Are Children in West Bengal Shorter Than Children in Bangladesh?

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Children in West Bengal and Bangladesh are presumed to share the same distribution of genetic height potential. In West Bengal they are richer, on average, and are therefore slightly taller. However, when wealth is held constant, children in Bangladesh are taller. This gap can be fully accounted for by differences in open defecation, and especially by open defecation in combination with differences in women's status and maternal nutrition.

Our conclusions are our own and do not necessarily represent the views of any organisation.

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Although researchers have long established that height differences between populations are largely driven by environmental differences – especially net nutrition and disease (Bozzoli et al 2009; Coffey 2013; Hatton 2013) – some commentators have recently asked whether the exceptional height deficit of India's children may be merely genetic (Panagariya 2013). The answer is of policy importance because adult height reflects health and net nutrition in the critical first few years of a child's life. Lifelong physical and cognitive development are lastingly shaped during this early period (Case and Paxson 2010; Spears 2012), and the average height of a population is a key indicator of the health and economic productivity of the adult workforce (Case and Paxson 2008; Vogl forthcoming). India cannot afford to misunderstand the causes of child height.

To illustrate these facts about population height, in this note, we focus on a simple comparison between children living in the Indian state of West Bengal and children living in the neighbouring country of Bangladesh. These societies were split into different political states recently on a genetic time scale and much migration continues. Cultural, geographic, and agricultural factors are shared between these populations, although Bangladeshis are more likely to be Muslim.

To answer our question simply – no, children in West Bengal are taller, on average, than children in Bangladesh. However, families in West Bengal are also richer. Food and other care that money can buy are important determinants of early life net nutrition, and therefore of attained height. We show that at the same level of socio-economic status (SES), children in West Bengal are economically and statistically significantly shorter than children in Bangladesh, on average. Many factors may contribute to this gap, and a full accounting is beyond the scope of this note. Nevertheless, we document that differences in the disease environment – namely, that children in West Bengal are exposed to much more open defecation than children in Bangladesh – can fully statistically account for West Bengal's height deficit, especially in combination with differences in women's status.

Initial Comparisons

Table 1 (p 22) offers a simple comparison of human development summary statistics in West Bengal and Bangladesh. Panel A collects aggregate statistics that we report from published sources. We follow the format of Table 3.2 of Sen and Drèze (2013: 51), which we extend to West Bengal. Panel B reports our own computations from the data used in this paper's analysis. We pool data from India's 2005-06 National Family Health Survey (NFHS) and Bangladesh's 2007 Demographic and Health Survey (DHS). As part of an international DHS project, these surveys are designed to be comparable and can be used in combination. Summary statistics are computed to reflect the data in our analysis; thus children under 5 are the observations, not households. If young children are disproportionately concentrated in poorer or otherwise disadvantaged households, then these figures will suggest a lower level of human development than nationally representative figures would.

Two basic, well-known facts emerge from these summary statistics. First, people in West Bengal are richer than people in Bangladesh – they have a higher income per capita and are more likely to own private assets such as radios, bicycles, motorcycles, and telephones (although slightly less likely to have electricity). Second, Bangladeshis have advantages along other dimensions of human development – more women can read, mothers weigh more, women are more likely to participate in the economy and politics, and a much smaller fraction of the population defecates in the open without using a toilet or latrine.[1] One exception to this trend is infant mortality, which is lower in West Bengal; this is consistent with the multidimensionality of health (Coffey et al 2013a).

Using the same data, Figure 1 plots the average height-for-age of children under 5 at each month of growth and development. The negative numbers on the vertical axis indicate that children from both countries are shorter than would be average for a population of healthy children. The figure displays a familiar pattern – increasing height shortfalls as growth deficits accumulate until about two years of age, at which point growth paths are largely determined and adult stunting is likely. Bangladeshi children fall further below the norm than children in West Bengal do; so, without accounting for differences in their material environments, it is clear that children in West Bengal are taller, on average.

