Research Paper

Sanitation for all: a Panglossian perspective?

Priyam Das and Julia Crowley

ABSTRACT

At the deadline for meeting the Millennium Development Goals (MDGs), 2.1 billion (10^9) people had gained access to improved sanitation and 95 countries were able to meet the MDG sanitation target. However, 2.4 billion still lacked improved sanitation facilities. India is among those countries where open defecation stubbornly persists. Despite decades of government spending on the construction of toilets, and the recent Swachh Bharat Mission (SBM) to eradicate open defecation, toilet use remains a challenge. To draw attention to the deep deficits in sanitation services in smaller Indian cities, we explore what motivates sanitation uptake by the urban poor. Household survey data from 13 low-income settlements combined with interviews, focus-group discussions, and transect walks in three cities in central India allowed us to examine factors that influenced resource-constrained households' toilet ownership and toilet use versus open defecation. Our findings indicate that in urban settings, toilet ownership could, in fact, deter open defecation given the presence of other key conditions. Programs to build toilets under the SBM could, therefore, see favorable outcomes in cities provided there is a broadening of access to sanitation to include fecal sludge management. Our findings also underscore the importance of coproducing basic services.

Key words | India, low-income settlements, open defecation, sanitation, toilets, urban

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INTRODUCTION

Despite ample evidence to support the association of improved sanitation with direct and indirect economic benefits, and non-health related ones such as less time spent queuing up at shared sanitation facilities or walking to a site for open defecation, in India, efforts to increase access to sanitation for the urban poor has lagged behind those for drinking water supply (Water and Sanitation Program (WSP) 2010). The National Urban Sanitation Policy (NUSP) calls for the preparation of state and city sanitation plans with the goal to 'transform urban India into community-driven, totally sanitized, healthy and livable cities and towns' (Ministry of Urban Development 2008, p. 7) spawning a potpourri of sewerage projects to solve the sanitation problem. Such projects seek to engage poor communities (from cash/labor contributions to management and decision-making) in keeping with a decentralized, demand-driven approach (Das 2016). The Swachh Bharat (Clean India) Mission launched by the Prime Minister in 2014 was a clarion call to address the sanitation crisis by making India open defecation free by 2019. Its urban component aims to make 4,041 statutory towns open defecation free by promoting toilet use and behavioral change, and strengthening the capacity of urban local bodies to design, operate and manage sewerage systems and support private sector participation for capital expenditure (Ministry of Statistics and Program Implementation 2016, p. 2). Despite such well-intentioned policy initiatives, there remain considerable challenges on the ground that merit scrutiny. The goal of building 2.5 million individual toilets and community and public toilets fell short by 46 percent and 32 percent, respectively, at the end of the 2015 fiscal year (Ministry of Statistics and

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Program Implementation 2016). An issue of particular importance is that of toilet use as studies have indicated that the supply driven approach promoting the construction of toilets does not guarantee the use and maintenance of toilet facilities (see, for instance, Chambers 2009; Pattanayak *et al.* 2009; Routray *et al.* 2015). Hygiene, sanitation, and water supply are development priorities that can reduce disease burden and child mortality worldwide (Bartram & Cairncross 2010). Yet, unless sanitation systems match the needs of a diverse group of users, the global declaration of water and sanitation as a human right will remain elusive (Joshi *et al.* 2011), which raises the question: is 'sanitation for all' a Panglossian perspective given the ground realities? Drawing on data from 13 low-income settlements in smaller cities in central India, we provide a nuanced understanding of factors that could influence a household's decision to build a toilet, and their motivation for using a sanitation facility versus open defecation, to draw attention to the glaring deficit in sanitation provisions in the smaller urban centers of India and the need to direct public funding to address these gaps.

