Ashoka University Economics
Discussion Paper 87

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October 2022

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https://ashoka.edu.in/economics-discussionpapers

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Discriminatory Social Norms and Early Childhood Development

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Abstract

India is home to nearly a third of all world's stunted children with a prevalence rate of 38.6 percent. A comparison by social groups reveals sharp intergroup disparities, with the upper caste (UC) Hindu children being 57 percent less likely to be stunted compared to Dalit or Scheduled Caste (SC) children. We explore the role of discrimination in shaping disparities in stunting rates between the socioeconomically dominant UCs and the stigmatized SCs. We show that districts with high prevalence of the illegal but widely pervasive stigmatising practice of untouchability have higher rates of stunting among SC children. To show how discriminatory social norms adversely affect early childhood development for stigmatised and marginalised groups, we exploit the fact that the historical geographical span of Hinduism was bounded to the south by the Vindhya mountain range. We compare how the heights and stunting rates of the UC-Hindu and SC children vary within the same state between those living within 100km to the north and south of the Vindhya range using a difference-in-differences (DID) estimator. The DID estimator shows that there are no differences in child height and stunting rates for UC-Hindu children living to the north and south of the Vindhya range. In contrast, the SC children living to the south of the Vindhya range are seen to have 40 percent lower levels of stunting. To illustrate channels, we document disparities across the north and south of the Vindhya range in provision of prenatal and antenatal services for SC mothers, education and health outcomes of SC mothers, as well as disparities in the rates of vaccinations of SC children.

(The latest version of the paper is here.)

Keywords: caste, stunting, discrimination, untouchability, India

JEL: I1, J13, Z12, Z13

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1 Motivation

Low height-for-age or stunting, often a manifestation of chronic child malnutrition is a global health concern, with one in four children worldwide classified as stunted (UNICEF, 2018). India is not only home to nearly a third of all world's stunted children, but Indian children are shorter than children in sub-Saharan African (SSA) countries that are poorer than India. This has led to a large body of literature trying to uncover the puzzle of "why Indian children are short" relative to their African counterparts (Deaton, 2007; Panagariya, 2013; Jayachandran and Pande, 2017; Spears, 2018)[1].

The India-Africa focus has resulted in most of the literature overlooking the disparities within India. To illustrate the role of social group disparities within India, Panel A of Figure 1 plots the average height-for-age Z score (HFA Z-score)[2] and Panel B plots the rates of stunting for SSA and five major social groups in India that account for the two key cleavages in Indian society, *viz.*, caste and religion. These are: upper caste Hindus (UC-Hindus); the middle-ranked Other Backward Classes (OBCs); Scheduled Castes (SCs) or Dalits, subject to the stigmatizing practice of untouchability; Scheduled Tribes (STs) or Adivasis, which are marginalised tribal groups; and the upper caste Muslims (UC-Muslims).[3] 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.

Differentiating in this manner reveals that the children belonging to the the socioeconomically dominant group in India, viz., UC-Hindus, 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 children belonging to SC, ST, OBCs and UC-Muslim groups are -1.64, -1.68 -1.49 and 1.52, respectively. In other words, the gaps

[1]We would like to thank Gaurav Datt, Andreas Grunewald, Karen Macours, Devesh Rustagi, Anisha Sharma and Alessandro Tarozzi for helpful comments and suggestions on earlier drafts. We are also grateful to conference participants at many institutions e.g., Yale University; Indian Statistical Institute, New Delhi; Delhi School of Economics; Goethe University; International School of Business, Hyderabad; Summer School in Development Economics, Prato; German Development Association Meeting, Gottingen; Watson Institute for International and Public Affairs, Brown University, and many others, where earlier versions of this research project were presented, for their suggestions and useful comments. We are responsible for all remaining errors and omissions.

[2]The HFA Z-score 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 (WHO Multicentre Growth Reference Study Group, 2006). On the other hand, a child is classified as stunted if they are more than 2 standard deviations below the world reference median.

[3]See Section 2 for expanded definitions of these social categories.

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 patterns in stunting: on average, 32% of children in SSA are stunted. With a stunting incidence of 29%, UC-Hindu children are 3% points less likely to be stunted than children in SSA. 43, 44, 39 and 39% of the SC, ST, OBCs and UC-Muslim children, respectively, are stunted. Thus, SC, ST, OBCs and UC-Muslims children are 14, 15, 10 and 10% points, or 35 to 50%, 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" relative to their African counterparts needs to be reformulated as "why are children belonging to *some* groups shorter than African children?" This question needs to be complemented with the question "why are the gaps in child height between social groups within India so high?" This is the question that we address in this paper. We focus on the gaps in child height and stunting between the two ends of the caste hierarchy - UC-Hindus and the SCs - and elucidate the role of caste- based discrimination in moderating these gaps.

1.1 Main Results

Drawing on the National Family Health Survey 2015-16 (NFHS-IV) of India, we first provide a detailed description of the gaps in child height and stunting incidence between SC and UC-Hindu under-five children. We find that the gap in child heights is present at all age profiles (0-60 months), and it remains roughly constant at around 0.40 standard deviation units (relative to the world reference median) in favor of UC-Hindu children. In terms of stunting, we find that SC children are around 50% more likely to be stunted than the UC-Hindus. The distribution of stunting prevalence by district highlights the sharp disparities between the two groups: whereas for SC children the prevalence of stunting is greater than 50% in a quarter of the districts in the country, the commensurate figure for the UC-Hindus is around 3%.

Examining the regional patterns shows that both the rates of stunting as well as the gaps between the groups are highest in the northern plains of India comprising of the states of Bihar (& Jharkhand), Madhya Pradesh (& Chattisgarh), Uttar Pradesh (& Uttarakhand) and Rajasthan collectively also known as the BIMARU states.

To understand the importance of caste-based discrimination in moderating these gaps, we draw on the Indian Human Development Survey 2011-12 (IHDS-II). The IHDS-II provides self-reported nationally representative data on the practice and experience of the illegal, but widespread, and highly stigmatizing practice of untouchability. The data shows that nationally around 28% of households report practicing untouchability, and 21% of SC households report being subject to the practice of untouchability. Moreover, the rates of practice and experience are seen to be especially high in the BIMARU region states with on average 45% of households reporting practicing untouchability and 35% of SC households reporting being subject to its practice. We match the data from IHDS-II to that from NFHS-IV and find a strong negative association between the practice of untouchability and child height for SC children, whereas the heights of the UC-Hindu children are uncorrelated with the practice of untouchability.

To establish a causal link between the practice of untouchability and child height, we exploit the fact that the historical geographical span of Hinduism was bounded to the south by the Vindhyas mountain range (Thapar, 1990). Historical evidence shows that the descendants of the Indo-Europeans such as the Indo-Aryan tribes entered present day northern India around 1500 B.C. Their influx and their conflicts with pre-Aryan populations gradually transformed the relationships between tribes into hierarchical arrangements, which are the earliest manifestation of the caste system. Scholars have examined evidence of linguistic and genetic spread to determine the geographic areas where the Indo-Aryans dominated. This came to be called Arayavarta, the Land of the Aryas, which was the cultural centre of traditional Hinduism. The natural boundaries of the Aryan lands were defined by the Vindhya mountain range, with the land of the Aryas lying to the north of the Vindhyas range.

Drawing on this history, we suggest that the caste system and practices such as untouchability more strongly define the social code of the caste system to the North of the Vindhyas range compared to the South of the Vindhyas range. Hence, we compare how the heights and stunting rates of the UC-Hindu and SC children vary between those living within 100 km to the north relative to those living 100 km to the south of the Vindhyas using a difference-in-differences (DID) estimator.

The DID estimator shows that there is no effect on child height and stunting rates for UC-Hindu children living to the north or south of the Vindhyas range. In contrast, the SC children living to the south of the Vindhyas range are seen to be around 30% taller, and have 40% lower levels of stunting than their SC counterparts living to the north of the Vindhyas range.

We carry out a series of tests to rule out alternative explanations. We show that there is no influence of economic status, measured by a wealth index score on anthropometric outcomes for the north-south Vindhyas divide, that is, the interaction between the wealth index score with a dummy for living south of the Vindhyas range is close to zero and statistically insignificant. We also carry out the same comparison but restricting the analysis to one side of the Vindhyas, i.e. either 100 kms north or 100 kms south of the Vindhyas and find that the DID estimator shows no differences in heights of SC children living 0-50km and 50-100km to the north (south) of the Vindhya range. In other words, we can show that the results can not be attributed to a north-south gradient on either side of the Vindhya mountain range, but only arise when residing on opposite sides of the Vindhyas range.

Our explanation of higher rates of stunting for SC children living north of the Vindhyas is the higher prevalence of untouchability-related practices that negatively affect the well-being of SC children through discrimination in the provision of health and other public services. Consistent with this, comparing UC-Hindu and SC mothers from the north to those from the south and, we find that SC mothers living 100 km to the south of the Vindhyas range are more likely to report that they received some form of prenatal care, and less likely to have a home delivery. Moreover, SC mothers in the south also have more years of schooling and are less likely to be of short stature, compared to their counterparts to the north of the Vindhyas.

To explore the role of untouchability on health service delivery to children, we focus on disparities in the rates of vaccination, where ethnographic studies have found evidence of untouchability related stigmatisation and exclusion (Acharya, 2010; Davenport et al., 2010). Again employing the DID estimator, we find that SC children living within 100 km south of the Vindhya range are more likely to be vaccinated compared to their northern SC peers. In conclusion, our results provide evidence to show how caste-based discrimination and marginalisation affects the early childhood health indicators differentially for SC and UC-Hindu children. To the best of our knowledge, our paper is the first to demonstrate the causal impact of discriminatory norms on health outcomes in the Indian context. Our results show that the roots of present-day adult life caste disparities lie in early childhood disparities. This result significantly validates the argument that contemporary caste disparities are perpetuated via ongoing discrimination and not a hangover of the past.

