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Regional disparities in adult height, educational attainment, and late-life cognition: Findings from the Longitudinal Aging Study in India (LASI) ☆

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ABSTRACT

State policies over time in India may have led to significant differences by sex in population health and cognition. In this paper, we use data from the pilot wave of the Longitudinal Aging Study in India, conducted in Karnataka, Kerala, Punjab, and Rajasthan, to examine state variations in health, educational attainment, and male preference, and how these variations contribute to gender differences in late-life cognition in India. We find men and women born in Punjab are taller than those elsewhere, but do not find any gender differences in height across states with differential male preference. We do find a significant gap in educational attainment that correlates with male preference. We find paternal education benefits both sons and daughters, while maternal education contributes to daughters' educational attainment. Finally, we find that paternal education benefits daughters' late-life cognition, while maternal education benefits sons' late-life cognition, and that children's education has positive association with older adults' cognitive functioning as well.

Introduction[4]

State governments in India have diverged in their policies, rates of economic growth, and investments in education (Ahluwalia, 2000; Alessandrini et al. 2008; Datt and Ravallion, 2011; OECD, 2011). Over time, such cross-state differences have widened (Bhattacharya and Sakthivel, 2004; Purfield, 2006; Sen and Himanshu, 2004) and may have led to significant variations in population health and cognition. In this paper, we examine cross-state variations in adult height and educational attainment and their separate influence on later-life cognition. Adult height is considered to be a good measure of levels of nutrition during early childhood and the prenatal period (Deaton, 2008; Smith et al., 2010; Steckel, 1979).

Ever since Sen (1990) found evidence of "missing women" in imbalanced sex ratios, discrimination against women has been recognized as a critical issue in India. The case of 'missing women' has deep historical roots, dating at least to the mid-nineteenth century, when British censuses also indicated a problem of 'missing women' in northern regions such as Punjab (Chakraborty and Kim, 2008). The overall sex imbalance at birth in India actually increased between 1901 and 2011 (Ja et al., 2011), and cross-state variations in sex imbalance remain substantial. Discrimination against women is also more pronounced in ruling castes and among Hindus than among lower castes and other religious groups (Borooah et al., 2009; Chakraborty and Kim, 2008). A substantial literature has informed and continues to improve upon what we know about inequitable human capital investment (Mishra et al., 2004). Building on this literature, we further investigate gender differences in cognition in India.

Specifically, we examine state variations in adult height, educational attainment, and male preference and how these variations contribute to gender differences in late-life cognition in India. We do so by using recently available data from the Longitudinal Aging Study in India (LASI). The pilot wave of LASI collected rich survey data as well as direct anthropometric and cognitive-functioning

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[4] Abbreviations used in this article include LASI (Longitudinal Aging Study in India), OBC (other backward class), OLS (ordinary least squares), PSU (primary sampling unit), SC (scheduled caste), SES (socioeconomic status), and ST (scheduled tribe).

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measures for a representative sample of respondents aged 45 and older from four states: Karnataka, Kerala, Punjab, and Rajasthan. These states were chosen for their geographic dispersion and cultural diversity. Using LASI data, we also explore the effect of education for respondents as well as their parents and adult children on late-life cognition.

Data

LASI is designed to be a panel survey representing persons at least 45 years of age in India and their spouses regardless of age. The pilot LASI survey was fielded from October to December 2010. These four states were chosen to capture regional variations as well as socioeconomic and cultural differences across India (Arokiasamy et al., 2012). Primary sampling units (PSUs) were stratified across urban and rural districts within each of the four states. LASI randomly sampled 1546 households from these stratified PSUs ($N = 63$). Among them, 950 households with a member at least 45 years old were interviewed (response rate of 88.5%). From these households, 1486 age-qualifying individuals and 197 non-age eligible spouses participated in individual interviews (response rate of 90.9%).

The multidisciplinary survey consisted of two main sections: the household interview and the individual interview. The household module asks about physical environment and household finances, including income, expenditure, consumption, and assets, and could be completed by any knowledgeable household member at least 18 years old. The individual module asks about demographics, family, social activities, health and health behaviors, cognition, work and pension, and includes biomarker collection. The individual interview was only for age-eligible household members and their spouses, and could be completed by a proxy respondent if necessary. Survey questions were translated into languages common in these states (e.g., Hindi, Malayalam), and interviews were done in the language of respondent's choice.