Factors affecting access to sanitation

Affordability remains a key hurdle to access. The public sector lacks sufficient revenue to provide subsidies while resource-constrained households find it difficult to invest in sanitation facilities and maintain them without any assistance. What is considered 'improved' sanitation (facilities designed to hygienically separate excreta from human contact) is typically unaffordable for such households; sanitation service providers are unable to keep up with mandated prices and coverage targets that are not aligned with their revenues; and civil society organizations find it challenging to scale up sanitary services making subsidies necessary to sustain sanitation initiatives (McGranahan 2015). Conventional sewerage systems have been called 'anti-poor technology' (Paterson *et al.* 2007, p. 901) as they require massive investments and are difficult to implement in informal settlements with minimal access to financial or other resources (Gandy 2006). On-site systems are more common in such areas. However, such systems are difficult to maintain without adequate assistance from municipal staff (Jenkins & Sugden 2006). Low-income households lack the resources to empty these systems on a regular basis. In rural India, Coffey *et al.* (2017) found that households prefer to build large latrine pits to avoid frequent emptying, escalating the cost. The more affordable twin-pit latrines promoted by the World Health Organization (WHO) are perceived as ritually polluting and socially undesirable. Moreover, there are social consequences of pit emptying that expose the schisms of caste associated with manual scavenging (Dasra 2012). Pit emptying is done by the *Dalits* who have historically been oppressed and expected to perform dangerous and demeaning work (Coffey *et al.* 2017). From a cost perspective, it is difficult to compare on-site and networked systems since there are discrepancies in how cost is calculated (Wankhade 2015, p. 562).

Property rights literature asserts that investment in housing improvements is inherently linked to tenure security (Van Gelder 2009). *De facto* tenure is an important step towards improving living conditions, human development, economic status, and access to entitlements (Mahadevia 2011). Assurance of occupancy rights without full property rights could be incentive enough for households to upgrade in informal settlements (Nakamura 2017). Based on a case study in Senegal, Scott *et al.* (2013) contend that *de facto* rather than *de jure* tenure security is sufficient for investment in sanitation facilities that are on-site and self-built. However, willingness to pay for sanitation infrastructure is not always the same as willingness to pay for sanitation services so there is a need to look more closely at whether there is a tradeoff between capital assets and operation and maintenance of on-site systems (Scott *et al.* 2013, p. 60). Utilities and municipalities are often unwilling or not allowed to provide services in low-income neighborhoods considered unauthorized (Murthy 2012) to deter immigration and deflect them to other localities (Feler & Henderson 2011). Infrastructure interventions have to be amenable to the tenure continuum and be able to accommodate tenants who form a sizeable proportion of households in informal settlements (Gulyani & Talukdar 2008). Since tenants typically have little control over their dwelling unit, they are less likely to make any long-term investments such as building a toilet, especially since owners typically capture financial benefits and can then extract higher rents (Jenkins & Scott 2007). When

improvements can help increase legitimacy of the settlement, even those with insecure tenure may have an incentive to invest in improvements (Robinson 2005). However, despite acting as an incentive to invest in a toilet, tenure security may not affect sanitary behavior (McGranahan 2015, p. 248), which is intricately linked to social issues. Motivations for sanitation adoption and use include the desire for privacy, convenience, and social status (Mara *et al.* 2010). Inadequate access to water and sanitation affects women and girls disproportionately often inducing psychosocial stress (Hirve *et al.* 2015) and compelling them to take on risks associated with open defecation (O'Reilly 2016). In India, latrines promoted by the government are perceived by some as being temporary or fake, and materials are sometimes repurposed or the space is used for bathing and washing (Coffey *et al.* 2014).

Urban sanitation has largely been self-provided and households are expected to carry the cost burden. However, there is a danger that sanitation facilities that are self-built may become a threat to the surrounding environment when they are not executed properly (Peal *et al.* 2014). Efforts to promote physical infrastructure highlight how little attention is paid to the continuum of sanitation such as collection, transport, and disposal of waste, each of which poses a potential threat to public health (Andersson *et al.* 2016), particularly for poorer households that are unable to maintain their on-site sanitation facilities (Jenkins *et al.* 2014). Such risks are exacerbated during annual flooding events (Baum *et al.* 2013). Moreover, despite efforts to induce behavioral change by bringing sanitation products to households and raising awareness about its private benefits (Cairncross 2004), they fall short in targeting consumers' needs and circumstances (Joshi *et al.* 2011) and reaching poorer households, particularly tenants (Jenkins & Sugden 2006). Segmenting households based on a behavioral approach to assess demand could address constraints at different stages of decision-making (motivation, choice, intention) by tailoring sanitation strategies to particular sub-groups (Jenkins & Scott 2007). Moreover, as pointed out by O'Reilly *et al.* (2017), structural inequalities will need to be addressed to render latrine building and usage viable, which calls for explanations about open defecation to move away from individual behaviors to solutions that focus on social and political change (p. 203).