1.2 Related Literature

The paper which is closest to our work is a recent study by Coffey et al. (2019). They explore gaps in child heights across social groups in rural India. They document that differences in socioeconomic status (SES) between SC (OBCs) and upper caste children fully explain gaps in child height in those areas where SC and OBC children do not live with higher caste neighbors. On the other hand, in areas where SC (OBCs) and upper caste tend to co-inhabit, SES cannot fully explain the gaps in child height. They interpret the remaining gaps in mixed neighborhoods 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" (Coffey et al., 2019, 1432). We go further and extend this work by providing more direct evidence on the link between caste discrimination and gaps in child height, as well as in public service delivery.

Our paper also relates to a lot of ground work and media reports (see Barbour et al., 2007 for an overview), as well as ethnographic and sociological literature that documents deep-rooted stigmatization and social discrimination of SC individuals often taking the form of untouchability related practices (Shah et al., 2006; Davenport et al., 2010). This extends to discrimination in access to public services such as food security programs (Thorat and Lee, 2005), in accessing health care for children (Acharya, 2010), in access to water resources (Bros and Couttenier, 2015) and public roads (Girard, 2020). Our paper documents the role of caste based discrimination in early childhood health disparities, which are mediated through discrimination in the provision of health care services.

The third body of work related to our paper is the literature on early childhood interventions, which show show large improvements in adult outcomes from investments in child health and human capital (Heckman et al., 2006; Gertler et al., 2014), as well as studies documenting lasting adverse effects of stunting that shape adult life disparities in cognitive, human capital, health and material outcomes (Case and Paxson, 2010; Currie and Almond, 2011; Currie and Vogl, 2013). The documented findings suggest that SC children are likely to be at a serious disadvantage in adult life as almost half of them are stunted, which results in multiple forms of disadvantage. Our results suggest that tackling early childhood stunting would play a major role in lowering adult life caste disparities. Recognising the deadly effects of untouchability and resultant social stigma on early childhood indicators of stigmatised groups can pave the way for urgent and appropriate policy responses.

The rest of the paper is organised as follows. Section 2 presents the data and descriptive statistics. Section 3 discusses caste-based discrimination, in particular the stigma of untouchability and the historical evidence on the region under the Indo-Aryan influence. Section 4 outlines our main identification strategy based on the historical spread of the Aryavarta region, and presents results along with falsification tests. Section 5 offers concluding remarks.

2 Data and descriptive statistics

We start by providing an overview of the five groups in society that account for the two most important cleavages in Indian society: caste and religion. We then focus on the two ends of the caste hierarchy and present a detailed picture of the disparities in child height between UC-Hindus and SC children. Our principal data source is the the National Family Health Survey of 2015-16 (NFHS-4), which provides anthropometric measures for a nationally representative sample of 230,898 under-5 children from India for whom information on caste is available. Our sample consists of 45,924 and 29,132 SC and UC-Hindu children, respectively, aged 0-59 months. We also additionally employ the Indian Human Development Survey (IHDS-II) conducted in 2011-12, when we explore the role of caste based discrimination in affecting the gaps in child height.

2.1 The social groups

A five-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. While there has not been a caste-based census since 1931, representative national surveys indicate that UC-Hindus are roughly 14% of the population.[4] The SC and ST comprise around 17 and 7% of the national population, respectively, and are among the most socioeconomically disadvantaged groups. The SC have been not only at the bottom, but on the margins of the caste system, and called "avarnas" (sans varna), that is, unfit to be granted a varna. This is because their traditional caste-based occupations were considered dirty and polluting, as a result of which they historically were ostracised as outcastes and considered untouchable. SCs and STs are administrative

[4] We would 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.

categories, each containing several hundred castes (jatis) and communities, created for the purposes of affirmative action. SCs use the term "Dalit" (meaning oppressed) as a term of self-identification. STs, are often referred to as "Adivasis" (original inhabitants or indigenous people). In the paper, we use SC and Dalit (and ST-Adivasi) interchangeably. The OBCs, comprising roughly 44 to 46 % of the population, is a group of intermediate to low-ranked castes and communities that did not suffer the stigma of untouchability (Deshpande, 2013). The last group labeled UC-Muslims are the non-SC-ST-OBC Muslims. While overall, the minority Muslim community faces multiple forms of disadvantage (Sachar et al., 2006), there are caste-like cleavages within the Muslim community. The group UC-Muslim captures the relatively better-off members of the community.

2.2 Height-for-age-Z-scores and stunting by caste

Panel A and B of Figure 2 presents the height-for-age (HFA) z-score and the average rates of stunting, respectively, on the y-axis and the child's age in months on the x-axis for the two groups. The graphs shows three features: (i) at every age profile the UC-Hindu children are taller, and have lower rates of stunting, than the SC children; (ii) the height-for-age-Z-score drops, and the stunting rates increase, sharply for both groups till about 20 months of age and then remains roughly stable; and (iii) the height-for-age-Z-scores, and the stunting patterns, of the two groups demonstrate the same time trends.

To understand differences by caste group, we construct district level averages of stunting for SC and UC-Hindu children. The data set has information on 585 districts in the country. However, for the group under consideration, we only include districts where the group has a minimum of 25 observation. This leaves us with 467 and 369 districts for the SCs and upper caste Hindus, respectively.[5] We classify the districts into five categories:

1. Category 1 where the average rate of stunting lies in the range of 0 to 20 %;
2. Category 2 where the average rate of stunting lies in the range of greater than 20 and less than equal to 30 %;
3. Category 3 where the average rate of stunting lies in the range of greater than 30 and less than equal to 40 %;

[5]The average number of observations for the SCs and upper caste Hindus in these districts is 93 and 73, respectively.

4. Category 4 where the average rate of stunting lies in the range of greater than 40 and less than equal to 50 %; and

5. Category 5 where the average rate of stunting lies in the range of greater than 50 %.

Panel A of Table 1 shows that for the SC children in only 8 (or 1.71% of the) districts the average rate of stunting is between 0 and 20 %; in 64 districts (13.70%) the average rate of stunting is greater than 20 and less than equal to 30%; in 139 districts (29.76%) the average rate of stunting is greater than 30 and less than equal to 40%; in 140 districts (29.98%) the average rate of stunting is greater than 40 and less than equal to 50%; and in 116 districts (24.84%) the average rate of stunting is greater than 50%.

In contrast, Panel B of Table 1 shows that for the UC Hindus, in 65 districts (17.62%) the average rate of stunting is between 0 and 20%; in 136 districts (36.86%) the average rate of stunting is greater than 20 and less than equal to 30%; in 111 districts (30.08%) the average rate of stunting is greater than 30 and less than equal to 40%; in 47 districts (12.74%) the average rate of stunting is greater than 40 and less than equal to 50%; and in 10 districts (2.71%) the average rate of stunting is greater than 50%.

In other words, for Dalit children, in 55% of the districts stunting rates are greater than 40%, whereas this is the case only in 15% of the districts for the UC-Hindu children. In contrast, there are only 15% of districts in which the stunting rates for SC children are lower than 30% whereas this is the case in 54% of the districts for the UC-Hindu children.

2.3 Regional differences in stunting by caste

To shed light on regional patterns, we plot the district level averages of stunting for the SC and UC-Hindus. Figure 3 plots color coded heat maps showing the spatial distribution of the average proportion by district and social group, where the thin black lines depict the district boundaries and the thick black lines the state boundaries and the prevalence of stunting is increasing in the intensity of the color.

In terms of regional patterns, Figure 3 shows a very clear pattern with the areas with the highest prevalence of stunting for SCs concentrated in the states of Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Rajasthan and Uttar Pradesh, as can be seen by the northern and central plains being largely red in color. These states are also refereed to as BIMARU, 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 (Bose, 2000). The BIMARU region is also important due to its high population share; it comprises 50.8 % of our total sample. In fact in the BIMARU region in 180 (or 82% of the) districts the prevalence of stunting is greater than 40 % for the SC children; and in 99 (or 45% of the) districts more than half the SC children are stunted. However, for the upper castes in the BIMARU region, in only 20% of districts is stunting greater than 40% and only in 3.61% is it greater than 50%.

In contrast, in the southern[6] and northern regions[7] of the country, only in 24 and 22% of the districts, respectively, is the prevalence of stunting higher than 40 % for the SC children. For the upper caste Hindus in the southern region their prevalence of stunting is greater than 40 % in 16% of the districts, and in the Northern region in 10% of the districts. The eastern[8] and western regions[9] present an intermediate picture. In 34% and 65% of the districts, respectively, the prevalence of stunting is greater than 40 % for the SC. On the other hand, in the eastern regions, for the upper castes 5% and 17% of the districts the prevalence is greater than 40 % for the upper caste Hindus and OBCs, respectively.

Our estimates reveal that in the BIMARU region of India, which is home to more than 50% of India’s population, not only are rates of stunting the highest for SC children, but also that the gaps between SC and UC-Hindu children in stunting incidence are the highest. This provides the motivation for our exploration of the role of discrimination in affecting caste gaps in child height.

[6]The states included in the southern region are Andhra Pradesh, Karnataka, Kerala, Tamil Nadu and Telangana.

[7]The states included in the northern region include Chandigarh, Delhi, Haryana, Himachal Pradesh, Jammu & Kashmir and Punjab

[8]The states included in the eastern region are Assam, Orissa and West Bengal

[9]The states included in the western region are Goa, Gujarat, and Maharashtra.

3 Untouchability and Caste-based discrimination

3.1 The stigma of untouchability

To what extent might these gaps in children heights be a reflection of societal discrimination and stigma towards lower ranked 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 (Barbour et al., 2007). These are reflections of the highly stigmatizing practice of untouchability, rooted in the belief in ritual purity that regards association with waste matter "impure". Based on this belief, all groups whose traditional occupations have contact with human or animal waste or bodily fluids are themselves regarded as impure. Examples of such occupations are manual scavenging, butchery, leather workers, midwifery etc. Even though untouchability is legally abolished and its practice punishable by law, overt and covert instances of untouchability are widely prevalent.

