Second, we document that many people living in households with latrine access nevertheless defecate in the open. Third, we describe patterns of use among owners of government-supported and government-constructed latrines, and use our data to predict the effects of a universal government latrine construction

programme. Finally, we consider respondents' stated preferences and beliefs about latrine use and open defecation.

3.1 Lack of Demand for Simple, Affordable Latrines

3.1.1 Respondents Conceive Expensive Latrines

Do people in rural India defecate in the open because they are poor? In Table 1, we have already seen evidence against this proposition: in many poorer countries, a much smaller fraction of the population defecates in the open. This suggests that most households in India could afford to build the kinds of inexpensive latrines that are widely used in poorer countries. Yet, in our survey, over 78% of respondents who do not have a latrine also cite the cost of a latrine as an important reason for why they defecate in the open. How can this perception be understood, in comparison with the international context? One explanation is that people in rural India have a globally unique concept of the minimal requirements for an acceptable latrine.

We find that respondents indeed have a very expensive notion of what constitutes a latrine. We asked male respondents to enumerate for us what features an inexpensive, but usable latrine would have, and how much each of the parts would cost. The latrines that they described cost more than Rs 21,000, on average, and in many cases much more. Given these large estimates, it is no surprise that people perceive cost as a barrier to building a latrine. What this suggests is not that these respondents could not afford to build latrines that safely contain faeces, but rather that there is a widely-held belief that latrines are expensive assets, perhaps even luxuries.

In fact, a usable latrine that safely contains faeces could be built much less expensively; such a latrine could, importantly, improve health relative to open defecation. Indeed, the simple latrines that have been used to essentially eliminate open defecation in Bangladesh cost around Rs 2,500, at purchasing power parity;³ this is much less than even the Rs 10,000 allocated for latrine construction by the Indian government, to say nothing of the Rs 21,000 which our respondents imagined is required to build a latrine.

Our respondents' estimate of Rs 21,000 can be compared with the results of a recent, large-scale experimental study in rural Indonesia. Cameron et al (2013) asked survey respondents how much they were willing to spend on a "cheap" latrine. Indonesian respondents imagine much less expensive latrines: the average reported minimal cost to build a latrine was only Rs 4,492 in purchasing power parity terms. The lower price for a latrine in Indonesia is particularly striking, in light of the fact that Indonesians are richer than Indians, on average, and could therefore afford to spend more.

3.1.2 Missing 'Middle Rungs' on the Sanitation Ladder

Many international sanitation professionals and experts describe a "sanitation ladder": ranging from open defecation up to flush toilets with a piped sewer. Successive rungs on the ladder represent more hygienic and more expensive sanitation options. However, the sanitation ladder in India appears to be missing

its middle rungs, with no intermediate steps on which households climb gradually up from open defecation.

Table 1, which presents UNICEF-WHO JMP data on the types of toilets used in different countries, illustrates this point. Table 1 splits the population into three categories: open defecation, unimproved or shared sanitation, and improved sanitation. The data for India show a “missing middle”: no country listed has a smaller “middle” fraction of unimproved or shared sanitation. Many countries, in contrast, have both a lower fraction of the population defecating in the open and a lower fraction with improved sanitation.⁴

In India, only 16% of the population is on a middle rung, compared with 40% in Bangladesh, and 45% for sub-Saharan Africa overall. Although the table only presents country-level statistics, the contrast for rural India is even starker: only 6% of rural Indians are in a middle category. In many countries, proceeding up the sanitation ladder was not only the path out of open defecation, but also an important step towards improved health and human capital.

For India to follow this path, policymakers must learn how to convince people in rural India to use “middle” alternatives to open defecation. Promoting the use of less expensive latrines is necessary in part because buying a toilet for each of the 123 million households that lacks one at our respondents’ estimated minimal price of Rs 21,000 would cost Rs 2,56,000 crore, or approximately one-sixth of the annual total expenditure of the Government of India in 2012-13.

3.2 Households, Individuals, and Latrine Use

Measuring sanitation behaviour at the household level has created a blind spot for many studies in the literature: in rural north India, many people who live in households that own a latrine nevertheless defecate in the open. Unlike other widely cited data sources,⁵ our survey asked about the usual sanitation behaviour for each person in the household.⁶ Therefore, we know both who lives in households with a latrine, and who usually

uses one. In particular, we asked whether each person over the age of two usually defecates in the open or in a toilet or latrine.

