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ABSTRACT

The Impact of Caste: A Missing Link in the Literature on Stunting in India

India is home to some 120 million children under the age of 5, 36 percent of whom are chronically malnourished. The associated high prevalence of stunting has generated a stream of research explaining why chronic malnourishment in India is higher than in poorer countries of sub-Saharan Africa. Surprisingly, this body of research has overlooked a crucial feature of chronic malnourishment in India – that is, the difference in stunting incidence across caste and religious groups. A comparison by social categories reveals that not only are the height gaps between social groups in India two to three times larger than the India–Africa gap, but that children from the socio-economically dominant group, the upper caste Hindus, are even taller than their African counterparts. We find significant caste gaps in child height in samples that are balanced on an extensive set of covariates. We also show that height gaps are higher in areas where discrimination is more prevalent. Our results suggest that incorporating considerations of caste is essential to understanding the problem of chronic malnourishment in India today.

JEL Classification: I1, J13, J24

Keywords: early childhood development, stunting, malnourishment, caste, India

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Chronic child malnutrition is a global health concern, with one in four children worldwide classified as stunted (*1*). India is home to nearly a third of all stunted children. This has led to a large body of literature trying to understand "why Indian children are short," particularly in comparison to children in sub-Saharan Africa (SSA) who, on average, face a worse disease environment and have access to fewer calories (*2–5*).

The Africa-India puzzle is shown in Panels A and B of Figure 1. Panel A plots the average height-for-age Z score (HFA Z-score), which is the number of standard deviations of the actual height of a child from the median height of the children of his/her age as determined from the World Health Organization child growth standards (*6*). Panel B plots the rates of chronic malnutrition, which measures the proportion of children who are more than 2 standard deviations below the world reference median. Figure 1 includes data from from 30 countries in sub-Saharan Africa (SSA), which have a combined under-five population of 132 million and India which has a under-five population of 121 million.

Indian children have a HFA Z-score of -1.48, which is an additional 0.16 standard deviation units less than the SSA average of -1.32. The rate of chronic malnutrition is 13 percent higher in India than in SSA (36 vs. 31 percent).

The India-SSA comparison, however, elides over the crucial inequalities that exist *within* Indian society. In Panel C and D of Figure 1, we plot the average HFA Z-score and the rates of chronic malnutrition for SSA and the four major social groups in India: the upper caste Hindus (UC-Hindus), Scheduled Castes and Tribes (SC-ST), Other Backward Classes (OBCs) and upper caste Muslims (UC-Muslims). The four-way classification accounts for the two key cleavages in Indian society: caste and religion. The first category, UC-Hindus, are the non-SC-ST-OBC Hindus, i.e. high-ranking castes, conventionally seen at the top of the hierarchy. They are the socioeconomically dominant group in India comprising 14 percent of the population. The SC-ST comprise 33 percent of the population and are among the most socioeconomically

disadvantaged groups and receive preferential affirmative action, for which purpose they are listed in a government schedule (hence called the Scheduled Castes and Scheduled Tribes). While the nomenclature of SC and ST are the official administrative categories, *Dalit* meaning "oppressed" and *Adivasi*, meaning "indigenous people," is often used to describe SC and ST communities. The OBCs, comprising 46 percent of the population, is a group of intermediate to low-ranked castes and communities, which also receive affirmative action since 1992 in central government services, and since 2006 in central and private institutes of higher education (*7*). The last group labeled UC-Muslims are the non-SC-ST-OBC Muslims. Since the publication of the Sachar Committee report on the the social, economic and educational status of Muslims they have been recognized as a group facing multiple forms of disadvantage in the country (*8*). We would also like to highlight that our use of the term "upper caste" (UC) is neither an endorsement of the caste hierarchy, nor of the implicit association of superiority or inferiority that comes with this nomenclature. It is a descriptive term that is widely understood.

Differentiating in this manner reveals a drastically different picture: the upper caste Hindus, the socioeconomically dominant group in India, are a whole 0.20 standard deviation units taller than children in SSA, relative to the world reference median (HFA Z-scores of -1.12 and -1.32). However, the average HFA Z-score for the SC-ST, OBCs and UC-Muslim group are -1.65, -1.49 and 1.52, respectively. In other words, the gaps in child heights between the social groups in India are two to three times greater than the India-SSA child height gap.

We see similar gaps in chronic malnourishment and associated stunting: on average, 31 percent of children in SSA are stunted. With a stunting incidence of 26 percent, UC-Hindu children are 5 percentage points less likely to be stunted than children in SSA. 40, 36 and 35 percent of the SC-ST, OBCs and UC-Muslims children, respectively, are chronically malnourished. Thus, the SC-ST, OBCs and UC-Muslims children are 14, 10 and 9 percentage points, or 35 to 50 percent, more likely to be stunted compared to the UC-Hindu children.

The patterns shown in Figure 1 suggest that the question of "why Indian children are short" needs to be rephrased to "why are the gaps in child height between social groups within India so high?" Accordingly, there is a clear need to explicitly account for caste and religion when explaining child height gaps. In this paper we take the first step in this direction: we explore the extent of gaps across the caste groups. Next, we study the differences in covariates across caste groups that affect child height and to statistically estimate their contribution to the observed gaps in child height. Finally, we explore the association between the enduring stigmatization and discrimination against subaltern groups and gaps in child height.

Material and Methods

Our principal data source is the the National Family Health Survey of 2015-16, which provides anthropometric measures for a nationally representative sample of 230,898 under-5 children from India, for whom information on caste and religion is available, to examine the factors affecting child height.

We identify five important categories of covariates that affect child height, namely: (i) lack of access to sanitation, captured by two variables: no household access to toilet facility and household members defecating in a bush/field; and the exposure of a household to open defecation at the primary sampling unit level; (ii) the mother's human capital, measured by two indicators: years of schooling and ability to read measured by an actual test; (iii) mother's anthropometric status as captured by the HFA Z-score, the weight-for-height (WFH)-Z score and age; (iv) asset differences as captured by the wealth index factor score; and (v) intra-household allocation and fertility decisions, proxied by birth order and sibling size. Part II of the Supplementary Material provides information on the rationale behind each of the indicators and Table S10 its association with child height.

To gauge the importance of the covariates in explaining differences in child anthropometric

outcomes across social groups, we use entropy balancing (*9*). We reweight the data from the UC-Hindus to create samples of UC-Hindus that exhibit the same mean, variance and skewness on the covariates, as the other three caste and religious groups, as outlined in Table 1. We then estimate the following regression with and without the entropy balancing weights:

$$O_{ij} = \alpha + \beta_j * Group_j + \mathcal{X}_i + \epsilon_{is}, \tag{1}$$

where O_{ij} refers to the HFA-Z-Score or a dummy for being stunted for child i from group j. $Group_j$ is categorical variable capturing the social group the child belongs to: UC-Hindus, SC-ST, OBCs and UC-Muslims and where UC-Hindus are the omitted category. $\mathcal{X}_i$ is a vector of fixed effects for age in months, gender, age in months interacted with gender and rural dummy. The standard errors are clustered at the level of primary sampling unit which is defined as group identifier combining state, urban-rural residence and the sampling cluster number.

To be able to account for variation in the extent of caste gaps across different parts of the country, we estimate Equation 1 both for the entire country and for five of its major regions, namely, (i) BIMARU comprising of Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Rajasthan, Uttar Pradesh and Uttaranchal; (2) SOUTH comprising of Andhra Pradesh, Karnataka, Kerala, Tamil Nadu and Telangana; (3) NORTH comprising of Chandigarh, Delhi, Haryana, Himachal Pradesh, Jammu & Kashmir and Punjab; (4) EAST comprising of Assam, Orissa and West Bengal; and (5) WEST comprising of Goa, Gujarat, and Maharashtra. In the Supplementary Material we also shows the results for two other regions/categories: North-East and the Union Territories, as well as each of the 36 states and union territories in the country.

The division of the country is not based solely on geography but also employs a classificational category coined by Ashish Bose in the mid-1980s'. BIMARU "is an acronym formed from the first letters of the names of the Indian states of Bihar, Madhya Pradesh, Rajasthan, and Uttar Pradesh. This literally translates into "sick" in Hindi and is the part of the country that

has been traditionally the most socioeconomically backward. The present-day states of Chhattisgarh, Jharkhand and Uttarakhand were part of Madhya Pradesh, Bihar and Uttar Pradesh, respectively, at the time the BIMARU acronym was coined and we thus include them in the category of BIMARU (*10*). The BIMARU region is also important due to its high population share and comprises 50.8 percent of our total sample.

To highlight the role of societal discrimination and stigmatization of subaltern groups in the anthropometric gaps between social groups (*11–13*), we leverage a unique question from the second wave of the Indian Human Development Survey (IHDS-II) conducted in 2011-12, which asks households if any member engages in the illegal and highly stigmatizing practice of untouchability. The practice of untouchability originated from the belief in ritual purity, which is one of the central cornerstones defining the caste hierarchy. Traditionally, castes were endogamous, hereditary and occupation specific. Castes whose traditional occupations were considered the most "polluting" (for instance, scavenging, sweeping, association with dead animals, e.g. in the leather industry) were ostracised and completely segregated such that even their sight was considered "polluting." Even though untouchability is legally abolished and its practice punishable by law, overt and covert instances of untouchability are widely prevalent. See Supplementary Material Part IV for summary evidence on the prevalence of untouchability in the provision of health care. The IHDS-II shows widespread prevalence of this practice, with an average of 33 percent of respondents affirming the engage in some form of untouchability, with the share being as high as 45 percent in the BIMARU region. We calculate the state level averages of the proportion of households practicing untouchability, merge it with the NFHS-IV data and then partition the sample by quintiles.

To estimate the effect of practice of untouchability on anthropometric outcomes, we esti-

mate:

$$O_i = \sum_{k=1}^{k=5}(SC * QuintileUT_k)\psi_{1k} + \sum_{k=1}^{k=5}(QuintileUT_k)\psi_{2k} + \beta_1 SC_i + \epsilon_i, \quad (2)$$

where O_{is} is the HFA Z-score (or a dummy for being stunted) of child i resident in state s. $QuintileUT_k$ refers to the k quintiles of the distribution of the practice of untouchability by households. The standard errors are clustered at the level of primary sampling unit.

Results

Table 1 shows that besides mother's age, there are large intergroup differences in the covariates that affect child height, especially between UC-Hindus and SC-ST. To highlight a few, 58 percent of SC-ST households have no access to a toilet facility and defecate in a bush/field, compared to 23 percent UC-Hindus; maternal literacy is 83 percent for UC-Hindus compared to 51 percent for SC-ST; SC-ST mothers have 5.26 years of schooling compared to 9.47 for UC-Hindu mothers; and the average HFA Z-score of UC-Hindu mothers is -1.82 compared to -2.15 for SC-ST mothers. Table 1 thus suggests that an important portion of the gaps in child height and chronic malnourishment are due to these very large differences in access to sanitation, as well as the health and human capital of mothers.

Table 2 displays the results from estimating Equation 1. It presents the gaps between the UC-Hindus and each of the other three social groups in the unweighted and re-weighted sample for India as whole, as well as across the five regions. For the HFA Z-score, we see that the all-India raw gaps of -0.53, -0.37 and -0.40 for the SC-ST, OBCs and UC-Muslims, respectively, shrink to -0.12, -0.11 and -0.12 in the re-weighted sample. In fact, for the southern and northern parts of the country, in the re-weighted sample, gaps in HFA Z-score between the groups become insignificant. On the other hand, the gaps in the BIMARU region remain large and sizeable for the SC-ST and OBCs. In the case of the UC-Muslims, the largest disadvantage is visible in the

eastern states of Assam, Orissa and West Bengal. In sum, even when we compare children from samples balanced on the set of covariates outlined in Table 1, a gap three-quarters the size of the raw gap between India–SSA remains unexplained.

Suggestive evidence that the gaps in anthropometric outcomes for the subaltern group of SC is affected by societal discrimination is presented in Figure 2. It shows the results of estimating Equation 2 and the plotting the predicted marginal values. Panels A and B plot the predicted HFA Z-score and proportion stunted, respectively, for the SC and UC-Hindus by the quintiles for the practice of untouchability. The figure shows a striking pattern: for the SC children, their HFA Z-score sharply decreases in relation to the practice of untouchability. In contrast, the upper caste children display a much weaker association between height/chronic malnutrition levels and the proportion of households reporting practicing untouchability. In the Supplementary Material, we explore the impact of the practice of untouchability on the whole pathway of child development. Our results show that the areas where households are more likely to engage in the practice of untouchability are the same areas as those where SC mothers and children are less likely to be able to access or use a whole range of antenatal and postnatal health inputs. The association between the practice of untouchability on antenatal and postnatal health inputs is shown in Tables S15 and S16 in the Supplementary Material. The pattern shown in Figure 2 also suggests that the large spatial variation in child undernutrition that has been documented in the context of India (*14*) is driven principally by the variation in the heights of the subaltern groups rather than that of the UC-Hindus.

Discussion

The results show that the extent of gaps across caste and religious groups are far greater than the extent of gaps that have been highlighted in the India-Africa comparison. In fact, as Figures S1 and S2 in the Supplementary figures shows, out of the 30 SSA countries in the data, only

children from eight countries have higher HFA Z-scores as compared to UC-Hindu Children. On the other hand, children from only two and four countries, respectively, have lower HFA Z-scores than those of SC-ST and UC-Muslim children. Moreover, in two of the three most populous states in India, Uttar Pradesh and Bihar, the SC-ST are 17 and 22 percentage points more likely to be stunted than the UC-Hindus (see Figure S5 in the Supplementary Material). Within SSA such large gaps are only seen when comparing Gabon (the country with the lowest levels of chronic malnutrition in SSA) to Niger or Burundi (the countries with the highest levels of chronic malnutrition in SSA). These suggest that caste and religious identity have to be explicitly accounted for if the high burden of chronic malnourishment in India is to be addressed.

