A Life-Course Perspective on Gender Differences in Cognitive Functioning in India

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Abstract

We examine gender differences in four measures of cognitive health among older individuals in India. We use a life-course approach and estimate the impact of circumstances in childhood, choices in adulthood and current circumstances on current cognitive functioning. Our objective is to understand the correlates of cognitive functioning in later-life more generally, and of female disadvantage in particular. We observe a female disadvantage across all cognitive. Our estimates indicate that educational attainment and employment status history can account for the entire female disadvantage in one cognitive measure, but sizable gaps remain in the other measures even after controlling for these variables. Notably, our estimates indicate that circumstances in childhood have an impact on later-life cognition. A decomposition analysis reveals that the predicted cognition gap is driven by differences in characteristics between men and women, as well as the asymmetric returns to these characteristics. We conclude that policies aimed at correcting the gender imbalance in educational outcomes may not be sufficient to close the gender cognition gap. This also has implications for an aging society like India.

JEL Classification: J16, C21, I12, N35

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1 Introduction

The impact of childhood deprivation in food, education and health on later-life cognitive and non-cognitive skills, educational attainment, health, income and overall quality of life has been well-documented.[1] In a series of papers, Heckman and co-authors characterize the learning process that has implications for the optimum timing of investment in human capital.[2] These characteristics imply that the returns to investing in skill formation early in the life-cycle (in utero and in the first couple of years) are very high and that the family environment is more important than the school environment for skill acquisition over the life-cycle.

Gender-based discrimination in the allocation of cognitive resources in childhood adds another negative dimension to the relationship between poverty and well-being over the life-cycle. Research from high-income countries shows that women make large gains in health, income and cognition when living standards improve and they have better access to food, education, employment opportunities and healthcare (Hoynes et al., 2012; Flynn, 2012). A recent cross-country comparison of gender differences in cognition over time indicate that cognitive performance of the population increased in Northern Europe as these countries grew richer. Notably, women's cognitive performance has surged, causing the gender gap to narrow in tasks that men used to have a distinct advantage in (numerical skills), and widening the gap in skills where women have always had an advantage (verbal skills and short-term memory) (Weber et al., 2013). Similar trends were also evident in the relatively poorer countries of Southern Europe, but on a more modest scale. These findings are relevant for developing countries, which are characterized by relatively high poverty rates and often, by unequal investments in cognitive resources between boys and girls (Parish and Wilis, 1993; Mammen and Paxson, 2000).

India presents a complex web of inequalities along dimensions of caste, religion, geography and especially gender.[3] Paradoxically, years of stable economic growth have been accompanied by

[1]See Van den Berg et al., 2006; Paxson and Schady, 2007; Zhang et al., 2008; Case and Paxson, 2009; Hoynes et al., 2012; Doblhammer et al., 2013; Layard et al., 2013; Lee et al., 2014

[2]Cunha et al., 2006; Heckman, 2006; Cunha and Heckman, 2007

[3]See, for instance, Drèze and Sen, 1996; Pande, 2003; Mishra et al., 2004; Subramanian et al. 2008; GOI, 2010;

a deterioration in some social development indicators. For instance, despite averaging an annual GDP growth rate of 6% since 1980 and about 10% for many years in the last decade, India's sex ratio (number of girls for every 1000 boys in the 0-6 age range, for example) has declined substantially between 1990 and 2005 (Jha et al., 2011). There is also evidence of persistent under-investment in girls in terms of nutrition, health care and education, all of which are crucial factors for healthy cognitive functioning over the life-cycle.[4]

We use the pilot wave of the Longitudinal Survey of Aging in India (LASI) to examine gender differences in four measures of cognitive functioning among older (45+) Indians. We ask the following questions: (1) What is the extent of female disadvantage in cognitive functioning in India across different measures of cognition?; (2) In addition to current circumstances, what impact do childhood socioeconomic status and choices made in adulthood have on cognitive functioning in middle-age and old-age?; and (3) How much of the gender gap in cognition is due to differences in attributes between men and women, and how much is due to differences in the returns to these attributes?

We find a sizable female disadvantage across all four measures of cognitive skills in the raw data. We adjust for various individual and household characteristics, sequentially adding sets of variables that capture aspects of childhood socioeconomic status (SES), choices made in adulthood and current socioeconomic circumstances including health status. Adding these controls eliminates the gender gap in one measure of cognitive functioning; sizable gaps remain for the other three measures. We find significant geographic variation in cognitive function across states. Consistent with many other studies for developing countries, we also find that education plays a big role in explaining the gender cognition gap. However, childhood circumstances continue to affect later-life cognition, even after we adjust for age, education and a rich array of other characteristics. The decomposition analysis of the predicted gender gaps in cognition reveals that the relative contributions of gender differences in attributes on the one hand and gender differences in returns

Mammen and Paxson, 2000.

[4] Behrman and Deolalikar, 1990; Mammen and Paxson, 2000; Mishra et al., 2004; Asadullah et al., 2014; Barcellos et al., 2014

to attributes on the other, vary across the different measures of cognition.

Our paper adds to the literature on the levels and patterns of cognitive functioning in developing countries, which has only begun to emerge recently. In contrast to trends in developed countries, evidence from developing countries shows that men outperform women on every measured aspect of cognitive functioning. Papers documenting this include Alderman et al.,1996 (Pakistan); Zhang, 2006 (China); Nguyen et al., 2008 (Latin America and the Caribbean); Yount, 2008 (Egypt); Zunzunegui et al., 2009 (Latin America and the Caribbean); Maurer, 2010 and Maurer, 2011 (Latin America and the Caribbean); Onadja et al., 2013 (Burkina Faso); Lee et. al., 2014 (India). Among these, all except Zhang (2006) and Lee et al. (2014) take a life-course perspective in explaining the gender cognition gap. The principal findings of these papers are that childhood SES affects later-life cognition and that gender differences in educational attainment explain a large portion of the gender gap in cognition.[5]

These findings have important implications for developing countries, which face formidable challenges in expanding economic opportunities for their working-age populations for achieving strong, sustained and balanced economic growth in a globalized world (ILO, 2013). Cognitive skills have become increasingly important for work tasks over time (Broadberry, 1997; Spitz-Oener, 2006; Skirbekk, 2008). Schmidt and Hunter (1998) show that an individual's test scores on cognitive ability are more highly correlated with her labor market productivity than any other observable characteristic. Education, in addition to increasing cognitive skills and labor-market productivity, has significant spillover effects on non-market aspects of the individual's life and on society. Grossman (2006) has emphasized the *causal* role of education in increasing productivity in a number of non-market outcomes such as consumption, savings, own health, fertility and child health and cognitive development. Cutler and Lleras-Muney (2006) survey a large literature establishing a positive gradient between education and health. Michael (1973) estimates that education raises non-market productivity by three-fifths as much as it raises market productivity.

[5]The only exceptions are Onadja et al. (2013), who do not find a strong association between education and cognition, and Zunzunegui et al. (2009) who find that SES in childhood and educational attainment can explain only a small portion of the gender gap in cognition.

Persistent cognition gaps portend deeper challenges for aging economies, as poor cognition is associated with a higher prevalence of age-related morbidities, functional limitations and mental decline. Many studies document a higher likelihood of dementia among women in Latin America, Africa and Asia (Kalaria et al., 2008). While India is currently a young country, it is projected to experience a dramatic increase in the elderly dependency ratio by 2050 and demonstrate all the symptoms of an aging society (Scommegna, 2012). Without urgent intervention to redress the systematic underinvestment of resources in girls and women, the combination of lower cognitive functioning and a higher life expectancy means a higher disease burden, a greater level of dependency and a lower quality of life for Indian women in old age.

Our paper extends the work of Lee et al. (2014). We examine gender differences in cognitive skills using the same data set (LASI) that they do. However, our paper differs from theirs in many aspects. We explicitly employ a life-course perspective to understand how gender differences in access to resources across different stages in life contribute to later-life cognitive differences between men and women. This allows us to identify specific childhood circumstances that are associated with later-life cognition. Lee et al. (2014) use two measures of cognitive function - episodic memory and a global cognitive summary measure that combines numerical skills and orientation functions. We use four different measures of cognitive function - episodic memory, verbal skills, numerical skills and orientation. Since evidence from developed countries indicates that men and women tend to have different cognitive competencies, we choose to study gender differences across various measures of cognition.[6] Moreover, cognitive science tells us that each of these cognitive functions measure different aspects of intelligence.[7] Lee et al. (2014) examine the variation of gender differences by region (North versus South). Their results indicate a regional disadvantage in cognition; they find that the two Northern states (Punjab and Rajasthan) do worse on their two chosen measures of cognitive skills, compared to the Southern states (Kerala and

[6]Men have a distinct advantage in visuospatial abilities such as object rotation and numerical skills, while women routinely outperform men in verbal fluency and memory (Maitland et al., 2000; Weiss et al., 2003).

[7]For instance, verbal abilities are classified as crystallized intelligence while numerical skills and working memory are aspects of fluid intelligence. Crystallized intelligence increases cumulatively with experience while fluid intelligence peaks at adolescence and then declines, though the rate of decline varies across individuals (Nisbett et al., 2012).

Karnataka). We estimate state-specific effects for the four states in the data, and do not find a regional divide. The Northern state of Punjab outscores the other states on episodic memory while Kerala in the South outperforms the other three states in verbal skills. A notable difference is that we decompose the predicted gender cognition gap, to understand the importance of differences in attributes among men and women, relative to gender differences in the returns to these attributes. Lee et al. (2014) use the biometric module of the data, to include well-documented risk factors such as under-nutrition and emotional distress in their analysis. We are constrained in this respect by lack of access to data in the biometric module. Nevertheless, we see our paper as complementing Lee et al. (2014). To our knowledge, ours is only the second paper to use the LASI data set to examine gender gaps in cognitive skills in India.

All the papers cited above that use data from developing countries, including ours, use cross-sectional methods, and the findings cannot therefore be interpreted as causal. Importantly, selection into education based on childhood cognitive ability may impart an upward bias to the education-cognition gradient. Nevertheless, the weight of the combined evidence from all the research points to the existence of a pathway linking early life conditions to later-life cognitive health, often operating through education.

The rest of the article is organized as follows: Section 2 describes the data and presents some descriptive statistics. We present the empirical strategy in Section 3 and results in Section 4. Section 5 concludes.

2 Data and Descriptives

We use the 2010 pilot wave of the Longitudinal Aging Study of India (LASI) survey. The LASI is modeled on the Health and Retirement Survey (HRS) of the United States that was launched in 1992, and is designed for similar objectives - to understand the challenges and opportunities of an aging population, with a particular focus on changes in labor force participation and health transitions of older individuals.[8] LASI is designed to be a nationally representative longitudinal survey of India's aging population 45 years or older and their spouses.[9] LASI covers demographic, health, economic, and psychosocial topics relevant to studies on aging. The first wave was conducted in 2012 but the data has not yet been released for public use.

We use the pilot wave of LASI that was conducted in 2010 in four states - Punjab and Rajasthan in the North and Kerala and Karnataka in the South. A representative sample was drawn from the four states (using the 2001 Indian Census). In addition to geographic variation, these states capture socioeconomic and cultural differences in India as well (Lee et al., 2014; Pal and Palacios, 2008). In order to capture a number of socioeconomic conditions, primary sampling units (PSUs) were stratified across urban and rural districts within each state. The survey randomly sampled 1,546 households from these stratified PSUs, and among them, households with a member at least 45 years old were interviewed. Data were collected from 1,683 individuals during October through December of 2010. Our analysis accounts for the complex survey design features of the data.

