Are Children in West Bengal Shorter Than Children in Bangladesh?

ARABINDA GHOSH, AASHISH GUPTA, DEAN SPEARS

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.

Although researchers have long established that height differences between populations are largely driven by environmental differences – especially net nutrition and disease (Bozoli 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 (DHIS). 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.

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

Arabinda Ghosh is in the Indian Administrative Service, West Bengal; Aashish Gupta is with the Research Institute for Compassionate Economics, Sitapur, Uttar Pradesh; and Dean Spears (dean@riceinstitute.org) is with the Centre for Development Economics, Delhi School of Economics, and RICE.
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

\[
\text{height}_{ip} = \beta_0 + \beta_1 \text{West Bengal} + \beta_2 \text{mother's height} + \gamma \text{controls}_{ip} + \epsilon_{ip},
\]

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 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>
<thead>
<tr>
<th>Table 1: Summary Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bangladesh</strong></td>
</tr>
<tr>
<td>Population (millions), 2011</td>
</tr>
<tr>
<td>GDP per capita (PPP), 2011</td>
</tr>
<tr>
<td>Population density, 2011</td>
</tr>
<tr>
<td>Urban population (%), 2011</td>
</tr>
<tr>
<td>Infant mortality rate, 2011</td>
</tr>
<tr>
<td>Open defecation, 2011 (%)</td>
</tr>
<tr>
<td>Female labour force participation, 2010 (%)</td>
</tr>
<tr>
<td>Women’s share of legislative seats, 2011 (%)</td>
</tr>
</tbody>
</table>

**Figure 1: Unconditionally, Children in West Bengal Are Taller**

\[
\text{Average height-for-age} = \beta_0 + \beta_1 \text{West Bengal} + \gamma \text{controls},
\]

\[\text{controls} = \text{had telephone, has motorcycle, has radio, has refrigerator, has bicycle, has electricity, has radio, mother's BMI, mother literate, household open defecation.}\]
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. 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”

![Figure 2: At the Same SES, Children in Bangladesh Are Taller](image)

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

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

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.
means that, controlling for ses and sani-
tation, children in West Bengal are again
slightly taller than children in Bal-
gadesh. As column 6 shows, the three vari-
ables together can “explain” over 160%
of the gap.

Conclusions
It is well known that when environmen-
tal conditions change, population aver-
age 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 dra-
matic improvement in health”. He con-
cludes, consistently with our analysis here,
that “the most important proximi-
tate source of increasing height was the
improving disease environment as re-
exhibited 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 aver-
age, than even children in much poorer
countries in Africa. Children in Bangla-
desh 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 Bangla-
deshi neighbours. This gap can be fully
accounted for by differences in open de-
fecation, and especially by open defeca-
tion 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 ex-
planation 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 Bangladesis 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 defeca-
tion 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
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 house-
holds, 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 signifi-
cantly different from 0 due to the much smaller
sample (p = 0.12).

REFERENCES
and Housing Census: Preliminary Results, July
(Dhaka: Ministry of Planning, Government of
Bangladesh).
– (2011b): Population and Housing Census – Socio
Economic and Demographic Report – National
Series, Vol 4 (Dhaka: Ministry of Planning,
Government of Bangladesh).
Bhalotra, S., C. Valente and A H O van Soest (2010):
“The Puzzle of Muslim Advantage in Child Sur-
vival in India”, Journal of Health Economics, 29
(2), pp 191-204.
Bozzoli, C., A Deaton and C Quinama-Domeque
(2009): “A Multivariate Analysis of Child Dis-
tease”, Demography, 46 (4).
Case, A and C Paxson (2008): “Stature and Status:
Height, Ability, and Labor Market Outcomes”,
Journal of Political Economy, 116 (3).
Checkley, W, G Buckley, R Gilman, A Assis, R Guerr-
rant, S Morris, K Molbak, P Valentin-Branch,
C Lanata, R Black and The Childhood Malnu-
trition and Infection Network (2008): “Multi-
country Analysis of the Effects of Diarrhoea on
Childhood Stunting”, International Journal of
Epidemiology, 37 (6): 1364-1373.
Coﬀey, D, A Deaton, J Drèze, D Spears and A Taro-
and Implications”, Economic & Political Weekly,
Vol 48, No 34.
Coﬀey, D, R Khera and D Spears (2013b): “Women’s
Status and Children’s Height in India: Evidence
from Joint Indian Households”, RICE Working
Paper.
Coﬀey, Diane (2013): “Maternal Nutrition, Early
Life Mortality, and Height in India”, RICE
Geruso, M and D Spears (2013): “Sanitation and
Health Externalities: Resolving the Muslim
Mortality Paradox”, University of Texas at Aus-
tin Working Paper.
Government of India (2011a): “Provisional Popula-
tion Tables”, Census of India 2011, Series 1
(India), Paper 1 of 2011, Ofﬁce of the Registrar
General, New Delhi.
of India 2011, Series 1 (India), Paper 2 of 2011,
Ofﬁce of the Registrar General, New Delhi.
of the Registrar General, New Delhi, Oct.
– (2013a): Economic Survey 2012-13 (New Delhi:
Ministry of Finance).