Table 1 and Table 2 show that public policy in improving access to sanitation or augmenting human capital will have a greater chance of improving child anthropometric status if provision of these services is targeted by caste and religious identity. This is especially the case for the BIMARU region, where gaps across groups are especially sharp. For instance, whereas 73 and 69 percent of SC-ST households defecate in the open and are exposed to open defecation, respectively, the corresponding figures for UC-Hindus are 31 and 46 percent. In a similar vein, 77 percent of the UC-Hindu mothers are literate compared to 36 percent for the SC-ST mothers.

However, as the regressions with entropy balancing weights in Table 2 show there remain sizable gaps even when comparing samples that are balanced on these covariates. These combined with the pattern illustrated in Figure 2 of increasing gaps in areas where discrimination is more prevalent are consistent with the *weathering* hypothesis (*15*), where subaltern groups face deterioration in health conditions as a result of discrimination and cumulative exposure to socioeconomic disadvantage. These are also supported by the self-professed practice of untouchability by health workers including physicians and nurses, teachers and elected and government officials in the IHDS-II; for instance, in the BIMARU region 42 percent of health workers self-report practicing some form of untouchability (see Table S13 in the Supplementary Material).

The IHDS thus suggests not only high prevalence of stigmatizing behaviour in society, but more worrying is that such attitudes are professed by almost a quarter of key public service providers such as teachers, nurses and village officials.

Conclusion

There is growing evidence on the impact of early childhood conditions on a variety of later life outcomes, such as health, cognition and mortality (*16–18*). In particular, stunting is associated with adverse consequences in later life for morbidity and mortality, non-communicable diseases, learning capacity and productivity (*19, 20*). Our results have important implications if India is to reap its demographic dividend (*21*). By 2026 India's average age would be 29 which is least among the global average (*22*). However, the benefits of this age structure are unlikely to come to bear in the face of the extreme levels of chronic malnourishment prevalent among the subaltern groups in India today.

Our results show that the literature by juxtaposing the rates of chronic malnourishment in India with the prevalence rates in SSA has missed a key dimension of childhood malnourishment in India, namely, caste gaps. Our paper shows that upper caste children are actually taller than African children, and India's child height deficit is entirely driven by the children from stigmatized and disadvantaged caste groups.

Our result on caste-as-a-missing-link shows that the caste gaps in child height are not entirely a reflection of class or socioeconomic status (SES) differences. While caste groups differ on an extensive set of covariates that are determinants of child height, we show that sizable gaps remain even when comparing samples that are balanced on the same set of covariates. The evidence shows that the illegal, but widespread, practice of untouchability is positively associated with height gaps between upper and lower caste (Dalit) children. In particular, variation in the practice of untouchability does not affect the height of upper caste children, but higher spread of

untouchability-related practices is associated with lower heights of Dalit children. The results moreover suggest a role for discriminatory practices in affecting service delivery to pregnant and nursing mothers from stigmatized groups and consequently the health outcomes of lower caste children. Further investigation of this link and public policy to tackle this remains an important future task.

Data Archival

The replication materials for the paper and the Supplementary Material are available at the Open Science Foundation Platform under the heading "The Impact of Caste: A Missing Link in the Literature on Stunting in India" and accessible at the following https://osf.io/24tgd/link.

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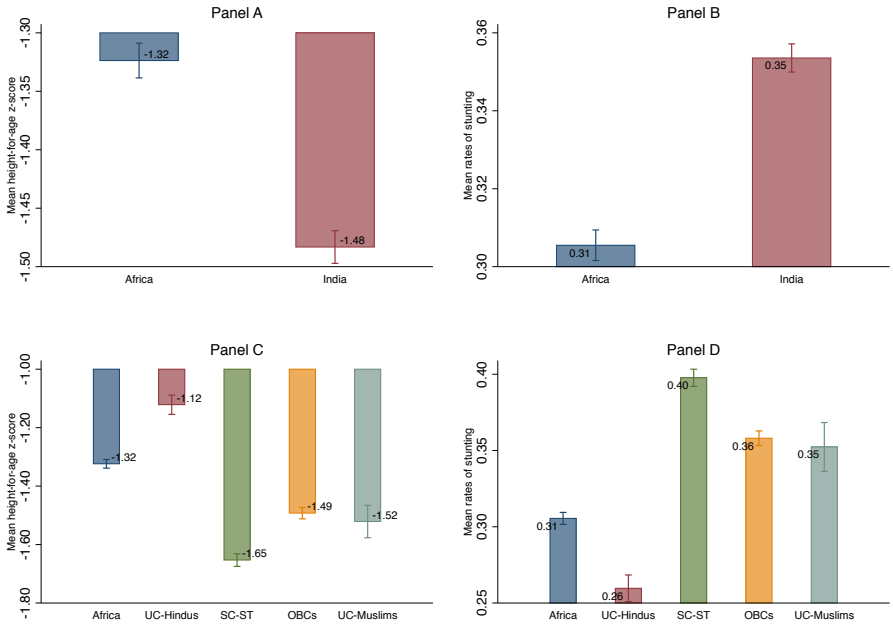

Figure 1: Child heights and chronic malnutrition: sub-Saharan Africa and India and its social groups

Notes: The data on the Height-for-age(HFA)-Z scores are from the latest available round of the Demographic and Health Surveys, conditional on being later than 2010. The mean for sub-Saharan Africa is based on the average of 30 countries, as listed in Table S1. The data on the HFA Z-score for India and its four social groups is from the Nation Family Health Survey-IV, 2015-16.

Table 1: Potential covariates of child height by social group

	UC-Hindus	SC-ST	OBCs	UC-Muslims
	(1)	(2)	(3)	(4)
Dummy HH Defecates in Open	0.23	0.58	0.45	0.24
	(0.42)	(0.49)	(0.50)	(0.43)
HH Exposure to Open Defecation at PSU	0.32	0.54	0.47	0.28
	(0.33)	(0.35)	(0.35)	(0.31)
Years of Education	9.47	5.26	6.46	5.44
	(4.77)	(4.86)	(5.26)	(4.77)
Literacy Dummy	0.83	0.51	0.60	0.54
	(0.37)	(0.50)	(0.49)	(0.50)
Wealth Index Factor Score	51414.59	-44227.64	-4145.69	-5819.15
	(93046.94)	(89138.15)	(95927.95)	(94492.55)
Mother's HFA Z-score	-1.82	-2.15	-2.00	-1.93
	(0.96)	(0.97)	(0.99)	(0.97)
Mother's WFH Z-score	-0.68	-1.19	-0.98	-0.89
	(1.22)	(1.09)	(1.16)	(1.21)
Mother's Age	26.96	26.66	26.81	27.08
	(4.67)	(5.06)	(4.84)	(5.29)
Birth Order	1.84	2.27	2.19	2.55
	(1.03)	(1.46)	(1.41)	(1.70)
Sibling Size	2.05	2.56	2.47	2.86
	(1.06)	(1.49)	(1.44)	(1.74)
Rural Residence Dummy	0.60	0.80	0.72	0.57
	(0.49)	(0.40)	(0.45)	(0.50)
Observations	29132	95040	95802	10924

Notes: The table presents the mean and standard deviation (in parentheses). The variables are from the NFHS-IV. See Table S3-S9 in the Supplementary Material for the summary statistics by the seven regions in the country.

Table 2: Raw gaps and gaps between caste/religious groups in samples balanced on covariates

	India	BIMARU	SOUTH	NORTH	EAST	WEST
	(1)	(2)	(3)	(4)	(5)	(6)
			DV–HFA-Z Score			
UC-Hindu Average	-1.12	-1.23	-0.90	-1.09	-1.01	-1.12
			Panel A–Unweighted Sample			
SC-ST Dummy	-0.53***	-0.67***	-0.39***	-0.29***	-0.47***	-0.42***
	(0.011)	(0.016)	(0.049)	(0.030)	(0.029)	(0.038)
OBC Dummy	-0.37***	-0.48***	-0.21***	-0.13***	-0.23***	-0.18***
	(0.012)	(0.016)	(0.046)	(0.034)	(0.033)	(0.038)
UC-Muslims Dummy	-0.40***	-0.47***	-0.21**	-0.11*	-0.60***	-0.13**
	(0.019)	(0.027)	(0.096)	(0.061)	(0.043)	(0.057)
			Panel B–Entropy Balanced Weighted Sample			
SC-ST Dummy	-0.12***	-0.17***	0.075	-0.057	-0.091	-0.14*
	(0.029)	(0.040)	(0.085)	(0.056)	(0.072)	(0.082)
OBC Dummy	-0.11***	-0.13***	-0.037	-0.020	-0.095*	-0.037
	(0.023)	(0.029)	(0.065)	(0.052)	(0.050)	(0.059)
UC-Muslims Dummy	-0.12***	-0.12**	-0.063	0.053	-0.29***	-0.11
	(0.041)	(0.046)	(0.13)	(0.099)	(0.084)	(0.13)
			DV–Stunting Dummy			
UC-Hindu Average	0.26	0.30	0.24	0.21	0.21	0.26
			Panel C–Unweighted Sample			
SC-ST Dummy	0.14***	0.17***	0.092***	0.062***	0.12***	0.13***
	(0.0030)	(0.0047)	(0.012)	(0.0080)	(0.0087)	(0.0098)
OBC Dummy	0.098***	0.12***	0.048***	0.042***	0.073***	0.057***
	(0.0032)	(0.0047)	(0.011)	(0.0087)	(0.0091)	(0.0095)
UC-Muslims Dummy	0.093***	0.11***	0.039*	0.047***	0.17***	0.0093
	(0.0050)	(0.0074)	(0.023)	(0.015)	(0.012)	(0.014)
			Panel D–Entropy Balanced Weighted Sample			
SC-ST Dummy	0.028***	0.039***	-0.026	0.0024	0.027	0.037**
	(0.0074)	(0.011)	(0.023)	(0.017)	(0.021)	(0.019)
OBC Dummy	0.028***	0.028***	0.00030	0.011	0.037**	0.016
	(0.0058)	(0.0080)	(0.017)	(0.014)	(0.015)	(0.015)
UC-Muslims Dummy	0.026**	0.016	-0.013	0.0035	0.11***	-0.0034
	(0.011)	(0.014)	(0.040)	(0.028)	(0.028)	(0.028)

*** p<0.01, ** p<0.05, * p<0.1

Notes: The unweighted samples in Panel A and C are ordinary least square estimates of the gaps between the UC-Hindu and the other three groups, where the survey weights are employed. The entropy weighted sample in Panels B and D consists of samples of UC-Hindus which are chosen such that they are balanced on the covariates listed in Table 1 when compared to the other three social groups. See Supplementary Material Table S11 for gaps in the other two regions.

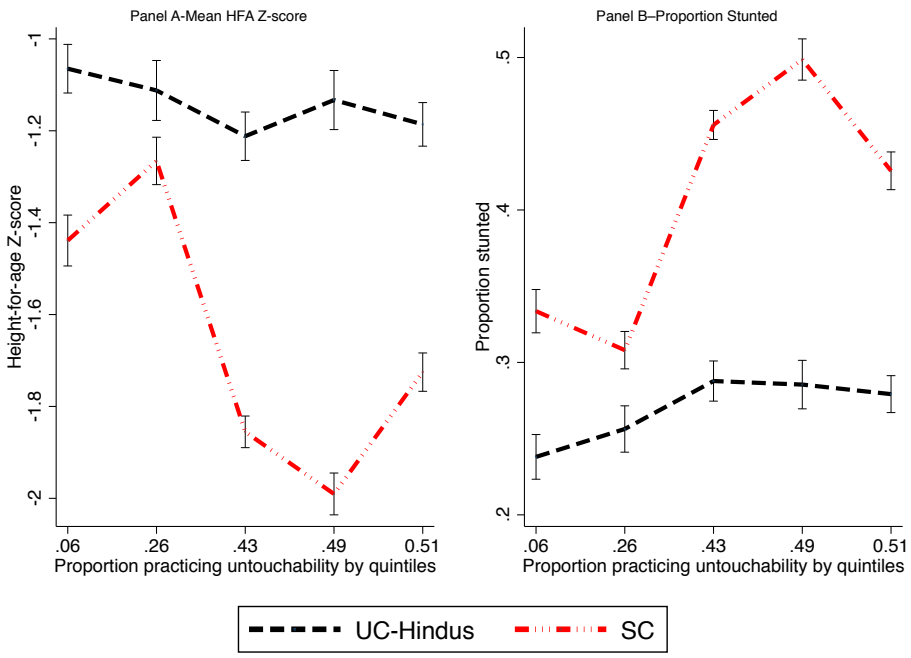

Figure 2: Practice of untouchability and gaps in HFA Z-score and chronic malnutrition
Notes: The practice of untouchability by households at the state level is calculated from the second round of the Indian Human Development Survey (IHDS) conducted in 2011-12. The above plots the predicted values with the 90 percent confidence intervals arising from a regression estimating the gaps in HFA Z-score and likelihood of being chronically malnourished between SC and UC-Hindus at the five quintiles for the practice of untouchability. The regression results are presented in table S14 of the Supplementary Material.