STUDY SITES

Post-decentralization in India, local governments were charged with the responsibility of basic service provision. The Constitutional Amendment Act of 1992 directed the Public Health Engineering Department of Madhya Pradesh to transfer assets in the water supply sector to the respective municipal corporations for operation and maintenance (O&M). However, decentralization has been somewhat piecemeal and local government efforts are often outpaced by the growing demand for water and sanitation services. Consequently, external agencies and donors have been engaged to rehabilitate aging infrastructure and curtail inefficiencies by ushering in demand management. It is within this broader context that the informal settlements in the three cities were studied. Gwalior, Indore, and Jabalpur are among the growing second tier cities in India with 25.6 percent (5,135,829) of the total urban population of Madhya Pradesh (Government of India 2011). However, local governments in these cities are faced with the challenge of providing basic services such as water and sanitation, particularly to resource-constrained settlements. Census 2011 figures indicate that Class I cities (population of 100,000 and above) have a lower percentage of households that practice open defecation as compared to smaller class size cities. Others have indicated that urbanization increases the likelihood of using a toilet (see, for instance, Banerjee *et al.* 2016).

RESEARCH METHODOLOGY

Data were collected during 2007–2008 and in 2011 in three cities in Madhya Pradesh where only 20 percent of urban households are connected to a sewer system and 22 percent defecate in the open (Ministry of Urban Development 2012). A household survey using stratified random sampling was designed and administered in the local language (Hindi) to about 625 households in 13 informal settlements. Households were selected from a list of applications for a domestic water supply connection and at least 100 households were selected per city. For instance, in Indore, a total of 850 households received a connection out of which we aimed for a sample size of 100 households, so we included

every eighth household. The selected households were included in the study only if they agreed to participate. The study protocol was approved by a review board at the University of California, Los Angeles. Nine of the settlements were part of a poverty pocket situation analysis that mapped poverty levels and environmental infrastructure deficiencies to prioritize interventions. Collection of data for the poverty pocket situation analysis informed the Municipal Action Plan for Poverty Reduction (see UN-Habitat 2006a, 2006b). We selected both notified and non-notified slums. In the Indian context, notified slums refer to slums that have received notification from the concerned local government agency making them eligible for basic services. Some have argued that the deficiency of basic services such as water and sanitation in non-notified slums may be related to poor health outcomes (see, for instance, Subbaraman *et al.* (2012) for a detailed discussion). Effort was made to include the same number of households from each city. A supervisor and two to four enumerators (from local universities and non-governmental organizations (NGOs)) were trained to administer the questionnaire. The instrument was pre-tested and revised prior to full-scale administration. The enumerators were instructed to request the member responsible for the water and sanitation needs of the household to participate in the survey. Respondents were asked about demographic and socioeconomic characteristics of their household; participation and collective action; existing water and sanitation services; water and sanitation projects; relationships among key actors; and residential history and housing. To maintain consistent quality, the enumerators were asked to complete only four questionnaires per day as each took about 90 minutes to complete. Data from interviews with government officials, representatives of the external agency and water and sanitation committees, and intermediaries (individuals who were involved in mobilizing communities) in 2007–2008, coupled with data from focus group discussions and follow up interviews in 2011, complemented the survey. Transect walks were done with residents and intermediaries to triangulate data from other sources. They typically included selecting two to three key lanes in the clusters that presented the greatest diversity of water and sanitation facilities and highlighted local technology and practices. They were selected in consultation with local NGO representatives and key informants in the settlements.

UNDERSTANDING THE SANITATION LANDSCAPE

Table 1 presents data from the household survey. It indicates that overall 53 percent of households surveyed reported that they use individual toilets whereas 40 percent resort to open defecation. A majority of those who used individual toilets reported having septic tanks. Although in some cases, the terms 'toilet' and 'latrine' have been used interchangeably, a latrine typically refers to a simpler technology. Almost 83 percent of households reported being dissatisfied with their existing sanitation facilities of which 50 percent reported being dissatisfied about the lack of a proper sewerage system and 21 percent about maintenance issues. Most households were willing to pay Rs.25–100 for connection to a networked sewerage system. However, in Gwalior, a majority was not willing to pay. About 48 percent of

Table 1 | Status of water supply, sanitation, and drainage in the settlements studied