From the survey, we draw data on adult height, parents' socioeconomic status (SES), and SES in adulthood as well as on cognitive ability. LASI interviewers measured height in centimeters, and we use natural log of height in our equations. For education, LASI collected data on years of schooling, highest degree earned, and literacy of respondents and their parents.

Caste is an important indicator of SES in India. We include a categorical variable based on respondents' self-report: scheduled caste, scheduled tribe, other backward class (OBC), and all "other" caste or affiliations, including "no caste" affiliation. The scheduled castes (SCs) and scheduled tribes (STs) are two groups of historically-disadvantaged people recognized in the Constitution of India. They have often been excluded from education, public spaces (e.g., temples, wells for drinking water), and most other aspects of civil life in India (Subramanian et al., 2008). The primary criteria for delimiting ST includes traditional occupation, definitive geographical area, and cultural characteristics reflecting a range of tribal modes of life such as language, customs, traditions, and religious benefits. While less marginalized and stigmatized than scheduled castes or tribes, members of OBC are also recognized by the Indian government as being of relatively lower social status and having barriers to economic and educational opportunities.

For cognitive ability, LASI administered tests for word recall (both immediate and delayed), a modified version of the Min-Mental State Exam, and serial 7s (see Lee et al., 2011, for a comprehensive description). We create a summary index for these cognitive tests, ranging from 0 to 32. Cronbach's alpha for this summary measure is 0.91 (0.90 for men and 0.91 for women), indicating high internal consistency. We examine gender differences in each individual cognitive test as well as in the summary index.

Below, we review prior literature and our data and results for findings on adult height, education, and gender differences and their effects on late-life cognition in India.

Adult height

The positive association between height and economic condition was noted as far back as 1829 when Louise Villermé recognized that height is taller and men grow faster in wealthier countries (Komlos and Meermann, 2007). Height had been widely recognized as an indicator for malnutrition by physicians and nutritionists in the 1950s and by economists two decades later (Heller and Drake, 1979; Steckel, 1979). More recently, substantial empirical research using increasingly available micro-data has investigated the relationship between height and economic development in developing countries (Steckel, 1995, 2009).

Within India, one of the largest developing nations in the world, Deaton (2008), using height as measured directly in the 2005–06 National Family Health Survey and state-level household expenditure data from the 1983 National Sample Survey,[5] found that Indian men born between 1956 and 1990 were getting taller at more than three times the rate Indian women were. Using data from LASI, we examine height of Indian men and women born between 1907 and 1965. Deaton (2007) attributed the gender difference in height growth to gender discrimination giving men more access to food and health care than women had. He also found the differential trend in adult heights to be consistent with the trend in the ratio of females to males, a widely-accepted measure of gender discrimination.

We examine cross-state variations in adult height and per capita consumption. Among the four states where the LASI sample was drawn, Punjab had the highest level of per capita consumption in 1960–61 (the earliest available data on state-specific per capita consumption), as shown in Table 1. Possibly reflecting cross-state variations in economic development, mean heights for both men and women are highest in Punjab. Punjab is also where male-preference is the most pronounced, as indicated by an unbalanced child sex ratio. According to the 2001 Census, for every 1000 boys aged 0–6, only 798 girls lived in Punjab. In contrast, Kerala had 960 girls for every 1000 boys.

We do not find any significant height difference between men and women across states. This result is puzzling. Such difference might be due to mortality bias, but we do not find significant cross-state height differences between men and women less than 70 years of age. Male preference may also be manifest primarily through abortion and to a lesser degree, influence intra-household allocation of nutrition. Genetics may also be a cause of this result, with taller tribes living in northern India. Unfortunately, we cannot test these hypotheses with our data but only call for future research on them.

To further examine gender difference in height, we estimated the model,

$$\text{Height}_i = c_1 + \beta_1 \text{Age}_i + \beta_2 \text{Dad's education}_i + \beta_3 \text{Mom's education}_i + X_\rho + \epsilon_{1i} \quad (1)$$

where Height_i is individual i's adult height; Age_i captures economic conditions when individual i was born; and Dad's education_i and Mom's education_i capture both years of schooling and literacy of father and mother. X is a vector of control variables, including caste, state and urban/rural residence at birth, and ε_i is the error term, that

[5] While Deaton (2008) acknowledged potential endogeneity in that a taller person may decide to reside in richer state, he was unable to control for it given that birth-year-and-place specific economic data were unavailable.