Religion and Sanitation Practices*

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Abstract

Infant mortality among Hindus is higher than among Muslims in India, and religious differences in sanitation practices have been cited as a contributing factor. To explore whether religion itself is associated with differences in sanitation practices, we compare sanitation practices of Hindus and Muslims living in the same locations using three nationally-representative data sets from India. Across all three data sets, the unconditional religion-specific gap in latrine ownership and latrine use declines by approximately two-thirds when conditioning on location characteristics or including location fixed effects. Further, we do not find evidence of religion-specific differences in other sanitation practices, such as handwashing or observed fecal material near homes. We conclude that household sanitation practices vary substantially across areas of India, but that religion itself has less direct influence when considering differences between Hindus and Muslims within the same location.

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Worldwide, one billion people practice open defecation and an estimated 2.5 billion people do not have improved sanitation facilities, such as flush toilets (UNICEF/WHO, 2014a).[1] The limited availability and use of such facilities, the pervasiveness of fecal material, and inconsistent handwashing all contribute to the transmission of infections with severe negative consequences for child health and educational attainment.[2] India faces particularly daunting sanitation challenges, with 597 million individuals practicing open defection and 450,000 deaths attributed to diarrheal illness per year (UNICEF/WHO, 2014b).

In response to this sanitation problem, India has expended substantial resources to subsidize latrine construction.[3] Government construction of latrines has been central to improvements in sanitation practices, and especially reducing the costs of latrines for poorer households (Gertler et al., 2015; Guiteras, Levinsohn and Mobarak, 2015). There has been mixed evidence on health improvements following Indian sanitation initiatives (Patil et al., 2013, 2014; Spears, 2014), however, which has given rise to an argument that deeply rooted cultural beliefs may limit improvements in sanitation practices.

Recent attention has been drawn to substantial differences in latrine use between Hindus and Muslims in India (BBC, 2012, 2014; The Economist, 2014). Geruso and Spears (2018) attribute a lower infant mortality rate for Muslims, relative to Hindus, to a higher rate of latrine use among Muslims that they conclude is due to differences in religious beliefs. Hindus are more likely to live in rural areas with less access to sanitation infrastructure, however, and so lower rates of latrine use and higher rates of open defecation may reflect differences in household locations rather than religion itself.

[1] "Improved sanitation facilities" refers to facilities that reliably separate human fecal material from human contact, and may include: flush toilets, piped sewer systems, septic tanks, ventilated improved pit latrines, or composting toilets (UNICEF/WHO, 2014a).

[2] See Nandy et al. (2005), Chambers and Von Medeazza (2013), Hueso and Bell (2013), UNICEF/WHO (2014b), and Adukia (2017).

[3] In the 1980s, the Central Rural Sanitation Program (CRSP) was directed towards improving access to sanitation facilities and associated changes in sanitation behaviors. These policy efforts evolved into India's Total Sanitation Campaign (TSC), implemented in 1999, which included the building of latrines in poorer households (WSP, 2011; Spears, 2014). This Total Sanitation Campaign was absorbed into the broader Swachh Bharat Mission Program, which emphasized an educational component intended to drive behavioral changes in latrine use, handwashing, and other sanitation practices (AFC, 2005).

In this paper, we explore the religious divide in sanitation practices in India, considering in particular the role of location-specific factors in driving observed differences between Hindus and Muslims. To do so, we use data from three nationally-representative surveys: the Indian Human Development Survey (IHDS), the District Level Household and Facility Survey (DLHS-3), and the National Family Health Survey (NFHS-3). Each data set provides detailed information on latrine ownership or latrine use at the household level.

We examine the role of household religion in predicting differences in household sanitation practices. We emphasize that if differences in household sanitation practices are being driven by religion itself, then household sanitation practices should continue to differ substantially by religion when we compare Hindus and Muslims within the same geographic areas.[4]

We estimate unconditional differences between Hindus and Muslims in latrine ownership and latrine use, similar in magnitude to Geruso and Spears (2018), but these differences are reduced by approximately two-thirds after controlling for measures of urbanization and other location characteristics. When replacing these location characteristics with location fixed effects, we estimate a similarly large reduction in the Hindu-Muslim gap. Latrine ownership remains 5.3 percentage points lower in Hindu households than in Muslim households, using IHDS data in our preferred specification (95% confidence interval: 1.5pp lower – 9.1pp lower). This estimate is similar across specifications, once controlling for local characteristics or location fixed effects, and are similar in DLHS-3 data and NFHS-3 data. While there remains some difference in latrine ownership and latrine use, the unconditional differences by household religion largely reflect differences in household location.

We then extend our analysis to consider other sanitation practices and do not find differences between Hindus and Muslims in reported handwashing or observed fecal material near homes. We estimate that Hindus are 1.1 percentage points more likely to report washing

[4]Note that religion may influence average sanitation practices in locations, which would be absorbed into location fixed effects, whereas our main analysis focuses on how religion differentially affects households of that religion. Using a machine learning technique (LASSO), we also estimate that average sanitation practices in locations are more predicted by locations' rural status and female literacy than by locations' religion shares.

hands after defecating (95% confidence interval: 1.7pp less likely – 3.9pp more likely). There is also a 1.7 percentage point lower chance of the surveyor observing fecal material near Hindu households (95% confidence interval: 2.2pp more likely – 5.7pp less likely).

Finally, we do not estimate differences in latrine use between Hindu and Muslim households that have migrated from rural to urban areas. The point estimate implies that Hindu migrant households are 2.7 percentage points less likely to use a latrine than Muslim migrant households, though the estimated precision is lower due to a decreased sample size (95% confidence interval: 11.3pp less likely – 7.9pp more likely). These estimates focus on migrant households only, which may differ in religiosity from non-migrant households. The estimated difference is statistically smaller than the unconditional difference between all Hindu households and all Muslim households, but would not reject our estimated differences controlling for household location.

Understanding sanitation practices of Hindus and Muslims is part of a broader literature seeking to understand differences in outcomes more generally between Hindus and Muslims in India. An Indian government report in 2006 noted that Muslim identity was associated with higher poverty rates (Sachar et al., 2006), which followed a period of lower intergenerational mobility among Muslims relative to Hindus (Asher, Novosad and Rafkin, 2018) and lower educational achievement among Muslims (Maitra and Sharma, 2009; Azam and Bhatt, 2015). By contrast, there is a lower infant mortality rate among Muslims (Bhalotra and van Soest, 2008; Deolalikar, 2010; Kumar et al., 2013), which has raised the suggestion that religion and associated practices may be important factors for infant mortality (Bhalotra, Valente and van Soest, 2010). Differences in child height and weight among Hindus, relative to Muslims, have also been attributed to cultural differences (Jayachandran and Pande, 2017). Muslim women have more children in India (Moulasha and Rao, 1999), though Jeffery and Jeffery (2000) emphasize that fertility differs substantially across geographic areas in India and that differences between Hindus and Muslims are exaggerated by not comparing Hindu

and Muslim households within geographic areas.[5]

We estimate that, while there is a substantial unconditional association between religion and sanitation practices, a comparison of Hindu and Muslim households within similar locations finds more similar sanitation practices. Our estimates suggest that household religion itself has less influence on sanitation practices, as compared to characteristics of household location. Sanitation practices are substantially better in urban settings, with better access to sanitation infrastructure, for both Hindus and Muslims.