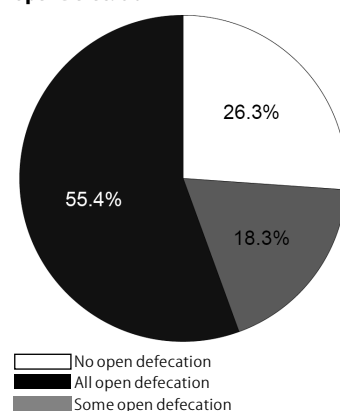
3.2.1 Open Defecation despite Latrine Access

Figure 3 divides the households in our sample into three groups: those in which everybody defecates in the open, those in which no one defecates in the open, and those in which some people defecate in the open but some do not. The third category is a considerable 18% of households. This suggests that estimates of person-level open defecation rates based on the number of households who own latrines likely underestimate exposure to open defecation.

Table 3 summarises latrine use at the household and at the person level, for our full sample and separately for each of the states our survey visited. Panel A presents household-level statistics. Open defecation is very common, even in households with access to a latrine. In our four focus states, 80% of all interviewed households had at least one member who defecates in the open. Forty-eight per cent of households with a working latrine – which we determined either by the fact that someone in the household used it or by the presence of a pit and seat – had at least one member who nevertheless defecates in the open. Strikingly, in the four focus states, 45% of households with a latrine user also had at least one household member who defecates in the open.

Panel B presents person-level statistics. These illustrate what is

Figure 3: Households, by Members’ Open Defecation



Observations are households, categorised by open defecation behaviour of household members. “Some open defecation” indicates households where at least one member defecates in the open and at least one member uses a toilet or latrine.

missed by household-level counts of latrine ownership. In our sample, 57% of households do not own a latrine, but 64% of people defecate in the open. This gap is not because of a difference in household size between households with and without latrines. Rather, the gap exists because many people who live in households with latrines usually defecate in the open.

Comparing across states, Haryana indeed provides some contrast: in every row, the Haryana average is statistically significantly different from the combined average of the four focus states. However, the gap between Haryana and the focus states is largest for latrine ownership; it is more similar

Table 3: Open Defecation, by Households and Persons (in %)

Statistic	Sub-sample	All States	Focus States*	Bihar	MP	Rajasthan	UP	Haryana
Panel A: Household-level averages								
Owens latrine	All households	43.2	34.7	27.4	40.3	28.3	39.1	79.9
Any member ODs	All households	73.8	79.8	84.1	75.6	87.6	76.2	47.2
Any ODs, despite latrine	Households that have a latrine	40.1	42.9	43.8	41.9	57.4	38.5	34.9
Any ODs, despite a user	Households with at least one latrine user	41.1	44.7	51.6	35.8	64.2	39.8	34.0
Any ODs, despite working latrine	Households with a working latrine	43.9	47.9	54.2	40.8	66.2	42.5	35.7
Panel B: Person-level averages								
Defecates in the open	All persons over 2 years old	64.1	70.4	75.0	67.5	76.7	65.0	30.8
ODs, despite HH owning latrine	Persons >2, in households owning latrine	21.1	23.4	22.5	25.6	30.5	19.7	15.8
ODs, despite user in HH	Persons >2, in households with a user	21.0	23.7	29.3	17.7	37.7	18.4	13.9
Male OD, despite having latrine	Males >2, in HH owning a latrine	25.1	27.8	26.4	30.1	33.6	24.8	19.1
Female OD, despite having latrine	Females >2, in HH owning a latrine	16.6	18.6	18.1	20.8	27.1	13.4	12.0
Panel C: Person-level open defecation, combined estimate reweighting survey latrine use using 2011 Census latrine ownership								
Defecates in the open	All persons over 2 years old	81.6	83.0	83.1	88.4	83.1	80.7	50.4

* “Focus states” are Bihar, Madhya Pradesh, Rajasthan, and Uttar Pradesh. OD = open defecation.

to the other states on sanitation behaviour conditional on ownership. This pattern suggests that open defecation may be less common in rural Haryana largely because people there are richer, and more likely to own expensive latrines – not because people there are more committed to latrine use, or more willing to build and use simple, inexpensive latrines.