More directly related to field of health, the study by Shah et al. (2006, 104) on *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 % of the villages surveyed, public health workers refused to visit Dalit villages. In 15-20 % of villages, Dalits were denied admission to public health clinics; if admitted, in 10-15 % of the villages they received discriminatory treatment. Similarly, Acharya (2010, Table 7.3, 218), based on interviews with around 200 Dalit children, reports widespread discrimination in rural public health care services in the states of Gujarat and Rajasthan. 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 (Acharya, 2010, 215). For instance, 91 % of Dalit children report experiencing caste-based discrimination in receiving medicines, and 87 % in the conduct of pathological tests. These practices are especially prevalent among grassroots workers with 94 % of respondents reporting that Auxiliary Nurse Midwife (ANM) refuse to enter Dalit homes; 93 % reporting that public health workers refuse to touch children while dispensing medicine, and 98 % report they serve food last to SC children. These discriminatory practices are driven by prejudiced notions harbored by service providers about Dalit children. As Acharya (2010,

225) writes, "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" (see also Acharya 2010, Table 7.8, 225).

Davenport et al. (2010), in a study of 1589 villages in Gujarat, document that the practice of untouchability is not only pervasive but takes myriad forms; they identify 98 distinct practices in eight distinct spheres.[10] Particularly relevant to our setting they document that in more than two-thirds of the villages non-Dalit midwives do not provide services to Dalit women; in 53% of villages, Dalit children are both seated separately from non-Dalit children at the Mid-day meal at school, as well as expected to go home to drink water; and in more than 10% of villages even private doctors will not physically touch a Dalit. In a similar vein, another study conducted in 77 villages in Gujarat finds that rates of polio vaccination are half those of upper caste children and the practice of untouchability is a key factor underlying these differences in the rate of vaccination.[11]

To be able to measure the prevalence of discriminatory norms and practices, we leverage a unique question in the second round of the Indian Human Development Survey (IHDS) conducted in 2011-12, covering more than 42,000 households, which asks, "In your household, do some members practice untouchability", which is further followed up by "Would there be a problem if someone who is scheduled caste were to enter your kitchen or share utensils." We code households who answer in the affirmative to either of these questions as households who practice untouchability. We aggregate all households at the level of the state, and then create a state level indicator that captures the proportion of households that practice untouchability. We interpret this as proxy for the prevalence of discriminatory practices in a state.

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 43 percent, respectively. Looking at the prevalence of the practice of untouchability by occupation shows that 28 percent of teachers, 23 percent of nurses and village officials, and 22 percent of police self-report practicing some form of untouchability.

In addition, it also asks SC households whether any member was subject to the practice

[10]These are in the folowing sphers: 1) water for drinking, 2) food and beverage, 3) religion, 4) touch, 5) access to public facilities and institutions, 6) caste-based occupations, 7) prohibitions and social sanctions and 8) private sector discrimination.

[11]See here for more details.

of untouchability in the past 5-years. Figure 4 plots the scatter plot and the fitted line showing the self-reported practice of untouchability by households on the x-axis and the proportion of SC households reporting experiencing untouchability on the y-axis. The figure shows, one, that there are large differences in the practice of untouchability across Indian states. The prevalence and experience is extremely high in the BIMARU states - Bihar, Chattisgarh, Rajasthan, Uttrakhand, Uttar Pradesh and Madhya Pradesh - with on average 45% of households reporting practicing untouchability. On the other hand, in states such as Kerala, Andhra Pradesh and Tamil Nadu in the south show prevalence of less than 20 %. In between are states such as Haryana, Punjab, Gujarat and Assam with intermediates levels of prevalence of the practice.

Two, the experience of untouchability is increasing in its practice suggesting that these practices are not confined to the private sphere but result in actual stigmatization of SC individuals. Moreover, as expected the experience of untouchability is highest in the BIMARU states with 35% of SC households reporting being subject to the practice of untouchability. This figure is as low as 9 and 11% in the southern and northern regions and 11 and 21% in the east and west, respectively.

The data also exhibits a strong association between the practice of untouchability and child height for SC children, but not for the UC-Hindu children. 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. We then estimate the following equation:

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

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.

Figure 5 shows the results of estimating Equation 1 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 (stunting) sharply decreases (increases) in relation to the practice of untouchability. In contrast, the height/chronic malnutrition levels of the UC-Hindu children and the proportion of households reporting practicing untouchability do not show any such relationship.

3.2 The Historical Roots of the North-South Divide

The sharp difference in the prevalence and experience of untouchability, and in particular the concentration in the northern plains and the significantly lower rates in the South, can be traced to the establishment and evolution of the caste system on the Indian subcontinent. Joseph (2018)'s summary of DNA-based research confirms the accounts of historians of ancient India, such as Thapar (1990), from whose work we can establish the following timeline. The north-west of India had a pre-Aryan civilisation, the Indus Valley civilisation that started to decline in importance around the 2nd millennium B.C. When descendants of the Indo-Europeans such as the Indo-Aryan tribes from the northern Iranian plateau or migrants from southern Russian steppes entered around 1500 B.C., the Indus Valley civilisation had completely disintegrated. They entered the subcontinent from the north-west and moved inwards towards the east and south.

As multiple groups entered the subcontinent, there are accounts of conflicts both within migrant groups as well as between the migrants and pre-migrant non-Aryan populations. The influx of Indo-Aryan pastoralists and their conflicts with pre-Aryan populations gradually transformed the relationships between tribes into a hierarchical arrangements, which eventually solidified into the varna system, the earliest manifestation of the caste system, as the Aryans settled into agricultural life.

Scholars have examined evidence of linguistic and genetic spread to determine the geographic areas where the Indo-Aryans dominated. This came to be called *Arayavarta*, the Land of the Aryas, which was the cultural centre of traditional Hinduism. The "Vindhya complex, a continuous chain of mountains, hills and plateaus which stretches across central India" separated Aryavarta from "mleccha desas" or "barbarian lands", where non-Aryan languages were spoken, and Hindu rituals were not observed." (Southworth, quoted in Joseph 2018, 207). Mlecchas are people who cannot speak Sanskrit and are not Aryans. Manusmriti, a text composed around the beginning of the common era or a little earlier, laid down "social obligations and duties of various castes and of individuals in different stages of life" (see introduction of Doniger and Smith, 1992). It defines Aryavarta as the "country between the Himalayas and the Vindhya mountains, to the east of the 'Disappearance' and to the west of Prayaga[12]. Manusmriti included the entire stretch between eastern and western seas, between the two mountain ranges as what “the wise men call the Land of the Aryans” (v.22, Chapter 2, Manu, p.27, 1991 edition), whereas Sharma (1958) describes Aryavarta as the region between the Punjab and Bihar, and between Himalayas and the hills of Malwa” (p. 91), not stretching all the way between the two seas.

This historical literature backed by recent genetic evidence suggests the importance of the Vindhya mountains as the dividing line between Aryan and non-Aryan dominated regions. Untouchability was not a feature of Aryavarta in its early years. On the contrary, Sharma (1958) presents a range of evidence to show that intermixing, intermarriage, commensality were normal social practices governing interaction between social classes. Manual work was not stigmatised and neither were Sudras. Over time, roughly around 100 C.E. the divisions between varnas became rigid and intermixing came to a halt. Brahmananical society, that possessed the knowledge of metals and agriculture, “not only developed a contempt for manual work but also extended it to the hands that practiced it”. Sharma writes “against the backdrop of a very low material culture of the aborigines, the increasing contempt for manual work, combined with primitive ideas of taboo and impurity associated with certain materials, produced the unique social phenomenon of untouchability” (Sharma, 1958, p.146). This was the strongest in the Aryavarta region, whereas religions such as Buddhism and Jainism contested it.

This history is the basis of our contention that the caste system and the untouchability related practices strongly define social practices to the North of the Vindhyas range, in comparison to the South of the Vindhyas range which were not directly under the influence of the Indo-Aryan social order. This is also evident in the descriptive evidence from the IHDS-II that shows that the prevalence and experience of untouchability is concentrated in the norther plains of India.

[12]The Himalayas and the Vindhyas are the two great mountain ranges in Northern and Central India. Prayaga is the city that was called Allahbad, now renamed as Prayagraj; Vinasana (the ‘Disappearance’) is the place where the river Sarasvati disappears.

4 The north and south of Vindhyas and gaps in childhood stunting

4.1 Method

To be able to identify the effect of the social practices associated with untouchability on child height, we propose comparing how the gaps in stunting rates vary between the UC-Hindu children and SC children living to the north and south of the Vindhyas.

To be able to undertake this comparison, we carry out the following steps: First, we take the map of Vindhyas mountain range which is denoted by the yellow line in Figure 6.[13] Next, we overlay the data from the National Family Health Survey (NFHS-4) which provides the geographical coordinates for all of the respondents in the data. The third step involves assigning each individual a location, i.e. as living to the north or south of the Vindhyas range. Next, we calculate the distance for each of the respondent from the closest point to the Vindhyas. Finally, we compare how the rates of stunting vary between the UC-Hindu children and SC children within each state living in the north relative to the south of the Vindhyas range.

The key identifying assumption is that conditional on living in the same state within 100 kms of the Vindhyas range, any difference in the rates of stunting between UC-Hindu children and SC children living to the north relative to the south of the Vindhyas range is as a result of greater adherence to discriminatory caste norms or practices that are more prevalent in the north, i.e., the Aryavarta region. However, it is important to note that the Vindhyas act as a natural geographical barrier, implying that geography also varies to the north and south of the Vindhyas range. In order to ensure that the differences in stunting are not a result of differences in geography, we use detailed geographical information at the cluster level from the NFHS. This allows us to control for physical features that might potentially have a bearing on stunting outcomes. In addition, our strategy involves comparing how the rates of stunting vary between the SC and UC-Hindu children across the north and south, in other words a difference-in-differences (DID) estimator. This implies for geography to

[13]The southern edge of the escarpment is defined as north and parallel to Narmada. Further to the east, we employ the plains-highland edge (see Figure 6). Since our hypothesis is that Brahmin culture did not transmit south of the Vindhyas, and the impassibility of the Vindhyas is that it consists of highlands and is forested, we employ the the escarpment edge (but of course the plateau is no longer the Vindhyas but the Chhota Nagpur plateau). This results in separation of the Indo-Gangetic Plains from what we call the central Indian highlands, as we should expect.

bias our estimates, geography would require to have differential effects on stunting by caste identity.