The paper proceeds as follows. Section I describes the data, and Section II presents descriptive statistics. Section III describes the estimating equations, and Section IV presents the results. Section V concludes.

I Databases on Indian Households: IHDS, DLHS-3, NFHS-3

We analyze data from three nationally-representative surveys of households in India: the first wave of the Indian Human Development Survey 2004–05 (IHDS), the third wave of the District Level Household and Facility Survey 2007–08 (DLHS-3), and the third wave of the National Family Health Survey 2005–06 (NFHS-3). These data sets each contain different information on sanitation practices, and provide complementary insights on the relationship between sanitation practices and religion. The IHDS includes the most data on various sanitation practices, but is a smaller sample. The DLHS-3 has more households, but has fewer detailed questions on sanitation practices. The NFHS-3 provides an opportunity to follow migrants' behaviors, though district-level identifiers are not available.

We study three sanitation practices: (1) whether an individual or household owns or uses a latrine, (2) whether the respondent washes hands with soap after defecation, and (3) whether the interviewer observed fecal matter (human or animal) around the dwelling of the respondent at the time of the survey.[6] We limit our analysis to households in which the

[5]There is also evidence of differences in contraceptive use among Muslim women and Hindu women who report not wanting additional children (Dharmalingam and Morgan, 2004; Dharmalingam, Navaneetham and Morgan, 2005), though other evidence suggests similar female autonomy within the household for Muslim women and Hindu women (Jejeebhoy and Sathar, 2001; Desai and Temsah, 2014).

[6]In our analysis, "latrine" refers to all types of latrines or toilets. The IHDS and DLHS-3 ask the

household head is either Hindu or Muslim, which covers between 86% and 92% of surveyed households in each data set.

The Indian Human Development Survey (IHDS) collected data from 41,500 households across 384 districts in 33 states and union territories from 2004 to 2005 (Desai, Reeve and NCAER, 2005). These data cover three sanitation practices: latrine ownership, handwashing, and observed fecal material.

The third wave of the District Level Household and Facility Survey (DLHS-3) collected data from 720,000 households across 601 districts in 34 states and union territories from 2007 to 2008 (IIPS, 2010). DLHS-3 includes data on whether the household reports owning a latrine but does not report data on other sanitation practices.

The third wave of the National Family Health Survey (NFHS-3) collected data from 109,000 households in 29 states and union territories from 2005 to 2006 (IIPS, 2007). NFHS-3 includes data on whether the household reports typically using a latrine but does not report data on other sanitation practices.

Our analysis explores the cross-sectional relationship between religion and sanitation practices, and so we chose three data sets from a similar time period that each provide similar but complementary data on sanitation practices (latrine ownership, latrine use, observed fecal material, and handwashing).[7]

The data sets each include information about households, which we use to define a set of household characteristics: caste of household head, occupation of household head, education of household head, household size, age of survey respondent, number of female members of the household, whether the household has piped water, and proxies for household wealth (an indicator variable for whether the household owns their house; indicator variables for the presence of electricity, a cell phone, television, bicycle, car, and motorcycle; and distance to

respondent about the type of latrine that her family "has," while the NFHS-3 asks the respondent about the type of latrine that her household "uses." Note that Geruso and Spears (2018) define "open defecation," using NFHS data, as when the household reports not using a latrine.

[7]As a robustness check, we ran our analysis on later waves of the data sets (IHDS-II in 2011-12, DLHS-4 in 2012-13, and NFHS-4 in 2015-16) and find similar results.

fuel source).[8]

In each data set, we observe the household's "primary sampling unit" or PSU, which corresponds to the household's village, town, or neighborhood as designated in each survey's sample design. We also merge in data at the district level from the 2011 Indian Census, reported separately for urban and rural areas of each district. These data provide detailed information about a household's location. For each data set, we weight each household using the provided household-level sample weights.

II Descriptive Statistics and Preliminary Evidence

To explore the relationship between religion and sanitation, we begin with descriptive statistics that we separate by religion and urban/rural status. Specifically, we split the data by whether the head of household is Hindu or Muslim, as well as by whether the household is in a rural or urban location.[9]

Using data from the IHDS, Hindu households are on average 18 percentage points less likely to have a latrine than Muslim households (Table 1). Yet this overall difference masks significant heterogeneity across urban and rural areas. In urban areas, the gap between Hindu and Muslim latrine ownership is 4 percentage points, whereas in rural areas the gap is 18 percentage points.[10]

The large overall difference in latrine ownership between Hindu and Muslim households is similar to the rural gap between Hindu and Muslim households, which reflects several features of the data. Latrine ownership is substantially lower in rural areas, and Hindus live disproportionately in rural areas as compared to Muslims.[11] Further, a majority of both

[8]The availability of these variables vary slightly across data sets: the IHDS data do not include information on homeownership, and only the IHDS data include the occupation of the household head and the distance to the closest fuel source.

[9]"Urban" is defined in the 2011 India Census, which is based on total population, population density, and non-agricultural labor activity.

[10]Other notable differences between the two group means include the following: family size is slightly smaller among Hindus, and there are fewer Hindus in urban areas that have less than or equal to 5 years of education. The main regression analysis will control for family size and education, along with other characteristics.

[11]Note that the overall difference between Hindus and Muslims is not a weighted average of the difference between Hindus and Muslims in urban areas and the difference between Hindus and Muslims in rural areas.

Hindu and Muslim households live in rural areas. In the 2011 Indian Census, the Hindu rural share was 71% compared to the Muslim rural share of 60%. These demographics align with those in IHDS-sampled households, for which approximately 68% of Hindu households resided in rural areas compared to 56% of Muslim households. Figure 1 plots the share of Indians and Muslims living in urban areas over time, which shows longstanding differences in urbanization between Hindus and Muslims. In each decade, Muslims are more urbanized than Hindus.[12]

The differences between Hindus and Muslims in latrine ownership reported in the IHDS data (Table 1) are similar to the differences in latrine ownership reported in the DLHS-3 data (Appendix Table 1) and differences in latrine use reported in the NFHS-3 data (Appendix Table 2). We calculate large unconditional differences between Hindus and Muslims, between 18 and 23 percentage points, which are similar to the 25 percentage point difference reported by Geruso and Spears (2018) using NFHS data pooled across 1992-93, 1998-99, and 2005-06. This overall difference is similar to the rural difference between Hindus and Muslims, with smaller differences between Hindus and Muslims in urban areas.