The LASI questionnaire consists of two main sections: the household interview and the individual interview. The household module asks about household finances, expenditure, consumption, and assets and can be answered by any knowledgeable household member 18 years of age or older. The household response rate was 88.6%. The individual interview is only for age-eligible household members and their spouses, and can be answered by a proxy respondent if necessary (we exclude proxy respondents in this analysis). The individual response rate was 91.7%. We further restricted the analysis in this paper to 1,486 respondents who are at least 45 years or age; spouses under age 45 were excluded.[10]

As part of a comprehensive health module, the LASI administered a cognitive function exam to respondents that included tests of episodic memory, verbal fluency, numerical skills and orientation. These tests are based on the mini-mental state examination (MMSE) or Folstein test, which is

[8]Sister surveys to the HRS were launched in many other countries - England, Ireland, Mexico, Korea, China, Japan and a number of countries in continental Europe.

[9]LASI will follow 30,000 individuals over time, surveying them once every 2 years.

[10]The survey questions were translated into the languages common in these states (i.e., Hindi, Malayalam, Kannada, Punjabi), and the interview was done in the language of respondents choice.

now an internationally accepted standard for studying cognitive impairment. It is commonly used to screen for dementia and to document individuals' response to treatment over time.[11] These tests have been validated for use among low-literacy populations like those in India (Arokiasamy et al., 2012).

Episodic memory refers to our ability to consciously recall specific events and situations from the past.[12] The LASI pilot survey administered a test of episodic memory to respondents, including both immediate and delayed word recall tests. Survey staff read aloud ten words to respondents and asked them to recall these words when the interviewer finished (immediate recall). Respondents were given a score between 0 and 10, depending on how many words they recalled. They were again asked to recall these words at the conclusion of the cognitive functioning tests (delayed recall), with the same scoring pattern. Following Lee et al. (2014), we added the scores for immediate and delayed recall, to create a summary score for episodic memory, ranging from 0 to 20.

Verbal fluency test is one in which participants have to say as many words as possible from a category in a given time. This category can be semantic, such as animals or fruits, or phonemic, such as words that begin with a specific letter. The LASI tested verbal fluency based on how many unique animals (including birds) the respondents could name in 1 minute.[13] The scores on this test ranged from 0 to 50. *Numerical ability* tests among older populations include the ability to count backwards and to do simple computation problems. The LASI tested for numerical

[11] See Folstein et al., 1975.

[12] Episodic memory is considered as one of the major cognitive capacities enabled by the brain. Episodic memory loss is usually the first symptom of Alzheimer's disease. It is processed in different stages, from encoding (taking in and storing information) to retrieval, either by recognition or recall. Immediate memory recall refers to recall of information that has just been encoded, while delayed recall refers to recall of information after a delay (de Jager, 2010).

[13] The surveyor gave the following instruction to the respondents: "Now we are going to ask you to think of animals and name as many as you can. If you wish you may also include birds along with animals. Count categories of animals (e.g., dogs), as well as specific types (e.g., collie, terrier) as correct. Any members of the animal kingdom, real or mythical, are scored as correct, except repetitions and proper nouns (e.g., Mickey Mouse). I am going to give you one minute and I want to see how many animals you can name."

ability by asking respondents (1) to count backwards from 20, and if they got this right, (2) to count backwards again from 100; (3) to subtract 7 from 100 and then again from 93 for a total of five iterations (popularly referred to as serial 7s); and (4) 2 simple computation problems.[14] Respondents earned a score of 1 for each correct answer and a 0 for wrong answers, giving a range on this measure of a minimum of 0 and a maximum of 9. *Orientation* refers to the cognitive ability of an individual to know who they are, where they are, and what day and year it is. Disorientation is also, typically, an indicator of early stage Alzheimer's disease. LASI respondents were asked to name the current date (date of month, day of week, month, year) with reference to either the English calendar or the vernacular calendar. They were also asked to name the prime minister. We created an indicator variable that equals 1 if respondents answered either the current date or the name of the prime minister correctly, and 0 if they got both wrong.

Table 1 presents the demographic profile of our sample of LASI respondents who are at least 45 years of age. We classify variables according to (i) basic correlates; (ii) childhood circumstances; (iii) adult characteristics; and (iv) current circumstances, in keeping with our decision to use a life-course approach to study cognitive functioning. Variables in Panel A represent the basic characteristics of the sample. The age distribution reflects the fact that India is still a young nation. Kerala has the highest proportion of older individuals, and this follows from the fact that the state entered into the second phase of demographic transition - marked by a declining birth rate and falling levels of mortality - in the late 1960s (Kumar, 1994), well ahead of other states in India. Women are over-represented in the Southern states, and this is presumably a consequence of the favorable sex-ratios in South India, relative to the North. The sample is drawn largely from rural areas, but here again, there is variance across states - Karnataka is considerably more urbanized compared to Rajasthan, for instance. The distribution of caste and religious groups also varies across states. Punjab has a notably higher proportion of Scheduled Castes (SCs) while the Scheduled Tribes (STs) are over-represented in Rajasthan.[15] Sikhs represent nearly 60% of the

[14] Problem 1. "A shop is having a sale and selling all items at half price. Before the sale, a sari costs 300 Rs. How much will it cost in the sale?"; Problem 2: "If 5 people all have the winning numbers in the lottery and the prize is 1,000 Rs, how much will each of them get?".

[15] The Scheduled Castes and Scheduled Tribes are two groups of historically disadvantaged people recognized in the

population in Punjab but they have negligible presence in other states. Christians are a dominant group in Kerala but not in the other states. The predominant religious group in Rajasthan and Karnataka is Hindu. These differences in demographic profiles across states provide rich variation for the relationships of interest in this paper.

Variables in Panel B in Table 1 reflect some of the childhood circumstances of the respondents. Kerala is an outlier in terms of both mother's and father's literacy status. In all states, mother's literacy rates are considerably smaller than the father's, reflecting the historic underinvestment in girls' education. The predominant share of the sample spent their childhood in rural areas, as is evident from the distribution of the type of settlement in childhood. There is some heterogeneity in self-reported health in childhood, though most of the sample appear to have been healthy as children.

Panel C reveals that over three-fourths of the sample is married in all states. Both Punjab and Kerala are among the states with the lowest fertility rates in India, and this is reflected in the average number of children per married respondent. There is significant heterogeneity in literacy levels and educational attainment. Kerala stands apart, with 88% literacy and a sizably bigger proportion of people with above primary school education. In contrast, in the Northern states, well above 50% of the sample has no formal schooling. Just over one-fifth of the sample from the Southern states (Kerala and Karnataka) have ever worked for pay for at least 6 months in the past. The corresponding shares are much lower for the Northern states.

Variables in Panel D reflect some aspects of current living conditions of households in our sample that reveal both the socioeconomic status as well as the quality of life of the average household. Descriptive statistics on some lifestyle variables are also presented. Large inter-state variation

Constitution of India. Other Backward Class (OBC) is a collective term used by the Government of India to classify castes, other than SCs and STs, which are educationally and socially disadvantaged.

in per capita consumption reflects significant differences in economic prosperity across states.[16] Despite the variance in household consumption across states, a very small proportion of households report experiencing food insecurity.[17] A significantly higher fraction of respondents live alone (by themselves) in Kerala and Karnataka, compared to Rajasthan and Punjab.

ADL is a binary indicator reflecting limitations in activities of daily living.[18] About 10% of the sample report having difficulty with an ADL, with the fraction being slightly over 10% in the Southern states and lower than 10% in the 2 Northern states. There is much higher variation in reported rates of CVD (cardiovascular disease - coded as 1 if respondent was diagnosed with any of the following: hypertension, diabetes, congestive heart disease, angina, coronary heart disease, or has had a stroke). Kerala reports a significantly higher rate of CVD (45%), compared to the other states. While some of this difference might reflect a relatively older population in the state, it is also likely that people in Kerala visit the doctor more regularly. Perhaps as a consequence of this, a notably higher fraction of people in other states report being in excellent health, compared to Kerala.

About 58% of the sample live in households that use poor quality cooking fuel.[19] Indoor air pollution caused by using such fuels inside the house dramatically increase the risk of CVD. According

[16] LASI uses the OECD modified equivalency scale to derive the household per capita consumption measure. This scaling assigns different weights to household members by age: household heads are given a weight of 1, additional adults are given 0.7, and children (under 16) are given 0.3. See http://www.oecd.org/eco/growth/OECD-Note-EquivalenceScales.pdf

[17] The food insecurity variable was coded as 1 if the response was affirmative for at least one of the following 4 questions: (1) In the last 12 months, did you (or other adults in your household) ever reduce the size of your meals or skip meals because there wasn't enough money to buy food to eat?; (2) In the last 12 months, were you ever hungry but didn't eat because you couldn't afford enough food to eat?; (3) In the last 12 months, did you lose weight because you didn't have enough money to buy food to eat?; (4) In the last 12 months, did you ever not eat for a whole day because there wasn't enough money to buy food to eat?. It is coded as 0 otherwise.

[18] The variable takes a value of 1 if the respondent reported having difficulty with at least one of the following 4 activities: dressing, walking, eating or bathing. Otherwise, it is coded as 0.

[19] Good quality cooking fuel is defined as 1 if the household uses coal, charcoal, natural gas, LPG, kerosene or electricity for cooking, and 0 otherwise. Bad cooking fuel includes dung cakes, crop residue and firewood (See Arokiasamy et al., 2012.)

to the World Health Organization (WHO), 4.3 millions deaths across the globe (nearly 7% of all deaths) in 2012 were caused by indoor air pollution that is generated by cooking with fuels like wood, coal and cow dung inside the house (WHO, 2014). While all states have a large share of households using such fuels, Rajasthan is an outlier. Over 60% of households have no indoor plumbing. Kerala and Rajasthan are the biggest contributors to this number.[20] Over 15% of households do not have electricity, with Rajasthan contributing disproportionately to this statistic. Over one-third of households have no private toilet and use public spaces for their toilet needs. This practice is much more common in Rajasthan and Karnataka than in Punjab or Kerala.

Respondents were asked about their perceived (relative) socioeconomic status (SES) in society.[21] For the overall sample, households are quite evenly distributed across the different strata. Interestingly, over two-fifths of the sample in Kerala placed themselves in the lowest SES quintile and only 10% thought they belonged to the highest stratum in society. Neighborhood safety is not a concern for most of the respondents.

There is not much variation across states with regard to the lifestyle variables. Over two-thirds of the sample have never smoked, had alcohol or exercised. There is a higher share of current smokers and drinkers in Kerala and Karnataka, compared to the Northern states, and over 20% of the sample report doing heavy exercise in all states except Punjab.

Figure 1 plots the distribution of scores for episodic memory and verbal skills for the entire sample. 'Ceiling effects' are common in the measurement of cognitive functioning. Since these measures are generally designed to detect cognitive decline, individuals with good cognitive functioning

[20] The statistic that the predominant share of households in Kerala having no piped water inside the house is consistent with findings from other data sources. See Arokiasamy et al. (2012) and references therein.

[21] Respondents were shown a picture of a 10-rung ladder and told the following: "Think of this ladder as representing where people stand in society. At the top of the ladder are the people who are the best off - those who have most money, most education, and best jobs. At the bottom are the people who are worst off - who have the least money, least education, and the worst jobs or no jobs. The higher up you are on this ladder, the closer you are to the people at the very top and the lower you are, the closer you are to the people at the very bottom. Please mark a cross on the rung on the ladder where you would place yourself." We divided the responses into quintiles and created 5 indicator variables.

often score the maximum points on these tests. If this is the case, then the econometric analysis will have to take such censoring into account (Yount, 2008; Maurer, 2010; Maurer, 2011). In our case, this would apply specifically to the episodic memory and verbal skills measures. As is evident from Figure 1, the distributions do not indicate the presence of any ceiling effects in either measure.