	Gwalior ($n = 201$)	Indore ($n = 221$)	Jabalpur ($n = 200$)	All cities ($n = 622$)
Water supply, sanitation, and drainage	*% households*			
<30 minutes to collect water	54.2	72.9	26.0	51.7
Aware about health and sanitation	96.5	27.1	95.5	71.5
Willing to pay for sanitation	30.8	80.1	99.0	70.2
Uses individual toilet	34.3	75.1	46.5	52.7
Resorts to open defecation	64.7	24.0	32.5	39.8
Has open pit toilet	1.0	17.2	10.5	9.8
Has septic tank	34.3	46.6	65.5	48.7
Wastewater flows into open drains	8.5	21.7	73.5	34.0
Wastewater flows into streets	71.1	55.7	15.5	47.7
Wastewater flows into water bodies	11.9	5.4	6.5	7.8
Dissatisfied with the current sanitation system	97.0	76.4	76.5	83.1
Has toilet in dwelling unit	34.3	73.3	42.0	50.6

Source: Field Survey 2007–2008.

households reported that wastewater flows directly into the streets and 34 percent reported that it flows into open drains. Access to basic services varied across the three cities. In Indore, 73 percent of respondent households reported having individual toilets compared to only 34 percent in Gwalior and 42 percent in Jabalpur where 65 and 33 percent of households reported open defecation, respectively.

Transect walks revealed that many households were located in difficult terrain including steep slopes, swampy lands, and rocky ground that is unsuitable to build on. This made it costly to build proper sanitation facilities and even costlier to maintain them. In some cases, space constraints made it difficult to build septic tanks and there was no networked sewerage system. Site observations revealed households with unused toilets that served as storage. Some households had even constructed makeshift toilets over open drains. Residents reported health problems and the prevalence of waterborne diseases such as malaria and diarrhea, and expressed concern about their children's health due to unsanitary conditions in their neighborhoods. When asked if they boil water for drinking, some residents lamented about not having enough fuel to cook, let alone boil water. Residents with no toilets reported open defecation near a pond. However, the government had fenced off the pond, disallowing open defecation. Women therefore reported going to open drains near their homes when it was dark while men had to walk further away to search for suitable places to defecate. Some households had toilets but they remained unused due to a lack of water supply. Observations at community meetings indicate that although there had been attempts to mobilize community members to address the sanitation problem such efforts remained piecemeal. For instance, in one settlement, a social worker offered to help the residents, particularly women, form a registered committee to manage a community toilet block. The toilet block had been lying unused so the plan was to repair the toilets and charge every household Rs.1 per day. They could make the payment on a daily or monthly basis. He had estimated the overall cost for operating the toilet block and residents were preparing a survey to assess if households would be willing to use the toilets and pay for use. They would use the tariff for O&M (hiring staff, purchasing cleaning supplies, and so on). However, they did not discuss the status of the sewerage system and water supply.

Sample characteristics

Table 2 presents descriptive statistics for household characteristics in Gwalior, Indore, and Jabalpur. Sampled households have a mean of 5.61 people in Gwalior as compared to 4.97 in Indore and 5.39 in Jabalpur. In Indore and Jabalpur, they are predominantly Hindu whereas in Gwalior

Table 2 | Socio-demographic characteristics of the sample

	Gwalior ($n = 201$)	Indore ($n = 221$)	Jabalpur ($n = 200$)
Household characteristics[a]			
Educational attainment of women			
No education	78.6	57.9	24.0
Primary education	6.0	17.2	30.0
More than high school	6.5	12.2	16.5
Household size (number of people)	5.61	4.97	5.39
Scheduled Tribe[b]	13.4	12.2	18.5
Scheduled Caste[b]	0.5	15.8	24.5
Hindu	58.2	99.5	98.0
Muslim	41.8	0.0	0.5
Household consumption (in 1000 Rupees [INR])	16.63	43.44	53.13
Housing and tenure[a]			
Continued residence in settlement (in years)	12.3	15.6	27.4
Moved for family reasons	34.3	10.4	2.5
Moved for financial reasons	46.3	48.9	15.5
Bought or inherited land[c]	57.1	86.1	73.0
Squatting/without official documents	41.9	13.9	25.5
Owns house	96.5	96.8	99.5
Rents house/room	2.5	3.2	0.0
Has toilet in dwelling unit	34.3	73.3	42.0

[a]In % unless indicated otherwise.
[b]Scheduled Castes (SCs), Scheduled Tribes (STs), and Other Backward Classes (OBCs) are caste categories that are recognized by the Constitution of India and comprise of historically marginalized groups. The Constitution and other legislations provide a framework for affirmative action for the categories.
[c]Claimed ownership by stating that they had bought or inherited the land.
Source: Field Survey 2007–2008.

sampled households are 58 percent Hindu and 42 percent Muslim.