Table 1 also includes other sanitation practices: whether household members wash their hands after defecating, and whether the surveyor observed fecal material near the home. Hindu households report slightly higher handwashing than Muslim households in urban areas (row 2, column 6) and slightly lower handwashing in rural areas (row 2, column 9). Surveyors are less likely to observe fecal material near the homes of Hindus, and this gap is roughly the same in rural and urban areas (8% vs. 7%, respectively). These other measures

The overall difference also reflects lower latrine ownership in rural areas than in urban areas, along with a greater share of Hindus living in rural areas than the share of Muslims living in rural areas. For example, there could be no difference between Hindus and Muslims in both rural areas and urban areas and there could still be an overall difference between Hindus and Muslims.

[12]According to Gayer and Jaffrelot (2012, p. 10), Muslims represent the most "urbanized religious community of any significant size in India" and more than "50% of Indian Muslims are living in towns and cities in seven states, which, otherwise are predominantly rural." Muslims historically dominated Indian Ocean trade routes, and were more likely to settle along pilgrimage routes and in urban areas, which is a pattern that has persisted (Jha, 2013). In addition, according to the 2011 Indian Census, Muslims were less likely to own land than other religious groups, and hence may move toward urban centers and out of the agricultural sector. Traditionally, Muslims worked in industries such as silk, hand and power looms, the leather industry, automobile repairing, and garment making (Sachar et al., 2006).

of sanitation practices do not mechanically track differences in latrine ownership.

Figure 2 shows religion-specific differences at the state level, which complements the summary statistics by rural and urban status in Table 1 (IHDS) and Appendix Table 1 (DLHS-3). In Figure 2, we plot the difference between Hindu and Muslim households in latrine ownership (IHDS and DLHS-3) across states. In some states, Muslim households are more likely to own latrines than Hindu households; in other states, the converse is true. Much of the density is near zero, reflecting similar latrine ownership among Hindu and Muslim households. The variation shown in Figure 2 does not suggest that Hindu households have consistently lower latrine ownership once comparing Hindus and Muslims in more similar geographic locations.

Figure 3 explores the relationship between the Hindu-Muslim gap in latrine ownership and urbanization. The figure plots the difference in the state-level shares of Hindus and Muslims who report owning a latrine (y-axis) against the state-level difference in the shares of Hindus and Muslims living in urban areas (x-axis). The correlation between the two differences is 0.75. The states with large differences in latrine ownership between the two groups are also more likely to have considerable divides in the share of each group living in urban settings.

III Estimating Equation

To further examine the differences in sanitation practices across Hindus and Muslims, now controlling for household characteristics and location characteristics, we estimate the following equation:

$$Y_{ijd} = \alpha + \beta Hindu_i + \tau X_i^h + \rho X_{jd}^l + \epsilon_{ijd}, \tag{1}$$

where i signifies household, j denotes the household's town/village/neighborhood (PSU), and d is the household's district. The outcome Y_{ijd} represents one of the sanitation practices discussed above: whether the household owns or uses a latrine, whether the respondent washes hands with soap after defecation, and whether human or animal fecal matter is

observed near the home. *Hindu* is an indicator variable equal to one if the head of household is Hindu.

Household characteristics are denoted by X_i^h, for which summary statistics are reported in Table 1 (IHDS), Appendix Table 1 (DLHS-3), and Appendix Table 2 (NFHS-3). The list includes sociodemographic characteristics that may influence latrine ownership and other sanitation practices in India, which are: caste, occupation, and education of household head; household size, number of female members in the household, and age of survey respondent; whether the household has piped water; and proxies for household wealth (indicator variables for whether the household owns their house; indicator variables for the presence of electricity, a cell phone, television, bicycle, car, motorcycle; and distance to fuel source).[13]

Characteristics of the household's location are denoted by X_{jd}^l, which are drawn from the 2011 Census.[14] These variables include measures of urbanization and local demographic composition: an indicator for urban area; log population density; share of population working in agriculture; share of population that are minority religious groups (Jain, Sheik, Christian, Buddhist); share of population that is Muslim; share of population belonging to a Scheduled Caste (SC) or Scheduled Tribe (ST); and the sex ratio. We include these control variables because urbanization affects the availability of sanitation infrastructure and the returns to improved sanitation practices.[15] Further, the average demographic composition of areas is associated with different economic environments.[16]

In some specifications, we replace the location-specific characteristics (X_{jd}^l) with fixed

[13]The data sets vary slightly in which of these variables are available. The IHDS data do not include information on homeownership. Only the IHDS data include the occupation of the household head and the distance to the closest fuel source.

[14]These variables are measured at the district level, reported separately for urban areas of the district and rural areas of the district.

[15]Urbanization impacts the returns to hygienic behaviors since communicable disease is more easily transmitted in dense areas. By contrast, low population density might reduce the risk of infectious disease. A more agriculturally oriented area might also value the fertilizer content of human waste.

[16]We have noted that Muslims live disproportionately in more urban areas, and the presence of other minority groups (Jain, Sheik, Christian, Buddhist) can also be associated with different economic environments. Note that in controlling for the Muslim share of districts, we are still comparing Hindu and Muslim households but within locations that have similar demographic shares. We also include the sex ratio, which varies across India along with differences in the local economy.

effects for household primary sampling unit (PSU) that corresponds to the household's village, town, or neighborhood. These fixed effects capture unobservable local factors that may influence sanitation practices in a geographic area. PSU fixed effects absorb the control variables for household location, as the household location characteristics are homogeneous within a PSU.

In all specifications, we limit the sample to households that are headed by a Hindu or Muslim. We report standard errors that are clustered at the PSU level (village, town, or neighborhood), which adjusts for the spatial correlation in sanitation practices within nearby areas.

IV Results

IV.A Main Estimates

Table 2 reports results from estimating equation (1), using the IHDS data set in which we observe three sanitation practices. Panel A reports estimated differences in latrine ownership for Hindus, relative to Muslims. Panel B reports estimated differences in handwashing. Panel C reports estimated differences in whether no fecal material was observed around the house.

Column 1, panel A, reports that Hindus are 17.9 percentage points less likely to own a latrine than Muslims, without adjustment for other covariates (95% confidence interval: 13.0pp less likely – 22.9pp less likely). Column 2 reports similar differences between Hindus and Muslims when controlling for household characteristics, such as household demographics and proxies for household wealth, though these controls do contribute substantial explanatory power (raising the adjusted R-squared from 0.014 to 0.341).

Column 3 reports that Hindus are 5.6 percentage points less likely to own a latrine than Muslims, after controlling for differences in household location (95% confidence interval: 1.2pp less likely – 10.0pp less likely). This estimate is statistically smaller than the unconditional difference between Hindus and Muslims, and represents a 68.7 percent decline in the unconditional difference (reported in column 1). Similarly, column 4 reports a difference of

6.8 percentage points when replacing these location controls with fixed effects for household PSU (village, town, or neighborhood), such that the estimated differences between Hindus and Muslims are restricted to households in close geographic proximity. Column 5 reports a difference of 5.3 percentage points when jointly including controls for household characteristics, location characteristics, and PSU fixed effects (95% confidence interval: difference of 1.5pp – 9.1pp). The standard errors on our estimates are similar, or decreasing, as we add additional controls because the decrease in degrees of freedom is counterbalanced by the predictive power of the controls. Columns 6 and 7 report this difference separately for urban areas (3.2pp) and rural areas (5.6pp).