Table 2 reports summary measures of our 4 measures of cognitive function disaggregated by state and by gender. It reveals that men outperform women in every cognitive measure, on average. These differences are significant, except in the case of episodic memory in Kerala and verbal fluency in Karnataka. Punjab outranks the other states in episodic memory while Kerala ranks first on all other measures. Rajasthan scores poorly on the numerical skills measure but outranks Karnataka on verbal fluency. Thus, there is no clear-cut North-South divide in cognitive skills, based on average performance indicators. This suggests that not only are the risk factors for poor cognitive performance likely to differ across states but that they are also likely to affect the various cognitive measures differently. Thus, analyzing cognitive performance by combining states and/or combining different cognitive measures is likely to conceal a number of interesting relationships.

All individuals experience a decline in cognitive capacity as they age, though the point in the lifespan when the decline begins and the rate of decline vary across individuals and across the type of cognitive function (Finkel et al., 1998). There is little evidence of decline in crystallized abilities (for example, verbal skills), that depend on knowledge accumulated over time while fluid abilities that relate to the ability to learn new things and to solving novel problems, show evidence of decline from early adulthood (Skirbekk, 2008). Table 3 reports our measures of cognitive function, decomposed by age and gender. Episodic memory and numerical skills appear to decline monotonically with age, while for verbal skills and orientation, the decline is apparent only from the mid-50s. Consistent with the literature, the decline is much steeper in numerical skills than in verbal skills. With the exception of orientation, the decline is much sharper for women between 55 and 74 years of age, compared to men in the same age range. We note that these statistics cannot be interpreted as pure aging trends; they reveal a combination of cohort and age effects.

In Table 4, we report gender differences in some of the risk factors as well as characteristics, that are known to affect cognitive functioning. There is little evidence of significant differences in risk factors between the genders. The age difference is significant only in Punjab. Women are more likely to report difficulties with ADL and diagnosed CVD. However, these gender differences are either not significant, or only marginally so. In contrast, gender differences in characteristics are all positive in men's favor - men are more educated, more likely to have worked and more likely to be married - and also statistically significant. Differences in education are notable for all states, but especially in Rajasthan.

3 Empirical Strategy

We estimate the following linear regression:

$$C_i = \alpha + \beta Female_i + X_i^j \gamma^j + \epsilon_i \quad (1)$$

where C is one of our four measures of cognitive functioning for individual i, 'Female' is the gender dummy, ϵ is the error term and X is a vector of individual and household characteristics and j indexes different specifications. Since we use a life-course approach, we are interested in estimating the impact of variables reflecting characteristics at different stages of the individual's life, on the cognition outcome variables. We operationalize this by sequentially adding variables representing different life stages into the regressions. We estimate Equation 1 using the ordinary least squares (OLS) method.

In our first specification ($j = 0$), X^0 comprises variables that are exogenous to the outcomes, as well as geographic indicators (state of residence and urban status) (Panel A variables in Table 1). We refer to this specification as Model 1. These variables appear in all our specifications. Our second specification ($j = 1$) introduces variables representing the individual's SES in childhood, in addition to those in X^0 (variables in Panel A and Panel B in Table 1). In the third specification, we add characteristics decided in adulthood to the basic model (variables in Panel A and Panel

C in Table 1). We next examine the impact of variables that represent the current socioeconomic situation of the individual (variables in Panel A and Panel D in Table 1). In the last specification ($j = 4$), we add variables from all stages and estimate the full model (variables in Panels A, B, C and D in Table 1). Our coefficient of interest is β, which captures gender differences in the particular measure of cognitive functioning.

We also decompose the predicted gender difference in cognitive functioning based on the method proposed by Oaxaca and Blinder (Blinder, 1973; Oaxaca, 1973). The Oaxaca-Blinder decomposition analysis complements the conventional regression analyses by summarizing the shares of the male-female gap in mean cognition scores that are attributable to gender differences in mean attributes on the one hand, and to gender differences in the returns to these attributes on the other.

The decomposition analysis is based on running the regressions specified in Equation 1 separately for men and women and obtaining parameter estimates $\hat{\gamma_M}$ and $\hat{\gamma_F}$ respectively.[22] The predicted levels of cognitive functioning for the 2 genders are now $\hat{C_M} = X_M \hat{\gamma_M}$ and $\hat{C_F} = X_F \hat{\gamma_F}$. We can now decompose the mean male-female difference in predicted levels of cognition as:

$$\begin{aligned} \overline{\hat{C_M}} - \overline{\hat{C_F}} &= \overline{X_M}\hat{\gamma_M} - \overline{X_F}\hat{\gamma_F} \\ &= (\overline{X_M} - \overline{X_F})(W\hat{\gamma_M} - (\mathbf{I} - W)\hat{\gamma_F}) + (\overline{X_M}(\mathbf{I} - W) + \overline{X_F}W)(\hat{\gamma_M} - \hat{\gamma_F}), \end{aligned} \tag{2}$$

where the first component in Equation 2 is attributable to differences in mean characteristics (the 'explained' component), and the second component is attributable to differences in their effects (the 'unexplained' component). $\bar{X}$s denote subpopulation means, $\mathbf{I}$ denotes the identity matrix and W is the weighting matrix proposed by Neumark (1988) and Oaxaca and Ransom (1994), which uses the coefficients from a pooled model over both sexes (and includes a dummy variable for gender as a control variable) as the reference coefficients.[23] W is calculated as follows:

[22]See Yount (2008) and Maurer (2011).

[23]Note that in this case, there is a simple relationship between the magnitude of the female dummy coefficient from the pooled OLS regression, and the unexplained component of the decomposition. Bonnal et al. (2013) show that if the correlation between the group indicator variable (the female dummy in our case) and the set of control variables X is

$$W = (X'_M X_M + X'_F X_F)^{-1}(X'_M X_M) \tag{3}$$

In addition to reporting the summary measures of the explained and unexplained differences in later-life cognition for each measure, we also present the specific contributions of variables that significantly contribute to these differences.

4 Results

Panel A in Table 5 presents estimates for each of the 4 measures of cognitive function, from ordinary least squares (OLS) models adjusted for age, state of residence, urban status, caste and religious identity. The first row reports the mean and standard deviations of the corresponding measure, for ease of comparison with the coefficients. Female disadvantage is evident across all cognitive measures; the coefficient of the female indicator variable is negative and significant for all measures of cognition. The magnitude of disadvantage varies, representing nearly one-third of the standard deviation (SD) for episodic memory, over one-fifth of the SD for verbal fluency, nearly 50% of the SD for numerical skills and over two-fifths of the SD for orientation. All cognitive functions decline with age. Consistent with the literature, the decline in verbal fluency appears to begin at a later age, compared to the other functions (Finkel et al., 1998; Skirbekk, 2008).

The summary statistics in Table 2 revealed that Punjab ranked highest with respect to episodic memory. The regression results reflect this as well; relative to Punjab, the other 3 states have a sizable disadvantage in episodic memory. Notably, Kerala's deficit is about four-fifths of a SD relative to Punjab. On all other measures, Kerala does considerably better while Rajasthan is statistically no different from Punjab. Karnataka does worse than Punjab on verbal fluency but is statistically

weak, the magnitude of the coefficient on the indicator variable from a pooled OLS regression is the same as the size of the unexplained component of the Oaxaca-Blinder decomposition. If there is a correlation between the indicator variable and X, we can still infer the unexplained component from the coefficient of the indicator. Testing the null hypothesis on the indicator variable in equivalent to testing the null hypothesis of the unexplained component.

indistinguishable on the other measures. Thus, there is considerable heterogeneity among states across the different measures of cognition and no clear-cut North-South divide in performance. Living in urban areas positively affects all cognitive measures. In terms of differences by caste, scheduled tribes (ST) do just as well as scheduled castes (SC) across all measures. Other backward castes (OBC) and the residual category (None/Other) perform significantly better than the SCs in all measures except verbal fluency. Verbal fluency is the only cognitive measure that is unaffected by caste status. Religion does not appear to have a strong influence on cognitive performance in general though Christians do much better than Hindus (over one-third of a SD) in verbal fluency, and there is evidence of some negative self-selection into the residual (Other) category.

In Panel B, we present the decomposition of the predicted male-female differences in cognitive function based on the specification in Panel A.[24] For all measures, the predicted cognition gap is marginally smaller than the actual gaps in Table 2. Across all measures, the returns to characteristics (the coefficient effect) not only explain the entire gender gap in cognitive abilities but are in fact bigger than the gap, largely driven by the intercept coefficient (the constant term). As a consequence, the differences in characteristics (the 'explained' component) are negative and significant, except in the case of episodic memory. This implies that women are in fact better endowed than men in the specified characteristics that favor cognition at later ages, and that these endowment effects act to mitigate some of the difference arising from bigger returns to characteristics for men relative to women.

4.1 Childhood Influences

We now augment the specification in Table 5, by including controls for early-life circumstances - specifically, mother's and father's literacy, type of settlement that respondent resided in during childhood (village/town/city) and self-reported health status in childhood (excellent/good/fair). In our view, these variables reflect the extent of cognitive stimulation as well as socio-economic

[24] The decomposition results for categorical predictors are estimated using the deviation contrast transform, hence these estimates do not depend on the choice of the base category (Jann, 2008).

status in childhood, both of which are established predictors of cognitive function in adulthood (Heckman, 2006b). Table 6 reports the estimates from this specification. For some of the variables used in the first specification (Table 5), we only indicate whether the variable is significant (jointly significant in the case of variables with more than 1 indicator variable) in order to conserve space.

Estimates from Panel A suggest that introducing variables that reflect early-life circumstances *increases* female disadvantage in episodic memory and verbal fluency, decreases it marginally in numerical skills while leaving the deficit essentially unchanged in orientation. Mother's literacy is positively and strongly associated with episodic memory (nearly 30% of 1 SD) while father's literacy exerts a positive influence on all measures of cognition but especially on numerical skills (53% of a SD) and orientation (one-third of a SD). Self-reported health in childhood has no effect on episodic memory but is associated with all other measures of cognition. Relative to having been in excellent health during childhood, having been in poorer health negatively affects current verbal, numerical and orientation skills. These effects are particularly substantial for numerical skills and orientation when respondents report poor childhood health. Similarly, childhood spent in a village, as compared to a city, is detrimental to all cognitive skills except verbal fluency. Again, these effects are large and significant. In summary, not controlling for circumstances in childhood understates the extent of female disadvantage in episodic memory and verbal skills and overstates this disadvantage in numerical skills. Note that the inclusion of these variables increases the R^2 values in Table 6, compared to those in Table 5, indicating that these variables are important correlates of cognitive skills (Oster, 2014).

Age continues to influence the outcome variables even after the introduction of the additional control variables. State effects are now much weaker. Notably, Kerala now has the advantage over other states only in verbal skills; it is statistically no different from Punjab in numeracy and orientation. In fact, none of the states are distinguishable from the others in numeracy and orientation. Urban status and caste status no longer affect episodic memory and verbal fluency. This is possibly due to the fact that educational attainment, especially among older cohorts, is unequally distributed across caste groups in India (Chauhan, 2008). In our sample, SC and ST status was negatively correlated with both mother's and father's literacy while OBC and Other castes displayed a positive correlation with parents' literacy. Urban status was correlated with rural/urban residence status in childhood; respondents who spent their childhood in a village are less likely to be living in urban areas. All these correlations were significant at the 5% level. Thus, inclusion of parents' literacy status and type of settlement in childhood weakens the association between our outcome measures and the caste and urban status variables.

The decomposition of the predicted cognition gap in Panel B of Table 6 reveals the same trends as those in Table 5. Again, the predicted cognition gaps are only marginally smaller than the corresponding raw gaps in Table 2. Differences in the mean values of the control variables - the explained component - are negative for all measures and significant for orientation and verbal fluency, and marginally significant for numerical skills. The unexplained component - the returns to characteristics - is bigger than the cognition gap for each measure and statistically significant at the 1% level. However, the constant term is now positive and significant only for orientation.