In particular, we estimate the following DID estimator:

$$\begin{aligned} O_{isc} = \alpha + \beta_1 SC_i + \beta_2 \text{South of Vindhyas} + \beta_3 SC_i * \text{South of Vindhyas} \\ + \delta_s + \eta_1 X_{sc} + + \eta_2 X_{isc} + f(BD)_{sc} + \epsilon_{isc} \end{aligned} \tag{2}$$

O_{isc} is either a dummy for whether stunted, or the the HFA-Z-score, for child i, residing in state s and cluster c. The coefficient β_1 associated with the SC dummy captures the difference in stunting rates between the SC and UC-Hindu children. The coefficient β_2, on the other hand, captures whether living to the south of Vindhyas has any effect on stunting rates. The key coefficient of interest is β_3, associated with the interaction between the SC dummy and a dummy for living south of the Vindhyas range. It informs us whether living to the south of Vindhyas has any differential effect on the SC children.

δ_s is a state fixed effect, and ensures we compare children living within the same state. The function $f(BD)_{rcep}$ represents a second-order RD polynomial of the distance from the centroid of each cluster to the closest point on the Vindhyas range. The cluster level controls are denoted X_{sc} and account for geographical and demographic features – total population for the period 2005-15; annual precipitation, aridity, mean temperature, wet days for the period 2005-15; growing season length; gross cell production; absolute latitude; proximity to water; proximity to national borders – that potentially have a bearing on child height. Finally, X_{isc} represents a set of individual-level dummies for age in months, gender and urban residence. The standard errors, ϵ_{isc}, are clustered at the level of the primary sampling unit to account for spatial correlation.

Figure 7 shows the average rates of stunting and HFA-Z-scores for the UC-Hindu and SC children living 100km to the north and south of the Vindhyas, respectively. We observe that the average HFA-Z-score (-1.19 vs -1.05) and rates of stunting (0.30 vs 0.28) for the UC-Hindu children are not statistically different across the north and south of the Vindhyas range. This suggests that there is no generic benefit to child height associated with living to the south of the Vindhyas.

On the other hand, the SC children living to the south of the Vindhyas show an economically important and statistically significant improvement in heights and reduction in stunting; more specifically, they show a 8% points or a 17% reduction in their rates of stunting when they live to the south of the Vindhyas range. We next turn to formally estimating the importance of the north-south divide.

4.2 Results

Table 2 shows the results of the estimation exercise, where the dependent variable is a dummy for being stunted. Column (1) estimates the gap between the SC and UC-Hindus for the entire sample and shows the SC children are 14% points, or 50% more likely to be stunted as compared to the UC-Hindu children. Column (2) now restricts the sample to individuals living within 100km to the north or south of Vindhyas and shows that for this restricted sample the SC children are 21% points, or around 70%, more likely to be stunted as compared to the UC-Hindu children. This increase in stunting rates for the SC children in the reduced sample is to be expected as now we ignore the southern states where the SC children have better anthropometric outcomes.

Column (3) introduces the interaction between the SC dummy and dummy for living to the south of Vindhyas. We observe that living to the south of Vindhyas range has no implication for the stunting rates of UC-Hindu children. This is reassuring as this suggests that there is no change in factors between the North and South of the Vindhyas that has any implications for stunting on average. On the other hand, it reduces rates of stunting for SC children by 6.7% points, or that the rates of stunting among SC children living to the south is more than 25% less than of the SC kids living to the north.

In Column (4), we introduce the extensive set of geographical controls and find that, if anything, the inclusion of the controls suggests an even larger reduction in stunting rates for SC children living to the south of the Vindhyas. Moreover, again we observe no effect of living to the south of Vindhyas on the rates of stunting rates for UC-Hindu children. This suggests that geography is not what explains the differences in the relative stunting rates across the north and south of the Vindhyas.

In Columns (5) and (6), we restrict the sample to living within a distance of 150 and 75km, respectively, to the north and south of the Vindhyas. Column (6) shows that when restricting the sample to 75km from the Vindhyas shows a reduction of 9.7% points or around 40% lower rates of stunting relative to the stunting rates of SC children to the north. In addition, living to the south of the Vindhyas again has no effect on the rates of stunting for the UC-Hindu children.

Table 3 shows the results for height-for-age-Z-scores rather than the stunting dummy as the dependent variable. The results show a similar pattern. Column (1) shows that the SC children are -0.51 standard deviations shorter than the UC-Hindu children, whose average HFA-Z-score is -1.12. In the restricted sample in column (2), that is, comparing children living 100km north and south of the Vindhyas, the SC children are whole -0.76 standard deviations (sd) units shorter than the UC-Hindu children, whose HFA-Z-score is -1.13 sd units. Column (3) and (4) show that the SC children living to the south of the Vindhyas are taller than their SC counterparts in the north; in particular, in column (4), which includes the geographical controls, the SC children living to the south are 0.24 sd units or around 30% taller. Moreover, there is no association between living south of the Vindhyas and the HFA-Z-score of UC-Hindu children.

4.3 Does discrimination underlie the North-South differences in stunting rates?

Our interpretation attributes the differences in child height and stunting between SC children from the north and the south of the Vindhyas range, shown in Tables 2 and 3, to differences in untouchability related practices across the mountain range.

4.3.1 Falsification tests

Socioeconomic status or caste? One potential objection to such an interpretation could be that socioeconomically disadvantaged groups, for reasons unrelated to caste-based discrimination, benefit from living to the south of the Vindhyas. To address this concern, we create a dummy for whether a mother belongs to the bottom three quartiles of the wealth index.[14] We then include this dummy for belonging to the bottom 60% of the wealth distribution and its interaction with the dummy for living to the south of the Vindhyas to Equation 2.

The results of the exercise are shown in Column (1) of Table 4. We find a similar pattern: no advantage for the UC-Hindu children living to the south of the Vindhyas and a 8% point

[14] According to the DHS "The wealth index is a composite measure of a household's cumulative living standard. The wealth index is calculated using easy-to-collect data on a household's ownership of selected assets, such as televisions and bicycles; materials used for housing construction; and types of water access and sanitation facilities." See here for further details.

reduction in stunting rates for the SC living to the south. Looking at the bottom 60% shows they are 15% points more likely to be stunted relative to the top 40% of the population. However, its interaction with the dummy for living to the south of the Vindhyas is positive and insignificant.

In Column (2), we allow for a more flexible specification and interact the dummies for the four quintiles of the wealth index - poorer, middle, richer and richest - with a dummy for living to the south of the Vindhyas.[15] The results, similar to Column (1), show no advantage for the UC-Hindu children living to the south of the Vindhyas and around 6% point reduction in stunting rates for the SC living to the south. Again, not surprisingly, we observe that the rates of stunting are lower for the higher wealth quintiles; for instance the richest are 28% points less likely to be stunted than the poorest. However, more importantly from our perspective, the interactions of the wealth quintile dummies with the dummy for living to the south of the Vindhyas are all statistically insignificant.

In Column (3), we include the wealth index value of the household interacted with the dummy for living south of the Vindhyas.[16] We observe that as expected, higher wealth is associated with lower levels of stunting but again the interaction between the wealth index score and dummy for living to the south of the Vindhyas is close to zero and statistically insignificant.

The results presented in Columns (1)-(3) of Table 4 suggest that the results cannot be attributed to advantages accruing to socioeconomically disadvantaged groups, or more generally shows that socioeconomic status has no bearing on stunting due to living south of the mountain range.

North-South gradient or the Vindhya range? Another potential concern could be that in the areas close to the Vindhyas there is geographical gradient to child height for the SC group for reasons unrelated to caste based discrimination. To address this concern, we compare the SC with the UC-Hindu children and estimate Equation 2. However, this time we first restrict the sample to SC and the UC-Hindu children living within 100 km *only* to the North of the Vindhyas. We then compare differences for those located within a distance 0-50 km to the north with those located 50-100 km to the north. Second, we compare SC

[15] The omitted category is the the mothers belonging to the lowest wealth quintile, that is, the poorest.

[16] The wealth index value refers to the household's wealth index value generated by the product of standardized scores (z-scores) and factor coefficient scores (factor loadings) of wealth indicators. See https://www.idhsdata.org/idhs-action/variables/WEALTHS#description_section for further details.

and UC-Hindu children living within 100 km *only* to the South of the Vindhyas. We then compare differences for those located within a distance 0-50 km to the south with those located 50-100 km to the south. If our initial results are robust, the differences stem from not a north-south gradient on either side of the Vindhya mountain range, but actually due to residing on opposite sides of the Vindhyas range, then the above DID estimator should show no differences in heights of SC children living 0-50km and 50-100km to the north (south) of the Vindhya range.

Column (4) of Table 4 shows the results of restricting the sample to SC and the UC-Hindu children living within 100km to the North of the Vindhyas. The coefficient on the interaction between the SC dummy and the dummy indicating living 50-100 km to the North is not statistically different from zero. In addition, the dummy for living 50-100 km North of Vindhyas is also not statistically different from zero.

Column (5) of Table 4 shows the results of restricting the sample to SC and UC-Hindu children living within 100km to the South of the Vindhyas. The coefficient on the interaction between the SC dummy and the dummy indicating living 50-100 km to the South, and the dummy for lying 50-100Km South of Vindhyas are again not statistically different from zero.

In sum, the results shown in Table 4 suggest that the economically significant gain in height for the SC children living just to the south of the Vindhyas range cannot be attributed to: (i) the differences related to socioeconomic position proxied by the wealth index; and (ii) there being a general north-south gradient to child heights for the SC and the UC-Hindu children in the area close to the Vindhyas but not crossing the mountain range.

4.3.2 The north-south divide in provision of services and mother's health

Our explanation of higher rates of stunting for the SC children living north of the Vindhyas is the prevalence of practices that negatively affect the well-being of SC children through discrimination in provision of health and other public services. These affect child anthropometric outcomes through directly affecting the provision of prenatal and postnatal services to mothers, and provision of key services such as vaccination to children. In addition, discrimination might affect the human capital and health of mothers, which in turn, have implications for child height.

We first test whether , in fact, the data does demonstrate disparities in provision of health services for SC mothers across the north-south divide. We again estimate Equation 2 with the following two dependent variables: (i) a dummy that takes value 1 if a mother reports receiving prenatal care from no health provider; (ii) a dummy that takes value 1 if a mother reports giving birth at home.