The Impact of Caste: A Missing Link in the Literature on Stunting in India
SUPPLEMENTARY MATERIAL

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Supplementary Material

The supplementary materials contains the following:

- **Part I - Detailed comparison of India and sub-Saharan Africa.**
- **Part II - Covariates of child height: Rationale and relationship to child height.**
- **Part III - Detailed description of gaps in India by time, regions and groups.**
- **Part IV - Untouchability, child height and service delivery.**

1 Part-I

This contains the list of countries included in calculating the sub-Saharan African average and the average HFA-Z-Scores and rates of chronic malnutrition for each of the 30 countries and India by it's social groups presented in Figure 1. It includes the following figures and tables:

1. Table S1 contains the list of countries included and the sample years in which the demographic and health surveys were conducted.

2. Figure S1 contains the height-for-age-Z-Score (HFA-Z-Score) by country, as well as the four social groups of India.

3. Figure S2 contains the rates of chronic malnourishment by country, as well as the four social groups of India.

Table S1: Countries included in the sample from the Demographic and Health Surveys

Country Name	Year
Angola	2015-16
Benin	2017-18
Burkina Faso	2010
Burundi	2016-17
Cameroon	2011
Chad	2014-15
Comoros	2012
Republic of Congo	2011-12
Democratic Republic of Congo	2013-14
Ethiopia	2016
Gabon	2012
Ghana	2014
Guinea	2018
India	2015-16
Ivory Coast	2010-11
Kenya	2014
Lesotho	2014
Liberia	2013
Malawi	2015-16
Mali	2018
Namibia	2013
Niger	2017
Nigeria	2018
Rwanda	2014-15
Senegal	2017
Sierra Leone	2013
South Africa	2016
Tanzania	2015-16
Togo	2013-14
Uganda	2016
Zambia	2013-14
Zimbabwe	2015

Notes: The table presents the countries included in our sample and the year in which the DHS data was collected.

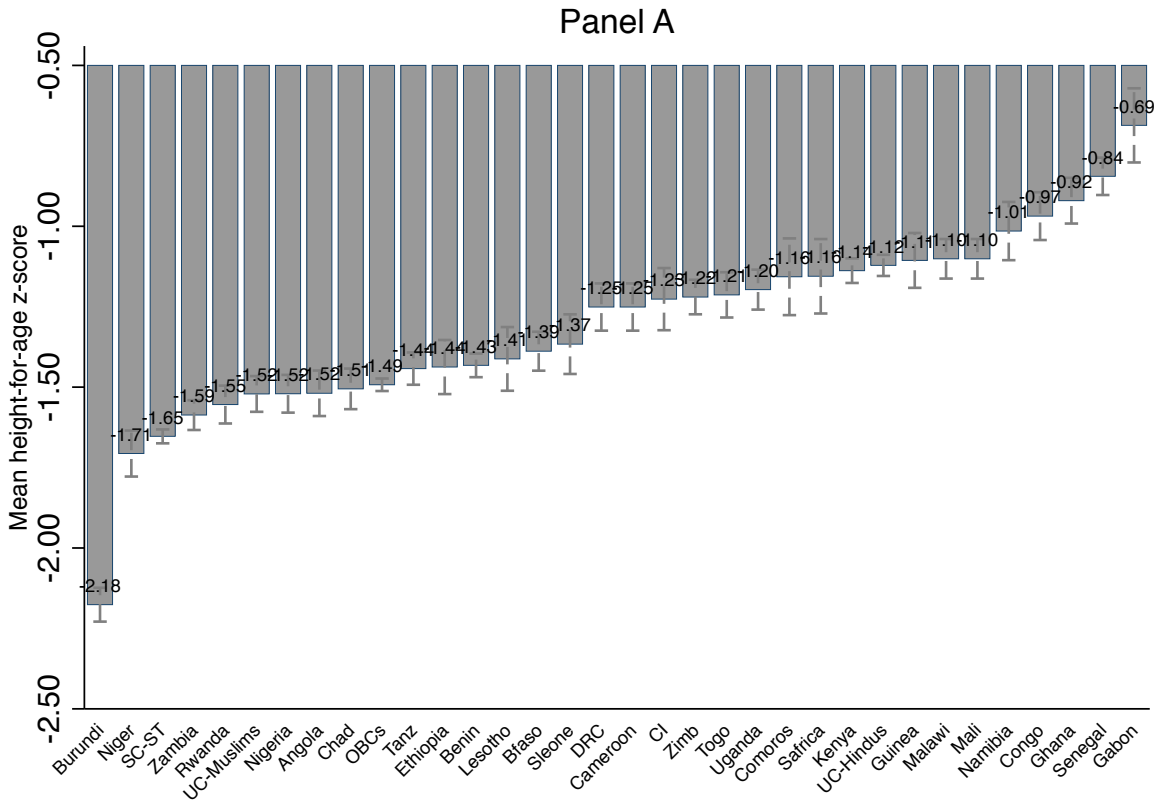

Figure S1: Child heights by countries in sub-Saharan Africa and social groups in India
Notes: The data on the Height-for-age(HFA)-Z-scores is from the latest available round of the Demographic and Health Surveys, conditional on being later than 2010. The list of countries included is provided in Table S1.

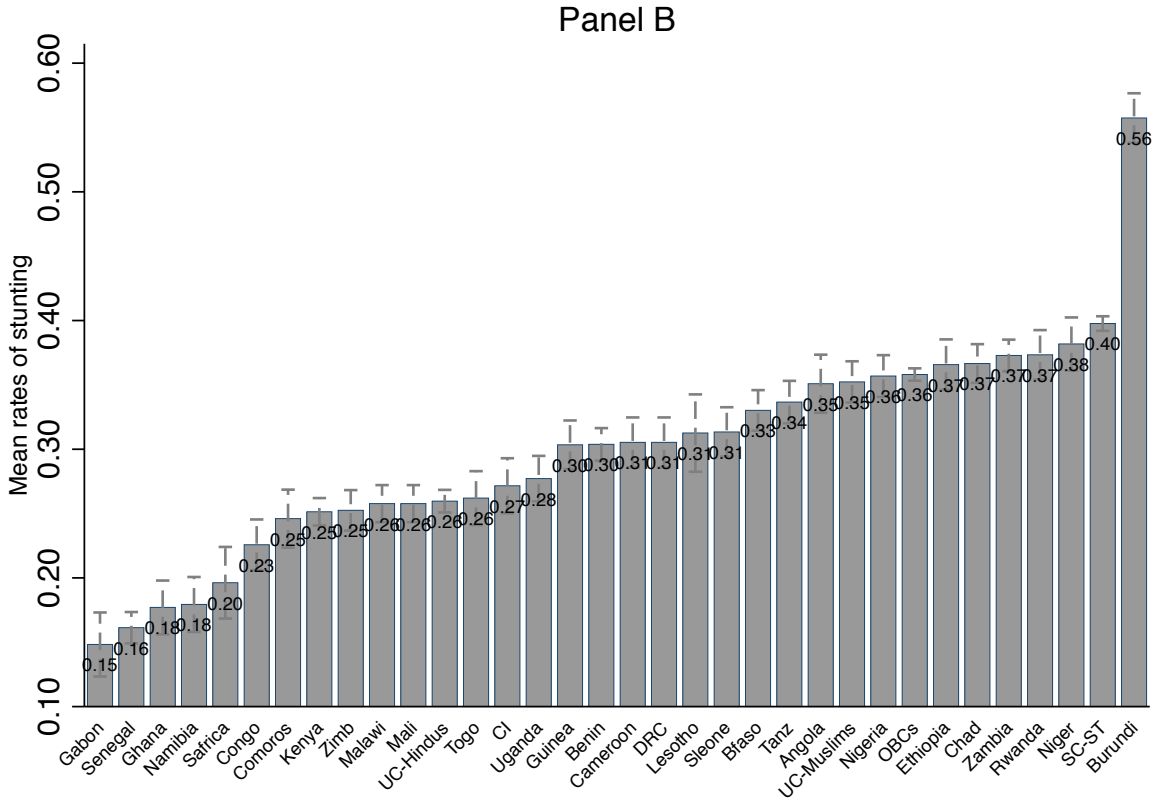

Figure S2: Chronic malnutrition levels by countries in sub-Saharan Africa and social groups in India

Notes: The data on chronic malnutrition is from the latest available round of the Demographic and Health Surveys, conditional on being later than 2010. The list of countries included is provided in Table S1.

2 Part-II

Table S2 present the weighed sample size and their share for our sample by each of the seven regions in the country, namely: (1) BIMARU comprising of Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Rajasthan, Uttar Pradesh and Uttaranchal; (2) SOUTH comprising of Andhra Pradesh, Karnataka, Kerala, Tamil Nadu and Telangana; (3) NORTH comprising of Chandigarh, Delhi, Haryana, Himachal Pradesh, Jammu & Kashmir and Punjab; (4) EAST comprising of Assam, Orissa and West Bengal; (5) WEST comprising of Goa, Gujarat, and Maharashtra; (6) NORTH-EAST comprising of Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura; and (7) UNION TERRITORIES comprising of Andaman and Nicobar Islands, Dadra and Nagar Haveli, Laskhadweep and Puducherry.

BIMARU 'is an acronym formed from the first letters of the names of the Indian states of Bihar, Madhya Pradesh, Rajasthan, and Uttar Pradesh. It was coined by Ashish Bose in the mid-1980s' (*1*). This literally translates into "sick" in Hindi and is the part of the country that has been traditionally the most socioeconomically backward. The present-day states of Chhattisgarh, Jharkhand and Uttarakhand were part of Madhya Pradesh, Bihar and Uttar Pradesh, respectively, at the time the BIMARU acronym was coined and we thus include them in the category of BIMARU.

The choice of the two socioeconomic covariates aasociated with child height is governed by factors that have been highlighted to be important determinants of child height in literature exploring the Africa-India gap. First, the importance of sanitation as captured by the practice of open defecation and exposure to open defecation at the level of the primary sampling unit (*2, 3*); second, the effect of intra-household allocation and fertility decisions as proxied by importance of birth order resulting in misallocation of resources in households and affecting child height (*4, 5*), and the role of number of children (that is the number of siblings) in moderating

infant mortality rates and child height (*6, 7*). The other determinants are standard covariates - (iii) mother's human capital; (iv) the economic position of the household as captured by the wealth index (*8*) (v) mother's health status as captured by her height-for-age-Z-score, weight-for-height-Z-Score and age.

Table S3- S9 present the group averages on the covariates by each of the seven regions in the country and shows that on all covariates that we consider the BIMARU regions shows the poorest set of outcomes, especially for the subaltern groups in the country. These large gaps seem to suggest that BIMARU is even today a relevant category for thinking about differences at a regional level. Moreover, as Table **??** shows it is also the most populated region comprising 50.8 percent of our sample.

Table S10 presents the correlation between the key covariates of child height presented in Table 2 of the manuscript and the child's HFA-Z-Score. The results show that the set of five covariates considered are all statistically significant determinants and show the expected relationship with child height. Moreover, in line with recent work (*7*), it shows that once we account for number of siblings, increasing birth order is positively rather than negatively correlated with child height.

It includes the following figures and tables:

1. Table S2 presents the weighted sample sizes and their shares for the seven regions of the country and are from the fourth round of NFHS, NFHS-IV, conducted in 2015-16.

2. Table S3 presents the mean and standard deviation (in parentheses) from the BIMARU region for the covariates of child height presented in Table 2 of the main manuscript and used to create balanced samples from the fourth round of NFHS, NFHS-IV, conducted in 2015-16.

3. Table S4 presents the mean and standard deviation (in parentheses) from the SOUTH for

the covariates of child height presented in Table 2 of the main manuscript and used to create balanced samples from the fourth round of NFHS, NFHS-IV, conducted in 2015-16.

4. Table S5 presents the mean and standard deviation (in parentheses) from the NORTH for the covariates of child height presented in Table 2 of the main manuscript and used to create balanced samples from the fourth round of NFHS, NFHS-IV, conducted in 2015-16.

5. Table S6 presents the mean and standard deviation (in parentheses) from the EAST for the covariates of child height presented in Table 2 of the main manuscript and used to create balanced samples from the fourth round of NFHS, NFHS-IV, conducted in 2015-16.

6. Table S7 presents the mean and standard deviation (in parentheses) from the WEST for the covariates of child height presented in Table 2 of the main manuscript and used to create balanced samples from the fourth round of NFHS, NFHS-IV, conducted in 2015-16.

7. Table S8 presents the mean and standard deviation (in parentheses) from the NORTH-EAST for the covariates of child height presented in Table 2 of the main manuscript and used to create balanced samples from the fourth round of NFHS, NFHS-IV, conducted in 2015-16.

8. Table S9 presents the mean and standard deviation (in parentheses) from the UNION TERRITORIES for the covariates of child height presented in Table 2 of the main manuscript and used to create balanced samples from the fourth round of NFHS, NFHS-IV, conducted in 2015-16

9. Table S10 shows the correlation between child HFA-Z-Scores and the covariates of child height presented in Table 2 of the main manuscript and used to create balanced samples from the fourth round of NFHS, NFHS-IV, conducted in 2015-16.

Table S2: Sample size from the various regions of the country

REGION	Weighted Frequency (1)	Percent (2)	Cumulative (3)
BIMARU	117298	50.8	50.8
SOUTH	41912	18.15	68.95
NORTH	13846	6	74.95
EAST	25205	10.92	85.87
WEST	29938	12.97	98.83
NORTH EAST	2341	1.01	99.84
UNION TERRITORIES	359	0.16	100
Total	230898	100	

Notes: The table presents the weighted sample sizes and their shares for the seven regions of the country and are from the fourth round of NFHS, NFHS-IV, conducted in 2015-16.