4.2 Influence of Adulthood Choices

We now examine the impact of choices made in adulthood on the 4 cognitive measures and the gender gap in these measures. To our first specification (Model 1), we add the following variables as controls: indicator variables for educational attainment levels, literacy, marital status indicator, number of children and past employment status (ever worked versus never worked).[25] We report these estimates in Table 7. We again report the mean and standard deviations of the corresponding measure in the first row, and estimates of the female indicator variable from Model 1 (Table 5) in the second row, for ease of comparison.

We first note, from estimates in Panel A of Table 7, that controlling for educational attainment, literacy, marital status, number of children and work status history wipes out the female disadvan-

[25] In low-literacy populations such as those in rural India, it seems important to control for literacy, in order to differentiate those who are functionally literate even with no formal schooling. Manly et al. (2005) have also argued that in poor population settings comprising of a number of ethnic minorities, literacy indicators rather than years of education better capture native ability.

tage in verbal skills and reduces it considerably in the other 3 measures - by 62%, 71% and 67% in episodic memory, numerical skills and orientation respectively - relative to the estimates in Table 5. Education appears to be the key variable driving this sharp reduction, with large gains beyond primary school levels. The education-cognition gradient is particularly steep for the highest level of education (over 12 years of schooling) relative to having no formal schooling, increasing cognition scores on episodic memory and numerical skills by over 1 SD, by nearly 1 SD for orientation and by over three-fourths of a SD for numerical skills. Even a few years of schooling increase numerical skills and orientation considerably, as does literacy. Thus, even basic education appears to have big impacts on these two cognitive measures. The positive and sizable effect of education on cognition is consistent with the findings of other studies (Maurer, 2011; Lee et al., 2014). Employment status history (whether the respondent ever worked for pay for over 6 months in her lifetime) impacts verbal fluency and numerical skills, increasing the former by about one-third of a SD and the latter by about 30% of a SD. Number of children appear to have no significant effect on cognitive skills. Age and state dummies continue to be significant. Caste indicators are jointly significant for orientation but only weakly so for episodic memory and numerical skills, while the religion indicators are only significant for verbal fluency. Thus, it appears that some of the effects of childhood circumstances that contribute to female cognitive disadvantage disproportionately, can be reversed with educational attainment, employment and marital status. In the case of verbal skills, the reversal appears to be complete. In other cognitive measures, sizable cognitive gaps remain.

Panel B of Table 7 reports the decomposition of the predicted cognition gap based on the specification in Panel A, and is notably different from the estimates in Table 5 and Table 6. The predicted cognition gap for episodic memory is now bigger than the corresponding summary measure in Table 2, while those for verbal skills, numeracy and orientation are considerably smaller; there is no statistical difference between men and women in verbal skills. Thus, the control variables in this specification go a long way in explaining the cognitive gender gap in verbal skills and numeracy.[26] Now, the 'explained' component is positive and bigger than the 'unexplained' component for all

[26] This is also evident from the fact that the R^2 value for numeracy in Table 7 is much bigger than that in Table 5.

measures, and statistically significant for all outcome measures except verbal skills. On average, men's higher educational attainment explains around 30% of the gender gap in all 3 measures where there is a statistically significant gender gap in predicted cognition. Higher employment rates contribute around 16% to the male advantage in numerical skills. Moreover, men also enjoy significantly higher returns to characteristics. The only exception is for episodic memory, where women enjoy higher returns to living in urban areas compared to men. However, the intercept difference is positive and significant for this cognition measure. These estimates imply that even if women are given the same education levels and employment rates as men, they would still underperform in cognitive functions.

4.3 Influence of Later-Life Circumstances

We next examine the influence of current circumstances - household living conditions, financial circumstances and self-reported health status - on the 4 cognitive measures. We add the following variables to those in our first specification (Model 1): logarithm of per capita household expenditure, indicator for whether household faces food insecurity, indicators for household living conditions (whether household has electricity, indoor plumbing, indoor toilet, type of fuel used for cooking), indicators for whether respondent lives alone, has difficulty with activities of daily living (ADL), has been diagnosed with CVD, self-rated health, indicators for past and current life-style habits (smoking, alcohol consumption and exercise), perception of relative socio-economic status (SES) and neighborhood safety. A number of these variables - household expenditure, food insecurity status, perception of neighborhood safety and household living conditions - capture the household's SES which is hypothesized to have a direct as well as indirect impact on cognition, as noted in the introduction.[27] Lifestyle variables affect the risk of morbidity, which in turns impairs cognitive functioning (Yount, 2008; Séverine et al., 2012). Subjective perception of relative SES is a proxy for life satisfaction, which is a measure of cognitive well-being.[28] We report the estimates

[27] See for instance, Mani et al., 2013; Maurer, 2011.

[28] Kahneman et al. (2006) argue that when people are asked how satisfied they are with their lives, they are subject to 'focusing effects'; they tend to reflect on their relative standing in the distribution of SES rather than their feelings

in Panel A of Table 8.

The array of variables introduced to control for current life circumstances causes female disadvantage in episodic memory to *increase* marginally, but reduces the gender gap by about 11% in verbal fluency, by nearly 20% in numerical skills and by about 12% in orientation. People living in Punjab continue to have an advantage in episodic memory compared to those living in other states. Kerala continues to do better than Punjab in verbal fluency and orientation. Living alone is considered a risk factor for dementia (Kalaria et al., 2008). However, this variable appears to have no impact on cognition in this specification. Limitations in activities of daily living (ADL) reflect some form of disability, and this variable has a big, negative effect on all cognition measures except numerical skills.[29] The positive and significant impact of CVD status on numeracy, though puzzling, is consistent with the evidence in Langa et al. (2009) and Lee et al. (2014). Relative to being in self-assessed excellent health, being in poor health adversely impacts cognitive functioning, especially for verbal skills and numeracy. Increases in per capita household expenditure, as expected, are positively associated with cognitive skills.

Consistent with the findings of the World Health Organization (WHO, 2014), using good fuel for cooking increases cognitive skills - around 23% of the corresponding SD for episodic memory and numerical skills, and about 15% of a SD for orientation. Having a toilet inside the house is associated with increases in episodic memory (26% of a SD) and orientation skills (45% of a SD). The perception of living in a safe neighborhood also has a sizable effect (nearly a third of the corresponding SD) for episodic memory and numerical skills. As noted earlier, these characteristics reflect the SES of the household and their impact is best interpreted in that light. Subjective assessment of relative SES of the household also tells us a qualitatively similar story, though there is some evidence of non-linear effects. Thus, relative to the lowest quintile, those in the second quintile of subjective SES appear to have higher levels of cognition in all measures except orientation while those in the third quintile do better on numerical skills (about 18% of a SD) but are statistically no different from those in the bottom quintile on other measures. We see the biggest

about their lives.

[29] Lee et al. (2014) and Andersen-Ranberg et al.(2008) also find a negative impact of ADLs on cognition measures.

effects for the fourth (except for orientation) and fifth quintiles. Numerical skills, in particular, appear to respond very strongly and consistently to increases in self-assessed SES.

With respect to lifestyle choices, current smokers have lower scores on episodic memory and orientation relative to non-smokers, and those who exercise regularly have better orientation skills (about 18% of a SD) compared to those who never exercise. We find a positive association between current alcohol consumption and numerical skills, which is in line with the findings of other studies (Anstey et al., 2009; Virta et al., 2010). In summary, while a number of variables included to control for current circumstances have sizable effects on cognition, the net effect of these variables does little to reduce the female disadvantage except in numerical skills. The decomposition analysis based on this specification is reported in Panel B of Table 8. As with the other specifications, the predicted cognition gap is positive and significant for all cognition measures. However, predicted gaps are now bigger for numeracy and verbal skills, relative to the actual gaps in Table 2. In line with the first two specifications (Models 1 and 2) and unlike the estimates for the third specification (Model 3), on average, women appear to do better in terms of characteristics that increase cognition (except for numerical skills), though these effects are not significant. However, returns to characteristics disproportionately favor men.

4.4 Influence of the Life-Course

We now examine the effects of cognitive resources over various life stages on cognitive outcomes in later-life. We estimate our model with the full set of control variables, comprising the basic, largely exogenous set of controls (Model 1), controls for childhood circumstances, controls for adult life choices and controls for current life circumstances. Panel A of Table 9 presents the results.

The inclusion of the full set of life-course variables eliminates the gender gap in verbal skills and reduces it by 51% in episodic memory, 74% in numeracy and by 61% in orientation. For episodic memory and orientation, this decline is smaller than the decline induced by the inclusion of controls for choices made in adulthood alone (Table 7). This is largely due to the importance of influences in childhood on later-life cognition. Notably, mother's literacy status increases episodic memory by about 22% of a SD even after controlling for circumstances and choices in different stages of life. Similarly, the type of settlement in childhood that the respondent resided in continues to have a significant impact on episodic memory, verbal skills and orientation. The respondent's health in childhood is correlated with verbal skills and numerical skills late in life, despite the addition of various other controls. Father's literacy status has a big (28% of a SD) and significant impact on an individual's numerical skills over the life time. These results support the view that the childhood environment is crucial for the development of skills and that cognitive resources acquired later may not completely reverse the deficit from lack of resources in childhood (Cunha et al., 2006). Nevertheless, education is a vital channel for cognitive skills in later years.

The returns to high educational attainment (more than 12 years of education) are bigger for verbal skills after controlling for childhood and later-life circumstances, compared to the specification without these controls (the corresponding coefficients are smaller in Table 7), suggesting that high levels of education can offset some of detrimental effects of childhood and current life circumstances on cognitive functioning. In general, the education-cognition gradients are steep for all cognition measures, though for verbal skills, the coefficient is statistically significant only for the highest educational attainment indicator. As in Table 7, relative to no formal schooling, even a few years of schooling increase numerical skills considerably - by 37% of a SD. Literacy has a big impact on numerical skills (29% of a SD) even after controlling for education. Marital status and number of children now affect only episodic memory. Controlling for childhood and current circumstances attenuates the positive effect of employment status history on verbal and numerical skills but only slightly; the coefficients continue to be sizable and significant.

The positive effect of CVD on numerical skills, found earlier, survives the additional controls. Per capita household expenditure also has a positive effect on numerical skills but the coefficient is much smaller relative to the corresponding coefficient in Table 8. Using good cooking fuel is now positively and significantly associated only with episodic memory; the effect of this variable on numerical skills and orientation is no longer statistically significant. Similarly, subjective SES significantly affects verbal skills but no other cognition measure. Household amenities - availability of electricity, piped water and indoor toilet - matters significantly for orientation but for no other cognition measure. Notably, the effect of living in a safe neighborhood on episodic memory is now bigger (40% of a SD) relative to the corresponding estimate in Table 8. Smoking continues to have a negative but marginally significant effect while exercising has a positive effect on episodic memory. The positive effect of drinking on numerical skills endures the addition of childhood circumstances and life cycle choices.

Panel B of Table 9 presents the decomposition of the predicted gender gaps in cognition. The gender gaps in cognition are all positive, and significant for all measures except verbal skills. For episodic memory, the predicted gap is marginally bigger than the corresponding mean difference in Table 2. As with Model 3 (Table 7), differences in attributes between men and women are positive and contribute significantly to the gender gaps. Thus, men are better equipped in attributes that positively affect cognition. In particular, they have higher educational attainment and are more likely to have worked, compared to women. While the addition of other controls lowers the magnitude of these effects (education and work history status) on the cognition gender gaps, they nevertheless continue to be sizable. Yount (2008), Maurer (2010) and Maurer (2011) also highlight the importance of education in explaining the gender cognitive gap. Unlike Alderman et al. (1996) and Maurer (2011), we do not find evidence of bigger returns to education for women compared to men. Overall, returns to characteristics also favor men, contributing nearly 50%, 33% and 63% of the gap in episodic memory, numerical skills and orientation respectively. There is, however, some evidence that women benefit disproportionately from living in urban areas.