For other sanitation practices, panels B and C report little substantive difference between Hindus and Muslims after controlling for the same characteristics. There are some unconditional differences between Hindus and Muslims, with less handwashing and less observed fecal material around Hindu households, but these differences are attenuated when comparing households within similar locations. For handwashing, column 5 reports that Hindus are 1.1 percentage points more likely to report washing their hands after defecating (95% confidence interval: 1.7pp less likely – 3.9pp more likely). For observed fecal material, column 5 reports that the surveyor is 1.7 percentage points more likely to not observe fecal material near Hindu households (95% confidence interval: 2.2pp less likely – 5.7pp more likely).[17]

Table 3 reports estimated differences in latrine ownership for Hindus and Muslims, using data from the DLHS-3. There is an unconditional 22.9 percentage point difference in latrine ownership between Hindus and Muslims (95% confidence interval: difference of 21.7pp – 24.1pp), which is substantively similar to the unconditional difference in latrine ownership in the IHDS data. This unconditional difference is in large part attenuated in columns 3, 4, and 5 when controlling for household location characteristics and/or fixed effects for PSU. Comparing Hindus and Muslims within the same location, with similar access to sanitation infrastructure, Hindu households are 5.7 percentage points less likely to report owning a

[17]Note that surveyor-observed fecal material near homes reflects that household's sanitation practices and potentially those of nearby homes.

latrine (95% confidence interval: 5.1pp less likely – 6.3pp less likely). This estimate is similar to that using IHDS data, but more precise given the larger samples in DLHS-3 data.

Our main analysis focuses on how religion differentially affects households of that religion, but an important caveat is that religion may also influence average sanitation practices within locations. For example, Hindu religious customs could influence sanitation practices of nearby Muslims and Hindus, such that influence of religion becomes absorbed into location fixed effects. While we focus on whether Hindu households have different sanitation practices than nearby Muslim households, we also explore how religion influences average sanitation practices in locations (i.e., the location fixed effects). We estimate using LASSO that average sanitation practices in locations are more predicted by locations' rural status and female literacy than by locations' religion shares.[18]

IV.B Analysis of Migrant Households

The prior analysis found that religion-specific gaps in latrine ownership were smaller when controlling for characteristics of household locations or including fixed effects by household location. To further disentangle religion from the local economic environment, we examine migrant households.

We now focus on Hindu and Muslim migrants, who have moved from rural areas and converged in similar urban locations that allow us to hold constant the available sanitation infrastructure and other features of an urban area. Another advantage to analyzing rural-to-urban migrants is that they have similar generational exposure to urban areas, which is important giving the long history of Muslim urbanization in India (see Figure 1). An important caveat to this analysis is that migrant households may be less religious, on average, than

[18]In practice, we estimate location fixed effects by regressing latrine ownership on household religion and PSU fixed effects. We then use LASSO to select which variables most predict variation in the fixed effects. Following the procedure suggested by Belloni, Chernozhukov and Hansen (2014), we include the household characteristics and location characteristics (from Table 2) along with their pair-wise interactions (including their squares). Out of this set of variables, 21 variable interactions are selected. The most commonly selected variables are distance from fuel source (selected 16 times), which proxies for the remoteness of rural areas, and female literacy (selected 6 times). A location's Muslim population share is chosen once, in an interaction with female literacy.

non-migrant households. Thus, differences between Hindu migrants and Muslim migrants may be smaller than differences between Hindus and Muslims in the general population.[19]

For this analysis, we use the NFHS-3 data that report migrant status and latrine use along with other household characteristics.[20] These migrants are moving from rural to urban areas, which could be within the same state or across state lines.

Table 4 reports that latrine use is similar among migrant Hindu and Muslim households, both unconditionally (column 1) and conditional on household characteristics (column 2). As a comparison, column 3 and column 4 report estimated differences in the NFHS-3 data using all households, which are similar to the estimated differences in Table 2 and Table 3. The sample size is substantially smaller when analyzing migrants only, and so there is less precision in estimating the difference in likelihood of latrine use between Hindu migrants and Muslim migrants in the same locations (95% confidence interval: 11.3pp less likely – 7.9pp more likely). This difference is not statistically different than the within-location difference for all households (column 4), but is statistically smaller than the unconditional difference between Hindus and Muslims (column 3).

V Conclusion

Improvements in sanitation have the potential to dramatically improve child health and adult health (UNDP, 2006).[21] Substantial efforts have been made to improve sanitation infrastructure in India and reduce open defecation, where there are the largest number of children and adults exposed to uncontained fecal material, but there remain concerns that deeply ingrained religious beliefs and associated traditional practices will limit the improvements in sanitation practices following investments in sanitation infrastructure.

Our estimates suggest that the unconditional differences in sanitation practices between

[19] From a bias perspective, differences between migrants and non-migrants would bias the estimated differences between Hindu migrants and Muslim migrants if selection of migrants is differential by religion.

[20] The NFHS-3 survey asked about the location of migrants' prior residence and current residence. We limit the sample to respondents who moved from the "countryside" to a "city," "large city," or "capital."

[21] For evidence on the historical importance of water and sewerage infrastructure for health in the United States, see work by Alsan and Goldin (forthcoming).

Hindus and Muslims are driven largely by differences in their locations rather than by differences in household religion itself. We estimate large unconditional differences between Hindus and Muslims in latrine ownership and latrine use, but this difference falls by approximately two-thirds when controlling for characteristics of household locations or adding location fixed effects to compare Hindu and Muslim households within more similar geographic locations. Among a sample of migrants from rural to urban areas, we do not estimate statistically significant differences in latrine use by Hindus and Muslims, though this analysis has less statistical power. When considering other sanitation practices, such as handwashing and observed fecal material near homes, we do not find consistent differences between Hindus and Muslims.

Our analysis relates to a broader literature seeking to understand differences between Hindus and Muslims in India. We highlight that sanitation practices vary substantially across areas of India, and many areas of India have few Muslims, such that analysis of differences between Hindus and Muslims should compare Hindu and Muslim households that live in similar locations and economic environments. There is an important distinction between household religious beliefs determining differences in behaviors and differences in households' locations generating differences across religious groups.