Accounting for Wealth

How would these results differ if we did adjust for differences in wealth? For the main analysis of this article, we use the pooled DHS data to estimate descriptive regressions of the form

$$height_{ip}=\beta_0+\beta_1\, West\ Bengal_p+\beta_2\, mother's\ height_{ip}+ SES_{ip}\theta + \gamma\, controls_{ip} + \varepsilon_{ip},$$

where *i* indexes individual children under five years old, and *p* represents local places, in this case survey primary sampling units (PSUs), according to which we cluster standard errors. Estimates are weighted according to DHS sampling weights. *Height* is the height-for-age z-score of a child and *West Bengal* is an indicator that the child is from the West Bengal sample. *SES* is a large vector of indicators of socio-economic status.

Unfortunately, DHS surveys do not measure economic variables such as consumption or income, so we use a long list of non-parametric indicators of asset ownership – indicators for the child's household having electricity, a radio, a television, a refrigerator, a bicycle, a motorcycle, a car, and a telephone. All of these interacted to allow different coefficients for rural and urban households; indicators for the type of floor in the child's home; number of people and women living in the child's home; whether the child was born by Caesarean section; and the mother's age when the child was born. In some specifications, we also control for a child's mother's height; although we primarily intend this variable as a further marker of SES (reflecting the mother's own upbringing), controlling for it should also remove any final doubt of the genetic comparability of these populations. Finally, we individually add three specific controls for factors known to be important for child height in a simple attempt to account for the height gap – exposure to open defecation; mother's literacy; and mother's body mass index (BMI) as an indicator of maternal social status, a predictor of in utero nutrition, and a correlate of breastfeeding quality (Coffey 2013).

Figure 2 (p 23) presents a non-parametric summary of our first result – at all levels of a socio-economic status index, children in West Bengal are shorter, on average.[2] In other words, although children in West Bengal are taller overall, they are also richer. At any particular level of wealth, average Bangladeshi children are taller than their economic matches in West Bengal. This suggests that some dimension of heterogeneity in West Bengal other than wealth puts children there at a growth disadvantage.

Table 1: Summary Statistics

	Bangladesh	West Bengal	India
Panel A: Published aggregate statistics			
Population (millions), 2011	142	91	1,241
GDP per capita (PPP), 2011	1,569	2,586	3,203
Population density, 2011	964	1,029	382
Urban population (%), 2011	29	32	32
Infant mortality rate, 2011	37	26	44
Open defecation, 2011 (%)	7.0	38.6	49.8
Female labour force participation, 2010 (%)	57	18	26
Women's share of legislative seats, 2011 (%)	18.6	11.2	10.7
Panel B: Our computations from DHS data, representative of children under 5			
Height-for-age z-score	-1.75	-1.70	
Household open defecation	0.21	0.53	
Local (PSU) open defecation	0.20	0.52	
Mother literate	0.61	0.54	
Mother's height (cm)	150.4	150.6	
Mother's BMI	20.1	19.3	
Urban residence	0.206	0.209	
Has electricity	0.439	0.422	
Has radio	0.232	0.284	
Has refrigerator	0.064	0.064	
Has bicycle	0.223	0.624	
Has motorcycle	0.033	0.070	
Has telephone	0.012	0.051	
SES index used in Figure 2	-0.166	0.251	

Figures in Panel A are indicative rather than definitive as they are based on various sources of survey and census data, not all originally constructed to be comparable. Source: All figures from World Development Indicators (World Bank, 2013) unless otherwise stated. Population for India and West Bengal from Government of India (2011a), Statement 3, p 47, for Bangladesh from Bangladesh Bureau of Statistics (2011a); GDP per capita (PPP) 2011 for West Bengal calculated using nominal state domestic product figures from Government of India (2013a), p A13; official exchange rate (local currency unit per $) and PPP conversion factor from World Bank (2013); population density (persons per sq km) for Bangladesh from Bangladesh Bureau of Statistics (2011), for India and West Bengal from Government of India (2011a); urban population for India and West Bengal from Government of India (2011b); infant mortality rate for India and West Bengal from Government of India (2012), proportion of population defecating in the open for Bangladesh from Bangladesh Bureau of Statistics (2011b), for India and West Bengal from Office of the Registrar General and Census Commissioner (2012), female labour force participation for India and West Bengal from Statement 24, Government of India (2013b); women's share of legislative seats from Sen and Drèze (2013).