There is a stark difference in the average monthly household expenditure reported by respondents across the three cities. It is difficult to accurately measure income in the settlements surveyed since most households do not have a steady income and depend on daily wages. Therefore, we used monthly household expenditure as a proxy for household income and overall economic status. Total monthly expenditure was calculated from responses to expenditure for food and non-food items. Non-food items included clothing, medical care, educational supplies, utility bills, social and religious obligations, and interest on loans. Households in Gwalior were economically weaker with a lower average monthly household expenditure compared to those in Indore and Jabalpur. Moreover, in Gwalior, the average monthly expenditure on food was 83 percent of the overall average monthly expenditure. Households in Indore and Jabalpur were relatively better off in this regard. Most men worked as daily wage laborers while women did home-based work such as embroidery, tailoring, making incense sticks and toys, which earned them very low wages. Some women were domestic workers in middle class neighborhoods. In Gwalior, 78.6 percent of households reported women with no education as compared to 58 percent in Indore and only 24 percent in Jabalpur. A majority of respondents reported that they own their home. Respondent households in Jabalpur reported an average of 27 years of residence whereas in Gwalior and Indore, the average length of residence was 12 and 16 years, respectively.

Model specification

For a nuanced understanding of what motivates sanitation uptake by the urban poor, we looked closely at factors that influence (i) toilet ownership and (ii) toilet use. We employed a binary logistic regression model to estimate the probability that a respondent household has toilet ownership as a function of its economic and social status. A second binary logistic regression model was developed to explain open defecation in the three study areas. Variables in the model were primarily drawn from the literature. We tested the independent variables to avoid problems of collinearity.

Variables in the model

The dependent variable in the first model is toilet ownership, which is coded as 1 if a household reported having a toilet in the dwelling and 0 if it did not. In the second model, the dependent variable is coded as 1 if the household reported open defecation by any member and 0 if it used a toilet. We use two broad categories of independent variables that could influence toilet ownership and open defecation. Economic status is measured in terms of average monthly household expenditure as a proxy for household income given the difficulty in accurately measuring income since most household members are daily wage laborers. Although scholars have used assets as a measure of household wealth, households in low-income informal settlements are often reluctant to divulge the value of their assets. They are, however, able to provide a more accurate estimate of their household expenditures (for instance, we found consistency in the unit price quoted for food items). Materials used for residential construction indicate level of perception of tenure security. For instance, houses with finished floors and roofs made of reinforced concrete slabs indicate a higher perception of tenure security. We also included variables to measure access to basic services. Household access to water supply is measured in terms of the amount of time required to collect water. Toilet ownership provides a useful measure for motivation to use toilets, especially since urbanization is associated with an increase in the likelihood of using toilets (Banerjee *et al.* 2016) although studies in rural settings find that the presence of toilets does not necessarily guarantee use (see, for instance, Coffey *et al.* 2014). We also included level of trust in government officials and whether a household reported receiving help from an organization to address their water and sanitation problems. Other studies have indicated that NGO and external agency intervention are positively associated with improved living conditions and economic status (see, for instance, Mahadevia 2011).

Social status is measured in terms of the educational attainment of women in the household and general awareness in the household about the link between water and sanitation and illness. Studies have indicated that households with higher educational attainment by women are more likely to use toilets than those where women's education is limited to preschool (Banerjee *et al.* 2016). There

is an inverse relationship between access to sanitation and female literacy (Ghosh & Cairncross 2014). Length of residence is particularly salient in the urban context as it could be an important determinant of the quality of basic services and has been found to be positively associated with improved living conditions and economic status (Mahadevia 2011). Households that have lived in a community for more than five years are also more likely to participate in community projects (Daniere *et al.* 2002). Perception of tenure security is important as it indicates motivation to settle in the neighborhood and to make housing improvements (Van Gelder 2009; Mahadevia 2011; Nakamura 2017). Finally, our qualitative data pointed to differences in sanitation behavior and access across our study sites, so we included city dummy variables. A study of sanitation coverage across regions, states and districts by Ghosh & Cairncross (2014) indicates substantial differences, calling for context-sensitive policy. Results from our empirical analysis are discussed in the following section.

TOILET OWNERSHIP AND TOILET USE

Tables 3 and 4 present the explanatory variables for respondents who have toilets in their dwelling unit and those who rely primarily on open defecation instead of using a toilet, respectively.