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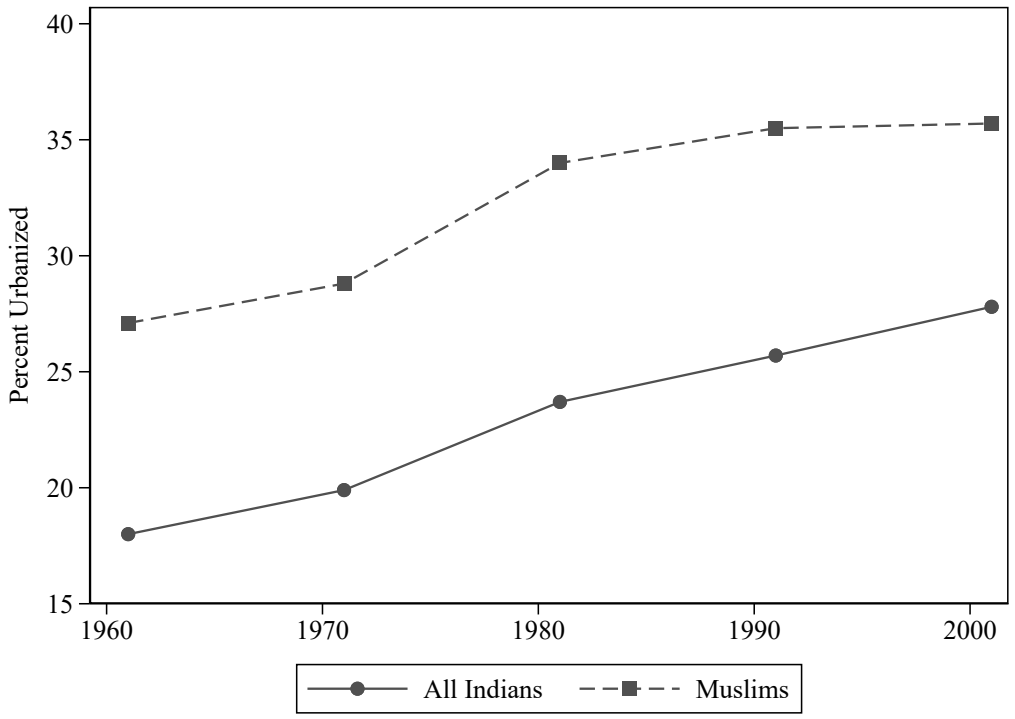
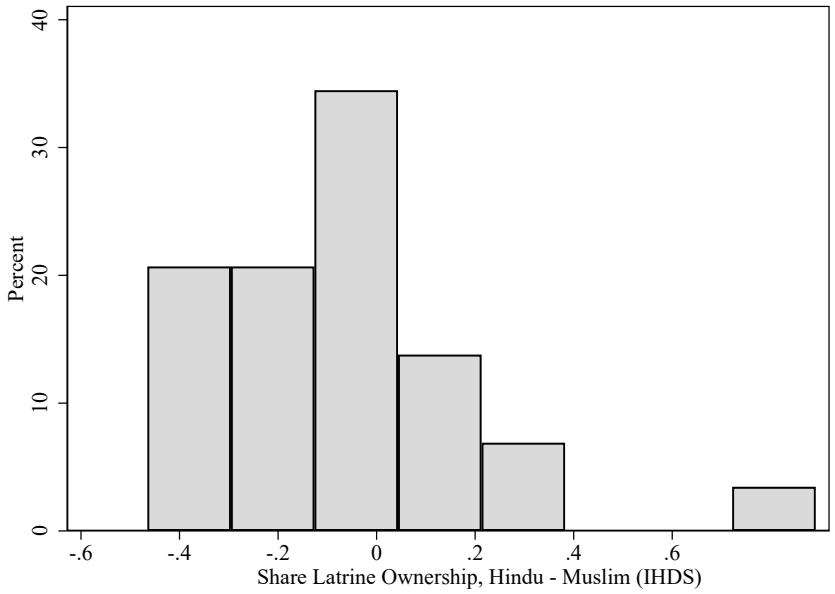
Figure 1: Urbanization Rates over Time for All Indians and for Muslims Only



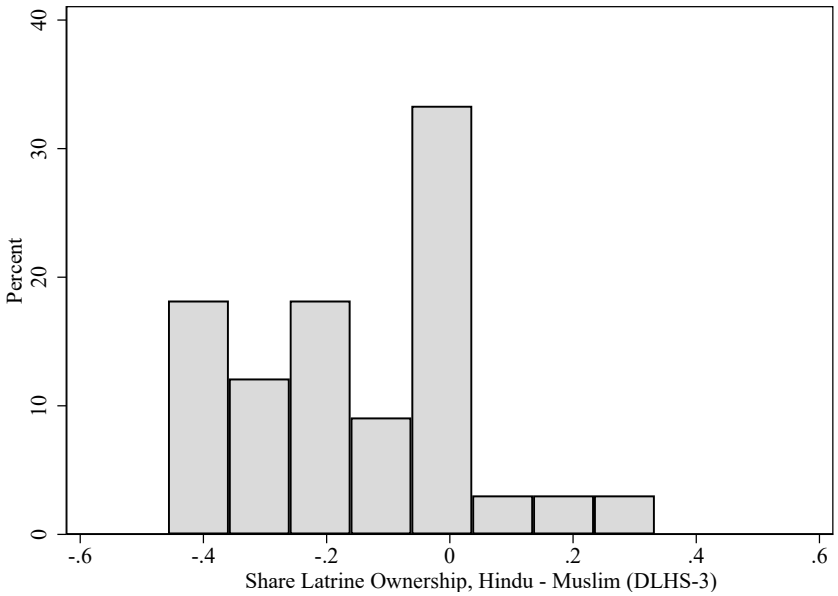
Note: This figure plots urbanization rates from 1960 to 2000, separately for all Indians and for Muslims only. The source of the data is the Prime Ministers High Level Committee 2006 *Report on the Social, Economic and Educational Status of the Muslim Community of India.*