The results of this exercise are shown in Table 5. Columns (1) and (2) show that on average SC mothers are 19 and 18 percentage points more likely to receive no prenatal care from any health service provider and to have the delivery at home, respectively. In other words, they are 2.35 times more like than UC-Hindu mothers to receive no prenatal care and 3 times more likely to deliver at home. We see that for SC mothers living to the South of Vindhyas the probability of receiving prenatal care from no health provider reduces by 12% points and for having a home delivery by 5.3% points. Thus, we observe better provision of health services for SC mothers living to the south of the Vindhyas.

In Columns (3) and (4), we explore the implications for two categories of mother's outcomes, namely: (i) a dummy for whether the mother is classified as being short in stature; and (ii) years of education. A woman is classified as being of short stature if she is less than 145cms in height. Short stature is important outcome as maternal short stature is more likely to be associated with childhood stunting (Hernandez-Diaz et al., 1999); reduced neonate size (Bisai, 2010); and cephalopelvic disproportion (Toh-Adam et al., 2012).

Column (3) shows that SC mothers on average are 11% points more likely to be short in stature. On the other hand, living to the South of the Vindhyas reduces the probability of being short in stature by 5.8% points for SC mothers. Turning to human capital, column (4) shows that SC mothers have 4.34 fewer years of schooling relative to UC-Hindu mothers. However, this gap is reduced by 1.12 years for SC mothers living to the south of the Vindhyas. In sum, Table 5 shows that there is a sharp improvement in both provision of services, as well as mother outcomes for SC women living south of the Vindhyas range.

To explore the implications of service delivery to children, we focus on disparities in the rates of vaccination. The DHS provides detailed information on the provision of the Bacillus Calmette–Guérin (BCG), diphtheria, pertussis (whooping cough), and tetanus (DPT), polio and measles vaccine. Moreover, for DPT and polio it provides information on how many doses were actually received by the children. We thus consider the following four vaccination outcomes: child having received (i) the BCG vaccine; (ii) 3 doses of the DPT vaccine; (iii) 4 doses of the polio vaccine; and (iv) the measles vaccine. We create a dummy variable that takes the value 1 if the data reports as the "vaccination date on card" or "vaccination marked on card" and 0 otherwise. We again estimate Equation 2 and the results are shown in Table 6. Column (1) shows that the SC children on average are 7.6, 8, 6.5 and 6.7% points less likely to have received the BCG vaccine, all 3 doses of DPT, all 4 doses of Polio and the measles vaccine, respectively. However, we again observe that SC children living to the south of the Vindhyas range experience an improvement in the rates of vaccination; more specifically, they are 7.3, 8.7, 3.84 and 5.93% points more likely to receive the BCG, 3 doese of DPT, 4 doses of polio and measles vaccine, respectively, as compared to their SC counterparts living to the north of the Vindhyas range.[17]

5 Conclusion

Using data from the National Family and Health Survey (2015-16), we highlight a missing link in the analysis of early childhood stunting in India: the role of social identity, specifically caste status, as evidenced in the height gaps between upper caste children and other major groups that are lower ranked. We begin by providing a detailed description of these gaps. The data show that at every age profile UC-Hindu children are taller than the SC children and the the stunting rates increase sharply for both groups till about 20 months of age, and remain roughly stable thereafter. The stunting rates for SC children, as well as the gaps between UC-Hindu and SC children, are seen to be the highest in the BIMARU region. In 45% of the BIMARU districts more than half the SC children are stunted whereas the corresponding figure is only 3.61% for the UC-Hindu children.

We summarize ethnographic and sociological evidence, as well as quantitative data from nationally representative data sets, to show the ubiquity of the illegal but stigmatizing practice of untouchability in the country. The prevalence of the practice is seen to be highest in the BIMARU region, the same part where SC children are the most severely disadvantaged. Linking data on the practice of untouchability and child height and stunting, we find that the practice of untouchability, adversely affects the heights of lower ranked Dalit or Scheduled Caste children, but not children from the higher ranked upper castes.

The clear geographical difference in the prevalence and experience of untouchability, especially the concentration in the northern plains, can be traced to the establishment and evolution of the caste system on the Indian subcontinent. In particular, the existing evidence shows that the historical geographical span of Hinduism was bounded to the south by the Vindhyas mountain range. The geographic areas where the Indo-Aryans dominated came to

[17] The effect on the rate of polio vaccination is not statistically significant.

be called the Arayavarta, the Land of the Aryas, which was the cultural centre of traditional Hinduism, and where the earliest manifestation of the caste system can be found.

Drawing on this history, we hypothesize that districts that lie to the North of the Vindhyas range, which were directly under the influence of the Indo-Aryan social order, even today have stronger adherence to caste-related practices, including the practice of untouchability, relative to the districts lying to the south of the Vindhyas. We implement a DID estimator and estimate how the heights and stunting rates of the UC-Hindu and SC children vary between those living within 100 km to the north relative to those living 100 km to the south of the Vindhyas.

Consistent with our hypothesis, we find that the SC children living to the south of the Vindhyas range are around 30% taller, and have 40% lower levels of stunting, than their SC counterparts living to the north of the Vindhyas range. Moreover, we find there is no effect on child height and stunting rates, for UC-Hindu living to the north or south of the Vindhyas range.

To confirm that this is the result of caste discrimination and not other factors, we conduct a number of falsification tests. Our tests allow us to rule out competing explanations such as differences across the mountain range being attributable to socioeconomic position of children, or to a geographical gradient to child malnutrition in areas close to the Vindhyas but not crossing the mountain range. Finally, consistent with the hypothesized mechanisms, we find SC mothers are more likely to receive prenatal and antenatal care and have higher years of education in the south compared to the north, i.e. health and human capital of SC mothers in the south is better than in the north. In a similar vein, we show that SC children living within 100 km south of the Vindhya range are much more likely to be vaccinated than their northern SC peers.

Our results reveal the importance of caste-based discrimination in affecting the early childhood health indicators differentially for SC and UC-Hindu children. To the best of our knowledge, our paper is the first to demonstrate the causal impact of discriminatory norms on health outcomes in the Indian context. Thus, we provide evidence that the root of present-day adult life caste disparities lies in early childhood disparities. This result significantly validates the argument that contemporary caste disparities are perpetuated via ongoing discrimination and not just a remnant of the past.

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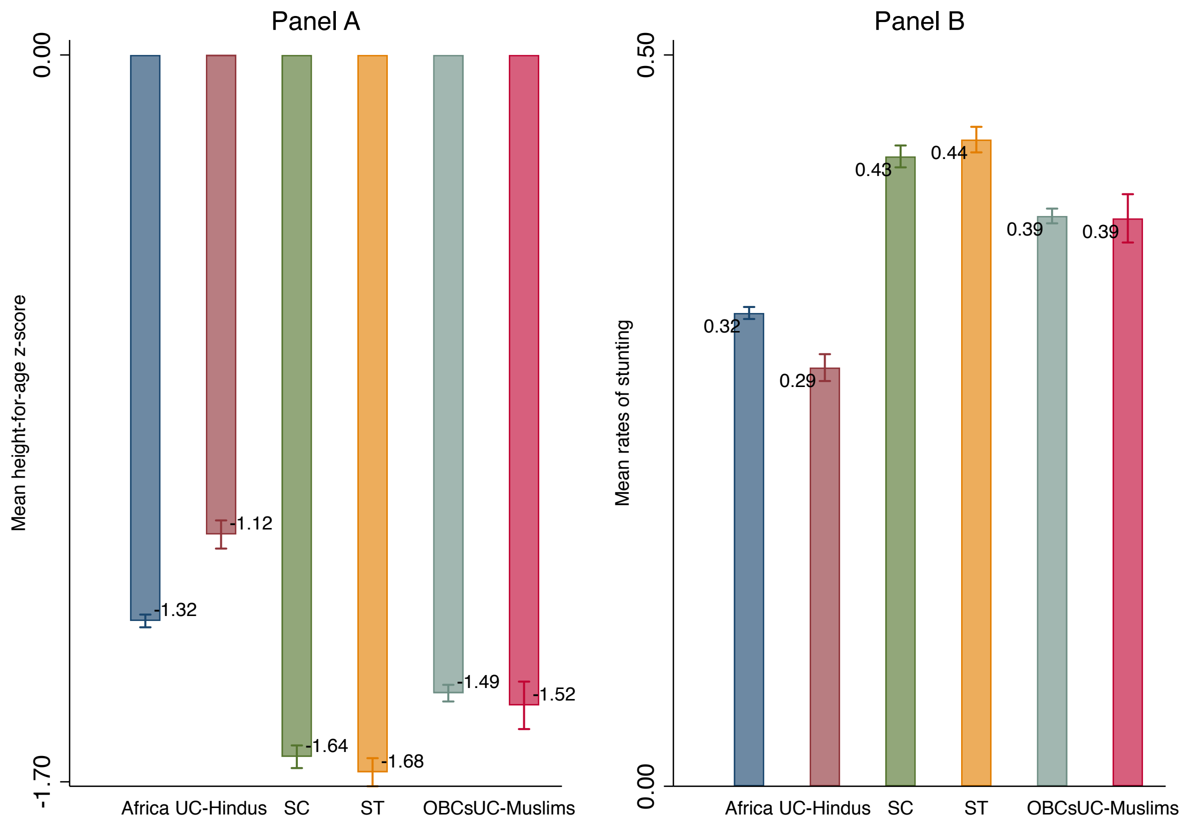
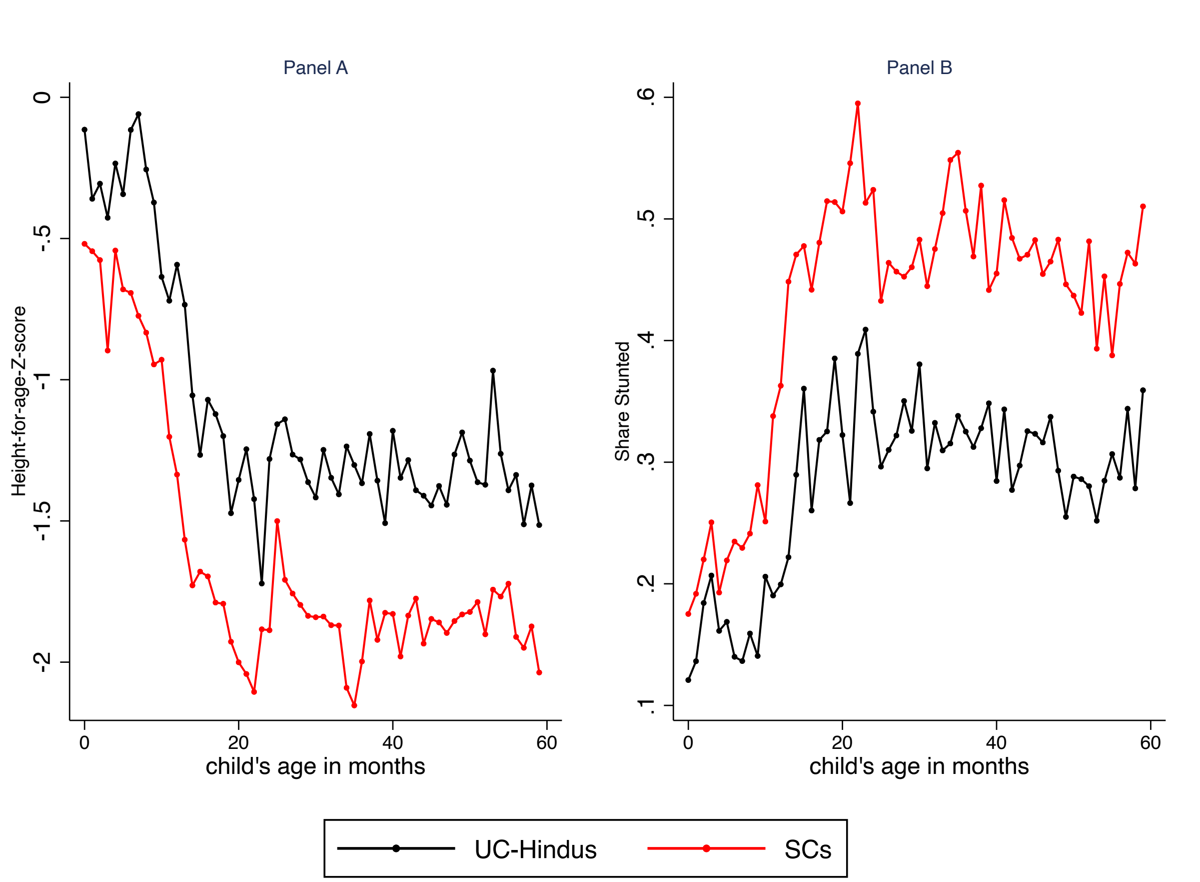