Table 3 | Toilet ownership

Explanatory variables ($n = 622$)	B coefficients	Odds ratios (95% C.I.)
Any education of women	0.457	1.579
>5,005 total monthly consumption	1.737*	5.679
Household size	−0.026	0.974
Number of women in the household	−0.007	0.993
Awareness about relation between sanitation and illness	0.882*	2.415
<30 minutes to collect water	−0.300	0.741
Willing to pay for connection to sewerage system	0.076	1.079
Received previous help from the government	−0.801*	0.449
Not squatting on land	0.439	1.551
Years in current residence (Log)	0.336	1.399
Floor made with permanent materials	1.411**	4.102
Roof made with RCC[a] slab	1.308*	3.697
Indore	2.085**	8.046
Jabalpur	−0.496	0.609
Model summary		
R-square (Nagelkerke)	41.4	
Diagnostic statistics	Statistic	*p* value
Hosmer and Lemeshow test	8.647	0.373

*p value <0.05.
**p value <0.001.
[a]Reinforced cement concrete.

Toilet ownership

Our findings indicate that households that reported higher average monthly consumption (which served as a proxy for income) were more likely to report toilet ownership. This is not unexpected because economic mobility is a necessary first step towards sanitation adoption (O'Reilly *et al.* 2017). Toilets are also associated with social status (Augsburg & Paul 2015). The affordability challenge is further reiterated by our finding that households whose dwellings were made of permanent materials (finished floors and roofs of reinforced concrete slabs) were more likely to report toilet ownership. Similarly, households surveyed in Indore were more likely to report toilet ownership compared to those in Gwalior. Again, this is not surprising because households in Indore were relatively better off economically than those in the other two cities. Households that reported receiving help from an institution or organization to address their water and sanitation problems were less likely to report toilet ownership. This could be an indication of low spending resources, which makes such households less likely to invest in toilets. Among households that report using a sanitation facility, the poorest are most likely to use a facility that needs fecal sludge management placing an additional burden on them to manage waste safely and therefore underscoring the inequities in financing and payments mechanisms which pass the cost of fecal sludge management on to users (Berendes *et al.* 2017, pp. 3080–3081). Furthermore, sometimes government subsidies are not adequate to cover the entire cost of toilet construction (O'Reilly *et al.* 2017). Wealthier households are found to build them without subsidies

Table 4 | Open defecation

Explanatory variables ($n = 622$)	B coefficients	Odds ratios (95% C.I.)
Any education of women	−0.316	0.729
>5,005 total monthly consumption	1.009	2.742
Household size	−0.012	0.988
Number of women in the household	−0.117	0.890
Awareness about relation between sanitation and illness	1.319	3.739
<30 minutes to collect water	−1.088*	0.337
Satisfied with current sanitation facilities	−1.258	0.284
Received previous help from the government	−0.037	0.964
Trusts the local government to a great extent	−1.876**	0.153
Not squatting on land	−1.281*	0.278
Has a toilet in dwelling unit	−6.402**	0.002
Indore	0.579	1.784
Jabalpur	−2.479**	0.084
Model summary		
R-Square (Nagelkerke)	83.5	
Diagnostic statistics	Statistic	*p* value
Hosmer and Lemeshow test	14.953	0.060

*p value <0.05.
**p value <0.001.

(Coffey *et al.* 2014). Our findings also indicate that households that reported thinking that there is a link between water and sanitation and illness were more likely to report toilet ownership. This is likely because having an education on the benefits of sanitation increases the demand for toilets (Banerjee *et al.* 2016), although Gross & Gunther (2014), for instance, found no such relationship.

Our qualitative data also highlight the importance of context in addressing the collective action challenge. In some settlements, we found evidence of self-help and a willingness to use shared toilets. For instance, in a settlement in Jabalpur, residents made efforts to collectively organize households to renovate and manage an existing government-built toilet block. At a committee meeting, an intermediary – a social worker and benefactor – pointed out that the residents would have to conduct a survey and hire caretakers. He assured them that he would speak to the commissioner about renovating the toilets and get them ready with lighting and other fixtures. The question before them was how many households would be willing to pay.

In other settlements, toilet blocks lay unused due to lack of privacy (no doors), water supply, or unsuitable location. The perception that toilets are luxury items (Coffey *et al.* 2014) compounds the collective action challenge and brings into focus the fragmented demand which is often complicated by the incongruent nature of the sanitation problem (McGranahan 2015, p. 244).

