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Height and cognition at older ages: Irish evidence

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HIGHLIGHTS

- The relationship between height and cognition in later-life is investigated.
- Seven measures of cognition are used.
- It is found that height is positively and significantly associated with cognition.
- This finding holds also when education and early-life indicators are controlled for.

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ABSTRACT

Previous research suggests that taller individuals have greater cognitive ability. The aim of this paper is to empirically investigate whether the relationship between height and cognition holds in later-life using data from the first wave of The Irish Longitudinal Study on Ageing (TILDA). Seven measures of cognition are used. These measures capture aspects of cognition which are more likely to decline in old age, such as cognitive flexibility, processing speed, concentration and attention. It is found that height is positively and significantly associated with cognition in later-life also when education and early-life indicators are controlled for. The finding that adult height is a marker for nutrition and health environment experienced in early-life is widely accepted in the literature. The findings of this paper suggest that height might have a greater value added, as it appears to be a useful measure of unobserved childhood experiences.

1. Introduction

A small but growing body of research suggests that taller individuals earn more than their shorter counterparts (Persico et al., 2004; Heineck, 2009; Lundborg et al., 2014). This "height premium" has been attributed to factors such as self-esteem, social dominance and discrimination against shorter people. Case and Paxson (2008a) offer a different explanation: taller individuals earn more because they have greater cognitive ability. The authors argue that gestation and childhood are crucial periods for height growth. If foetuses and children are well-nourished and in good health, they will eventually reach the adult height set by their genetic potential. Children from taller families will be taller, and children from shorter families will be shorter, but there will be no effect of height on adult outcomes. Children who are, however, exposed to poor nutrition, disease or adversity in utero or early childhood, will not attain their full potential height. There is evidence that physical and cognitive function develop together, suggesting that children who do not reach their potential height will also not reach their full cognitive potential (Deaton and Arora, 2009).

If it is the case that taller individuals have greater cognitive ability, do they also exhibit greater cognitive ability as they age? Do the (dis-)advantages experienced in early-life follow adults into old age? To our knowledge, there are only three economics-based studies that have tested this hypothesis: Case and Paxson (2008b) and Guven and Lee (2013, 2015). These studies use data from the *Health and Retirement Study* in the US *(HRS)*, the *English Longitudinal Study on Ageing (ELSA)*, and the *Survey of Health, Ageing and Retirement* in Europe *(SHARE)*. They all find a positive and significant association between height and cognition in later-life. In particular, Guven and Lee (2013, 2015) find that

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this association remains even after controlling for education and childhood circumstances.

The paper contributes to the existing literature in several ways. First, it provides evidence on the height–cognition relationship in later-life using data from older Irish adults. Historically, Ireland suffered relatively poor economic conditions and high level of infectious diseases in comparison to other European countries, suggesting considerable variation in early-life socioeconomic conditions. Second, it employs several measures of cognition which have three main advantages: (i) they are novel in the context of other longitudinal studies on ageing; (ii) they capture aspects of cognition which are more likely to decline in old age, such as cognitive flexibility, processing speed, concentration and attention; and (iii) they are administered and scored by trained nurses. Due to data limitation, the previous three studies employed mostly measures of word recall, verbal fluency or numeracy in face-to-face or telephone interviews. Third, it uses accurate anthropometric data to capture height. Evidence suggests that self-reported height, employed by Case and Paxson (2008b) and Guven and Lee (2015), is subject to over-reporting, which is often systematically related to age and socioeconomic status, and may lead to biased estimates of the height/cognition relationship (Maurer, 2010, p. 169).

2. Data

The dataset used is the first wave of *The Irish Longitudinal Study on Ageing* (TILDA), which was collected between October 2009 and July 2011. As detailed by Kearney et al. (2011), Cronin et al. (2013) and Whelan and Savva (2013), TILDA collects information on the economic, health and social aspects for a nationally representative sample of individuals aged 50 years and older. TILDA is based on a two-stage clustered sampling design with stratification. In the first-stage, sampling units are geographical clusters. In the second-stage, sampling units are households. Sampling weights are also applied. The method used for variance estimation is Taylor linearization. Both sampling stages provide a component to the variance estimator and have their finite population correction.