Table 10 summarizes the results from the various specifications. We first note that relative to Model 1, the coefficients of the female indicator variable are considerably smaller in the fully detailed model (Model 5) for all cognition measures. However, the predicted gender gap in episodic memory is bigger than the actual gap. The explained component of basic characteristics (age, state of residence, urban status, caste and religion indicators) is negative and significant in all models for verbal skills; for women, some of these characteristics work towards mitigating the overall disadvantage in verbal skills. For episodic memory, numerical skills and orientation, the unexplained component of the predicted cognition gap is positive and significant in all models, indicating that men enjoy better cognitive returns to characteristics in all stages of life. Estimates for the fully detailed model (Model 5) indicate that characteristics capturing adult circumstances - educational attainment, work history, marital status and number of children - jointly favor men for all measures. For episodic memory alone, the joint returns to these characteristics appear to favor women. A comparison of Model 3 with Model 5 indicates that for episodic memory and orientation, we would be underestimating the extent of female disadvantage by not controlling for circumstances in childhood and current circumstances. Literacy, education and employment matter significantly for numeracy (Model 3). Adding controls for childhood and current circumstances reduces female disadvantage in numeracy only marginally. However, childhood circumstances matter considerably for verbal skills, as a comparison of Models 1 and 2 indicate; the estimated female disadvantage is bigger with the inclusion of childhood influences. However, controlling for the full set of life-course variables eliminates the cognitive gap in verbal skills. This is not the case for the other 3 cognition measures. A significant gender gap remains - measuring 15% if an SD in episodic memory, 12% of an SD in numeracy and 17% of an SD in orientation - even in the fully detailed model. Notably, there is significant heterogeneity in the contribution of the explained and unexplained components of the predicted cognition gap across these 3 measures in the detailed model - for episodic memory, the two components explain roughly one half of the predicted gap while the explained component is twice the magnitude of the unexplained component for numeracy and about 60% of the unexplained component for orientation.[30]

[30]We also estimated age-wise and state-wise regressions for the four age groups and the four states respectively, based on the specification in Model 5. In general, the predicted gender cognitive gaps are bigger among older people, suggesting that women might experience greater cognitive impairment as they age. However, we cannot control for cohort effects with our data. With regard to the state regressions, the predicted cognitive gaps are positive (favoring men) and significant for all four measures in Rajasthan, for episodic memory and orientation in Punjab, for numeracy alone in Kerala and for orientation alone in Karnataka. These gaps are driven by different components in each case. However, the number of observations for all these regressions are small. For these reasons, we have not reported these results. They are, however, available upon request.

5 Conclusions

We examine gender differences in four cognitive skill measures among individuals aged 45 and over, using the 2010 pilot survey of the Longitudinal Aging Survey of India (LASI), that surveyed representative populations across 4 different states in India. We find a persistent female disadvantage across all 4 measures of cognitive skills in the raw data. We adjust for various individual and household characteristics, sequentially adding sets of variables that capture aspects of childhood SES, choices made in adulthood and current socio economic circumstances, including health status.

We find significant and sizable effects of state of residence; Punjab's supremacy in episodic memory is robust to various specifications, as is Kerala's in verbal skills. The decomposition of the predicted cognition gap in the detailed model (Table 9) also indicate that women would benefit significantly in terms of episodic memory and verbal skills, from moving to urban areas. Thus, there is robust evidence that 'geography' matters for everyone and that women may be particularly disadvantaged by being confined to rural areas. Being married is positively associated with episodic memory but with no other cognitive skill. Similarly, there is evidence of a negative association between number of children and episodic memory. Different aspects of current socioeconomic status matter for different cognitive skills, to varying degrees. Thus, living in a safe neighborhood and using good cooking fuel appears to matter for episodic memory while higher household consumption matters for numeracy. Lifestyle variables affect episodic memory and numeracy. Understanding how much of these effects is due to reverse causation, how much is due to correlations with unobserved variables, and how much of the effects, if any, are causal is beyond the scope of this paper. As the various waves of LASI data become available, it may be possible to address these questions.

Consistent with many other papers cited in the literature review, we also find that education plays a big role in explaining the gender cognition gap. In the richest model specification incorporating characteristics from various life stages (Model 5), differences in educational attainment between men and women explain 26%, 25% and 27% of the predicted cognition gap in episodic memory, numeracy and orientation respectively (Table 9). These big effects are not always mitigated by bigger returns to education for women, as other papers find (Maurer (2011), for instance). Moreover, childhood circumstances continue to affect later-life cognition, even after we control for a rich array of other characteristics. Thus, mother's literary status has a continued influence on episodic memory while father's literacy has a strong and significant effect on numeracy. Similarly, health status in childhood affects verbal and numerical skills while the type of settlement that the respondent resided in during childhood has a significant impact on later-life episodic memory.

Our results suggest that while the female disadvantage in cognition can be alleviated to some extent by closing the male-female education gap, it is unlikely to disappear completely as long as other cognitive resources are unequally distributed to girls and boys in childhood. Moreover, poor cognitive function is both a risk factor for, and a consequence of many chronic health conditions associated with the elderly, such as dementia (Lee et al., 2014). Thus, investments which work towards closing the cognition gap, beyond creating a healthy and skilled work force, would increase women's mobility, independence, well-being and overall quality of life at all ages (Hatch et al., 2007). More importantly, such investments have intergenerational spillover effects working through women's education, nutritional status and health. Expanding the social safety net - in particular, increasing outlays and coverage of government prenatal programs, and of cash and food transfers to poor families - is likely to generate substantial benefits to society that extend far into the future.

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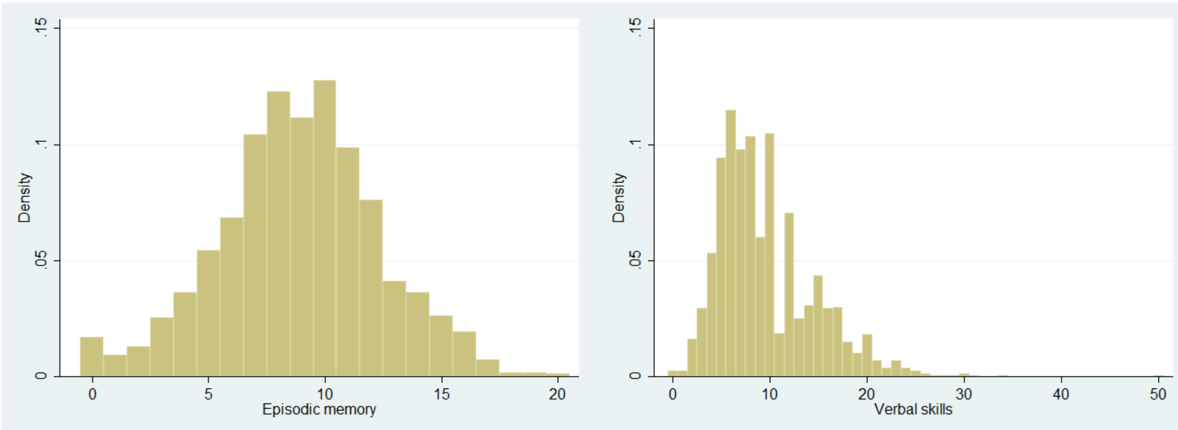

Figure 1: Density of Scores on Episodic Memory and Verbal Skills

Table 1: Demographic Structure (Sample Aged 45 and Above)

Variable	All states	Punjab	Rajasthan	Kerala	Karnataka
A. Basic correlates					
Age structure (%)					
Age 45-54	44.2	46.5	43.6	35.6	50.6
Age 55-64	27.9	27.5	23.4	30.2	30.8
Age 65-74	17.5	14.4	20.9	20.0	13.5
Age 75+	10.4	11.7	12.2	14.2	5.1
Females (%)	51.4	49.5	48.5	55.4	52.0
Urban residence (%)	27.2	29.7	19.2	25.0	36.0
Caste (%)					
SC	14.1	31.0	10.0	7.2	16.5
ST	12.9	0.0	32.4	0.0	8.7
OBC	40.0	10.5	28.1	42.8	59.4
None/Other	34.0	58.6	30.0	50.0	15.4
Religion (%)					
Hindu	75.8	33.5	84.7	70.6	89.2
Muslim	8.0	0.0	14.7	4.5	7.2
Christian	6.8	1.0	0.0	24.8	2.3
Sikh	8.0	58.7	0.0	0.0	0.0
Other	1.4	1.0	0.0	0.0	1.3
B. Childhood circumstances					
Mother literate	0.17	0.02	0.03	0.55	0.10
Father literate	0.27	0.06	0.08	0.70	0.23
Settlement type (%)					
City	0.10	0.08	0.14	0.01	0.15
Town	0.04	0.07	0.01	0.04	0.07
Village	0.86	0.85	0.86	0.96	0.79
Health (%)					
Excellent/V.Good	0.73	0.86	0.85	0.69	0.57
Good	0.22	0.07	0.13	0.21	0.37
Fair/Poor	0.06	0.08	0.02	0.10	0.06

Continued on next page

Table 1 – continued from previous page

Variable	All states	Punjab	Rajasthan	Kerala	Karnataka
C. Adult characteristics					
Married (%)	80.1	82.1	83.7	79.0	76.3
# children	3.16 (1.98)	2.67 (1.47)	3.82 (2.27)	2.75 (1.56)	3.01 (1.90)
Education (%)					
No education	48.0	59.9	79.5	7.5	42.4
<6 years	15.4	14.0	7.0	22.1	19.5
$6-12$ years	31.5	22.9	10.0	64.6	31.3
>12 years	5.1	3.3	3.6	5.8	6.9
Fully literate (%)	49.2	39.6	20.2	88.1	52.9
Ever worked (%)	0.15	0.13	0.05	0.21	0.22
D. Current circumstances					
Log consumption per capita	10.59 (0.92)	10.82 (0.64)	10.20 (0.89)	10.77 (0.77)	10.77 (1.01)
Food insecurity	0.03	0.04	0.04	0.01	0.04
Lives alone	0.12	0.11	0.06	0.15	0.17
ADL	0.10	0.08	0.08	0.12	0.11
Cardiovascular disease	0.23	0.26	0.08	0.45	0.20
Self-reported health:					
Excellent	0.43	0.55	0.55	0.11	0.49
Good	0.44	0.34	0.32	0.64	0.45
Fair	0.14	0.11	0.14	0.25	0.06
Good cooking fuel	0.42	0.69	0.12	0.48	0.57
Indoor plumbing	0.39	0.76	0.22	0.10	0.64
Electricity	0.84	0.96	0.57	0.98	0.96
Toilet	0.66	0.90	0.37	1.00	0.58
Subjective SES					
Quintile 1	0.20	0.15	0.17	0.42	0.07
Quintile 2	0.23	0.18	0.22	0.26	0.23
Quintile 3	0.18	0.15	0.15	0.13	0.28
Quintile 4	0.20	0.19	0.24	0.09	0.25
Quintile 5	0.19	0.32	0.24	0.10	0.17
Safe neighborhood	0.97	0.98	0.98	0.92	0.98

Continued on next page

Table 1 – continued from previous page

Variable	All states	Punjab	Rajasthan	Kerala	Karnataka
Smoking					
Never smoked	0.79	0.96	0.82	0.69	0.75
Current smoker	0.17	0.03	0.16	0.20	0.21
Former smoker	0.05	0.01	0.03	0.11	0.04
Drinking					
Never drank	0.86	0.90	0.92	0.74	0.88
Current drinker	0.09	0.09	0.05	0.12	0.11
Former drinker	0.05	0.01	0.03	0.13	0.01
Exercise					
Never exercised	0.67	0.67	0.65	0.66	0.69
Heavy exercise	0.22	0.14	0.24	0.23	0.22
Moderate exercise	0.12	0.20	0.11	0.11	0.09