So, what fraction of people living in these states defecates in the open? We note that our survey has oversampled latrine owners, relative to the 2011 Census. We therefore combine both data sources in Panel c to present our best estimate of the percentage of rural persons over the age of two who defecate in the open in these states. We take estimates of open defecation conditional on latrine ownership from the SQUAT survey data and reweight these to match census data on latrine ownership. In particular, for each state we compute

$$\text{estimated OD} = (\text{OD}|\text{owners}) \times \% \text{ owners} + (\text{OD}|\text{non-owners}) \times \% \text{ non-owners}$$

where “% owners” and “% non-owners” are household-level fractions from the 2011 Census, and conditional open defecation rates are from our survey. Relative to estimates using only the census, this computation takes into consideration that open defecation among latrine owners is greater than zero, and that open defecation among latrine non-owners is less than one.

Our overall estimate of 81.6% of rural persons in these states defecating in the open is not very different from the household-level census figure of 79.5% because the fraction of households that own latrines is relatively small, and because latrine use by non-owners partially balances open defecation by latrine owners. The difference between the census fraction of households without latrines and our combined estimate of person-level open defecation is greatest for Haryana, because it is the state with the most latrine ownership. Our best estimate suggests that most people in rural Haryana defecate in the open. This fact illustrates that the gap between household latrine ownership rates and person open defecation rates is likely only to grow as India continues to become richer, and to build more latrines that go partially unused.

3.2.2 Demographics of Defecation

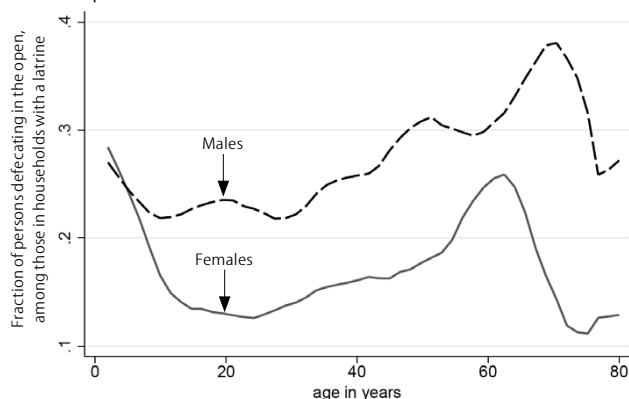
Within households with access to a latrine, who uses it? The bottom rows of Panel B of Table 3 contrast the latrine use of males and females, conditional on being a member of a household that owns a latrine. In every state, men living in households with latrines are more likely to defecate in the open than women living in households with latrines.

Rural north Indian households are well known to prescribe different social roles and ranks according to sex and age. Males have higher intra-household social status than females; older people of the same sex have higher status than younger people; and young women have very low intra-household status.

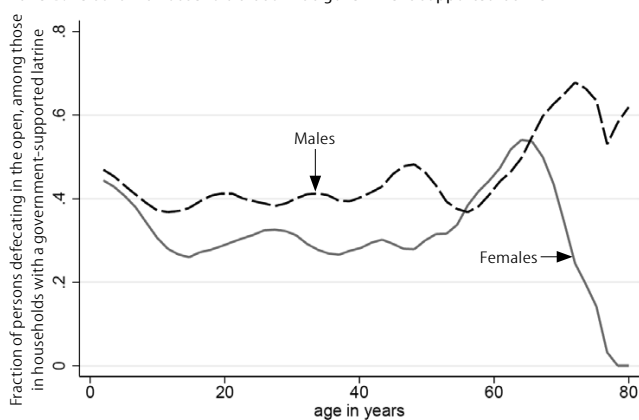
Figure 4 presents the average rates of open defecation by age and sex, among households that own a latrine. In a later section, we will discuss Panel B of Figure 4, which shows particularly high rates of open defecation among individuals

Figure 4: Open Defecation by Age and Sex, in Households with a Latrine

Panel A: All persons in a household that owns a latrine



Panel B: Persons in a household that owns a government-supported latrine



Observations are persons above two years of age, living in a household that owns a latrine. Kernel-weighted local regressions are plotted. $n = 9,628$. In Panel B, government-supported latrines are either built entirely by the government, or built with government materials or funding. In Panel A, privately constructed and government latrines are included.

in households with a government-supported latrine; here, we focus on Panel A, which includes all latrines, constructed either by the government or privately.