At wave 1, a total of 8175 respondents completed a face-to-face interview in their own home. Each respondent was also invited to undertake an extensive health assessment, either in a dedicated centre or in their own home. All assessments were carried out by trained and qualified nurses. A total of 5897 respondents underwent a health assessment.

3. Empirical strategy

3.1. Model

The regression model is:

$$\ln(Cog_i) = \beta_0 + \beta_1 \ln(Height_i) + \sum_j \beta_j X_{ij} + u_i \quad (1)$$

where: "*Cog*" is a measure of cognition of individual "*i*" ($i = 1, 2, \ldots, N$); "*Height*" is the individual's height; "X_j" is a set of other variables thought to impact on cognition; and "u" is an error term.

3.2. Variables

A large component of the TILDA health assessment is devoted to assessing cognition using pen-and-paper and computer-based tasks. Seven measures of cognition are collected: (1) *Montreal Cognitive Assessment* (*MoCA*); (2) *Colour Trail Task 1* (*CTT1*); (3) *Colour Trail Task 2* (*CTT2*); (4) *Choice Reaction Time (CRT)*; (5) *Choice Reaction Time Variability (VAR_CRT)*; (6) *Sustained Attention to Response Task* (*SART*); and (7) *Sustained Attention to Response Task Variability* (*VAR_SART*).

Height is measured in the health assessment by a qualified nurse. One potential issue with older people's height is that there could be shrinkage as a result of bone density loss (Fernihough and McGovern, 2015; Huang et al., 2013). In order to address this issue, the analysis on this paper focuses on individuals aged 50–70 (inclusive). Controls for age, sex, education and childhood circumstances are also included. Education is a potential pathway linking height and cognition in later-life. Childhood circumstances likely are the most relevant factors affecting both height and cognition. Childhood circumstances are based on retrospective self-reports between birth and age 14. Details of all variables, along with summary statistics, are provided in Table 1. Some of the questions concerned with the respondent's childhood socioeconomic and family circumstances were included in the third wave of TILDA. Therefore, the sample includes individuals aged 50 to 70 who participated in both Waves 1 and 3, with no missing observations on the variables of interest. The final sample size is 3545 respondents.

4. Regression results

To make interpretation easier, the natural logarithm of height and the seven cognition variables is taken so that the association between height and cognition can be considered as an elasticity. The transformed scores of *CTT1*, *CTT2*, *CRT*, *VAR_CRT*, *SART* and *VAR_SART* are then multiplied by "−1". This insures that a higher value of each of these variables corresponds a higher level of cognition, which makes interpretation of the estimates easier.

The estimated cognition–height elasticities are reported in Table 2. Three interesting results emerge. First, the height elasticity is positive and significant with respect to six cognition variables (see Panel 1). For example, a 1% increase in height is associated with 0.48% increase in the *MOCA* score or a 0.69% increase in the *CTT1* score. Second, the elasticity is still positive and significant in most regressions when education is controlled for, although it is smaller in magnitude (see Panel 2). Third, the inclusion of childhood variables has a modest effect on the magnitude of the elasticity (see Panel 3). An F-test suggests that the fraction of variation in cognition that is explained by the controls of the full specification is significantly larger than the fraction of variation explained when childhood characteristics are not controlled for. The regression results for the full specification are given in Table A.1 in the Appendix.

The robustness of the results is tested in two different ways. First, the regressions are re-estimated using a sample of all respondents aged 50 and older (results not shown). The estimated height elasticities are larger in magnitude than those reported in Table 2. However, a Wald-test suggests that this difference is not statistically significant at the 1% level. Therefore, the same conclusions are supported regardless of whether the sample is restricted to "younger" older people. This suggests that the issue of shrinkage in old-age is likely not a major problem when examining the relationship between height and cognition amongst older people. The authors suspect that this may be an outcome of using measured height versus self-assessed height.

Second, the association between height and occupational attainment is also investigated. If height impacts on cognition, and in turn cognition impacts on socioeconomic success you would expect height to directly impact on socioeconomic success. Since the sample consists of older people, only a fraction of the sample are working, so it is not possible to use wage or salary as a measure of socioeconomic success. However, TILDA collects information on occupation, based on "current job" for those in employment at the time of interview or on "most recent job" for those not in