Table 2: Cognitive Functioning

	All States	**Punjab**	**Rajasthan**	**Kerala**	**Karnataka**
A. Episodic Memory (0-20)	8.57 [0.15]	10.52 [0.23]	7.53 [0.40]	7.93 [0.19]	9.31 [0.26]
Males	9.08 [0.17]	11.12 [0.33]	8.28 [0.40]	8.04 [0.24]	9.80
Females	8.08 [0.19]	9.90 [0.22]	6.74 [0.50]	7.83 [0.27]	8.85
Difference (F-value)	1.00*** (22.01)	1.22*** (14.32)	1.54*** (9.98)	0.21 (0.40)	0.95*** (8.31)
B. Verbal fluency (0-50)	9.15 [0.21]	9.03 [0.30]	7.71 [0.43]	14.08 [0.43]	6.91 [0.25]
Males	9.55 [0.24]	9.33 [0.35]	8.41 [0.47]	14.93 [0.48]	7.03 [0.33]
Females	8.77 [0.21]	8.70 [0.31]	6.96 [0.41]	13.37 [0.49]	6.80 [0.23]
Difference (F-value)	0.78*** (13.50)	0.63** (4.92)	1.45*** (15.67)	1.56*** (10.60)	0.23 (0.97)
C. Numeracy (0-9)	3.59 [0.13]	3.60 [0.33]	2.30 [0.21]	5.02 [0.21]	3.80 [0.24]
Males	4.28 [0.16]	4.41 [0.40]	3.20 [0.32]	5.86 [0.20]	4.26 [0.25]
Females	2.95 [0.14]	2.78 [0.31]	1.35 [0.21]	4.34 [0.25]	3.38 [0.27]
Difference (F-value)	1.33*** (65.09)	1.63*** (44.57)	1.85*** (28.71)	1.52*** (37.43)	0.88*** (14.20)
D. Orientation (0-1):	0.58 [0.03]	0.64 [0.04]	0.41 [0.04]	0.81 [0.02]	0.54 [0.06]
Males	0.68 [0.03]	0.74 [0.04]	0.52 [0.07]	0.88 [0.03]	0.67 [0.05]
Females	0.49 [0.03]	0.55 [0.05]	0.29 [0.03]	0.74 [0.04]	0.42 [0.08]
Difference (F-value)	0.19*** (28.65)	0.19*** (25.21)	0.23*** (10.48)	0.14** (7.17)	0.25*** (19.01)

Table 3: Cognitive Function by Age and Gender

	45-54	55-64	65-74	>75
Episodic Memory	9.31 [0.20]	8.96 [0.25]	7.48 [0.35]	6.15 [0.41]
Males	9.77 [0.22]	9.39 [0.30]	8.09 [0.40]	7.14 [0.41]
Females	8.91 [0.25]	8.50 [0.29]	6.86 [0.43]	5.19 [0.58]
Difference (F-value)	0.86*** (9.05)	0.89*** (8.67)	1.23** (7.01)	1.95*** (7.22)
Verbal	9.25 [0.27]	9.51 [0.32]	8.65 [0.32]	8.59 [0.57]
Males	9.72 [0.38]	9.54 [0.43]	9.30 [0.43]	9.35 [0.64]
Females	8.84 [0.28]	9.47 [0.35]	8.00 [0.44]	7.81 [0.68]
Difference(F-value)	0.88** (4.70)	0.07 (0.02)	1.30** (4.70)	1.54* (3.98)
Numeracy	4.01 [0.15]	3.88 [0.24]	3.02 [0.24]	2.20 [0.29]
Males	4.46 [0.19]	4.65 [0.30]	3.80 [0.39]	3.31 [0.44]
Females	3.61 [0.17]	3.04 [0.27]	2.22 [0.29]	1.31 [0.26]
Difference (F-value)	0.85*** (20.46)	1.61*** (22.39)	1.58*** (9.92)	2.00*** (19.28)
Orientation	0.62 [0.03]	0.64 [0.05]	0.51 [0.04]	0.39 [0.06]
Males	0.71 [0.03]	0.75 [0.05]	0.59 [0.06]	0.50 [0.07]
Females	0.54 [0.03]	0.52 [0.06]	0.42 [0.06]	0.28 [0.07]
Difference (F-value)	0.17*** (14.23)	0.23*** (19.57)	0.17** (5.07)	0.22*** (8.44)

Note: Standard errors in parentheses

Table 4: Gender Differences in Characteristics

	All States	Punjab	Rajasthan	Kerala	Karnataka
Age (Years)	58.48 [0.39]	57.84 [0.82]	59.00 [0.89]	61.02 [0.82]	56.29 [0.45]
Males	58.71 [0.51]	59.33 [0.96]	58.32 [0.84]	61.12 [1.06]	57.15 [1.10]
Females	58.26 [0.52]	56.29 [0.80]	59.74 [1.34]	60.94 [0.91]	55.48 [0.57]
Difference (F-value)	0.45 (0.43)	3.04*** (17.56)	-1.42 (1.05)	0.18 (0.03)	1.67 (1.29)
Education (0-22)	4.27 [0.23]	3.19 [0.48]	1.82 [0.37]	7.75 [0.34]	4.52 [0.45]
Males	5.09 [0.30]	4.14 [0.54]	2.63 [0.51]	8.27 [0.32]	5.94 [0.57]
Females	3.48 [0.23]	2.22 [0.50]	0.95 [0.34]	7.33 [0.41]	3.22 [0.41]
Difference (F-value)	1.61*** (35.07)	1.92*** (30.80)	1.68*** (11.52)	0.94*** (9.43)	2.72*** (36.81)
Working/Ever worked (0-1)	0.45 [0.02]	0.39 [0.05]	0.63 [0.05]	0.29 [0.02]	0.43 [0.05]
Males	0.51 [0.03]	0.43 [0.05]	0.65 [0.04]	0.40 [0.04]	0.48 [0.06]
Females	0.40 [0.03]	0.36 [0.05]	0.60 [0.06]	0.20 [0.03]	0.39 [0.05]
Difference (F-value)	0.11*** (30.59)	0.07* (3.78)	0.05 (2.26)	0.20*** (21.72)	0.09** (6.93)
Married (0-1)	0.78 [0.01]	0.82 [0.03]	0.81 [0.03]	0.75 [0.02]	0.75 [0.02]
Males	0.92 [0.01]	0.88 [0.02]	0.90 [0.03]	0.92 [0.02]	0.96 [0.02]
Females	0.64 [0.02]	0.75 [0.04]	0.71 [0.05]	0.62 [0.04]	0.56 [0.04]
Difference (F-value)	0.28*** (114.88)	0.13*** (10.92)	0.19*** (12.03)	0.30*** (46.96)	0.40*** (66.55)
Cardio-vascular disease (0-1)	0.23 [0.01]	0.26 [0.04]	0.08 [0.01]	0.45 [0.02]	0.20 [0.03]
Males	0.21 [0.02]	0.23 [0.05]	0.07 [0.02]	0.44 [0.04]	0.18 [0.04]
Females	0.26 [0.01]	0.29 [0.05]	0.10 [0.02]	0.46 [0.03]	0.22 [0.03]
Difference (F-value)	-0.05** (5.36)	-0.06 (1.49)	-0.03 (1.15)	-0.02 (0.27)	-0.04 (0.88)
ADL (0-1)	0.10 [0.01]	0.08 [0.02]	0.08 [0.02]	0.12 [0.02]	0.11 [0.01]
Males	0.08 [0.01]	0.05 [0.02]	0.04 [0.01]	0.10 [0.02]	0.11 [0.02]
Females	0.12 [0.01]	0.11 [0.03]	0.12 [0.04]	0.13 [0.02]	0.11 [0.02]
Difference (F-value)	-0.04** (5.32)	-0.06* (4.61)	-0.08* (4.05)	-0.03 (0.93)	0.00 (0.02)

Note: Standard errors in parentheses

Table 5: Gender Differences in Cognitive Functioning (Model 1)

Variable	**Episodic memory**	**Verbal fluency**	**Numeracy**	**Orientation**
Mean (SD)	8.57 (3.57)	9.15 (4.88)	3.59 (3.27)	0.58 (0.50)
		A. OLS Estimates		
Female	-1.081***	-1.105***	-1.560***	-0.220***
	(0.166)	(0.173)	(0.140)	(0.024)
Age (Base:45-54) 55-64	-0.542**	-0.336	-0.597***	-0.047*
	(0.220)	(0.269)	(0.177)	(0.028)
65-74	-1.757***	-1.504***	-1.096***	-0.152***
	(0.262)	(0.329)	(0.181)	(0.032)
75+	-2.823***	-1.975***	-2.079***	-0.296***
	(0.352)	(0.453)	(0.240)	(0.052)
State (Base: Punjab) Rajasthan	-2.751***	-0.350	-0.219	-0.095
	(0.568)	(0.797)	(0.529)	(0.071)
Kerala	-3.006***	5.238***	1.894***	0.145**
	(0.507)	(0.792)	(0.507)	(0.071)
Karnataka	-1.651***	-1.619**	0.745	-0.079
	(0.532)	(0.707)	(0.518)	(0.081)
Urban	0.966***	0.685*	1.286***	0.173***
	(0.265)	(0.389)	(0.293)	(0.041)
Caste (Base: SC) ST	-0.139	-0.598	-0.350	-0.128
	(0.558)	(0.566)	(0.333)	(0.081)
OBC	1.140***	0.090	0.916***	0.254***
	(0.352)	(0.477)	(0.289)	(0.055)
None/Other	1.211***	0.527	1.584***	0.314***
	(0.372)	(0.392)	(0.327)	(0.050)

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Table 5 – continued from previous page

	Episodic memory	Verbal fluency	Numeracy	Orientation
Religion (Base: Hindu) Muslim	-0.528	-0.566	-0.535	-0.083*
	(0.470)	(0.506)	(0.432)	(0.045)
Christian	0.816	1.910**	0.266	0.075
	(0.512)	(0.825)	(0.364)	(0.053)
Sikh	-0.157	1.000	0.822	0.060
	(0.594)	(0.748)	(0.608)	(0.085)
Other	-1.856***	-3.148***	-1.043	-0.129
	(0.483)	(0.538)	(0.633)	(0.113)
R^2	0.2441	0.3804	0.2673	0.2845
B. Oaxaca-Blinder Decomposition				
Predicted Outcomes:				
Men	9.292***	10.028***	4.437***	0.707***
	(0.173)	(0.244)	(0.173)	(0.025)
Women	8.319***	9.290***	3.113***	0.528***
	(0.174)	(0.218)	(0.142)	(0.027)
Difference	0.972***	0.738***	1.325***	0.180***
	(0.190)	(0.221)	(0.165)	(0.027)
Due to mean characteristics	-0.096	-0.365**	-0.201**	-0.038***
	(0.099)	(0.151)	(0.087)	(0.013)
Due to returns to characteristics	1.068***	1.102***	1.526***	0.218***
	(0.163)	(0.164)	(0.137)	(0.023)
Constant	0.881*	0.719**	1.359***	0.306***
	(0.439)	(0.343)	(0.361)	(0.023)
N	1,609	1,606	1,678	1,560

Note: Standard errors in parentheses

Continued on next page

Table 5 – continued from previous page

	Episodic memory	Verbal fluency	Numeracy	Orientation
*** - significant at the 99% level; ** - significant at the 95% level; * - significant at the 90% level				

Table 6: Effect of Childhood Influences on Cognitive Functioning (Model 2)