Figure 2: Distribution of Hindu-Muslim Gap in Latrine Ownership

(a) Panel A. IHDS Data

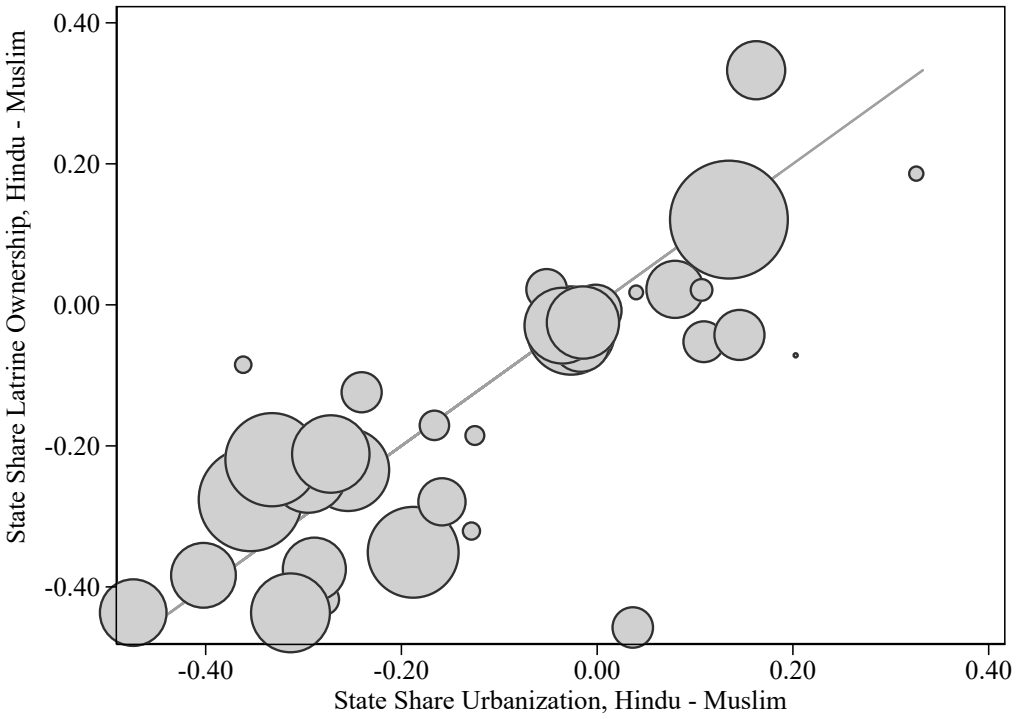


(b) Panel B. DLHS-3 Data



Note: These figures illustrate the frequency of the difference in the share of Hindu households and Muslim households that own a latrine. Panel A uses IHDS data. Panel B uses DLHS-3 data.

Figure 3: Hindu-Muslim Gap in Latrine Ownership, by State Urbanization



Note: This figure plots the correlation between the state-level average Hindu-Muslim gap in latrine ownership by state, calculated from DLHS-3, versus the state level difference in urbanization rates between Hindus and Muslim, calculated from the 2011 Indian Census. The correlation coefficient is 0.75. The size of the circle reflects the size of the state population.

Table 1. Summary Statistics in IHDS Data, by Religion and Urban Status

	All Households			Urban Households			Rural Households		
	Hindu	Muslim	Difference	Hindu	Muslim	Difference	Hindu	Muslim	Difference
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A: Sanitation Practices									
Own latrine	0.45	0.63	-0.18**	0.84	0.88	-0.04**	0.33	0.50	-0.18**
Wash hands	0.40	0.44	-0.04**	0.71	0.68	0.03*	0.30	0.33	-0.03*
No fecal material observed	0.75	0.70	0.06**	0.89	0.82	0.07**	0.71	0.63	0.08**
Panel B1: Household Characteristics									
Household size	5.10	5.82	-0.72**	4.69	5.72	-1.03**	5.24	5.88	-0.64**
Number of women	2.52	2.84	-0.33**	2.29	2.78	-0.49**	2.59	2.88	-0.29**
Electricity	0.71	0.67	0.05**	0.94	0.91	0.03**	0.64	0.54	0.09**
Piped water	0.39	0.31	0.08**	0.72	0.59	0.13**	0.28	0.17	0.11**
Cell phone	0.07	0.05	0.01**	0.20	0.11	0.09**	0.03	0.03	0.00
Television	0.46	0.40	0.06**	0.80	0.65	0.15**	0.35	0.28	0.07**
Bicycle	0.59	0.57	0.02**	0.59	0.53	0.06**	0.59	0.59	0.00
Car	0.01	0.01	0.00	0.04	0.02	0.02**	0.01	0.01	0.00*
Motorcycle	0.16	0.11	0.05**	0.34	0.18	0.16**	0.10	0.08	0.03**
Panel B2: Household Head Caste									
Scheduled Caste	0.25	0.01	0.23**	0.19	0.01	0.18**	0.27	0.02	0.25**
Scheduled Tribe	0.08	0.00	0.08**	0.02	0.00	0.02**	0.10	0.00	0.09**
Other Backward Caste	0.43	0.41	0.01	0.40	0.49	-0.09**	0.44	0.38	0.06**
Other Caste	0.25	0.57	-0.32**	0.39	0.50	-0.11**	0.20	0.60	-0.40**
Panel B3: Household Head Education									
< 5 years	0.48	0.57	-0.09**	0.23	0.43	-0.20**	0.55	0.64	-0.09**
5 to 9 years	0.29	0.27	0.02*	0.29	0.33	-0.03*	0.29	0.25	0.04**
10 to 12 years	0.16	0.11	0.05**	0.27	0.16	0.11**	0.12	0.09	0.04**
> 12 years	0.07	0.04	0.03**	0.20	0.08	0.12**	0.03	0.02	0.01*
Panel B4: Age of Survey Respondent									
15 to 25 years	0.18	0.21	-0.04**	0.15	0.20	-0.05**	0.19	0.22	-0.03**
26 to 35 years	0.32	0.32	0.00	0.33	0.34	-0.01	0.32	0.31	0.01
36 to 49 years	0.31	0.30	0.01	0.33	0.29	0.04**	0.30	0.30	0.00
No age reported	0.19	0.17	0.02**	0.19	0.17	0.02*	0.20	0.17	0.02*
Panel B5: Other Household Characteristics									
Distance to fuel source	22.29	11.57	10.73**	3.19	3.27	-0.09	28.37	15.67	12.69**
Number of observations	27,419	3,769		8,799	1,665		18,620	2,104	

Note: This table reports average household characteristics in the sample that draws from the IHDS data set using sample weights. In columns 1 and 2, we report the average values of all households. In columns 4 and 5, we report the average values of urban households. In columns 7 and 8, we report the average values of rural households. In columns 1, 4, and 7, we report the average values of Hindu households. In columns 2, 5, and 8, we report the average values of Muslim households. In columns 3, 6, and 9, we report the difference between the average values of Hindu households and Muslim households. For "wash hands," the sample sizes are 27,172 Hindu (18,408 in rural) and 3,745 Muslim (2,087 in rural). For "no fecal material observed," the sample sizes are 27,208 Hindu (18,483 in rural) and 3,738 Muslim (2,087 in rural). There are 1,530 rural PSUs and 938 urban PSUs. Sample weights are used. ** denotes statistical significance at the 1 percent level and * at the 5 percent level.

Table 2. Estimated Relationship between Sanitation Practices and Religion, IHDS Data

	All Households					Urban only	Rural only
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: Dependent Variable: Latrine Ownership							
Hindu	-0.179**	-0.163**	-0.056*	-0.068**	-0.053**	-0.032*	-0.056*
	(0.025)	(0.020)	(0.023)	(0.019)	(0.020)	(0.015)	(0.028)
Number of observations	31,188	31,188	31,188	31,188	31,188	10,464	20,724
Adjusted R-Squared	0.014	0.341	0.260	0.548	0.608	0.504	0.525
Panel B: Dependent Variable: Handwashing							
Hindu	-0.044+	-0.015	0.042*	0.000	0.011	0.017	0.011
	(0.023)	(0.017)	(0.021)	(0.016)	(0.014)	(0.018)	(0.019)
Number of observations	30,917	30,917	30,917	30,917	30,917	10,422	20,495
Adjusted R-Squared	0.001	0.268	0.214	0.470	0.527	0.503	0.453
Panel C: Dependent Variable: No Fecal Material Observed							
Hindu	0.057**	0.027	0.017	0.023	0.017	0.036*	0.009
	(0.022)	(0.021)	(0.019)	(0.020)	(0.020)	(0.015)	(0.029)
Number of observations	30,946	30,946	30,946	30,946	30,946	10,375	20,568
Adjusted R-squared	0.002	0.065	0.090	0.383	0.393	0.445	0.369
Controls:							
Household characteristics	No	Yes	No	No	Yes	Yes	Yes
Urban characteristics	No	No	Yes	No	n/a	n/a	n/a
Primary sampling unit FE	No	No	No	Yes	Yes	Yes	Yes