Figure 1: Unconditionally, Children in West Bengal Are Taller

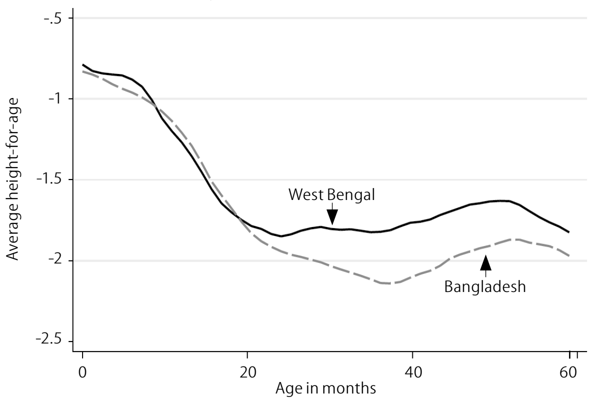


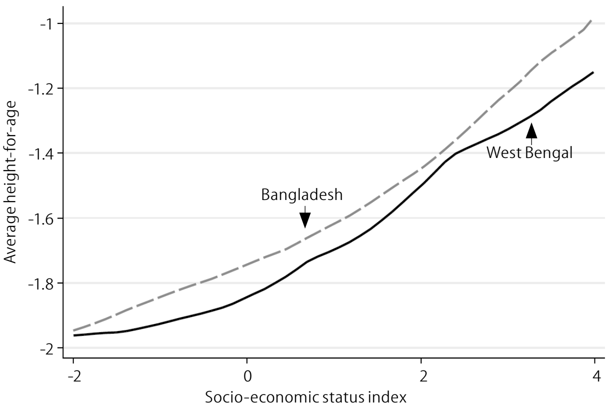
Table 2 (p 23) reports regression estimates. The first column confirms the basic result of Figure 1 – children in West Bengal are slightly taller, although the difference is not statistically significant. The second column adds the vector of SES controls. These controls statistically significantly improve the fit of the model ($F_{67,562} = 651$, $p = 0.00$). With these controls, the West Bengal indicator becomes negative – holding SES constant, children

Table 2: Children in West Bengal Are Shorter at the Same SES

	(1)	(2)	(3)	(4)	(5)	(6)
	Height-for-age z-score					
West Bengal	0.0485	−0.103*	0.0291	−0.0595	−0.0851	0.0639
	(0.0569)	(0.0598)	(0.0679)	(0.0598)	(0.0595)	(0.0663)
SES controls		—	—	—	—	—
Mother's height		0.0524***	0.0526***	0.0603***	0.0521***	0.0603***
		(0.00455)	(0.00456)	(0.00343)	(0.00453)	(0.00345)
Local open defecation			−0.363***			−0.319***
			(0.0852)			(0.0875)
Mother's BMI				0.0385***		0.0351***
				(0.00640)		(0.00636)
Mother literate					0.125**	0.0810*
					(0.0454)	(0.0460)
Gap "explained"			128%	42%	17%	162%
n (children under 5)	7,328	7,311	7,311	7,298	7,307	7,294

Standard errors clustered by survey PSU in parentheses. Two-sided p-values: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. See the text for a complete list of the SES controls.

Figure 2: At the Same SES, Children in Bangladesh Are Taller



in West Bengal are about one-tenth of a height-for-age standard deviation shorter than children in Bangladesh, as in Figure 2. This difference is not only statistically significant, it is important – it is more than 70% as large as the closely studied India-Africa height gap, as estimated by both Jayachandran and Pande (2013) and Spears (2013).

Explaining the Gap

Children in West Bengal and Bangladesh are presumed to share the same distribution of genetic height potential. Children in West Bengal are richer, on average, and are therefore slightly taller. However, when wealth is held constant, children in Bangladesh are taller. Which environmental differences can account for the fact that at the same level of socio-economic status children in West Bengal are notably shorter than children in Bangladesh?