Variable	Episodic memory	Verbal fluency	Numeracy	Orientation
Mean (SD)	8.57 (3.57)	9.15 (4.88)	3.59 (3.27)	0.58 (0.50)
Female (Model 1)	-1.081***	-1.105***	-1.560***	-0.220***
A. OLS Estimates				
Female	-1.126***	-1.161***	-1.531***	-0.221***
	(0.165)	(0.277)	(0.130)	(0.024)
Age	***	***	***	***
State (Base: Punjab)				
Rajasthan	-2.876***	-0.510	-0.682	-0.120
	(0.558)	(0.664)	(0.472)	(0.075)
Kerala	-3.869***	4.205***	0.617	0.057
	(0.562)	(0.700)	(0.447)	(0.073)
Karnataka	-2.016***	-1.741***	0.441	-0.101
	(0.533)	(0.616)	(0.450)	(0.076)
Urban			**	*
Caste	*		***	***
Religion	**	***		
Mother's literacy	1.056***	0.846*	0.600**	0.060
	(0.352)	(0.431)	(0.264)	(0.040)
Father's literacy	0.753**	1.156**	1.737***	0.166***
	(0.332)	(0.515)	(0.290)	(0.040)
Childhood health				
(Base: Excellent) Good	0.242	-1,395***	-0.969***	-0.050
	(0.307)	(0.283)	(0.161)	(0.032)
Poor	0.281	-1.323*	-2.302***	-0.236***
	(0.608)	(0.745)	(0.291)	(0.0.057)
Childhood residence				
(Base: City) Town	-0.260	2.367**	-0.844*	-0.155*
	(0.421)	(1.088)	(0.461)	(0.078)
Village	-1.467***	-0.184	-1.116***	-0.236***
	(0.396)	(0.551)	(0.295)	(0.045)
R^2	0.2774	0.4236	0.3681	0.3232
B. Oaxaca-Blinder Decomposition				
Predicted Outcomes:				

Continued on next page

Table 6 – continued from previous page

	Episodic memory	Verbal fluency	Numeracy	Orientation
Men	9.316***	9.988***	4.400***	0.706***
	(0.174)	(0.244)	(0.171)	(0.025)
Women	8.320***	9.210***	3.085***	0.525***
	(0.171)	(0.209)	(0.148)	(0.027)
Difference	0.996***	0.778***	1.315***	0.181***
	(0.186)	(0.217)	(0.175)	(0.026)
Due to mean characteristics	-0.100	-0.363**	-0.182*	-0.037***
	(0.095)	(0.142)	(0.094)	(0.014)
State	0.116*	-0.194**	-0.053*	-0.007
	(0.061)	(0.091)	(0.031)	(0.004)
Urban	-0.014	-0.001	-0.036*	-0.005
	(0.017)	(0.019)	(0.021)	(0.003)
Mother's literacy	-0.045*	-0.030	-0.022	-0.003
	(0.024)	(0.023)	(0.015)	(0.002)
Father's literacy	-0.032	-0.052	-0.068*	-0.008*
	(0.021)	(0.034)	(0.038)	(0.004)
Due to returns to characteristics	1.096***	1.141***	1.497***	0.218***
	(0.162)	(0.158)	(0.136)	(0.022)
Caste	-0.005	0.052	0.185*	0.011
	(0.135)	(0.093)	(0.100)	(0.022)
Mother's literacy	0.088	-0.187	-0.070	-0.026*
	(0.139)	(0.157)	(0.118)	(0.013)
Childhood Health	-0.650*	0.150	0.356*	0.014
	(0.362)	(0.443)	(0.180)	(0.028)
Constant	1.280	1.095	0.715	0.297***
	(0.763)	(0.777)	(0.516)	(0.022)
N	1,578	1,575	1,644	1,531

Note: Standard errors in parentheses

*** - significant at the 99% level; ** - significant at the 95% level; * - significant at the 90% level

Table 7: Effect of Choices in Adulthood on Cognitive Functioning (Model 3)

Variable	**Episodic memory**	**Verbal fluency**	**Numeracy**	**Orientation**
Mean (SD)	8.57 (3.57)	9.15 (4.88)	3.59 (3.27)	0.58 (0.50)
Female (Model 1)	-1.081***	-1.105***	-1.560***	-0.220***
A. OLS Estimates				
Female	-0.414**	0.005	-0.460***	-0.072**
	(0.191)	(0.221)	(0.150)	(0.029)
Age	***	***	***	**
State (Base: Punjab)				
Rajasthan	-2.947***	-0.451	-0.371	-0.144***
	(0.545)	(0.764)	(0.259)	(0.054)
Kerala	-4.518***	3.554***	-0.263	-0.189***
	(0.487)	(0.786)	(0.330)	(0.052)
Karnataka	-2.368***	-2.264***	-0.482	-0.208***
	(0.525)	(0.822)	(0.299)	(0.050)
Urban			**	
Caste	**		**	***
Religion		***		
Literate	0.134	0.654	1.342***	0.147**
	(0.452)	(0.539)	(0.410)	(0.064)
Schooling (Base: None)				
1-5 yrs	0.722	0.291	1.151***	0.216***
	(0.510)	(0.601)	(0.391)	(0.075)
6-12 yrs	2.533***	1.298**	2.543***	0.452***
	(0.567)	(0.637)	(0.436)	(0.070)
$>$ 12 years	4.366***	3.699***	3.772***	0.491***
	(0.724)	(1.244)	(0.594)	(0.077)
Married	0.511**	-0.060	0.189	0.065*
	(0.251)	(0.245)	(0.193)	(0.034)
#Children	-0.146*	0.022	0.069	0.002
	(0.074)	(0.069)	(0.043)	(0.006)
Ever worked	0.023	1.568***	0.946***	0.044
	(0.327)	(0.387)	(0.255)	(0.035)
R^2	0.3584	0.4000	0.4729	0.4495
B. Oaxaca-Blinder Decomposition				
Predicted Outcomes:				
Men	9.356***	9.564***	4.191***	0.680***
	(0.201)	(0.259)	(0.177)	(0.028)
Women	8.333***	9.373***	3.088***	0.536***
	(0.168)	(0.220)	(0.141)	(0.026)
Difference	1.023***	0.191	1.103***	0.144***

Continued on next page

Table 7 – continued from previous page

	Episodic memory	Verbal fluency	Numeracy	Orientation
	(0.218)	(0.240)	(0.175)	(0.032)
Due to mean characteristics	0.615***	0.169	0.668***	0.074***
	(0.162)	(0.208)	(0.139)	(0.022)
State	0.274***	-0.342***	0.003	0.008
	(0.087)	(0.111)	(0.024)	(0.006)
Marital Status	0.105*	-0.024	0.046	0.013*
	(0.054)	(0.053)	(0.043)	(0.007)
Literacy	0.031	0.081	0.168**	0.016*
	(0.056)	(0.071)	(0.068)	(0.008)
Education	0.321***	0.227**	0.328***	0.042***
	(0.097)	(0.094)	(0.090)	(0.014)
Work	0.008	0.296***	0.175***	0.009
	(0.059)	(0.082)	(0.053)	(0.006)
Due to returns to characteristics	0.415**	0.022	0.435***	0.070**
	(0.187)	(0.213)	(0.147)	(0.029)
Urban	- 0.267**	-0.154	-0.046	-0.007
	(0.108)	(0.109)	(0.103)	(0.018)
State	0.019	0.060**	0.029	-0.003
	(0.030)	(0.028)	(0.020)	(0.004)
Children	-0.434	-0.030	0.043	0.082*
	(0.333)	(0.342)	(0.222)	(0.043)
Constant	2.120**	0.082	0.875	0.175
	(0.897)	(1.019)	(0.695)	(0.172)
N	1,368	1,369	1,423	1,334

Note: Standard errors in parentheses

Note: *** - significant at the 99% level; ** - significant at the 95% level; * - significant at the 90% level

Table 8: Effect of Current Circumstances on Cognitive Functioning

Variable	**Episodic memory**	**Verbal fluency**	**Numeracy**	**Orientation**
Mean (SD)	8.57 (3.57)	9.15 (4.88)	3.59 (3.27)	0.58 (0.50)
Female (Model 1)	-1.081***	-1.105***	-1.560***	-0.220***
	A. OLS Estimates			
Female	-1.089***	-0.979***	-1.247***	-0.194***
	(0.220)	(0.283)	(0.158)	(0.023)
Age	***	***	***	***
State (Base: Punjab) Rajasthan	-1.780***	0.053	0.629	0.059
	(0.425)	(1.024)	(0.458)	(0.073)
Kerala	-2.259***	5.791***	2.459***	0.185**
	(0.443)	(1.027)	(0.554)	(0.084)
Karnataka	-0.906**	-1.491*	0.854**	-0.004
	(0.411)	(0.884)	(0.414)	(0.070)
Urban			**	
Caste			***	***
Religion		***		
Lives alone	-0.402	0.813**	0.086	0.040
	(0.268)	(0.395)	(0.250)	(0.037)
ADL	-0.749*	-0.874**	0.002	-0.105**
	(0.377)	(0.343)	(0.341)	(0.047)
Cardiovascular Disease	-0.233	-0.021	0.638***	0.052*
	(0.259)	(0.345)	(0.230)	(0.028)
Health rating (Base: Excellent) Good	0.167	-0.343	-0.197	0.012
	(0.225)	(0.298)	(0.151)	(0.032)
Poor	-0.679*	-1.328***	-0.706**	-0.049
	(0.378)	(0.500)	(0.324)	(0.047)
Log Expenditure per capita	0.279**	0.201	0.409***	0.037**
	(0.120)	(0.172)	(0.100)	(0.019)
Food insecurity	0.162	-0.025	0.557	0.039
	(0.665)	(0.721)	(0.447)	(0.065)
Good fuel	0.828***	0.229	0.771***	0.074**
	(0.241)	(0.283)	(0.258)	(0.030)
Piped water	0.288	0.478	-0.306	-0.046
	(0.342)	(0.392)	(0.247)	(0.044)
Electricity	0.301	-0.466	-0.545**	-0.073
	(0.402)	(0.587)	(0.258)	(0.065)
Toilet inside	0.928**	0.621	0.545*	0.229***
	(0.407)	(0.531)	(0.309)	(0.052)
Subjective SES				
(Base: Quintile 1) Quintile 2	0.380*	0.882**	0.620**	0.027

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Table 8 – continued from previous page

	Episodic memory	Verbal fluency	Numeracy	Orientation
	(0.226)	(0.394)	(0.258)	(0.044)
Quintile 3	0.533	0.677	0.554*	0.026
	(0.363)	(0.441)	(0.284)	(0.046)
Quintile 4	0.958***	1.211**	1.108***	0.086
	(0.325)	(0.492)	(0.320)	(0.055)
Quintile 5	0.897*	2.180***	1.359***	0.119**
	(0.457)	(0.510)	(0.340)	(0.046)
Safe neighborhood	1.098**	-0.402	1.026***	-0.056
	(0.426)	(0.778)	(0.328)	(0.064)
Smoking (Base:Never smoked)				
Current smoker	-0.801***	-0.049	-0.121	-0.083**
	(0.267)	(0.379)	(0.242)	(0.041)
Former smoker	0.098	0.981*	0.867**	-0.014
	(0.435)	(0.544)	(0.380)	(0.044)
Drinking (Base: Never drank)				
Current drinker	-0.260	0.106	0.741***	0.061
	(0.353)	(0.547)	(0.239)	(0.047)
Former drinker	-0.190	0.053	0.683	0.044
	(0.407)	(0.528)	(0.468)	(0.050)
Exercise (Base: Never exercised)				
Heavy exercise	-0.088	-0.115	0.318	0.091***
	(0.346)	(0.438)	(0.252)	(0.032)
Moderate exercise	0.826***	-0.080	-0.111	0.006
	(0.296)	(0.461)	(0.214)	(0.035)
R^2	0.3190	0.4263	0.3808	0.3620
B. Oaxaca-Blinder Decomposition				
Predicted Outcomes:				
Men	9.276***	10.156***	4.611***	0.709***
	(0.171)	(0.240)	(0.168)	(0.024)
Women	8.367***	9.344***	3.270***	0.535***
	(0.187)	(0.234)	(0.144)	(0.026)
Difference	0.909***	0.812***	1.340***	0.175***
	(0.195)	(0.236)	(0.165)	(0.028)
Due to mean characteristics	-0.184	-0.216	0.081	-0.024
	(0.156)	(0.227)	(0.113)	(0.020)
Age	-0.084*	-0.066	-0.056	-0.009
	(0.050)	(0.040)	(0.034)	(0.005)
State	0.078*	-0.269**	-0.111**	-0.008*
	(0.043)	(0.128)	(0.042)	(0.004)
Health Rating	0.014	0.049	0.034*	0.001