Note: The dependent variable in Panel A is an indicator variable for whether the household owns a latrine. The dependent variable in Panel B is whether the household engages in handwashing. The dependent variable in Panel C is whether the surveyor observed fecal material around the house. The data come from the IHDS data set. The main specifications report the average differences between Hindu households and Muslim households, in which the dependent variable for each household is regressed on a dichotomous variable for whether the household head reports being Hindu (Column 1). Columns 2 and 5-7 include a vector of household characteristics, including durable good indicators, household size, number of female household members, caste, presence of electricity, presence of piped water, household head education, survey respondent age, household head occupation, and distance to fuel source. Columns 3 and 5-7 include controls for a vector of within-district urban characteristics, including urban status, log population density, percent of workforce engaged in agriculture, share minority castes, share Muslim, share Scheduled Caste/Scheduled Tribe, share of females who are literate, and the sex ratio. Columns 4 -7 include primary sampling unit (PSU) fixed effects, which correspond to a village, town, or neighborhood. Including PSU fixed effects absorbs the controls for urban characteristics, as denoted by n/a. Column 6 restricts the sample to households living in urban areas. Column 7 restricts the sample to households living in rural areas. Sample weights are used. Robust standard errors clustered by PSU are reported in parentheses with ** denoting statistical significance at the 1 percent level, * at the 5 percent level, and + at the 10 percent level.

Table 3. Estimated Relationship between Latrine Ownership and Religion, DLHS-3 Data

	All Households					Urban only	Rural only
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Hindu	-0.229**	-0.231**	-0.083**	-0.051**	-0.057**	-0.054**	-0.056**
	(0.006)	(0.005)	(0.004)	(0.003)	(0.003)	(0.004)	(0.004)
Number of observations	613,588	613,588	613,588	613,588	613,588	137,915	475,671
Adjusted R-squared	0.024	0.395	0.364	0.590	0.651	0.539	0.548
Controls:							
Household characteristics	No	Yes	No	No	Yes	Yes	Yes
Urban characteristics	No	No	Yes	No	n/a	n/a	n/a
Primary sampling unit FE	No	No	No	Yes	Yes	Yes	Yes

Note: The dependent variable is an indicator variable for whether the household owns a latrine. The data come from the DLHS-3 data set. The main specifications report the average differences between Hindu households and Muslim households, in which the dependent variable for each household is regressed on a dichotomous variable for whether the household head reports being Hindu (Column 1). Columns 2 and 5-7 include a vector of household characteristics, including durable good indicators, household size, number of female household members, caste, presence of electricity, presence of piped water, household head education, survey respondent age, household head occupation, and home ownership. Columns 3 and 5-7 include controls for a vector of within-district urban characteristics, including urban status, log population density, percent of workforce engaged in agriculture, share minority castes, share Muslim, share Scheduled Caste/Scheduled Tribe, share of females who are literate, and the sex ratio. Columns 4 -7 include primary sampling unit (PSU) fixed effects, which correspond to a village, town, or neighborhood. Including PSU fixed effects absorbs the controls for urban characteristics, as denoted by n/a. Column 6 restricts the sample to households living in urban areas. Column 7 restricts the sample to households living in rural areas. Sample weights are used. Robust standard errors clustered by PSU are reported in parentheses with ** denoting statistical significance at the 1 percent level.

Table 4. Estimated Relationship between Latrine Use and Religion, by Migrant Status, NFHS-3 Data

	Rural-to-Urban Migrant Households		All Households	
	(1)	(2)	(3)	(4)
Hindu	0.059	-0.027	-0.191*	-0.072*
	(0.056)	(0.049)	(0.020)	(0.011)
Number of observations	3,386	3,386	92,404	92,404
Adjusted R-squared	0.003	0.462	0.017	0.658
Controls:				
Household characteristics	No	Yes	No	Yes
Primary sampling unit FE	No	Yes	No	Yes

Note: The dependent variable is latrine use. The data come from the NFHS-3 data set. The sample used in Columns 1 and 2 is limited to rural-to-urban migrant households. Columns 3 and 4 use the entire sample. The main specifications report the average differences between Hindu households and Muslim households, in which the dependent variable for each household is regressed on a dichotomous variable for whether the household head reports being Hindu (Columns 1 and 3). Columns 2 and 4 add controls for a vector of household characteristics, including durable good indicators, household size, number of female household members, caste, presence of electricity, presence of piped water, household head education, survey respondent age, home ownership, whether the household is located in an urban area, and Primary Sampling Unit (PSU) fixed effects, which correspond to a village, town, or neighborhood. The PSU fixed effects absorb any controls for urban characteristics. Sample weights are used. Robust standard errors clustered by PSU are reported in parentheses with * denoting statistical significance at the 5 percent level.

Appendix Table 1. Summary Statistics in DLHS-3 Data, by Religion and Urban Status

	All Households			Urban Households			Rural Households		
	Hindu	Muslim	Difference	Hindu	Muslim	Difference	Hindu	Muslim	Difference
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A: Sanitation Practices									
Own latrine	0.42	0.64	-0.23**	0.78	0.86	-0.08**	0.25	0.48	-0.23**
Panel B1: Household Characteristics									
Household size	5.16	6.01	-0.84**	4.88	6.06	-1.18**	5.29	5.97	-0.67**
Number of women	2.53	2.97	-0.45**	2.36	2.99	-0.63**	2.60	2.96	-0.36**
Electricity	0.69	0.68	0.01**	0.92	0.88	0.04**	0.58	0.52	0.05**
Piped water	0.23	0.24	-0.01**	0.48	0.41	0.07**	0.11	0.10	0.01**
Cell phone	0.39	0.43	-0.03**	0.64	0.58	0.07**	0.28	0.31	-0.04**
Television	0.45	0.42	0.04**	0.75	0.63	0.12**	0.31	0.25	0.06**
Bicycle	0.49	0.43	0.07**	0.50	0.43	0.07**	0.49	0.42	0.07**
Car	0.03	0.02	0.00**	0.07	0.04	0.03**	0.01	0.01	0.00**
Motorcycle	0.18	0.14	0.04**	0.34	0.23	0.11**	0.11	0.08	0.04**
Panel B2: Household Head Caste									
Scheduled Caste	0.20	0.03	0.17**	0.17	0.03	0.15**	0.21	0.03	0.19**
Scheduled Tribe	0.13	0.06	0.07**	0.04	0.05	0.00**	0.17	0.06	0.10**
Other Backward Caste	0.42	0.45	-0.04**	0.43	0.52	-0.09**	0.41	0.40	0.01*
Other Caste	0.26	0.46	-0.21**	0.36	0.41	-0.05**	0.21	0.50	-0.29**
Panel B3: Household Head Education									
< 5 years	0.44	0.54	-0.1**	0.26	0.43	-0.18**	0.52	0.62	-0.09**
5 to 9 years	0.29	0.28	0.01**	0.28	0.32	-0.04**	0.30	0.26	0.04**
10 to 12 years	0.18	0.13	0.05**	0.27	0.17	0.10**	0.14	0.10	0.04**
> 12 years	0.09	0.05	0.04**	0.20	0.08	0.12**	0.04	0.03	0.01**
Panel B4: Age of Survey Respondent									
15 to 25 years	0.16	0.18	-0.02**	0.15	0.18	-0.02**	0.16	0.18	-0.02**
26 to 35 years	0.27	0.28	-0.01**	0.27	0.28	-0.01**	0.27	0.28	-0.01**
36 to 49 years	0.28	0.28	0.01**	0.30	0.29	0.01**	0.28	0.27	0.01**
50 + years	0.28	0.25	0.03**	0.27	0.24	0.03**	0.29	0.26	0.03**
No age reported	0.01	0.01	0.00**	0.00	0.01	-0.01**	0.01	0.01	0.00**
Panel B5: Other Household Characteristics									
Own house	0.94	0.92	0.02**	0.86	0.86	0.00	0.97	0.97	0.00**
Number of observations	536,767	76,821		114,279	23,637		422,488	53,184	