Table S3: Potential covariates of child height by social group - BIMARU Region

	UC-Hindus	SC-ST	OBCs	UC-Muslims
	(1)	(2)	(3)	(4)
Dummy HH defacates in the open	0.31	0.73	0.57	0.37
	(0.46)	(0.44)	(0.50)	(0.48)
HH exposure to. open defacation at the PSU	0.46	0.69	0.59	0.42
	(0.34)	(0.29)	(0.32)	(0.36)
Years of Education	8.91	3.82	4.86	3.69
	(5.30)	(4.60)	(5.07)	(4.88)
Literacy Dummy	0.77	0.36	0.46	0.35
	(0.42)	(0.48)	(0.50)	(0.48)
Wealth index factor score	36142.32	-76836.15	-37318.24	-21393.86
	(98923.39)	(79617.95)	(92263.27)	(101224.82)
Mother's HFA-Z-Score	-1.86	-2.23	-2.13	-2.02
	(0.98)	(0.97)	(0.98)	(0.99)
Mother's WFH-Z-Score	-0.79	-1.40	-1.19	-1.00
	(1.17)	(0.96)	(1.05)	(1.19)
Mother's Age	27.19	27.16	27.03	28.22
	(4.65)	(5.28)	(5.05)	(5.40)
Birth Order	2.05	2.63	2.48	3.00
	(1.23)	(1.66)	(1.59)	(2.01)
Sibling Size	2.31	2.97	2.81	3.37
	(1.25)	(1.68)	(1.61)	(2.02)
Rural Residence Dummy	0.70	0.87	0.81	0.68
	(0.46)	(0.33)	(0.40)	(0.47)
Observations	14163	43127	62924	4938

Notes: The table presents the mean and standard deviation (in parentheses) for the BIMARU region comprising of Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Rajasthan, Uttar Pradesh and Uttaranchal. The variables are from the NFHS-IV.

Table S4: Potential covariates of child height by social group - SOUTH

	UC-Hindus	SC-ST	OBCs	UC-Muslims
	(1)	(2)	(3)	(4)
Dummy HH defacates in the open	0.16	0.53	0.28	0.13
	(0.37)	(0.50)	(0.45)	(0.34)
HH exposure to. open defacation at the PSU	0.24	0.49	0.31	0.20
	(0.29)	(0.32)	(0.32)	(0.28)
Years of Education	11.04	7.75	9.33	8.79
	(4.11)	(4.90)	(4.65)	(4.26)
Literacy Dummy	0.92	0.71	0.82	0.81
	(0.27)	(0.45)	(0.38)	(0.40)
Wealth index factor score	79622.14	2769.52	51227.86	70818.10
	(73356.98)	(70260.60)	(72147.68)	(62793.51)
Mother's HFA-Z-Score	-1.63	-2.02	-1.77	-1.79
	(0.96)	(0.98)	(0.96)	(0.92)
Mother's WFH-Z-Score	-0.39	-0.76	-0.53	-0.41
	(1.30)	(1.23)	(1.28)	(1.33)
Mother's Age	26.56	25.81	26.38	26.01
	(4.31)	(4.23)	(4.35)	(3.89)
Birth Order	1.62	1.78	1.71	1.92
	(0.71)	(0.88)	(0.83)	(0.97)
Sibling Size	1.84	2.04	1.94	2.26
	(0.73)	(0.90)	(0.84)	(1.01)
Rural Residence Dummy	0.56	0.71	0.54	0.37
	(0.50)	(0.45)	(0.50)	(0.48)
Observations	1518	6712	12700	450

Notes: The table presents the mean and standard deviation (in parentheses) for the SOUTH comprising of Andhra Pradesh, Karnataka, Kerala, Tamil Nadu and Telangana. The variables are from the NFHS-IV.

Table S5: Potential covariates of child height by social group - NORTH

	UC-Hindus	SC-ST	OBCs	UC-Muslims
	(1)	(2)	(3)	(4)
Dummy HH defacates in the open	0.09	0.18	0.10	0.17
	(0.29)	(0.39)	(0.30)	(0.37)
HH exposure to. open defacation at the PSU	0.11	0.15	0.11	0.17
	(0.21)	(0.22)	(0.17)	(0.24)
Years of Education	10.83	6.50	8.01	5.50
	(4.70)	(4.71)	(5.36)	(5.12)
Literacy Dummy	0.88	0.63	0.71	0.53
	(0.33)	(0.48)	(0.45)	(0.50)
Wealth index factor score	116978.27	59060.87	88970.11	35385.69
	(75177.05)	(76673.35)	(79833.06)	(87813.34)
Mother's HFA-Z-Score	-1.61	-1.75	-1.58	-1.47
	(0.97)	(0.99)	(0.98)	(0.95)
Mother's WFH-Z-Score	-0.41	-0.69	-0.63	-0.62
	(1.16)	(1.15)	(1.09)	(1.16)
Mother's Age	27.66	27.14	26.89	28.35
	(4.44)	(4.64)	(4.54)	(5.50)
Birth Order	1.77	2.02	2.05	2.53
	(0.92)	(1.18)	(1.35)	(1.75)
Sibling Size	1.97	2.30	2.31	2.85
	(0.94)	(1.19)	(1.39)	(1.75)
Rural Residence Dummy	0.42	0.61	0.54	0.56
	(0.49)	(0.49)	(0.50)	(0.50)
Observations	4969	8136	5623	1622

Notes: The table presents the mean and standard deviation (in parentheses) for the NORTH comprising of Chandigarh, Delhi, Haryana, Himachal Pradesh, Jammu & Kashmir and Punjab. The variables are from the NFHS-IV.

Table S6: Potential covariates of child height by social group - EAST

	UC-Hindus	SC-ST	OBCs	UC-Muslims
	(1)	(2)	(3)	(4)
Dummy HH defacates in the open	0.19	0.51	0.36	0.18
	(0.39)	(0.50)	(0.48)	(0.38)
HH exposure to. open defacation at the PSU	0.26	0.48	0.40	0.20
	(0.31)	(0.35)	(0.35)	(0.23)
Years of Education	8.94	5.18	7.28	5.61
	(4.07)	(4.25)	(4.19)	(4.04)
Literacy Dummy	0.85	0.54	0.73	0.58
	(0.36)	(0.50)	(0.44)	(0.49)
Wealth index factor score	12541.84	-68359.91	-29085.42	-51363.48
	(85452.49)	(73583.99)	(77564.44)	(71222.72)
Mother's HFA-Z-Score	-2.03	-2.28	-2.13	-2.06
	(0.95)	(0.91)	(0.97)	(0.93)
Mother's WFH-Z-Score	-0.65	-1.18	-1.02	-1.04
	(1.19)	(1.08)	(1.11)	(1.10)
Mother's Age	26.68	25.96	26.42	25.99
	(5.01)	(5.13)	(5.05)	(5.53)
Birth Order	1.60	1.94	1.81	2.28
	(0.80)	(1.16)	(1.06)	(1.48)
Sibling Size	1.70	2.10	1.96	2.48
	(0.83)	(1.20)	(1.10)	(1.51)
Rural Residence Dummy	0.67	0.84	0.83	0.72
	(0.47)	(0.37)	(0.37)	(0.45)
Observations	3062	10108	6124	2329

Notes: The table presents the mean and standard deviation (in parentheses) for the EAST comprising of Assam, Orissa and West Bengal. The variables are from the NFHS-IV.

Table S7: Potential covariates of child height by social group - WEST

	UC-Hindus	SC-ST	OBCs	UC-Muslims
	(1)	(2)	(3)	(4)
Dummy HH defacates in the open	0.24	0.48	0.31	0.16
	(0.42)	(0.50)	(0.46)	(0.37)
HH exposure to. open defacation at the PSU	0.26	0.45	0.33	0.18
	(0.30)	(0.34)	(0.30)	(0.23)
Years of Education	9.39	6.78	7.94	7.34
	(4.31)	(4.55)	(4.54)	(4.10)
Literacy Dummy	0.87	0.67	0.77	0.75
	(0.33)	(0.47)	(0.42)	(0.43)
Wealth index factor score	57532.42	-11290.61	36204.88	44839.02
	(83530.01)	(88651.90)	(79251.39)	(73320.25)
Mother's HFA-Z-Score	-1.81	-2.07	-1.87	-1.73
	(0.89)	(0.95)	(0.99)	(0.93)
Mother's WFH-Z-Score	-0.75	-1.26	-0.90	-0.70
	(1.25)	(1.12)	(1.24)	(1.26)
Mother's Age	26.59	25.90	26.75	26.40
	(4.62)	(4.64)	(4.58)	(4.64)
Birth Order	1.78	1.99	1.89	2.25
	(0.90)	(1.15)	(1.05)	(1.26)
Sibling Size	1.98	2.27	2.11	2.57
	(0.92)	(1.17)	(1.08)	(1.30)
Rural Residence Dummy	0.51	0.69	0.62	0.23
	(0.50)	(0.46)	(0.49)	(0.42)
Observations	3417	5664	5631	1333

Notes: The table presents the mean and standard deviation (in parentheses) for the WEST comprising of Goa, Gujarat, and Maharashtra. The variables are from the NFHS-IV.

Table S8: Potential covariates of child height by social group - NORTH-EAST

	UC-Hindus	SC-ST	OBCs	UC-Muslims
	(1)	(2)	(3)	(4)
Dummy HH defacates in the open	0.02	0.07	0.01	0.03
	(0.16)	(0.25)	(0.11)	(0.16)
HH exposure to. open defacation at the PSU	0.02	0.06	0.02	0.01
	(0.08)	(0.16)	(0.07)	(0.03)
Years of Education	9.21	6.55	8.41	6.06
	(4.28)	(4.45)	(3.95)	(4.35)
Literacy Dummy	0.84	0.66	0.82	0.61
	(0.37)	(0.47)	(0.38)	(0.49)
Wealth index factor score	23845.72	-22074.77	1447.12	-22854.86
	(74462.21)	(76132.88)	(68250.75)	(62791.97)
Mother's HFA-Z-Score	-2.01	-2.26	-2.15	-2.22
	(0.89)	(0.94)	(0.93)	(0.88)
Mother's WFH-Z-Score	-0.58	-0.89	-0.80	-0.72
	(1.10)	(0.93)	(1.10)	(1.06)
Mother's Age	29.09	28.85	27.64	26.99
	(5.75)	(6.14)	(5.79)	(5.81)
Birth Order	1.73	2.61	1.80	2.52
	(1.03)	(1.82)	(1.22)	(1.66)
Sibling Size	1.87	2.89	1.91	2.74
	(1.10)	(1.88)	(1.27)	(1.69)
Rural Residence Dummy	0.50	0.79	0.61	0.68
	(0.50)	(0.41)	(0.49)	(0.47)
Observations	1673	20320	1611	225

Notes: The table presents the mean and standard deviation (in parentheses) for the NORTH-EAST comprising of Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura. The variables are from the NFHS-IV.

Table S9: Potential covariates of child height by social group - UNION TERRITORIES

	UC-Hindus	SC-ST	OBCs	UC-Muslims
	(1)	(2)	(3)	(4)
Dummy HH defacates in the open	0.08	0.50	0.21	0.03
	(0.27)	(0.50)	(0.41)	(0.18)
HH exposure to. open defacation at the PSU	0.12	0.52	0.27	0.02
	(0.20)	(0.38)	(0.28)	(0.05)
Years of Education	9.44	7.89	10.95	9.63
	(4.47)	(5.19)	(4.27)	(4.97)
Literacy Dummy	0.87	0.69	0.91	0.71
	(0.34)	(0.46)	(0.28)	(0.46)
Wealth index factor score	66081.94	8288.93	80699.19	80176.13
	(73360.49)	(86589.69)	(70707.83)	(80298.50)
Mother's HFA-Z-Score	-1.87	-1.90	-1.69	-1.54
	(0.92)	(0.94)	(1.01)	(1.21)
Mother's WFH-Z-Score	-0.48	-0.74	-0.08	-0.81
	(1.30)	(1.27)	(1.27)	(1.30)
Mother's Age	27.36	27.88	27.40	27.22
	(4.62)	(5.21)	(4.43)	(4.42)
Birth Order	1.64	1.92	1.59	2.01
	(0.76)	(1.04)	(0.74)	(1.41)
Sibling Size	1.83	2.14	1.76	2.23
	(0.81)	(1.06)	(0.76)	(1.42)
Rural Residence Dummy	0.38	0.60	0.25	0.14
	(0.49)	(0.49)	(0.43)	(0.35)
Observations	330	973	1189	27

Notes: The table presents the mean and standard deviation (in parentheses) for the UNION TERRITORIES comprising of Andaman and Nicobar Islands, Dadra and Nagar Haveli, Laskhadweep and Puducherry. The variables are from the NFHS-IV.