Toilet use

Our analysis indicates that households that reported toilet ownership were less likely to opt for open defecation. This is contrary to what studies have found in rural areas where there is a 'revealed preference' for open defecation particularly when households have smaller latrine pits and are influenced by beliefs about ritual purity and pollution (see, for instance, Coffey *et al.* 2014; Routray *et al.* 2015; Coffey *et al.* 2017). Our finding is, however, consistent with other studies that indicate that the likelihood of using a toilet increases with increasing urbanization (see, for instance, Banerjee *et al.* 2016) as expanding city limits diminish privacy for open defecation (O'Reilly & Louis 2014). Our site observations indicated that a dearth of suitable defecation sites in urban settings acts as a deterrent as pointed out by a resident in one of the settlements in Indore during a transect walk,

> '*… there are no toilets here … everyone goes near the pond … but now there is a fence so we are not allowed to go there … so now we have to use the drains at night … in the dark … the men sometimes go further away … it is very difficult for the women …*' (Sirpur, Indore).

Also, households that reported that it took them less than half hour to collect water were less likely to resort to open defecation. This is not unexpected because competing uses of water (for cooking, washing, and other productive uses) make it difficult to allocate water for toilet use. Moreover, in most cases, water had to be collected from far away sources by queuing for hours at public standpipes or bought from private water vendors. For instance, according to one resident,

'*We have to get water from 1–2 kilometers away … carry … on bicycles … but it takes time and if we do not work what will we eat … everything is so expensive. Sometimes we have to bring water from the pond … everyone … adults … children … have to help collect water. Our children get sick due to the unsanitary conditions … every month we have to spend money to buy medicines. What we earn goes into treatment*' (Sirpur, Indore).

The finding is consistent with evidence that access to water, and supply-related and physical components of latrine construction influence latrine use (Barnard *et al.* 2013; Jenkins *et al.* 2014; Routray *et al.* 2015). Moreover, in India, cultural preferences are aligned with water-based sanitation practices given the need for post-defecation washing and bathing (O'Reilly & Louis 2014). Open defecation sites are therefore located close to water bodies where possible. Households that reported acquiring the land (buying or inheriting) rather than squatting without permission were less likely to resort to open defecation. This could be because local authorities are often unable to provide sanitation and water services to unauthorized settlements (Murthy 2012; McGranahan 2015). Fear of displacement could be a disincentive for investing in the upkeep of sanitation facilities (McGranahan & Mitlin 2016) that are required for toilet use. Moreover, households with a better standard of living are more likely to use toilets (Banerjee *et al.* 2016). The results also indicate that households that reported trusting the government to a great extent were less likely to defecate in the open. A probable explanation could be that households that reported trusting government officials tended to have a higher perception of tenure security and were more likely to make improvements in the hopes of being regularized. Finally, households surveyed in Jabalpur were less likely to resort to open defecation than those in Gwalior. They have a higher socioeconomic status than households surveyed in Gwalior, where lower socioeconomic status likely makes it more difficult for local sanitation standards to be enforced (McGranahan & Mitlin 2016). Moreover, investment in a sanitary toilet may not be linked with sanitary behavior (McGranahan 2015). For instance, although studies have shown that government-provided latrines are often underused (Coffey *et al.* 2017; Sinha *et al.* 2017), our data indicate that some households in Jabalpur reported using shared sanitation facilities and efforts were ongoing to renovate existing toilet blocks indicating that such options could be viable in urban areas where construction of individual toilets faces barriers (Patel *et al.* 2014).

Our study was not without its limitations. First, the observational nature of the study offers insight into likely associations, if any, but disallows causal inferences. Second, despite our efforts to include a reasonably comprehensive list of predictors that could be associated with toilet ownership and toilet use, there exists the possibility that the observed relationship between the dependent and independent variables may be due to the omission of certain unidentifiable variables which could affect our interpretation of results. It is difficult to collect robust data on sanitation, in slums in particular (Rains *et al.* 2018). Third, data for this study were gathered before the implementation of the Swachh Bharat Mission (SBM), which could have influenced access to sanitation given the allocation of financial resources and incentives to become open defecation free.