Open defecation conditional on latrine ownership tracks the pattern of intra-household status described above. Except for among young children, males are more likely to defecate in the open than females at every age. During the late childhood and teenage years, open defecation decreases quickly in age for young women with access to latrines. This could be driven by at least two factors: a preference among young women to use latrines, or a north Indian cultural norm that keeps women in their reproductive years inside the home.

For most in the adult age range, open defecation increases with age. This probably reflects two factors. First, older people, on average, are able to move more freely outside their homes and to enact their preferences. Second, in this cross-sectional survey, older people are members of earlier cohorts, born into earlier years when open defecation was even more common than it is today. However, open defecation decreases sharply in age among the oldest household members in the sample. In many cases, this change reflects disability or incontinence, which makes open defecation difficult or impractical.

It is noteworthy that the people who appear to have the most demand for latrine use – young women and the very old

– are typically not economic decision-makers within their households. It is likely an important constraint on latrine adoption in rural India that the people who are most likely to use latrines are the least likely to have the intra-household power to allocate resources to building one.

3.3 Use of Government Latrines

Media coverage of sanitation in India often emphasises the need for the government to provide “access” to sanitation. There may be considerable private benefits of owning a latrine, and therefore having the option to use one, especially in times of illness and bad weather. However, in this paper we build on existing research that demonstrates the negative externalities of open defecation. Therefore, when we consider rural Indians’ sanitation behaviour or the likely effects of hypothetical government sanitation efforts, we focus on the implications for open defecation. From the perspective of reducing the negative externalities of open defecation to improve health and human capital, latrine “access” is an importantly incomplete description of the sanitation challenge for rural India, where demand for latrine use is a key barrier.

Here, we focus on a related dimension of this issue: are the latrines that are being used provided by the government? Only a minority of all households in the survey – merely 9% – report having received either money or materials from the government for latrine construction; 32% of households in the survey own a toilet that was built without any government support; and the rest do not own a latrine. Thus, the large majority of households with latrines – 79% – received neither money nor materials (under which we include receiving a complete latrine) from the government to build their latrine.

Focusing only on households that own a latrine, Table 4 shows open defecation according to whether the household received government support to build its latrine or not. People who live in households with a latrine that was built with government support are more than twice as likely to defecate in the open as people who live in households whose latrine was privately constructed. Indeed, over 60% of households which received latrine materials from the government have at least one household member who defecates in the open.

Table 4: Latrine Use, by Private or Government Construction

	Household-Level			Person-Level		
	% of Household (1)	Any OD % (2)	Any Use % (3)	Male OD % (4)	Female OD % (5)	Person OD % (6)
Government provided neither money nor materials, materials, or both	78.8	35.7	95.6	20.0	11.7	16.1
Government provided materials	21.2	54.4	79.4	41.7	32.6	37.1
Government provided money	12.2	61.7	71.6	49.5	38.1	44.2
Government provided both money and materials	7.5	38.4	92.9	21.7	17.5	19.7
Government independently constructed entire latrine	1.5	75.0	75.0	65.3	50.7	57.8
Government independently constructed entire latrine	6.9	67.4	66.3	58.0	48.6	53.7

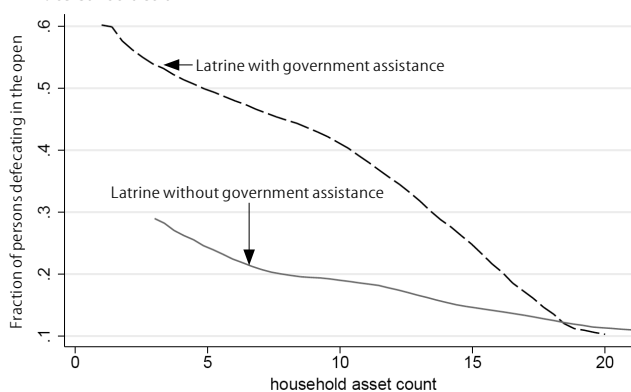
(1) “% of households” reports the distribution of the sample into categories by government construction, among households owning a latrine.

(2) Reports the fraction of households, within each construction category, where any member defecates in the open.

(3) Reports the fraction of households, within each construction category, where any member uses the latrine.

(4), (5), and (6) report the fraction of persons within each construction category who defecate in the open, for males, females, and both pooled.