Table S10: Countries included in the sample from the Demographic and Health Surveys

	DV- HFA-Z-Score											
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dummy HH defecates in the open	-0.54***											-0.056***
	(0.012)											(0.016)
HH exposure to. open defecation at the PSU		-0.73***										-0.090***
		(0.020)										(0.025)
Years of Education			0.070***									0.033***
			(0.0012)									(0.0023)
Literacy Dummy				0.62***								-0.033
				(0.012)								(0.022)
Wealth index factor score					3.8e-06***							9.3e-07***
					(6.7e-08)							(9.6e-08)
Mother's HFA-Z-Score						0.36***						0.29***
						(0.0065)						(0.0063)
Mother's WFH-Z-Score							0.24***					0.12***
							(0.0053)					(0.0053)
Mother's Age								-0.016***				-0.0044***
								(0.0011)				(0.0013)
Birth Order = 2									-0.11***			0.20***
									(0.012)			(0.014)
Birth Order = 3									-0.44***			0.36***
									(0.014)			(0.022)
Sibling Size = 2										-0.25***		-0.29***
										(0.015)		(0.017)
Sibling Size = 3										-0.62***		-0.56***
										(0.015)		(0.023)
Rural Dummy											-0.38***	0.032*
											(0.018)	(0.019)
Observations	212,646	212,646	212,646	211,173	212,646	211,873	210,276	212,646	212,646	212,646	212,646	208,807
R-squared	0.026	0.024	0.048	0.033	0.049	0.045	0.029	0.002	0.012	0.022	0.010	0.098

*** p<0.01, ** p<0.05, * p<0.1

Notes: The table presents the results of regressing the HFA-Z-Score on the covariates of child height. The standard errors are clustered at the level of the PSU.

3 Part-III

This presents, first, the average HFA-Z-Scores and rates of chronic malnutrition for India by it's social groups for the NFHS-II conducted in 1998-99 and NFHS-III conducted in 2005-06. This provides evidence that the gaps that are observed in 2015-16 are not transient but are persistent over the 18 year period the data covers.

Table 2 in the manuscript which presents the gap between the UC-Hindus and the other social groups for the unweighted sample (using the NFHS sample weights) and the entropy balanced arising from re-weighting the data from the UC-Hindus to create samples of UC-Hindus that exhibit the same mean, variance and skewness on the covariates outlined in Table 1 of the manuscript, as the other three caste and religious groups. Table 1 presents the gaps for All-India, north, south, east and west of the country. Here we also present the extent of gaps in the northeast and the union territories.

Finally, it then presents the extent of gaps on the child HFA-Z-Score, as well as rates of chronic malnourishment, for the three social groups for the major states in the country for the latest round of data, NFHS-IV-2015-16.

It includes the following figures and tables:

1. Figure S3 presents the average HFA-Z-Scores and rates of chronic malnourishment for the four social groups in India for the second round of NFHS, NFHS-II, conducted in 1998-99.

2. Figure S4 presents the average HFA-Z-Scores and rates of chronic malnourishment for the four social groups in India for the second round of NFHS, NFHS-III, conducted in 2005-06.

3. Table S11 presents the gaps on the HFA-Z-Scores and rates of chronic malnourishment between the UC-Hindus and each of the other three social groups: SC-ST, OBCs and

UC-Muslims. The gaps are presented for the seven regions in the country, as well as for all-India.

The next set of figures are based on estimating the following regression:

$$O_{ij} = \alpha + \beta_j * Group_j + \mathcal{X}_i + \epsilon_{is}, \tag{1}$$

where O_{ij} refers to the HFA-Z-Score or a dummy for being stunted for child i from group j. $Group_j$ is categorical variable capturing the social group the child belongs to: UC-Hindus, SC-ST, OBCs and UC-Muslims and where UC-Hindus are the omitted category. $\mathcal{X}_i$ is a vector of fixed effects for age in months, gender, age in months interacted with gender and rural dummy. The standard errors are clustered at the level of the primary sampling unit. The results of the estimation are shown in:

4. Figure S5 presents the regression estimates of the gaps between the SC-ST and UC-Hindus in HFA-Z-Score by state for NFHS-IV, conducted in 2015-16.

5. Figure S6 presents the regression estimates of the gaps between the SC-ST and UC-Hindus in chronic malnutrition by state for NFHS-IV, conducted in 2015-16.

6. Figure S7 presents the regression estimates of the gaps between the OBCs and UC-Hindus in HFA-Z-Score by state for NFHS-IV, conducted in 2015-16.

7. Figure S8 presents the regression estimates of the gaps between the OBCs and UC-Hindus in chronic malnutrition by state for NFHS-IV, conducted in 2015-16.

8. Figure S9 presents the regression estimates of the gaps between the UC-Muslims and UC-Hindus in HFA-Z-Score by state for NFHS-IV, conducted in 2015-16.

9. Figure S10 presents the regression estimates of the gaps between the UC-Muslims and UC-Hindus in chronic malnutrition by state for NFHS-IV, conducted in 2015-16.

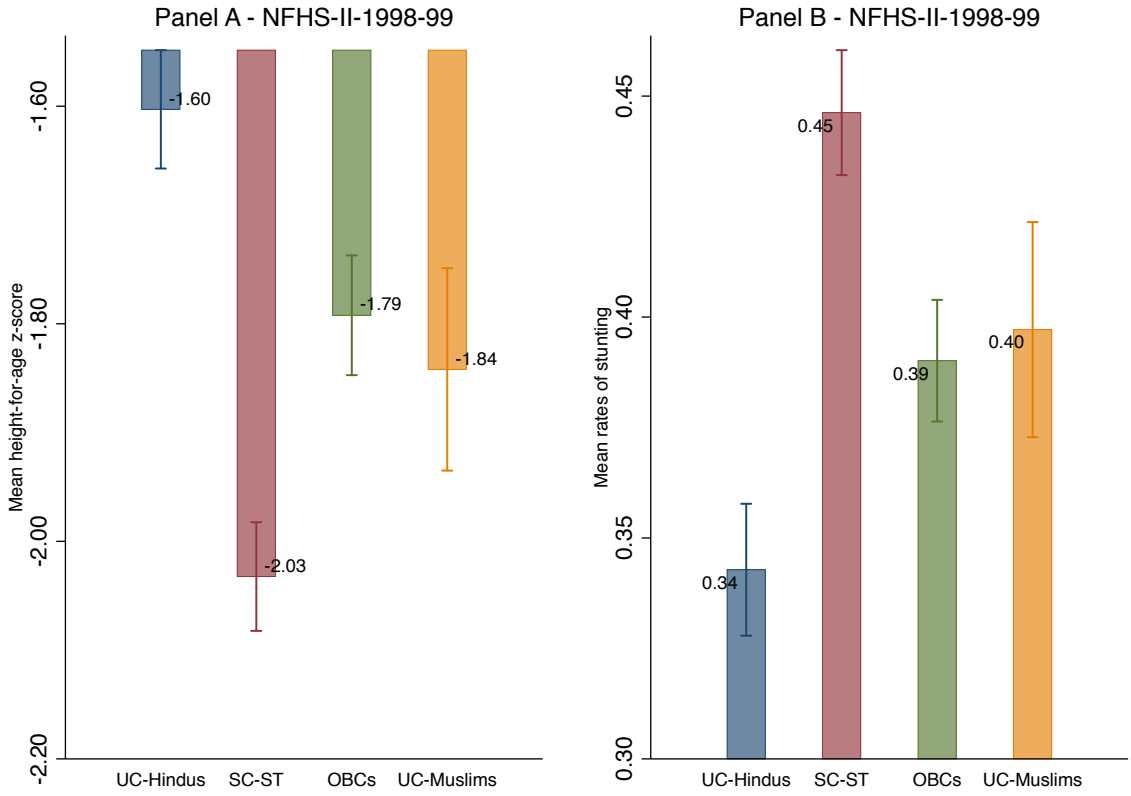

Figure S3: Chronic malnutrition levels by social groups in India: NFHS-II-1998-99
Notes: The data on child heights and chronic malnutrition is from the the Demographic and Health Surveys for India also known as the National Family Health Survey (NFHS-II) from the year 1998-99.

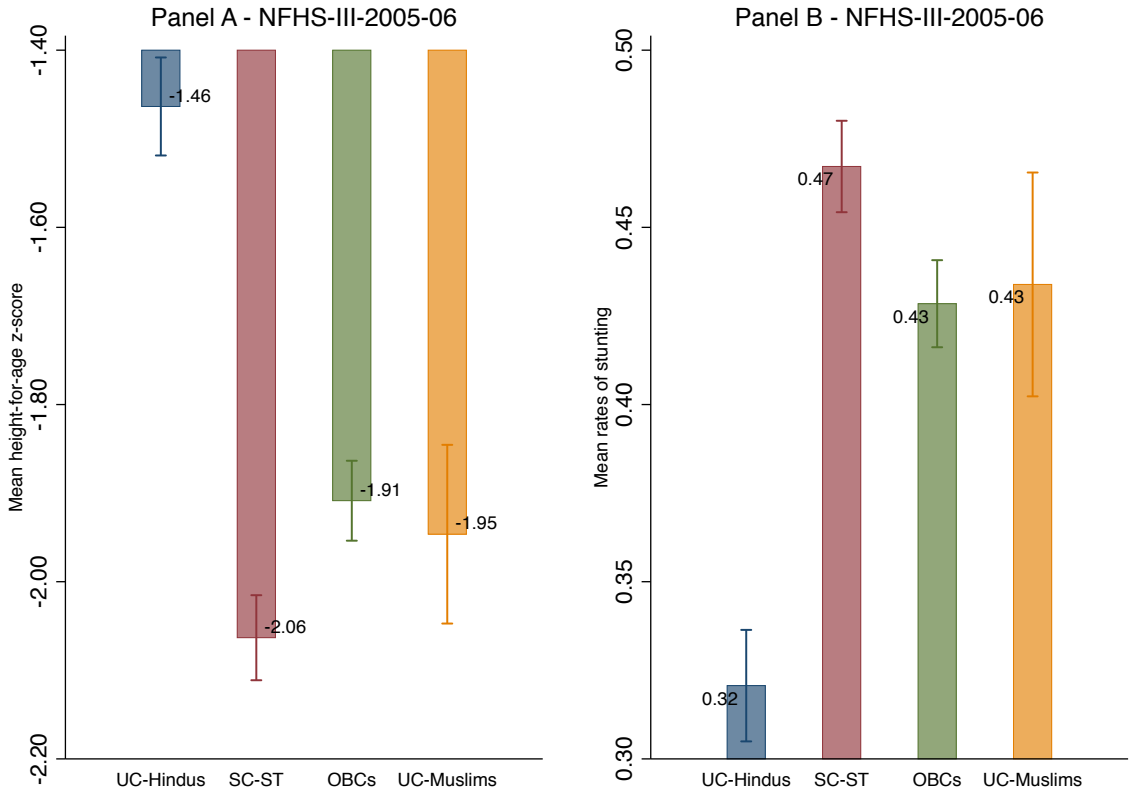

Figure S4: Chronic malnutrition levels by social groups in India: NFHS-III-2005-06
Notes: The data on child heights and chronic malnutrition is from the the Demographic and Health Surveys for India also known as the National Family Health Survey (NFHS-III) from the year 2005-06.

Table S11: Raw gaps and gaps between caste and religious groups in samples balanced on covariates

	India	BIMARU	SOUTH	NORTH	EAST	WEST	N-EAST	UNION TERRT.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
				DV - HFA-Z-Score				
UC-Hindu Average	-1.12	-1.23	-0.90	-1.09	-1.01	-1.12		
				Panel A - Unweighted Sample				
SC-ST Dummy	-0.53***	-0.67***	-0.39***	-0.29***	-0.47***	-0.42***	-0.23***	-0.45***
	(0.011)	(0.016)	(0.049)	(0.030)	(0.029)	(0.038)	(0.040)	(0.11)
OBC Dummy	-0.37***	-0.48***	-0.21***	-0.13***	-0.23***	-0.18***	0.022	-0.22*
	(0.012)	(0.016)	(0.046)	(0.034)	(0.033)	(0.038)	(0.053)	(0.13)
UC-Muslims Dummy	-0.40***	-0.47***	-0.21**	-0.11*	-0.60***	-0.13**	-0.53***	0.066
	(0.019)	(0.027)	(0.096)	(0.061)	(0.043)	(0.057)	(0.095)	(0.37)
				Panel B - Entropy Balanced Weighted Sample				
SC-ST Dummy	-0.12***	-0.17***	0.075	-0.057	-0.091	-0.14*	-0.19*	
	(0.029)	(0.040)	(0.085)	(0.056)	(0.072)	(0.082)	(0.11)	
OBC Dummy	-0.11***	-0.13***	-0.037	-0.020	-0.095*	-0.037	0.14*	-0.27
	(0.023)	(0.029)	(0.065)	(0.052)	(0.050)	(0.059)	(0.079)	(0.19)
UC-Muslims Dummy	-0.12***	-0.12**	-0.063	0.053	-0.29***	-0.11	-0.28*	
	(0.041)	(0.046)	(0.13)	(0.099)	(0.084)	(0.13)	(0.16)	
				DV - Stunting Dummy				
UC-Hindu Average	0.26	0.30	0.24	0.21	0.21	0.26		
				Panel C - Unweighted Sample				
SC-ST Dummy	0.14***	0.17***	0.092***	0.062***	0.12***	0.13***	0.099***	0.085***
	(0.0030)	(0.0047)	(0.012)	(0.0080)	(0.0087)	(0.0098)	(0.011)	(0.027)
OBC Dummy	0.098***	0.12***	0.048***	0.042***	0.073***	0.057***	0.0057	0.045
	(0.0032)	(0.0047)	(0.011)	(0.0087)	(0.0091)	(0.0095)	(0.014)	(0.028)
UC-Muslims Dummy	0.093***	0.11***	0.039*	0.047***	0.17***	0.0093	0.22***	-0.011
	(0.0050)	(0.0074)	(0.023)	(0.015)	(0.012)	(0.014)	(0.028)	(0.084)
				Panel D - Entropy Balanced Weighted Sample				
SC-ST Dummy	0.028***	0.039***	-0.026	0.0024	0.027	0.037**	0.058**	
	(0.0074)	(0.011)	(0.023)	(0.017)	(0.021)	(0.019)	(0.026)	
OBC Dummy	0.028***	0.028***	0.00030	0.011	0.037**	0.016	-0.026	0.14***
	(0.0058)	(0.0080)	(0.017)	(0.014)	(0.015)	(0.015)	(0.023)	(0.047)
UC-Muslims Dummy	0.026**	0.016	-0.013	0.0035	0.11***	-0.0034	0.14***	
	(0.011)	(0.014)	(0.040)	(0.028)	(0.028)	(0.028)	(0.052)	

*** p<0.01, ** p<0.05, * p<0.1

Notes: The unweighted samples in Panel A and C are ordinary least square estimates of the gaps between the UC-Hindu and the other three groups, where the survey weights are employed. The entropy weighted sample in Panels B and D consists of samples of UC-Hindus which are chosen such that they are balanced on the covariates listed in Table 1 of the manuscript when compared to the other three social groups.