CONCLUSION

In this study we examined factors that influenced toilet ownership and use in 13 low-income settlements in three smaller urban centers in central India. Since this is a cross-sectional study, the results indicate the significance and magnitude of these relationships measured at one point in time. However, the models presented are robust to variations in specification and choice of indicators. Our findings indicate that relatively less resource-constrained households and those who showed awareness about the link between water and sanitation and illness were more likely to have reported toilet ownership and households that reported toilet ownership were less likely to have resorted to open defecation. Our findings are salient because they indicate that factors that influence sanitation uptake in urban areas in India may not be the same as those in rural settings where there may be a preference for open defecation (Coffey *et al.* 2014, 2017; O'Reilly *et al.* 2017; Sinha *et al.* 2017). We find that, for the urban poor, having access to a toilet could, in fact, be an important step towards eliminating open defecation. However, other factors such as adequate access to

water supply, trust in government officials, and perception of tenure security play an instrumental role in sustaining toilet use. It is also important to note that there are caveats. For instance, sanitation behavior varies across regions, states, and districts (Ghosh & Cairncross 2014), and, in South Asia, religion and culture has also been found to influence latrine use (Vyas & Spears 2018).

Although the scale of the urban sanitation problem is not as staggering as that of the rural, high population density in urban areas means a high health burden is associated with open defecation. Our data illuminated the inadequacy of water, sanitation and wastewater systems in resource-constrained settlements. There are four key areas where our findings could provide important insights for policy.

First, motivating households to build toilets using subsidies could be worthwhile. The SBM is therefore an important catalytic intervention. However, given the density of informal settlements, it may be difficult to retrofit toilets due to space constraints besides other considerations such as soil characteristics, depth to water table, and distance from surface water, which are critical in avoiding groundwater contamination. This is often compounded by the topography such as in the case of Gwalior, where rocky terrain makes it costly to build sanitation facilities. For, instance, in our study, households that reported toilet ownership were those whose houses were built with permanent materials. It could be useful to explore creative incentives at the neighborhood level to spark collective action as demonstrated by the Orangi Pilot Project (Hasan 2010) rather than subsidies at the household level, which often end up benefiting the relatively better off households. Shared toilets may be worth exploring to ensure the 'middle rung' of the sanitation ladder is intact giving households an opportunity to upgrade when financially feasible. Improvements will need to gauge acceptability and where there are shared sanitation facilities particular emphasis on hygiene education is warranted.

Second, encouraging toilet use underscores the importance of coproducing water and sanitation services, particularly to derive health benefits from improved sanitation behavior. This may not be easy, however, from a demand management approach as demand for water does not always signal demand for sanitation, and typically households may be willing to pay for water but not sewer connections (Das 2015). Access to water is a key determinant of the type of sewerage system that could be installed and used. Informal settlements typically lack access to reliable household water supply, which may push people toward practicing open defecation. Our study indicates that water bodies are popular defecation sites. Efforts by local government to protect water bodies through sanctions for open defecation tend to shift such sites to open drains, which get flooded during the monsoon, spreading disease. While the SBM has done well to delink access to sanitation and land tenure, it may behoove the program to ensure a more comprehensive approach when it comes to water supply.

Third, in places where on-site facilities are feasible, subsidies could be directed towards proper fecal sludge management (collection, conveyance, treatment, and disposal), expanding the definition of 'access' to sanitation under the SBM. Our study indicates that households that reported toilet ownership were mostly connected to on-site systems. Given the contextual particularities, however, programs under the SBM could offer flexibility to implement systems that use locally appropriate technology and are socially acceptable. The unit cost differential between a toilet and sewer may be comparable to on-site sanitation (WSP 2014). There is evidence that, in India, the combined cost of a water closet and sewerage connection may be comparable to that of a pit latrine, and lower than the cost of a septic tank (Society for the Promotion of Area Resource Centers (SPARC) 2014; WSP 2014) in which case networked systems could offer a safer alternative in denser urban environments and public funds could be directed to laying this infrastructure.

Finally, exploring the role of public-private partnerships in O&M of sanitation facilities to ensure that risks to human and environmental health are minimized could be timely, particularly since there is pressure from civil society for more widespread implementation of the Prohibition of Employment as Manual Scavengers and their Rehabilitation Act and Rules 2013. Such services will, however, require adequate planning and regulation by the local government to ensure they do not increase the cost burden of resource-constrained households (see, for instance, Murray *et al.* 2011). Affordability remains a thorny issue both in terms of initial construction costs and operating costs associated with emptying and maintaining on-site systems. While

public assistance is well intentioned, the 'sanitation for all' mantra is daunting as there are several factors that trigger sanitation uptake and these may vary depending on socio-cultural context. Even with a shift in the scale of intervention and the flurry of resources that have become available under the SBM, without a broader view of 'access,' sanitation for all may remain just another Panglossian perspective.

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