Figure 5: Latrine Use by Household Asset Wealth and Government or Private Construction



Observations are persons above two years of age, living in a household that owns a latrine. “With government assistance” indicates receiving either money or materials from the government for the latrine, or both; “without” indicates households that received neither. Kernel-weighted local regressions are plotted.

The latrines that are least likely to be used are those that were built in entirety by the government, rather than constructed in part using government money or materials. More than half of people who live in a household with such a latrine defecate in the open; over two-thirds of such households have a member who defecates in the open; and one-third of such latrines are not usually used by anyone at all. In households with completely government-constructed latrines, even most young females in their 20s – a demographic group particularly likely to use available latrines – defecate in the open.

Returning to Figure 4, Panel B plots individual-level toilet use by age among people living in households with a latrine that was fully or partially supported by the government. In general, the patterns are similar to those found in Panel A: males are more likely to defecate in the open than females; children are more likely to do so than working age adults; and older adults are more likely to defecate in the open than younger adults, except among the very old. However, relative to Panel A, these demographic differences are more muted; essentially throughout the age and sex distribution, people with government-supported latrines are more likely to defecate in the open than people in the full sample of latrine owners.

These differences in use according to private or government construction reflect several possible mechanisms. First is selection: households that build their own latrines are,

on average, households that have more demand for latrines, possibly because of higher socio-economic status, better education, or a greater awareness of the health benefits of latrines. Second is quality: households that build their own latrines may choose to build a more expensive latrine, or one that more closely matches their own preferences.

Figure 5 provides evidence that selection based on socio-economic status is not the only reason for

differences in government and private latrine use. It plots the fraction of people defecating in the open at each level of asset wealth, measured as the count of a list of assets that the household owns. It plots this separately for people in households that did and did not receive government assistance to construct their latrine. Unsurprisingly, a higher fraction of people in richer households use an available latrine. However, at almost all levels of rich and poor, people are more likely to use privately built latrines than latrines constructed with government assistance.

3.3.1 Pit Size and Latrine Use

Why are government-supported latrines so much less likely to be used than private latrines? Although we will be unable to fully answer this question, it is clear that part of the explanation must be selection into latrine ownership: it is unsurprising that households which choose to build their own latrine are the most likely to use one. However, it is also the case that privately constructed and government-constructed latrines are physically different, on average. In particular, privately-constructed latrines have much larger pits below ground.

Table 5 presents summary statistics about the volume of latrine pits owned by surveyed households, as reported by respondents. Questions about pit size were only asked to male respondents; so pit volume is missing for many households with latrines. However, volume data is not differentially missing across any of the categories we will discuss. The data are skewed by a few very large pits, so we present both means and medians. Panel A splits latrines into those built with no government support, those built with at least some government support, and those fully built by the government. Government-constructed latrine pits are much smaller than privately constructed latrine pits: the median fully government constructed pit is less than a fifth the size of the median fully privately constructed pit.

Table 5: Latrine Volume by Use and Construction

	No Government Support	Some Government Support	Fully Government Construction
Panel A: By construction			
Mean pit volume	392	169	92
Median pit volume	240	83	42
Volume missing (%)	64	62	58
n (household latrines)	377	108	39
	No Open Defecation	Some Open Defecation	Majority Open Defecation
Panel B: By use			
Mean pit volume	349	321	277
Median pit volume	214	177	157
Volume missing (%)	64	66	67
n (household latrines)	297	191	93

Volume is in cubic feet.

Panel B shows that latrines with larger pits are much more likely to be used than latrines with smaller pits. Alongside the SQUAT survey, we conducted a companion qualitative study of behaviours, beliefs, and attitudes among households in rural, UP, Haryana, Gujarat, and Nepal, which do and do not have a member who has switched to latrine use in the past 10 years.⁷ In these qualitative interviews, people explain

that their concerns about pit emptying importantly reduce latrine use.

Although it is beyond the scope of this paper, these qualitative interviews suggest that enduring concepts of purity and pollution – uniquely related in India to caste – push rural Indians away from latrine use, and may complicate the development of the sort of markets for latrine pit emptying that exist in other countries. Very large pits are important because they are perceived to last a family at least a generation, without requiring emptying. This perception in rural India stands in important contrast with the simple, inexpensive latrines that we discussed earlier, which in other countries are periodically emptied or moved as a matter of course.