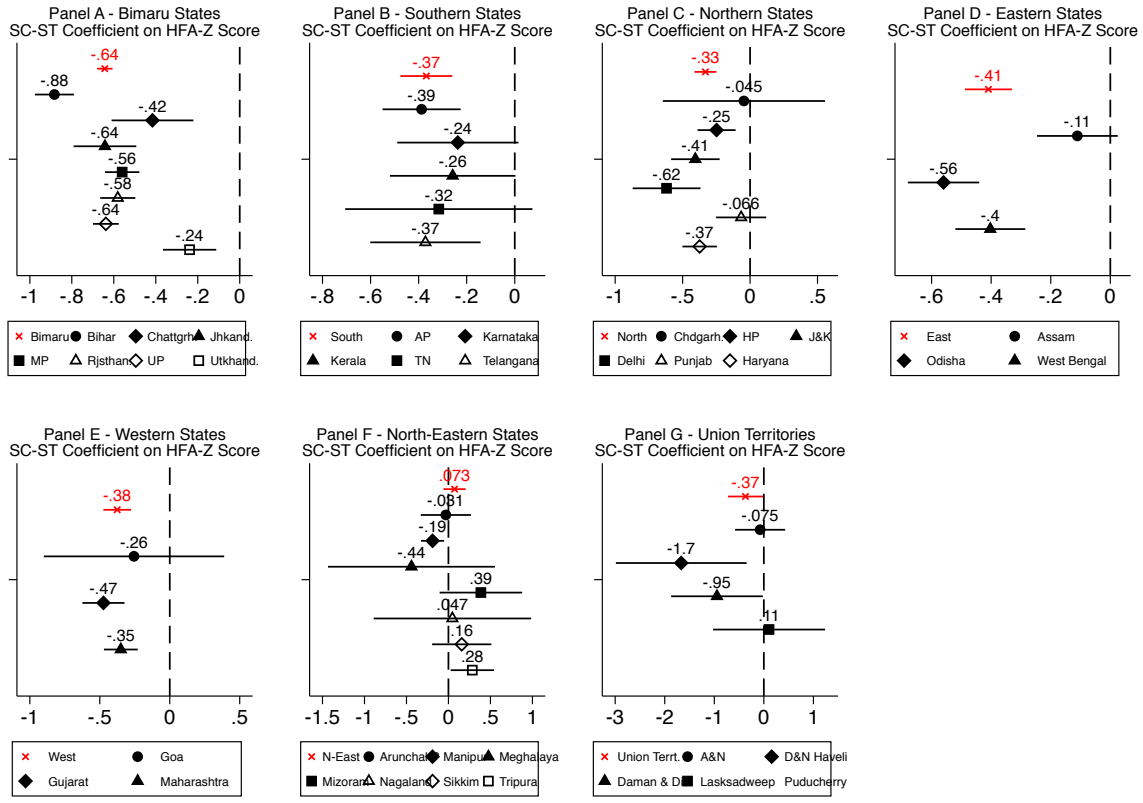

Figure S5: Gaps between the SC-ST and UC-Hindus in HFA-Z-Score by state

Notes: The above presents the results of regressing the dummies for social group on the HFA-Z-Score by state and include fixed effects for district of residence, all combinations of age in months and dummy for gender and rural residence. The data is from the the Demographic and Health Surveys for India also known as the National Family Health Survey (NFHS-IV) from the year 2015-16.

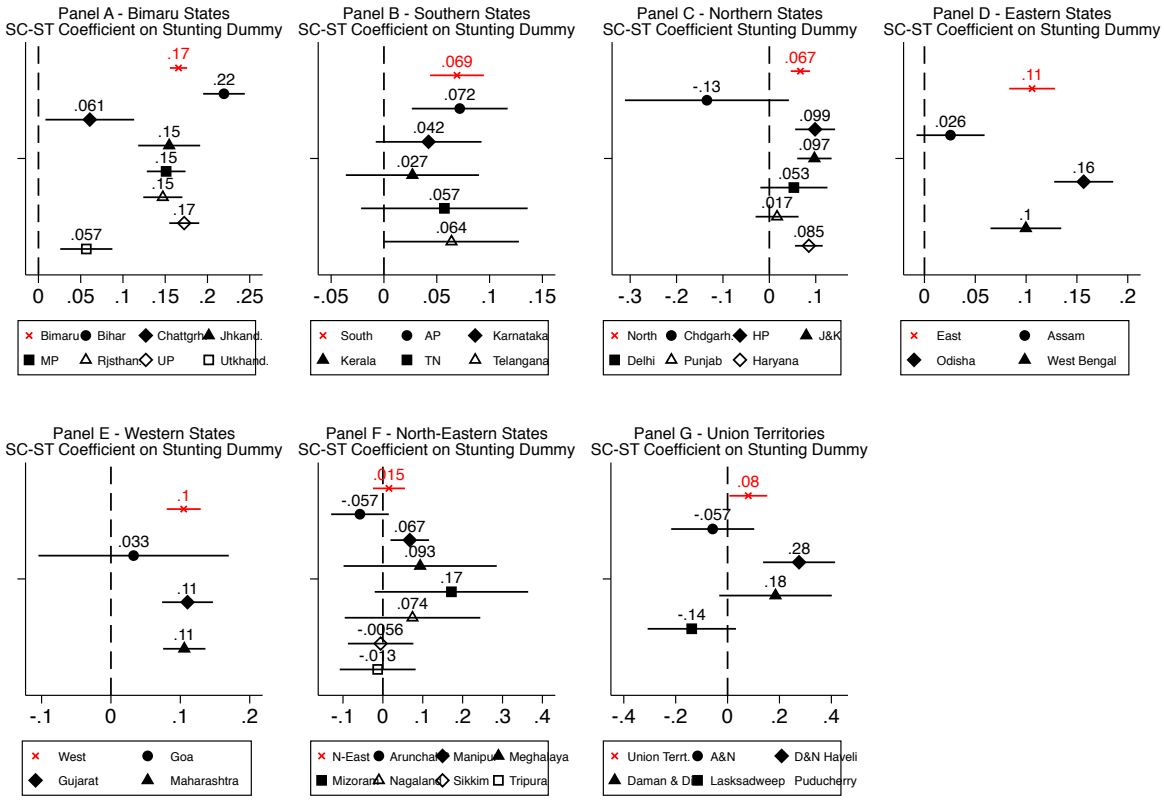

Figure S6: Gaps between the SC-ST and UC-Hindus in rate of chronic malnutrition by state
Notes: The above presents the results of regressing the dummies for social group on a dummy for stunting by state and include fixed effects for district of residence, all combinations of age in months and dummy for gender and rural residence. The data is from the the Demographic and Health Surveys for India also known as the National Family Health Survey (NFHS-IV) from the year 2015-16.

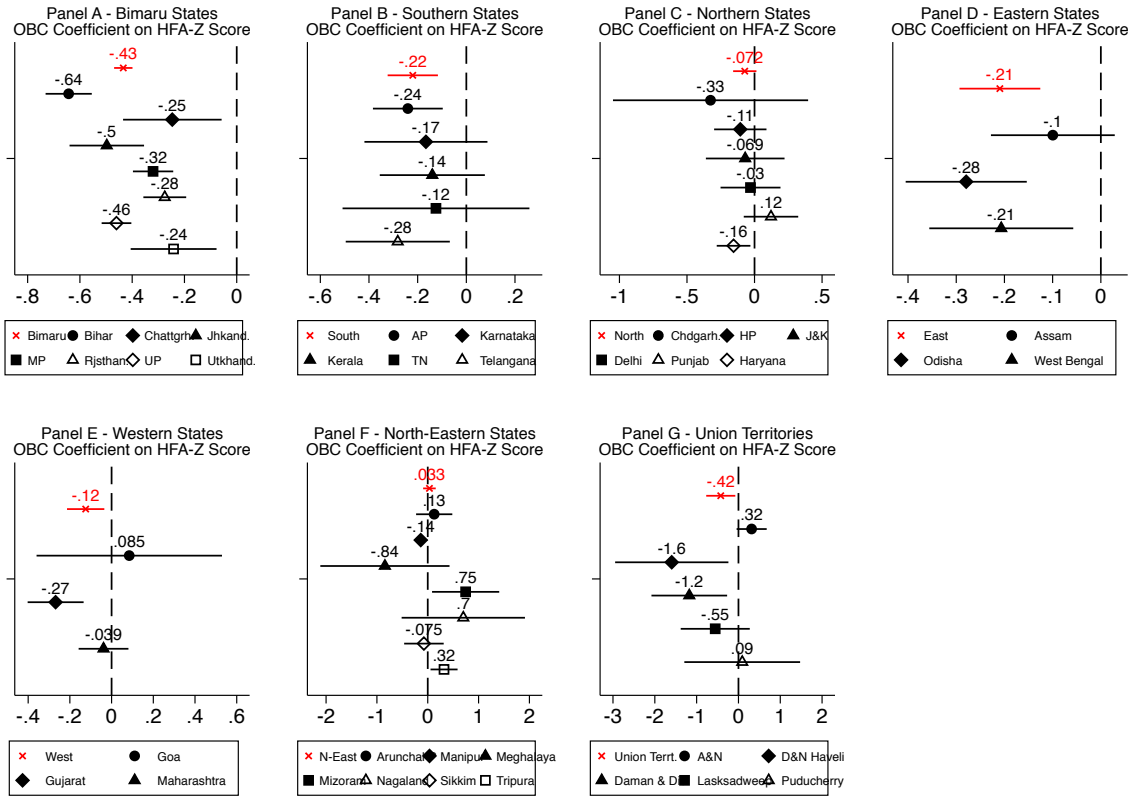

Figure S7: Gaps between the OBCs and UC-Hindus in HFA-Z-Score by state

Notes: The above presents the results of regressing the dummies for social group on the HFA-Z-Score by state and include fixed effects for district of residence, all combinations of age in months and dummy for gender and rural residence. The data is from the the Demographic and Health Surveys for India also known as the National Family Health Survey (NFHS-IV) from the year 2015-16.

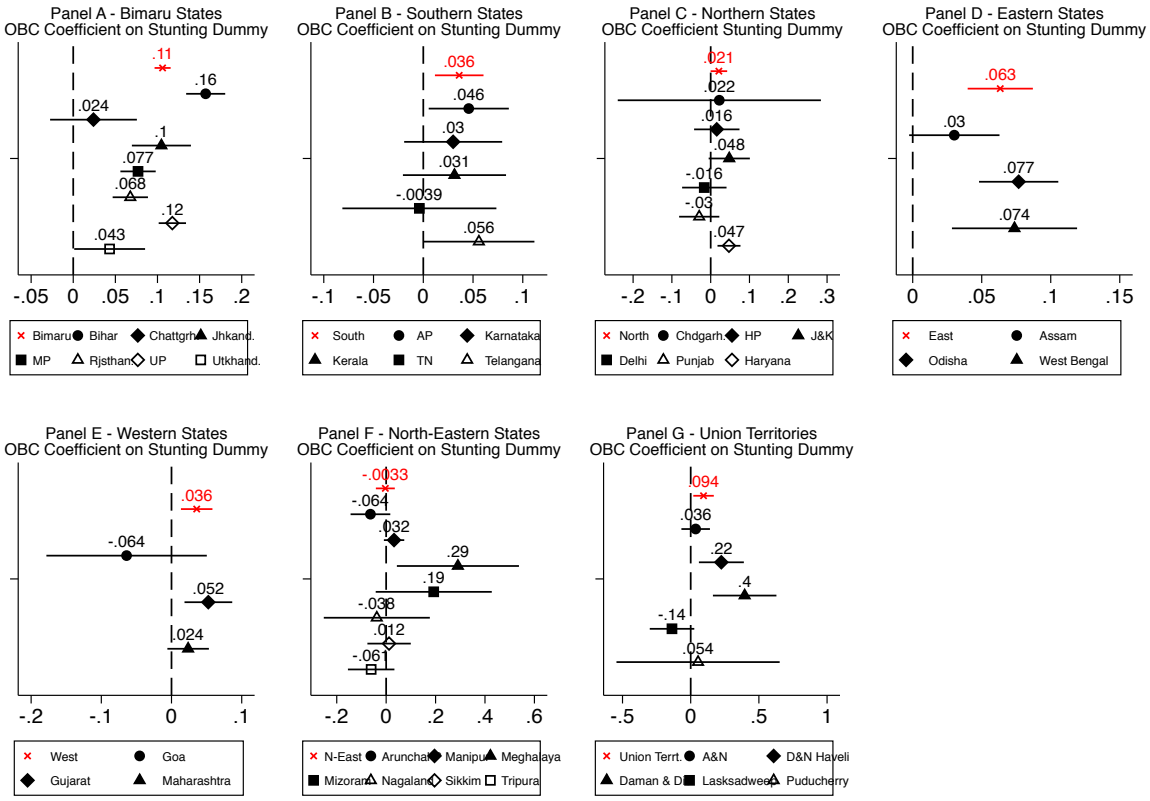

Figure S8: Gaps between the OBCs and UC-Hindus in rate of chronic malnutrition by state Notes: The above presents the results of regressing the dummies for social group on a dummy for stunting by state and include fixed effects for district of residence, all combinations of age in months and dummy for gender and rural residence. The data is from the the Demographic and Health Surveys for India also known as the National Family Health Survey (NFHS-IV) from the year 2015-16.