We consider two environmental factors that are important in the literature – women's status and disease due to poor sanitation.[3] At least since Ramalingaswami et al (1996), scholars have hypothesised that the low social status of young women of childbearing age could contribute to malnutrition of the children they care for. Recently, Coffey, Khera and Spears (2013b) have documented an effect of low women's status on child height in India by comparing children of women whose unequal social status is assigned by their husbands' age rank within joint rural families. We operationalise women's status with two variables – mother's literacy and mother's BMI, which has a direct association with child height as an indicator of maternal nutrition (Coffey 2013).

Open defecation is increasingly well understood to be an important constraint on child growth in south Asia. Poor sanitation releases faecal pathogens into the environment where they are encountered by children, especially in high population density areas such as those studied here. Faecal germs cause diarrhoea (Checkley et al 2008) and parasite infections; recent hypotheses and evidence also point to malabsorption of nutrients and chronic enteropathy (Humphrey 2009; Mondal et al 2011; Lin et al 2013; Kosek et al 2013), all of which prevent children from putting food to good use and growing to their height potential. Spears (2013) has documented that heterogeneity among developing countries in the density of open defecation can account for more than 60% of the variation in country-average child height, and that differences in exposure to local open defecation can fully statistically account for the India-Africa child height gap. Here, we follow Spears in constructing a sanitation independent variable as the fraction of the households surveyed in a child's local PSU who defecate in the open.

Can these three variables account for the shorter height of children in West Bengal at the same level of SES as children in Bangladesh? Columns 3 through 6 of Table 2 show that each of these three control variables, individually and together, statistically significantly predicts child height. Indeed, the predicted difference in height due to living in an area where no households defecate in the open, instead of an area where everybody defecates openly, is 85% of the difference in height associated with moving from the 25th percentile to the 75th percentile of the SES index, in a separate regression.

Although each variable reduces the West Bengal-Bangladesh height gap, mother's BMI reduces it by about 40%, and the local prevalence of open defecation to which a child is exposed reduces the gap by 120%. This "overshooting" means that, controlling for SES and sanitation, children in West Bengal are again slightly taller than children in Bangladesh. As column 6 shows, the three variables together can "explain" over 160% of the gap.

Conclusions

It is well known that when environmental conditions change, population average heights change. Studying Europe from the mid-19th century to the late 20th, Hatton (2013) documents that "in little more than a century average height increased by 11 cm – representing a dramatic improvement in health". He concludes, consistently with our analysis here, that "the most important proximate source of increasing height was the improving disease environment as reflected by the fall in infant mortality" (ibid: 1). Another striking example is that people in North Korea and South Korea old enough to be born before the partition are about the same height; people born more recently are shorter in the north (Pak 2004).

Children in India are shorter, on average, than even children in much poorer countries in Africa. Children in Bangladesh are shorter than richer children in West Bengal, but at the same level of socio-economic status, children in West Bengal are shorter than their Bangladeshi neighbours. This gap can be fully accounted for by differences in open defecation, and especially by open defecation in combination with differences in women's status and maternal nutrition. The good news is that change is possible – Kov et al (2013) find that when open defecation was reduced in Cambodia and Bangladesh, children grew taller. Whatever the exact environmental explanation for stunting in India, it is no myth. Neglecting its causes would be a human development tragedy and a waste of productive human capital that India can ill afford.

NOTES

1 It is beyond the scope of this article to explain why Bangladeshis are more likely to use toilets or latrines. Geruso and Spears (2013) observe using data from within India that Muslim children are exposed to much less open defecation than are Hindu children, on average, and that the association between sanitation and child death can statistically account for the Hindu-Muslim height gap identified by Bhalotra et al (2010).

2 We constructed a wealth index as the first principal component of the SES controls listed above; we did not use the wealth index included in the DHS because indicators of sanitation are used in its construction, and we wish to separate the contributions of wealth and sanitation.

3 A third important factor shaping child height in south Asia is heterogeneity within households, as highlighted in the case of birth order by Jayachandran and Pande (2013). When the sample in column 2 of Table 2 is restricted to first birth-order children, the West Bengal disadvantage grows in absolute value to -0.15 but is not statistically significantly different from 0 due to the much smaller sample (p = 0.12).

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