Notes: The data on the Height-for-age(HFA)-Z scores are from the latest available round of the Demographic and Health Surveys, conditional on being later than 2010. The mean for sub-Saharan Africa is based on the average of 30 countries, as listed in Table S1. The data on the HFA Z-score for India and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

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



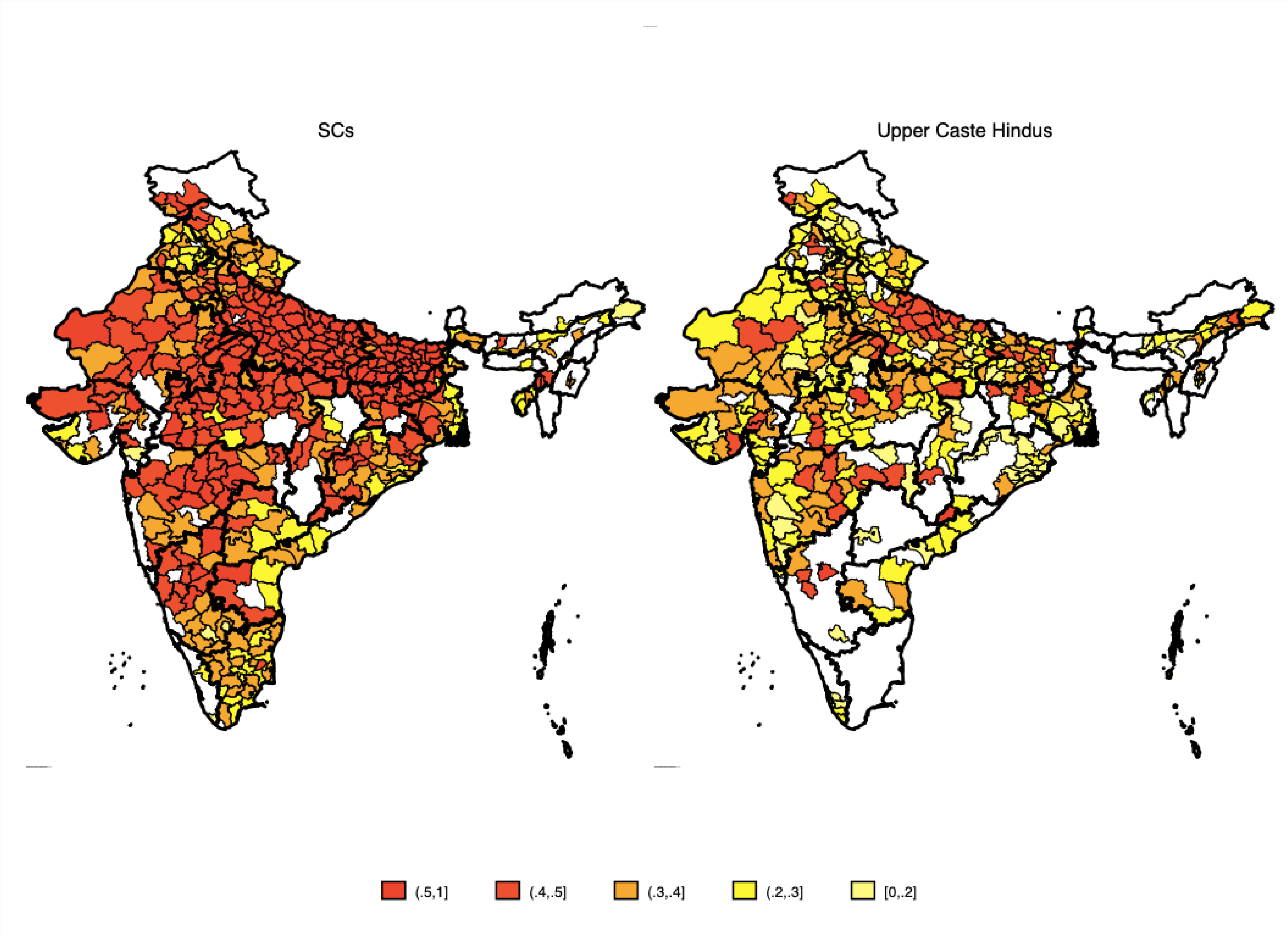
Notes: The data is from the Nation Family Health Survey-IV, 2015-16 and consists of a sample of 45,924 and 29,132 SC and UC-Hindu children, respectively.

Figure 2: Height-for-age-Z-score and stunting rates for SC and UC-Hindu children by months

	No. of Districts	Percent
	Panel A - SC children	
0< Share stunted <=20%	8	1.713
20%< Share stunted <=30%	64	13.70
30%< Share stunted <=40%	139	29.76
40%< Share stunted <=50%	140	29.98
Share stunted >50%	116	24.84
Total	467	100
	Panel B - UC-Hindu children	
0< Share stunted <=20%	65	17.62
20%< Share stunted <=30%	136	36.86
30%< Share stunted <=40%	111	30.08
40%< Share stunted <=50%	47	12.74
Share stunted >50%	10	2.710
Total	369	100

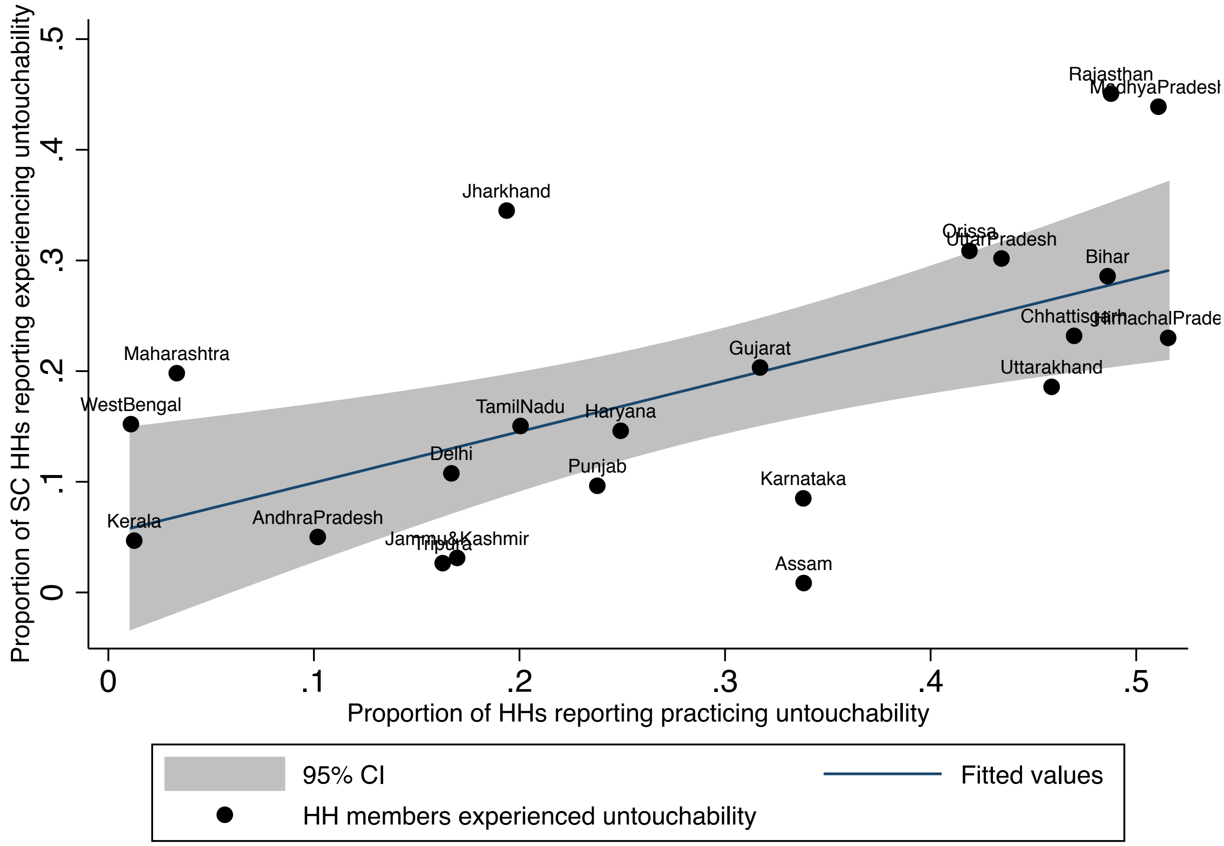
Notes: The table presents the prevalence rates of stunting by categories and districts for the SC and UC-Hindu children. Only districts with a minimum of 25 observation for that group are considered, whixh results in 467 districts for SCs and 369 districts for the UC-Hindus. The average number of SC children in each district is 95 with the median district having 80 observations. For the UC-Hindu children the average number of children in each district is 73 with the median district having 53 observations.