3.3.2 Predicting Effects of Government Latrine Construction

Prominent policymakers have recently suggested that the Indian government should build a latrine for every household without one. How much open defecation would remain if the government indeed built a latrine for every household in our survey that does not have one, but did nothing to change preferences with regard to open defecation? Here, we would like to know: What would be the effect of the *marginal* latrines that the government has yet to construct?

However, the data we have describe the observed use of *average* government-constructed latrines. Households that have government latrines are different from households that do not on a number of observed dimensions. Although our survey collects these demographic data, there are also a number of unobserved differences between households that have government latrines and those that do not; for instance, the desire to restrict the movement of women, health problems that make going in the open more difficult, and the value placed on the convenience of latrines. Many such unobserved differences will be related to the demand for latrine use; in particular, people living in households that already have latrines are almost certainly more likely to want to use latrines than people living in households without latrines. People in households with latrines – even government-built latrines – wanted them enough to accept them and maintain them sufficiently, such that they still existed as latrines when surveyors visited.

However, making the incorrect assumption that people living in households without latrines are as likely to use a government-provided latrine as are people in households with latrines, who share the observable demographic characteristics that we model, we can make an econometric prediction of how many people would defecate in the open, if they were given an average government latrine. This modelling is important because households without a latrine are observably different, on average, from households with a latrine: for example, they are poorer, and their average resident is older.

Among households with a government-supported latrine, we estimate a logistic regression of an indicator for individual-level open defecation on age as a quadratic, asset count as a quadratic, education, and district indicators, each interacted

with an indicator for being female, as well as caste category, religion category, and perceived village size category. This estimates a very simple model to predict open defecation by the demographic properties of people living in households with government latrines. The working paper version of this paper, available online at squatreport.in, provides more details on the regressions, including alternative model specifications.

We perform this procedure twice: among households with a latrine that was partially government constructed, and again among households with a latrine that was fully government constructed. These models fit the data well: the model for partially government-supported latrine owners correctly predicts 73.7% of individual cases, and the model for fully government-constructed latrine owners correctly predicts 72.2% of cases.

For people in households that do not own a latrine, we use these regression models to predict what the average open defecation would be from logistic predicted probabilities. This approach uses demographically similar people living in households with a government latrine to predict what people in households without a government latrine would do if they were to receive and accept one. The basic assumption is that, within these demographic categories, people would be equally likely to use a government-constructed latrine, whether or not they happen to own one.

Table 6 presents the results of this simple policy simulation. The model predicts that 55% of people would defecate in the open if they received a latrine that was constructed with any government support, among those currently living in households without a latrine. Since fully government-constructed latrines are less likely to be used in our data than are partially government-supported latrines, 66% of people living in recipient households are predicted to defecate in the open if they received a latrine that was *fully* government constructed.

Table 6: Predicted Open Defecation after Universal Latrine Construction Policy (in %)

	Focus States	All 5 States
Panel A: Model fit using households with fully government-constructed latrines		
Open defecation among new latrine recipients	66.0	66.3
Open defecation among all persons	50.5	46.4
Panel B: Model fit using households with government-supported latrines		
Open defecation among new latrine recipients	56.5	54.8
Open defecation among all persons	44.2	39.9

We can now return to the original question of this subsection: How much open defecation do our data, in combination with this simple demographic model, predict would remain if a statistically average fully government-constructed latrine were built for and accepted by every household that does not currently own a latrine? We answer this question by combining the actual latrine use data for people who live in households with a latrine with the predicted probability of latrine use from the demographic model for people who do not.

In the four focus states, the model predicts that person-level open defecation in our sample would fall from the observed 70% to a predicted 51%. Therefore, we conclude conservatively that

our data predict that even if the government were to construct a latrine for every rural household in Bihar, MP, Rajasthan, and UP that does not currently have one, more than half of all rural persons in our sample would still defecate in the open. This is not to suggest that an 18 percentage point decline in open defecation, if achieved, would not be an important advance in human development. However, even after such an ambitious construction scheme, rural India would still be very far from ending open defecation.⁸

There are several reasons to expect that the figures presented in Table 6 significantly underestimate the fraction of people who would defecate in the open if the government embarked on a universal latrine building programme, without any further efforts to change preferences regarding open defecation. First, they assume that there is no corruption or leakages in construction. However, the lack of demand for latrines can permit government agents to divert latrine construction funds without protest. Second, these calculations assume that every household that receives a latrine accepts it, and does not repurpose the materials or the superstructure for something else. Third, they ignore the fact that observed latrine ownership is correlated with greater preference for latrine use, such that households in which the marginal latrines that would be built would almost certainly have a lower demand for latrine use than households in which the average latrine exists.