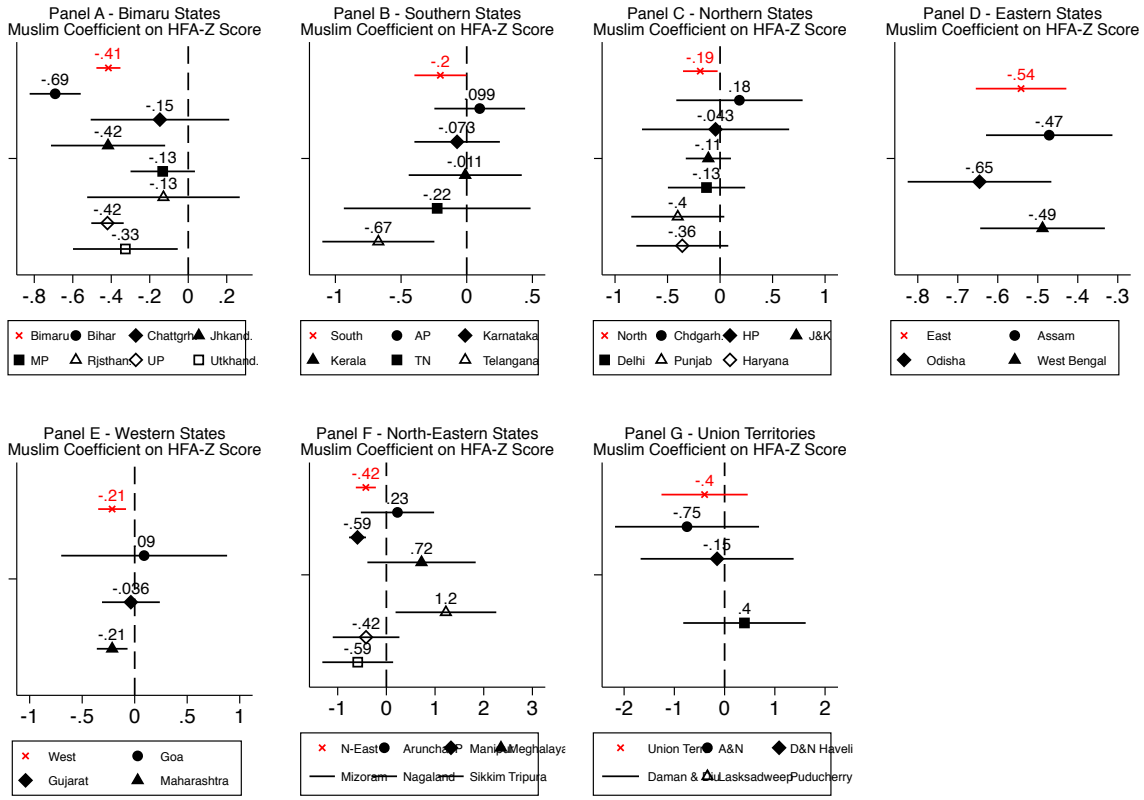

Figure S9: Gaps between the UC-Muslims and UC-Hindus in HFA-Z-Score by state
Notes: The above presents the results of regressing the dummies for social group on the HFA-Z-Score by state and include fixed effects for district of residence, all combinations of age in months and dummy for gender and rural residence. The data is from the the Demographic and Health Surveys for India also known as the National Family Health Survey (NFHS-IV) from the year 2015-16.

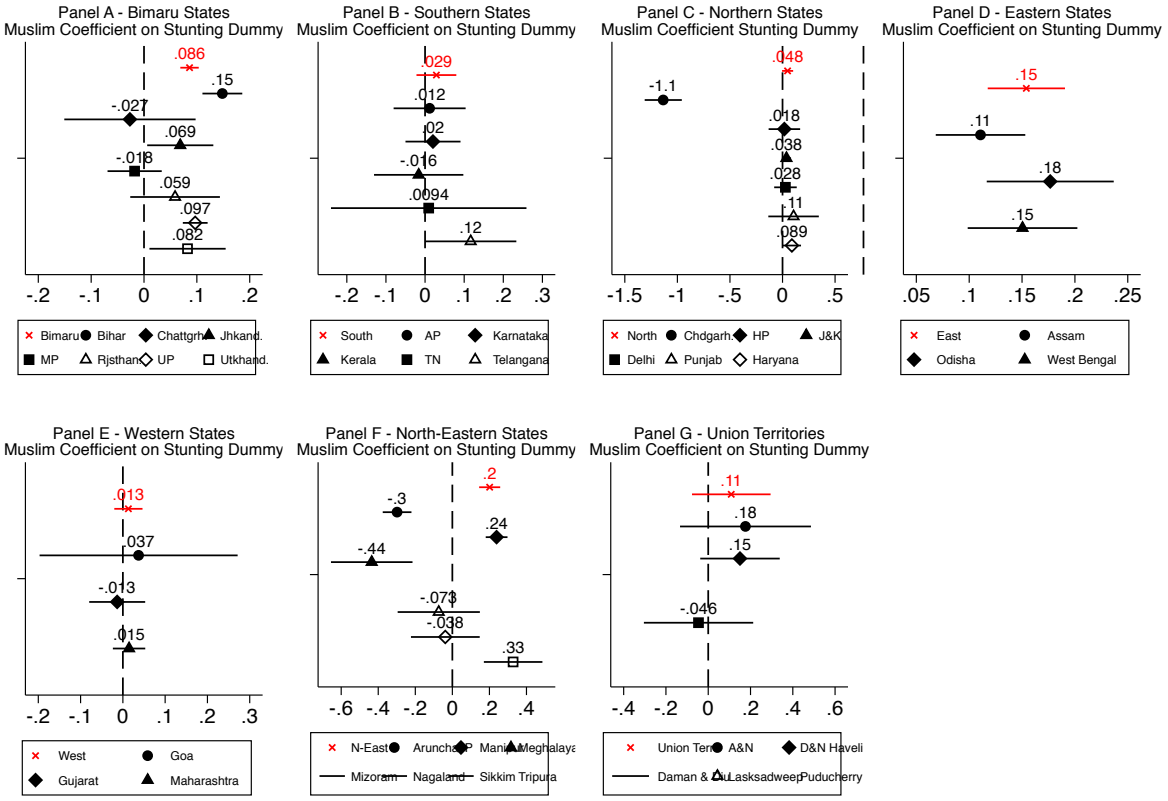

Figure S10: Gaps between the UC-Muslims and UC-Hindus in rate of chronic malnutrition by state

Notes: The above presents the results of regressing the dummies for social group on a dummy for stunting by state and include fixed effects for district of residence, all combinations of age in months and dummy for gender and rural residence. The data is from the the Demographic and Health Surveys for India also known as the National Family Health Survey (NFHS-IV) from the year 2015-16.

4 Part-IV

This part explores the relationship between the practice of untouchability and its effect on child anthropometric status, as well as the impact on the provision of ante and post natal services to pregnant and nursing mother's and children.

The key question is to what extent might these gaps in children heights be a reflection of societal discrimination and stigma towards subaltern groups? Despite decades of legal or formal equality between caste groups, discriminatory practices against Dalits such as residential segregation, violent hate and sexual crimes especially against Dalit women, denial of entry into temples, prohibitions on inter-caste marriages, forms of bonded labor, segregation in classrooms and discrimination by teachers, discriminatory access to water and irrigation facilities, unequal treatment under the justice system and discrimination in public streets and market places among others remain widespread and rampant (*9*).

More directly related to field of health the study *Untouchability in Rural India* reports that Dalits were denied entry into private health centers or clinics in 74 out of 348 villages surveyed. Moreover, the study found that in 30-40 percent of the villages surveyed, public health workers refused to visit Dalit villages. In 15-20 percent of villages, Dalits were denied admission to public health clinics; if admitted, in 10-15 percent of the villages they received discriminatory treatment (*10*).

Similarly, in the context of Gujarat and Rajasthan, based on interviews with around 200 Dalit children a study (*11*) reports widespread discrimination in rural public health care services in the states of . These patterns of discrimination are reported in all spheres ranging from home visits of health care professionals, practice of untouchability, information provision, dispensation of medicine, diagnosis and laboratory testing. For instance, 91 percent of Dalit children report experiencing caste-based discrimination in receiving medicines, and 87 percent

in the conduct of pathological tests. These practices are especially prevalent among grassroots workers with 94 percent of respondents reporting that Auxiliary Nurse Midwife (ANM) refuse to enter Dalit homes, 93 percent reporting that public health workers refuse to touch children while dispensing medicine, and 98 percent report they serve food last to SC children. These discriminatory practices are driven by prejudiced notions harbored by service providers about Dalit children. As the study (*11*) notes, "Conventionally, improper drainage, flies and garbage, and consumption of stale food mark their understanding of the Dalits. However, during the group discussions, 'children with running nose, which they keep licking', ill-clad or naked children playing in the dirty streets also emerged as the markers".

A recent study finds that "Although the average gap in height between higher caste and lower caste (SC and OBC) children in rural India cannot fully be explained by household-level SES variables, these variables can fully explain the caste height gap in those localities where SC and OBC children do not live with higher caste neighbors" (*12*). They interpret the remaining gaps, after accounting for the socioeconomic determinants, as presence of 'local' discrimination. They posit the hypothesis that in areas where the lower caste people inhabit with the higher castes, the higher caste "might enforce the social rank of lower caste households, especially SCs, in ways that could create stress and limit access to common resources, such as clean water, which would matter for child health but would not show up in household economic status"

These studies suggest that stigmatizing and extralegal practices against Dalits remain widely prevalent, and also affect access and quality of health care available to stigmatized groups. Table S12 shows the prevalence of the practice of untouchability by state and also presents the average HFA-Z-Score and rates of chronic malnutrition levels by state for the SC and UC-Hindus. We see the practice is widely prevalent, especially in the BIMARU states with 49, 48, 28, 51, 50, 44 and 47 percent of households report practicing untouchability in Bihar, Chhattis-

garh, Jharkhand, Madhya Pradesh, Rajasthan, Uttar Pradesh and Uttaranchal, respectively. The data shows that on average 24 percent of the households in a state report practicing untouchability, with the state at the 25^{th} (Nagaland) and 75^{th} percentile (Odisha) having 7 and 44 percent, respectively.

Table S13 shows the prevalence of the practice of untouchability by four occupation categories: (1) health workers which include physicians and nurses; (2) teachers; (3) elected and government officials which include elected officials, government officials and village officials; and (4) all other occupations. Looking at the prevalence of the practice of untouchability by occupation shows that 42 percent of health workers in the BIMARU region self-report practicing some form of untouchability. The IHDS data suggest not only high prevalence of stigmatizing behaviour in society, but more worrying is that such attitudes are professed by almost a quarter of key public service providers such as teachers, nurses and village officials.

Figure S11 shows that shows the scatter plot and the fitted line with 95 percent confidence intervals for the prevalence of untouchability and gaps in HFA-Z-score and rates of chronic malnutrition at the state level. It shows that gaps in stunting (height) between the SC and UC are increasing (decreasing) in the proportion of households who report practicing discrimination.

We next turn to examine how discrimination affects the quality of health care provided right from pregnancy to postnatal care, as well as services provided to infants through the Integrated Child Development Services (ICDS), one of the key institutions in India with the mandate to improve women and child health in India.

More specifically, we consider the effect on the entire pathway from pregnancy to infancy. More specifically, we consider seven antenatal and seven post birth factors that potentially affect child height:

- **Effect on antenatal services**: (1) whether registered pregnancy; (2) met any health worker in the last 3 months of pregnancy; (3) services received from Anganwadi or the

health care center during pregnancy - (i) any benefits[1]; (ii) health and nutritional education; (iii) supplementary nutrition; (4) weighed during pregnancy; and (5) during pregnancy whether mother given or bought iron tablets or syrup.

- **Effect on birth and postnatal care**: (1) gave birth in a public facility; (2) mother's health checked on discharge or delivery; (3) baby receives a postnatal check within 2 months of birth; (4) mother receives advice on breastfeeding; and (5) services post birth received from Anganwadi - (i) any benefits while breastfeeding;[2] (ii) infant received any benefits in the last 12 months; (iii) child was weighed after mother received counselling.

It includes the following figures and tables:

1. Table S12 shows the proportion of households reporting practicing untouchability by states in India. It also presents the average HFA-Z-Score and rates of chronic malnutrition levels by state for the SC and UC-Hindus.

2. Table S13 shows the proportion of people reporting practicing untouchability by certain professions and zones in India.