Table 1: Prevalence rates of stunting by category and districts of India



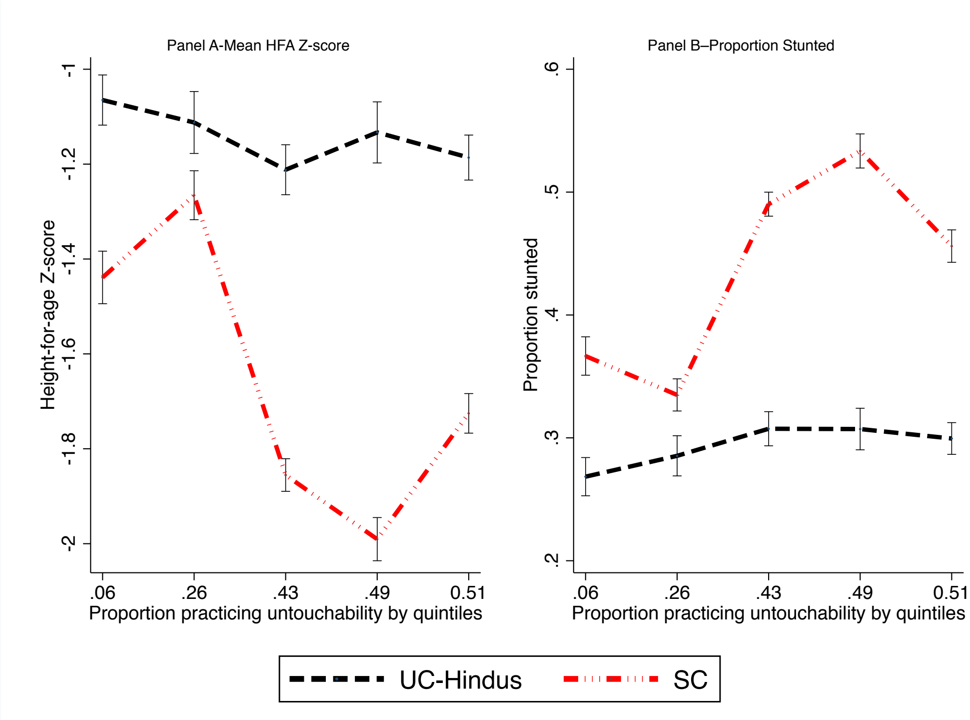
Notes: The data on the on stunting is from the Nation Family Health Survey-IV, 2015-16. Weighted district level averages are shown where the prevalence is increasing in the intensity of the color. Only districts with a minimum of 25 observation are shown. The average number of observation per district is 167.

Figure 3: Stunting prevalence by district for SC and UC-Hindus children aged 0-59 months



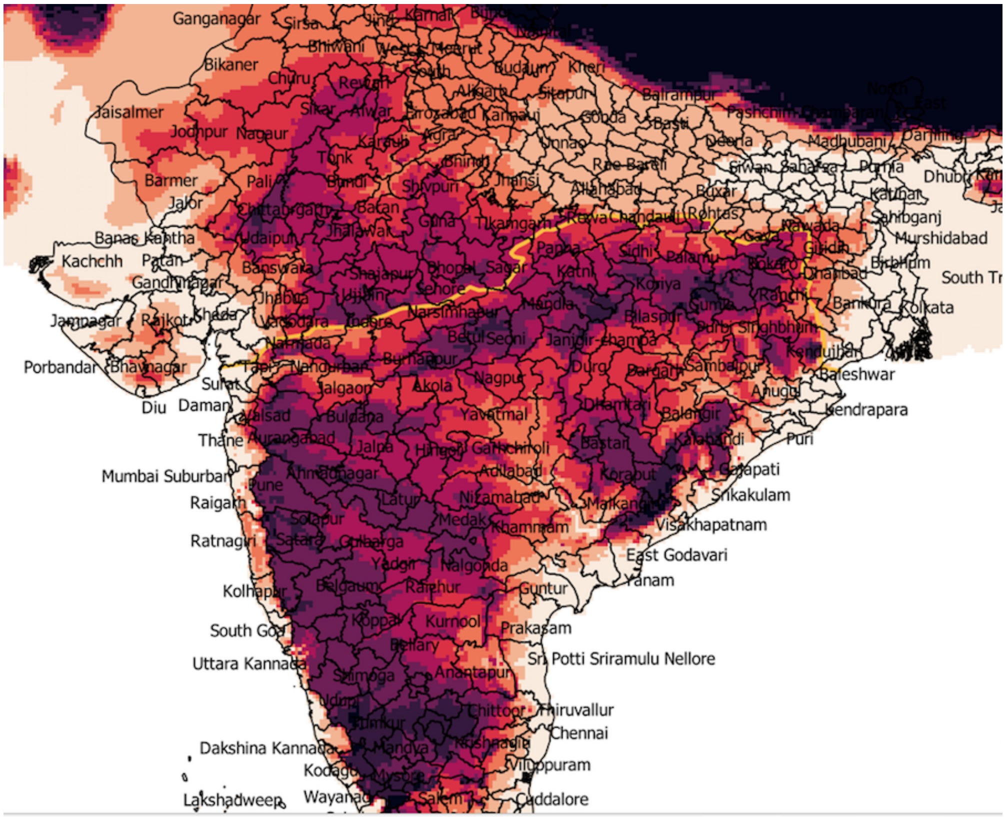
Notes: The prevalence and experience of untouchability at the state level is calculated from the second round of the Indian Human Development Survey (IHDS) conducted in 2011-12 and is based on self-reports by households on practice and experience.

Figure 4: The prevalence and experience of untouchability



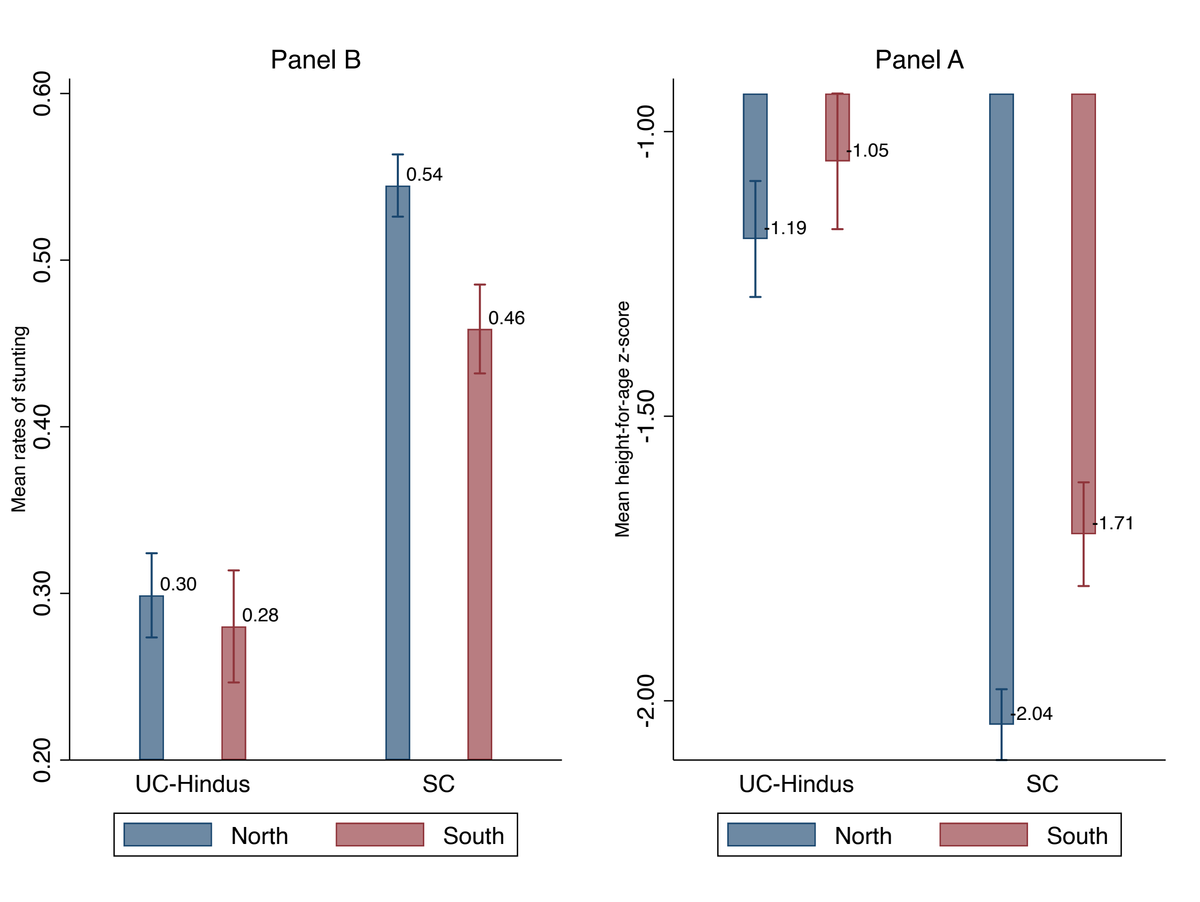
Notes: The practice of untouchability by households at the state level is calculated from the second round of the Indian Human Development Survey (IHDS) conducted in 2011-12. The above plots the predicted values with the 90 % confidence intervals arising from a regression estimating the gaps in HFA Z-score 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.