3.4 Stated Preferences

We have seen evidence that many people in rural north India reveal a preference for open defecation. In this section, we consider a different type of evidence: what people tell us. Our respondents explain that there are many pleasant advantages of open defecation, and that using a latrine is probably no healthier than going outside.

3.4.1 The Benefits of Open Defecation

We asked an open-ended question, where household members could volunteer their explanations of what is good or bad about open defecation and latrine use. Of people who defecate in the open, 47% explain that they do so because it is pleasurable, comfortable, or convenient. Of individuals who defecate in the open despite having access to a latrine in their household, fully 74% cite these same reasons.

Many respondents told us that defecating in the open provides them an opportunity to take a morning walk, see their fields, and take in the fresh air. Although it is beyond the scope of this paper to present these results in detail, the qualitative study found commonly-held perceptions about the benefits of open defecation, substantially similar to what we report here. Many people regard open defecation as part of a wholesome, healthy, virtuous life.

3.4.2 Failure to Recognise Health Effects

Sanitation behaviour is often not motivated by health in other countries: for example, in rural Benin, Jenkins and Curtis (2005) find that health benefits were not an important aspect motivating latrine adoption. Similarly, open defecation is

not widely recognised among rural north Indians as a threat to health.

We asked respondents to imagine two villages, one where everyone defecates in the open and one where nobody does: 43% of all respondents report that latrine use is no better for child health than open defecation. This figure even includes many respondents who already use latrines. Among those who defecate in the open, fully 51% report that widespread open defecation would be at least as good for child health as latrine use by everyone in the village.

Later in the survey, we asked an open-ended question about the possible benefits of latrine use and open defecation. Among respondents who defecate in the open, only 26% mention health improvements from latrine use as a benefit that could result from building a latrine; moreover, even these were often talking about the convenience of having a latrine for people who already have stomach ailments. Finally, we asked a further open-ended question about why children get diarrhoea. Only 26% responded with an answer that displays an understanding of any possible infectious causes of diarrhoeal disease.⁹

3.5 Is Access to Water a Constraint on Latrine Use?

Policy discussions and media accounts of open defecation in rural India often assert that access to water is a reason why so many people in India do not use latrines. The reasoning behind this claim is that large quantities of water are supposedly required to use and maintain latrines.

However, existing data further suggest that access to water is not a binding constraint on latrine use. In the 2005 India Human Development Survey, rural households with piped water are only 9 percentage points less likely to defecate in the open than rural households without piped water. This difference can be completely statistically accounted for by consumption, income, household size, and literacy, suggesting that it merely reflects a spurious correlation with socioeconomic status, and is not a true effect of access to water on open defecation.

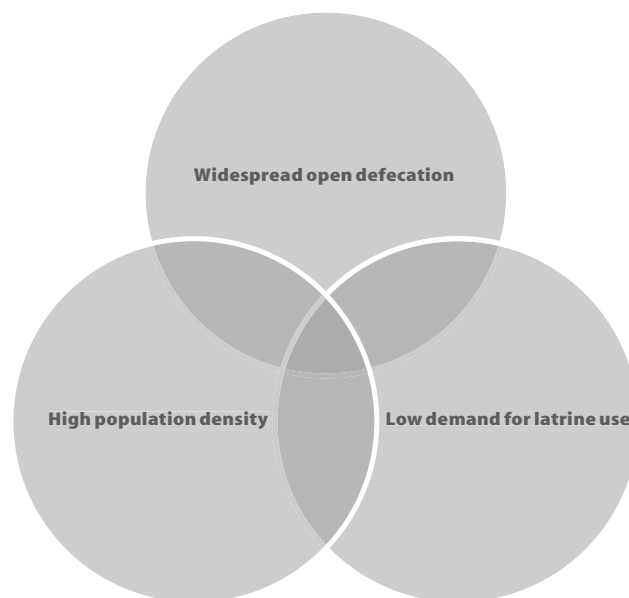
The results of the SQUAT survey corroborate this interpretation. In the survey, less than 1% of men and only 5% of women who defecate in the open suggest that lack of access to water could be a reason not to use a latrine. In our related qualitative research project, which we have conducted on sanitation preferences and beliefs in rural India and Nepal, water was rarely raised as a constraint on latrine use in 99 in-depth semi-structured interviews.