3. Table S14 presents the regression results corresponding to Figure 2 of the manuscript. It presents the predicted HFA-Z-Scores and rates of chronic malnutrition for the SC and UC-Hindu children by the quartiles of experience of untouchability of SC households. More, specifically the equation estimatedis:

$$O_i = \sum_{k=1}^{k=5}(SC * QuintileUT_k)\psi_{1k} + \sum_{k=1}^{k=5}(QuintileUT_k)\psi_{2k} + \beta_1 SC_i + \epsilon_i, \qquad (2)$$

where O_{is} is the height-for-age-Z (HFA-Z) score (or a dummy for being stunted) of child i resident in state s. $QuintileUT_k$ refers to the k quintiles of the distribution of the practice

[1]These refer to supplementary food, health check ups and health and nutrition education.
[2]These refer to supplementary food, health check ups and health and nutrition education.

of untouchability by SC households. The standard errors are clustered at the level of primary sampling unit which is defined as group identifier combining state, urban-rural residence and the sampling cluster number.

4. Table S15 and S16 explores the impact of stigmitization on the set of outcomes potentially affecting children's status of malnutrition, from conception to infancy, we restrict the sample to the UC and SC mothers and estimate the equation:

$$O_{is} = \alpha + \beta_1 * UT_s + \beta_2 SC_i * UT_s + \beta_3 SC_i + \eta X_i + \epsilon_{is}, \tag{3}$$

where O_{is} refers to one of the 14 outcomes, outlined above, for mother i resident in state s. The variable UT_s refers to the proportion of households reporting practicing untouchability in state s from the IHDS-II. SC_i is a dummy that takes value 1 if the mother belongs to the SC group and X_i are set of fixed effects for age in months and gender. The coefficient of interest is β_2, which is the one associated with the interaction of the SC dummy with the variable UT_s.

The results show that for 13 of the 14 outcomes the areas where the households are more likely to practice untouchability are precisely the same areas where the SC mothers and children face a reduction in accessing and utilizing key antenatal and postnatal inputs. It is also important to note that the coefficient on the variable "share of households practicing untouchability" is also negative and significant for 13 of the 14 outcomes, though the magnitude of the effect on the SC mothers is almost twice the size of the effect on the UC mothers for most of the outcomes considered.

Table S12: Practice of untouchability by households, child heights and chronic malnutrition

State Name	Share Practicing of Untouchability	HFA-Z-Score		Prop. Stunted	
		SC	UC-Hindus	SC	UC-Hindus
ANDHRA PRADESH	0.1	-1.42	-1.03	0.3	0.22
ARUNACHAL PRADESH	0	-0.9	-1.06	0.21	0.29
ASSAM	0.33	-1.32	-1.11	0.31	0.25
BIHAR	0.49	-2.08	-1.16	0.53	0.29
CHANDIGARH	0.22	-1.29	-1.18	0.3	0.22
CHHATTISGARH	0.48	-1.63	-1.14	0.36	0.28
DADRA AND NAGAR HAVELI	0.33	-1.56	-0.74	0.59	0.19
DAMAN AND DIU	0.33	-0.23	-0.07	0.07	0.17
DELHI	0.17	-1.74	-0.93	0.31	0.21
GOA	0	-0.99	-1.09	0.24	0.22
GUJARAT	0.32	-1.42	-1.1	0.35	0.25
HARYANA	0.25	-1.46	-1.16	0.34	0.26
HIMACHAL PRADESH	0.5	-1.32	-1.05	0.32	0.22
JAMMU AND KASHMIR	0.19	-1.45	-0.99	0.34	0.24
JHARKHAND	0.18	-1.87	-1.14	0.47	0.29
KARNATAKA	0.35	-1.43	-1.09	0.34	0.28
KERALA	0.01	-0.9	-0.57	0.19	0.16
MADHYA PRADESH	0.51	-1.79	-1.26	0.45	0.3
MAHARASHTRA	0.03	-1.4	-1.13	0.37	0.26
MANIPUR	0	-1.33	-0.99	0.3	0.2
MEGHALAYA	0.01	-0.91	-1.18	0.21	0.29
MIZORAM	0.03	-1.76	-1.11	0.55	0
NAGALAND	0.07	-1.11	-0.85	0.31	0.11
ODISHA	0.44	-1.47	-0.81	0.34	0.17
PUDUCHERRY	0.58	-0.8	1.12	0.2	0
PUNJAB	0.23	-1.23	-1.22	0.28	0.28
RAJASTHAN	0.5	-1.71	-1.17	0.42	0.28
SIKKIM	0.08	-0.91	-0.9	0.24	0.26
TAMIL NADU	0.21	-1.15	-0.79	0.29	0.22
TRIPURA	0.17	-1.09	-1.17	0.24	0.21
UTTAR PRADESH	0.44	-2	-1.32	0.5	0.32
UTTARAKHAND	0.47	-1.37	-1.05	0.34	0.26
WEST BENGAL	0.01	-1.4	-1.07	0.31	0.23

Notes: The table presents the share of households reporting practicing untouchability from the Indian Human Development Survey 2011-12 (IHDS-II). The average HFA-Z-Scores and rates of stunting are from the NFHS-IV.

Table S13: Practice of untouchability by occupation and regions

Occupation	BIMARU	SOUTH	NORTH	EAST	WEST	N-EAST	UNION TERRT.
Health Workers	0.41	0.08	0.12	0.14	0.05	0	1
Teachers	0.42	0.14	0.24	0.2	0.1	0.05	0.58
Elected and Govt. Officials	0.42	0.22	0.22	0.18	0	0	0
Others	0.42	0.17	0.21	0.16	0.12	0.06	0.52

Notes: The table presents the proportion reporting practicing untouchability by occupation and regions in the country. It is drawn from the Indian Human Development Survey 2011-12 (IHDS-II).

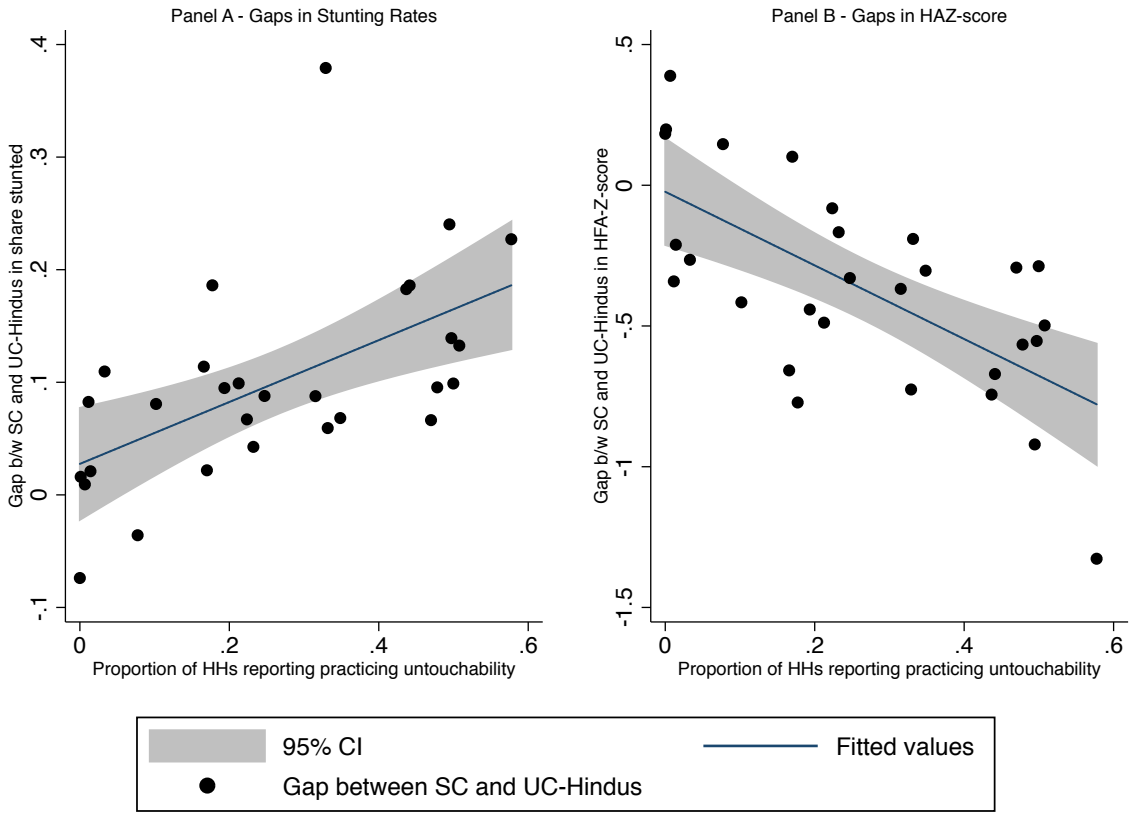

Figure S11: The prevalence of untouchability and gaps in HFA-Z-Score and chronic malnutrition between SC and UC-Hindus

Notes: The prevalence of untouchability at the state level is calculated from the second round of the Indian Human Development Survey (IHDS) conducted in 2011-12. The data on stunting gaps between the schedule castes and the UC-Hindus is based on the NFHS-IV from the year 2015-16.

Table S14: Practice of untouchability by households and child heights of UC-Hindus and SC

	DV - Predicted HFA-Z-Score	DV - Predicted Stunting rates
UC-Hindus - Untouchability Practice 1st Quintile	-1.06***	0.24***
	(0.032)	(0.0089)
SC - Untouchability Practice 1st Quintile	-1.44***	0.33***
	(0.034)	(0.0086)
UC-Hindus - Untouchability Practice 2nd Quintile	-1.11***	0.26***
	(0.040)	(0.0092)
SC - Untouchability Practice 2nd Quintile	-1.27***	0.31***
	(0.031)	(0.0075)
UC-Hindus - Untouchability Practice 3rd Quintile	-1.21***	0.29***
	(0.032)	(0.0080)
SC - Untouchability Practice 3rd Quintile	-1.86***	0.46***
	(0.021)	(0.0058)
UC-Hindus - Untouchability Practice 4th Quintile	-1.13***	0.29***
	(0.039)	(0.0097)
SC - Untouchability Practice 4th Quintile	-1.99***	0.50***
	(0.028)	(0.0082)
UC-Hindus - Untouchability Practice 5th Quintile	-1.19***	0.28***
	(0.029)	(0.0074)
SC - Untouchability Practice 5th Quintile	-1.73***	0.43***
	(0.025)	(0.0075)
Observations	68,650	74,188

Standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Notes: The table presents the results of estimating equation 2 and then using the STATA margins command to calculate the predicted values of the dependent variable. The standard errors are clustered at the level of the PSU.

Table S15: Effect of the practice of untouchability on antenatal inputs

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Effect on antenatal care						
	Regd. Preg.	Met Health Worker Last Three Months of Preg.	Dummies for Recd. Benefits from ICDS during Preg.			During Preg. Weighed	Given or Bought Iron Tablets
			Any	Education	Suppl. Nutrition		
SC*Share Practice untouchability	-0.103***	-0.207***	-0.117**	-0.101**	-0.235***	-0.336***	-0.0323
	(0.0233)	(0.0435)	(0.0483)	(0.0414)	(0.0169)	(0.0336)	(0.0440)
SC	0.0350***	0.172***	0.204***	0.0237	0.0225***	0.0507***	0.181***
	(0.00756)	(0.0172)	(0.0194)	(0.0146)	(0.00360)	(0.0121)	(0.0175)
Share Practice untouchability	-0.249***	-0.159***	-0.124***	-0.493***	-0.244***	-0.212***	-0.209***
	(0.0190)	(0.0370)	(0.0405)	(0.0334)	(0.0107)	(0.0270)	(0.0366)
R-squared	0.0345	0.0309	0.0338	0.0574	0.0779	0.0290	0.0387
Observations	56189	56189	74188	41753	47701	56189	56189

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: The table presents the results of estimating equation 2 and then using the STATA margins command to calculate the predicted values of the dependent variable. The standard errors are clustered at the level of the PSU.

Table S16: Effect of the practice of untouchability on birth and postnatal health inputs

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Effect on birth and postnatal care						
	Dummies for						
	Gave Birth in Public Health Facility	Health Check after Delivery /Discharge	Baby Postnatal Check Within 2 months	Breastfeeding Advice Recd.	Recd. Benefits from ICDS		
					While Breast-feeding	for Child in Last 12 Months	Counsel Post Child Weighing
SC*Share Practice untouchability	-0.369***	-0.159***	-0.223***	-0.0741*	-0.135***	-0.172***	-0.150***
	(0.0405)	(0.0595)	(0.0431)	(0.0386)	(0.0480)	(0.0442)	(0.0575)
SC	0.251***	0.109***	0.105***	0.0311**	0.197***	0.192***	0.0587***
	(0.0161)	(0.0249)	(0.0170)	(0.0135)	(0.0194)	(0.0177)	(0.0201)
Share Practice untouchability	0.235***	-0.0983**	-0.181***	-0.365***	-0.158***	-0.127***	-0.0909**
	(0.0304)	(0.0430)	(0.0338)	(0.0282)	(0.0402)	(0.0388)	(0.0464)
Constant	0.399***	0.208***	0.433***	0.906***	0.457***	0.520***	0.676***
	(0.0119)	(0.0175)	(0.0132)	(0.00968)	(0.0162)	(0.0157)	(0.0157)
R-squared	0.0306	0.0249	0.0166	0.0469	0.0329	0.0408	0.00990
Observations	74188	20345	56189	28113	74188	74188	31479

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: The table presents the results of estimating equation 2 and then using the STATA margins command to calculate the predicted values of the dependent variable. The standard errors are clustered at the level of the PSU.

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