Figure 5: Practice of untouchability and gaps in HFA Z-score and chronic malnutrition



Notes:

Figure 6: The map of Vindhyas and the south and north regions



Notes:

Figure 7: Average stunting rates and Height-for-age-Z-Scores for UC-Hindus and SC children living 100 km north and south of the Vindhyas

	Dependent variable - Dummy for classified as stunted					
	All India Sample		100kms		150kms	75kms
			North and South of Vindhyas			
	(1)	(2)	(3)	(4)	(5)	(6)
SC	0.14***	0.21***	0.24***	0.23***	0.23***	0.25***
	(0.0058)	(0.013)	(0.016)	(0.016)	(0.013)	(0.018)
South of Vindhyas			0.013	0.016	-0.0057	0.023
			(0.024)	(0.024)	(0.022)	(0.027)
SC*South of Vindhyas			-0.067**	-0.077***	-0.059**	-0.097***
			(0.027)	(0.026)	(0.023)	(0.030)
Distance from Vindhyas			2.1e-07	2.6e-07	-3.8e-07	-1.1e-07
			(8.9e-07)	(9.0e-07)	(5.3e-07)	(1.4e-06)
Distance sq. from Vindhyas			-0	-0	0	0
			(0)	(0)	(0)	(0)
Total population 2005-15				1.5e-08	-3.0e-08	5.6e-09
				(4.3e-08)	(3.6e-08)	(4.3e-08)
Annual precipitation 2000-15				0.00074	0.0014	0.0023
				(0.0027)	(0.0020)	(0.0031)
Aridity 2000-15				-0.012	-0.0071	-0.022*
				(0.0099)	(0.0064)	(0.012)
Mean temperature 2000-15				-0.023**	-0.019**	-0.027**
				(0.011)	(0.0098)	(0.014)
Wet days 2000-15				0.035**	0.025**	0.048***
				(0.015)	(0.012)	(0.018)
Growing Season Length				-0.013	0.000032	0.014
				(0.023)	(0.000024)	(0.028)
Gross Cell Prod.				-0.000022	-0.000015	-0.000023
				(0.000021)	(0.000020)	(0.000022)
Absolute lattitude				-0.021	-0.0076	-0.035*
				(0.015)	(0.012)	(0.018)
Proximity to National Borders				-3.0e-07**	-2.7e-07**	-3.1e-07**
				(1.3e-07)	(1.1e-07)	(1.5e-07)
Proximity to Protected Areas				-4.7e-07	-8.4e-08	-4.1e-07
				(3.2e-07)	(2.6e-07)	(3.9e-07)
Proximity to Water				2.6e-07**	6.2e-08	3.5e-07**
				(1.3e-07)	(9.5e-08)	(1.6e-07)
Urban Dummy				-0.054***	-0.079***	-0.057***
				(0.019)	(0.016)	(0.021)
Mean of UC-Hinuds	0.29	0.29	0.29	0.29	0.28	0.29
Age in months dummies	Yes	Yes	Yes	Yes	Yes	Yes
State dummies	Yes	Yes	Yes	Yes	Yes	Yes
Sex dummy	Yes	Yes	Yes	Yes	Yes	Yes
Observations	69,426	10,863	10,863	10,863	14,699	8,361
R-squared	0.079	0.118	0.120	0.124	0.122	0.135

Clustered standard errors in parentheses

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

Notes:

Table 2: Comparing SC and UC-Hindu children to the north and south of the Vindhyas range

	Dependent variable - HFA-Z-Score			
	All India Sample	100kms		
		North and South of Vindhyas		
	(1)	(2)	(3)	(4)
SC	-0.51***	-0.76***	-0.82***	-0.80***
	(0.021)	(0.046)	(0.058)	(0.057)
South of Vindhyas			0.023	0.025
			(0.091)	(0.090)
SC*South of Vindhyas			0.19**	0.24**
			(0.096)	(0.095)
Distance from Vindhyas			-3.2e-06	-3.6e-06
			(3.2e-06)	(3.2e-06)
Distance sq. from Vindhyas			0	0
			(0)	(0)
Total population 2005-15				-5.9e-08
				(1.6e-07)
Annual precipitation 2000-15				0.0035
				(0.0096)
Aridity 2000-15				0.027
				(0.035)
Mean temperature 2000-15				0.13***
				(0.040)
Wet days 2000-15				-0.16***
				(0.052)
Growing Season Length				0.12
				(0.083)
Gross Cell Production				0.000096
				(0.000068)
Absolute lattitude				0.14**
				(0.054)
Proximity to National Borders				1.4e-06***
				(4.7e-07)
Proximity to Protected Areas				2.4e-06**
				(1.1e-06)
Proximity to Water				-1.0e-06**
				(4.7e-07)
Urban Dummy				0.25***
				(0.067)
Mean of UC-Hinuds	-1.12	-1.13	-1.13	-1.13
Age in months dummies	Yes	Yes	Yes	Yes
State dummies	Yes	Yes	Yes	Yes
Sex dummy	Yes	Yes	Yes	Yes
Observations	69,426	10,863	10,863	10,863
R-squared	0.115	0.153	0.156	0.162

Clustered standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes:

Table 3: Comparing SC and UC-Hindu children to the north and south of the Vindhyas range

	Dummy for classified as stunted				
		100km to the North and South of Vindyas		100km to the North of Vindhyas	100km to the South of Vindhyas
	(1)	(2)	(3)	(4)	(5)
	Panel A - DV - Dummy for stunted				
SC	0.18***	0.13***	0.13***	0.22***	0.11***
	(0.018)	(0.019)	(0.019)	(0.025)	(0.028)
South of Vindhyas	-0.0069	-0.0062	0.0027		
	(0.027)	(0.037)	(0.025)		
SC*South of Vindhyas	-0.080***	-0.056*	-0.059*		
	(0.029)	(0.030)	(0.031)		
Bottom 60% of wealth distb.* South of Vindhyas	0.039				
	(0.032)				
Poorer*South of Vindhyas		0.023			
		(0.031)			
Middle*South of Vindhyas		0.055			
		(0.035)			
Richer*South of Vindhyas		0.028			
		(0.045)			
Richest*South of Vindhyas		-0.053			
		(0.045)			
Wealth Index Score*South of Vindyas			-9.5e-08		
			(1.4e-07)		
SC*50-100Kms North of Vindhyas				0.023	
				(0.031)	
SC*50-100Kms South of Vindhyas					0.039
					(0.039)
Bottom 60% of wealth distb.	0.15***				
	(0.023)				
wealth index - poorer		-0.067***			
		(0.018)			
wealth index - middle		-0.17***			
		(0.022)			
wealth index - richer		-0.22***			
		(0.027)			
wealth index - richest		-0.28***			
		(0.033)			
Wealth index factor score			-1.0e-06***		
			(1.0e-07)		
50-100Kms North of Vindhyas				-0.033	
				(0.033)	
50-100Kms South of Vindhyas					-0.024
					(0.045)
Cluster level controls	Yes	Yes	Yes	Yes	Yes
Age in months dummies	Yes	Yes	Yes	Yes	Yes
State dummies	Yes	Yes	Yes	Yes	Yes
Sex dummy	Yes	Yes	Yes	Yes	Yes
Observations	10,863	10,863	10,863	7,029	3,834
R-squared	0.135	0.146	0.146	0.131	0.154

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

Notes: Please refer to Table 2 for the list of cluster level controls.

Table 4: Falsification tests

	Sample of Mothers Living 100km North and South of Vindhyas			
	Dependent Variables:			
	No Prenatal Care	Dummy for Home Delivery	Short Stature	Years of Educ.
	(1)	(2)	(3)	(4)
SC	0.19***	0.18***	0.11***	-4.34***
	(0.015)	(0.014)	(0.014)	(0.20)
South of Vindhyas	0.060***	0.0016	0.040**	0.14
	(0.021)	(0.019)	(0.019)	(0.26)
SC x South of Vindhyas	-0.12***	-0.053**	-0.058***	1.12***
	(0.023)	(0.021)	(0.021)	(0.30)
Cluster level controls	Yes	Yes	Yes	Yes
Age in months dummies	Yes	Yes	Yes	Yes
State dummies	Yes	Yes	Yes	Yes
Sex dummy	Yes	Yes	Yes	Yes
Mean of UC-Hindus	0.14	0.09	0.087	9.83
Observations	8,476	11,661	6,630	6,570
R-squared	0.124	0.120	0.303	0.070

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

Notes: The cluster level controls include total population for the period 2005-15; annual precipitation, aridity, mean temperature, wet days for the period 2005-15; growing season length; gross cell production; absolute latitude; proximity to water; proximity to national borders; proximity to protected areas and an urban dummy.

Table 5: Effects on health services provided to mother and mother outcomes

	Sample of Children Living 100km North and South of Vindhyas			
	Dependent Variables: Dummy for receiving			
	BCG Vaccine	DPT Vaccine All 3 Doses	Polio Vaccine Doses All 4 Doses	Measles Vaccine
	(1)	(2)	(3)	(4)
SC	-0.0762***	-0.0802***	-0.0647***	-0.0673***
	(0.0160)	(0.0159)	(0.0151)	(0.0145)
South of Vindhyas	-0.0359	-0.0569**	-0.0302	-0.0387
	(0.0262)	(0.0258)	(0.0257)	(0.0241)
SC $\times$ South of Vindhyas	0.0728***	0.0876***	0.0384	0.0593**
	(0.0278)	(0.0274)	(0.0263)	(0.0253)
Mean of UC-Hindus	0.49	0.42	0.35	0.36
Cluster level controls	Yes	Yes	Yes	Yes
Age in months dummies	Yes	Yes	Yes	Yes
State dummies	Yes	Yes	Yes	Yes
Sex dummy	Yes	Yes	Yes	Yes
R-squared	0.132	0.133	0.120	0.153
Observations	11645	11661	11661	11605

Standard errors in parentheses

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

Notes: The cluster level controls include total population for the period 2005-15; annual precipitation, aridity, mean temperature, wet days for the period 2005-15; growing season length; gross cell production; absolute latitude; proximity to water; proximity to national borders; proximity to protected areas and an urban dummy.

Table 6: Effects on vaccinations