4 Conclusions

Widespread open defecation in rural India is a unique human development emergency. Each year, when global figures are recomputed, India is home to a larger and larger fraction of the remaining people in the world who defecate in the open. Enduring open defecation needlessly kills hundreds of thousands of babies and stunts the development and lives of those who survive, and the economy that all Indians share.

Standing in contrast to the importance of reducing open defecation are the revealed preferences for open defecation

Figure 6: Rural India's Triple Challenge



that we described in this paper. Few households construct affordable latrines, many people who own latrines nevertheless defecate in the open, and people in households with government provided latrines are particularly likely to defecate in the open.

Figure 6 illustrates the intersecting policy challenges for sanitation policy in the rural Indian states we study. First is the enormous scale of the problem: 70% of rural Indians – or approximately 550 million people – defecate in the open, adding up to staggering health and economic costs.

Second is the high population density (Hathi et al 2014; Spears 2014). High population density increases the health and human capital costs of open defecation: germs are more easily transmitted in high population density environments. As population density is very high in rural India, open defecation is particularly costly here. Finally, as this paper has documented, there is very low demand for latrine use, sharply limiting what mere latrine construction can accomplish. There is no logical necessity that required these challenges to intersect in one country, but they do. Whether open defecation can be importantly reduced in India – and thus, whether significant further progress can be made in reducing open defecation rates globally – will depend on the ability of policymakers to confront these intersecting challenges in rural north India.

Latrine construction is not enough to substantially reduce open defecation in the northern plains states, where it is concentrated. Indeed, our data, in combination with a simple demographic model, predict that more than half of people in our focus state sample would still be defecating in the open even if the government were to build a latrine for every household that does not have one, without changing preferences. However, the insufficiency of building latrines does not excuse the government from its responsibility. India needs a large-scale campaign to change sanitation preferences and promote latrine use.

NOTES

- 1 It is noteworthy that the behaviour of young women, who have particularly low intra-household status, may be especially uninformative about what these women "like". For example, some women with a latrine may nonetheless defecate in the open because the other members of their family do not want the pit to fill quickly. Other young women may wish to defecate in the open in order to meet their friends or get out of the house, but be prevented from doing so because their relatives want them to stay inside. Either way, such young women are likely to have the least influence over their household's decision to build a latrine or not.
- 2 We compute this estimate by making the (incorrect) assumption that household latrine ownership in the Indian census implies individual use for the numerator, and taking UNICEF-WHO Joint Monitoring Programme data for the denominator.
- 3 This calculation uses the 2011 International Comparison Project's (ICP) PPP exchange rate for household consumption.
- 4 To be sure, there are some very poor countries with a larger fraction of people defecating in the open than India, according to the JMP: South Sudan, Niger, Chad, Burkina Faso, Solomon Islands, Sao Tome and Principe, Cambodia, Benin, Togo, Namibia, and Mauritania. Combined, in these small countries there are 54 million rural people who defecate in the open, which is approximately the rural population of Rajasthan or Madhya Pradesh, and is less than 10% of the number of rural Indians who defecate in the open.
- 5 Three notable recent exceptions in India are a data set collected by Barnard et al (2013) in Orissa, Patil et al (2013) in Madhya Pradesh, and a valuable data collection project in India in progress by the south Asia region of the World Bank Water and Sanitation Programme. These surveys record individual-level behaviour.
- 6 We asked the one survey respondent from each household about the latrine use of all other household members. In particular, we asked whether persons "usually" use a toilet or latrine, or defecate in the open.

- 7 For more information on this qualitative study, visit <http://riceinstitute.org/wordpress/switching-to-latrines-in-rural-south-asia-a-study-of-health-technology-adoption-2014/>
- 8 If we scale up the fraction of households in our sample that do not have a latrine to match the 2011 Census (without changing predicted conditional open defecation rates), our model would predict about 59% open defecation after universal construction of government latrines, rather than about 51% as in Table 6.
- 9 These findings can again be compared with those from rural Indonesia (Cameron et al 2013): over two-thirds of respondents in the control group claimed that diarrhoea could be caused by "others practising open defecation".

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