Continued on next page

Table 8 – continued from previous page

	Episodic memory	Verbal fluency	Numeracy	Orientation
	(0.023)	(0.033)	(0.020)	(0.003)
Smoke	-0.176**	0.032	0.029	-0.017
	(0.071)	(0.093)	(0.066)	(0.011)
Drink	-0.062	0.007	0.182**	0.011
	(0.079)	(0.117)	(0.072)	(0.011)
Exercise	0.065	- 0.024	0.029	0.014**
	(0.070)	(0.084)	(0.047)	(0.007)
Due to returns to characteristics	1.093***	1.028***	1.259***	0.199***
	(0.211)	(0.260)	(0.155)	(0.027)
Health Rating	-0.213**	-0.108	-0.116	-0.007
	(0.096)	(0.116)	(0.097)	(0.014)
Food insecurity	-0.046	0.002	-0.023	-0.006
	(0.028)	(0.041)	(0.022)	(0.004)
Smoke	0.602	-0.034	-0.053	-0.132***
	(0.375)	(0.331)	(0.232)	(0.046)
Constant	1.280	4.342	2.586	0.786**
	(2.535)	(3.137)	(2.240)	(0.337)
N	1,525	1,524	1,545	1,479

Note: Standard errors in parentheses

Note: *** - significant at the 99% level; ** - significant at the 95% level; * - significant at the 90% level

Table 9: Effect of Life Course Variables on Cognitive Functioning (Model 5)

Variable	**Episodic memory**	**Verbal fluency**	**Numeracy**	**Orientation**
Mean (SD)	8.57 (3.57)	9.15 (4.88)	3.59 (3.27)	0.58 (0.50)
Female (Model 1)	-1.081***	-1.105***	-1.560***	-0.220***
	A. OLS Estimates			
Female	-0.527**	-0.145	-0.401**	-0.086**
	(0.237)	(0.257)	(0.145)	(0.035)
Age	***	***	***	***
State (Base: Punjab)				
Rajasthan	-2.292***	-0.444	-0.369	-0.050
	(0.479)	(0.863)	(0.306)	(0.067)
Kerala	-4.369***	3.825***	-0.539	-0.162*
	(0.611)	(0.979)	(0.444)	(0.083)
Karnataka	-1.983***	-2.149**	-0.629*	-0.144***
	(0.477)	(0.833)	(0.343)	(0.053)
Religion		***		
Mother literate	0.772*	0.229	0.212	0.008
	(0.420)	(0.587)	(0.233)	(0.047)
Father literate	0.099	0.424	0.922***	0.065
	(0.323)	(0.504)	(0.305)	(0.044)
Childhood health		**	***	
Childhood residence	***	*		*
Literacy	-0.026	0.424	0.958***	0.068
	(0.432)	(0.501)	(0.329)	(0.078)
Schooling (Base: None)				
1-5 yrs	0.837**	0.316	1.207***	0.247***
	(0.440)	(0.539)	(0.304)	(0.084)
6-12 yrs	2.204***	1.034	2.289***	0.442***
	(0.478)	(0.652)	(0.355)	(0.080)
$>$ 12 years	3.245***	3.720***	3.289***	0.428***
	(0.757)	(1.325)	(0.485)	(0.087
Married	0.572**	-0.113	0.112	0.029
	(0.279)	(0.284)	(0.207)	(0.033)
#Children	-0.148**	-0.038	0.017	0.001
	(0.064)	(0.068)	(0.045)	(0.007)
Ever worked	0.099	1.092***	0.797***	0.017
	(0.327)	(0.358)	(0.245)	(0.038)
Lives alone	-0.540*	0.664*	0.005	0.035
	(0.280)	(0.338)	(0.224)	(0.036)
ADL	-0.668	-0.838**	0.067	-0.090**
	(0.412)	(0.379)	(0.336)	(0.045)

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Table 9 – continued from previous page

	Episodic memory	Verbal fluency	Numeracy	Orientation
Cardiovascular Disease	-0.186	0.062	0.412**	0.016
	(0.288)	(0.366)	(0.200)	(0.034)
Health rating	*			
Log Expenditure per capita	0.180	-0.065	0.231**	0.019
	(0.127)	(0.150)	(0.094)	(0.015)
Food insecurity				
Good fuel	0.569**	-0.071	0.298	0.036
	(0.251)	(0.369)	(0.183)	(0.027)
Other household amenities+				***
Subjective SES		***	*	
Safe neighborhood	1.417***	-0.212	0.490	-0.103
	(0.518)	(0.964)	(0.309)	(0.073)
Smoking	*			
Drinking			**	
Exercise	**			
R^2	0.4203	0.4635	0.5551	0.4789
B. Oaxaca-Blinder Decomposition				
Predicted Outcomes:				
Men	9.414***	9.602***	4.349***	0.676***
	(0.209)	(0.258)	(0.184)	(0.028)
Women	8.397***	9.303***	3.206***	0.540***
	(0.181)	(0.226)	(0.149)	(0.026)
Difference	1.017***	0.299	1.143***	0.136***
	(0.223)	(0.255)	(0.194)	(0.033)
Due to mean characteristics	0.510**	0.090	0.763***	0.049*
	(0.196)	(0.218)	(0.165)	(0.029)
Age	-0.072*	-0.053	-0.038	-0.005
	(0.041)	(0.039)	(0.023)	(0.004)
State	0.293***	-0.360***	0.038	0.012*
	(0.090)	(0.112)	(0.033)	(0.007)
Married	0.112*	-0.034	0.026	0.006
	(0.056)	(0.057)	(0.043)	(0.007)
Literacy	0.009	0.057	0.120**	0.007
	(0.051)	(0.067)	(0.051)	(0.009)
Education	0.260***	0.213**	0.286***	0.037***
	(0.084)	(0.098)	(0.079)	(0.014)
Work	0.021	0.217***	0.146***	0.004
	(0.060)	(0.075)	(0.049)	(0.007)
Toilet	-0.015	-0.008	0.001	-0.008*
	(0.021)	(0.016)	(0.006)	(0.004)

Continued on next page

Table 9 – continued from previous page

	Episodic memory	Verbal fluency	Numeracy	Orientation
Drink	-0.086	-0.037	0.159**	-0.000
	(0.078)	(0.085)	(0.066)	(0.010)
Due to returns to characteristics	0.506**	0.210	0.380**	0.086**
	(0.222)	(0.241)	(0.181)	(0.036)
State	0.028	0.049	0.052*	-0.003
	(0.028)	(0.044)	(0.027)	(0.005)
Urban	-0.395**	-0.363**	-0.041	-0.017
	(0.164)	(0.155)	(0.114)	(0.024)
Alone	-0.038	0.050	0.096*	0.006
	(0.060)	(0.074)	(0.054)	(0.008)
Log Expenditure per capita	0.746	-5.025**	0.431	-0.342
	(2.056)	(1.999)	(1.857)	(0.309)
Toilet	0.091	0.826*	-0.151	0.012
	(0.466)	(0.419)	(0.346)	(0.069)
Drink	0.259	0.342	0.424	0.115*
	(0.554)	(0.651)	(0.525)	(0.067)
Constant	0.724	5.996*	1.721	0.608
	(2.577)	(3.105)	(2.240)	(0.364)
N	1,279	1,281	1,293	1,249

Note: Standard errors in parentheses; $+$ - whether household has electricity, indoor plumbing and toilet

*** - significant at the 99% level; ** - significant at the 95% level; * - significant at the 90% level

Table 10: Summary Results - Correlates of Female Disadvantage in Cognitive Functioning

	Episodic memory	Verbal fluency	Numeracy	Orientation
Mean (SD)	8.57 (3.57)	9.15 (4.88)	3.59 (3.27)	0.58 (0.50)
Mean cognitive gap	1.00***	0.78***	1.33***	0.19***
Basic (Model 1): Female	-1.081***	-1.105***	-1.560***	-0.220***
Predicted cognitive gap	0.972***	0.738***	1.325***	0.180***
Explained	-0.096	-0.365**	-0.201**	-0.038***
Unexplained	1.068***	1.102***	1.526***	0.218***
Basic+childhood influences (Model 2): Female	-1.126***	-1.161***	-1.531***	-0.221***
Predicted cognitive gap	0.996***	0.778***	1.315***	0.181***
Explained	-0.100	-0.363**	-0.182*	-0.037***
Basic	-0.011	-0.277**	-0.108	-0.025**
Childhood	-0.089**	-0.085	-0.074	-0.012**
Unexplained	1.096***	1.141***	1.497***	0.218***
Basic	0.193	0.356	0.401	-0.060
Childhood	-0.376	-0.310	0.381	-0.019
Constant	1.280	1.095	0.715	0.297***
Basic+Adult-life influences (Model 3): Female	-0.414**	0.005	-0.460***	-0.072**
Predicted cognitive gap	1.023***	0.191	1.103***	0.144***
Explained	0.615***	0.169	0.668***	0.074***
Basic	0.142	-0.409***	-0.042	-0.006
Adult	0.473***	0.578***	0.710***	0.080***
Unexplained	0.415**	0.022	0.435***	0.070**
Basic	-0.130	0.259	0.066	-0.084
Adult	-1.722**	-1.287*	-0.410	0.016
Constant	2.259***	1.051	0.780	0.138
Basic+current circumstances (Model 4): Female	-1.089***	-0.979***	-1.247***	-0.194***
Predicted cognitive gap	0.909***	0.812***	1.340***	0.175***
Explained	-0.184	-0.216	0.081	-0.024
Basic	-0.069	-0.349**	-0.195***	-0.025***
Current	-0.115	0.133	0.276***	0.001
Unexplained	1.093***	1.028***	1.259***	0.199***
Basic	-0.006	0.638	0.103	-0.075
Current	-0.180	-3.952	-1.431	-0.512
Constant	1.280	4.342	2.586	0.786**
Full model (Model 5): Female	-0.527**	-0.145	-0.401**	-0.086**
Predicted cognitive gap	1.017***	0.299	1.143***	0.136***
Explained	0.510**	0.090	0.763***	0.049*
Basic	0.186*	-0.424***	-0.013	0.003
Childhood	-0.049	-0.062	-0.076**	-0.005
Adult	0.407***	0.454***	0.578***	0.054***
Current	-0.033	0.121	0.273***	-0.003
Unexplained	0.506**	0.210	0.380**	0.086**
Basic	-0.212	0.153	0.111	-0.080
Childhood	-0.503	-0.764	-0.005	0.005
Adult	-1.436**	-0.876	-0.372	0.024
Current	1.934	-4.300	-1.074	-0.471
Constant	0.724	5.996*	1.721	0.608

Note: *** - significant at the 99% level; ** - significant at the 95% level; * - significant at the 90% level