Note: This table reports average household characteristics in the sample that draws from the DLHS-3 data set using sample weights. In columns 1 and 2, we report the average values of all households. In columns 4 and 5, we report the average values of urban households. In columns 7 and 8, we report the average values of rural households. In columns 1, 4, and 7, we report the average values of Hindu households. In columns 2, 5, and 8, we report the average values of Muslim households. In columns 3, 6, and 9, we report the difference between the average values of Hindu households and Muslim households. There are 21,936 rural PSUs and 6,983 urban PSUs. Sample weights are used. ** denotes statistical significance at the 1 percent level and * at the 5 percent level.

Appendix Table 2. Summary Statistics in NFHS-3 Data, by Religion and Urban Status

	All Households			Urban Households			Rural Households			Migrant Households		
	Hindu	Muslim	Difference	Hindu	Muslim	Difference	Hindu	Muslim	Difference	Hindu	Muslim	Difference
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A: Sanitation Practices												
Use latrine	0.41	0.60	-0.19**	0.82	0.85	-0.03**	0.22	0.44	-0.22**	0.84	0.78	0.06**
Panel B1: Household Characteristics												
Household size	4.90	5.71	-0.81**	4.55	5.74	-1.19**	5.06	5.69	-0.64**	4.88	6.05	-1.17**
Number of women	2.45	2.89	-0.44**	2.20	2.81	-0.61**	2.56	2.94	-0.38**	2.35	2.99	-0.64**
Electricity	0.68	0.61	0.06**	0.93	0.91	0.02**	0.56	0.43	0.13**	0.94	0.86	0.07**
Piped water	0.42	0.35	0.08**	0.72	0.65	0.07**	0.29	0.16	0.13**	0.70	0.60	0.10**
Cell phone	0.16	0.16	0.01+	0.37	0.29	0.07**	0.07	0.07	0.00	0.30	0.22	0.07**
Television	0.44	0.37	0.07**	0.75	0.63	0.11**	0.30	0.21	0.10**	0.71	0.55	0.16**
Bicycle	0.52	0.48	0.04**	0.52	0.45	0.07**	0.52	0.49	0.03**	0.52	0.41	0.11**
Car	0.03	0.02	0.01**	0.06	0.03	0.03**	0.01	0.01	0.00	0.02	0.01	0.01
Motorcycle	0.17	0.13	0.04**	0.32	0.22	0.10**	0.11	0.08	0.03**	0.24	0.14	0.10**
Panel B2: Household Head Caste												
Scheduled Caste	0.21	0.02	0.20**	0.18	0.01	0.17**	0.23	0.02	0.21**	0.21	0.03	0.17**
Scheduled Tribe	0.09	0.01	0.08**	0.03	0.00	0.03**	0.12	0.01	0.11**	0.03	0.00	0.03**
Other Backward Caste	0.42	0.36	0.06**	0.39	0.40	-0.01*	0.44	0.33	0.10**	0.37	0.44	-0.07**
Other Caste	0.27	0.62	-0.34**	0.40	0.58	-0.18**	0.22	0.64	-0.42**	0.39	0.52	-0.13**
Panel B3: Household Head Education												
< 5 years	0.48	0.60	-0.12**	0.27	0.45	-0.18**	0.57	0.69	-0.12**	0.29	0.50	-0.21**
5 to 9 years	0.27	0.26	0.02**	0.28	0.31	-0.03**	0.27	0.22	0.05**	0.33	0.33	-0.01
10 to 12 years	0.15	0.10	0.06**	0.24	0.16	0.08**	0.12	0.06	0.05**	0.27	0.12	0.15**
> 12 years	0.09	0.04	0.05**	0.21	0.08	0.13**	0.04	0.02	0.02**	0.11	0.05	0.06**
Panel B4: Age of Survey Respondent												
15 to 25 years	0.18	0.20	-0.02**	0.18	0.20	-0.02**	0.18	0.20	-0.02**	0.25	0.26	-0.02
26 to 35 years	0.29	0.31	-0.03**	0.29	0.32	-0.03**	0.29	0.31	-0.02**	0.43	0.43	0.00
36 to 49 years	0.27	0.26	0.01**	0.29	0.27	0.02**	0.26	0.26	0.01	0.32	0.30	0.02
50 + years	0.26	0.22	0.04**	0.24	0.21	0.03**	0.27	0.23	0.03**	n/a	n/a	n/a
No age reported	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	n/a	n/a	n/a
Panel B5: Other Household Characteristics												
Own house	0.90	0.88	0.02**	0.78	0.78	0.00	0.94	0.94	0.00	0.78	0.74	0.04
Number of observations	79,217	13,187		35,936	7,282		43,281	5,905		2,879	507	

Note: This table reports average household characteristics in the sample that draws from the NFHS-3 data set using sample weights. In columns 1 and 2, we report the average values of all households. In columns 4 and 5, we report the average values of urban households. In columns 7 and 8, we report the average values of rural households. In columns 10 and 11, we report the average values of households that migrate from rural to urban areas. In columns 1, 4, 7, and 10, we report the average values of Hindu households. In columns 2, 5, 8, and 11, we report the average values of Muslim households. In columns 3, 6, 9, and 12, we report the difference between the average values of Hindu households and Muslim households. There are 1,991 rural PSUs and 1,618 urban PSUs. There are 817 PSUs in the migrant household analysis. Sample weights are used. ** denotes statistical significance at the 1 percent level, * at the 5 percent level, and + at the 10 percent level.