Economics and Human Biology 11 (2013) 178–184

Contents lists available at SciVerse ScienceDirect

Economics and Human Biology

journal homepage: http://www.elsevier.com/locate/ehb

The association of adolescent socioeconomic position and adult height: Variation across racial/ethnic groups

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ARTICLE INFO

Article history:
Received 9 December 2011
Received in revised form 22 June 2012
Accepted 22 June 2012
Available online 22 July 2012

Keywords:
Height
Childhood
Socioeconomic position
Race/ethnicity

ABSTRACT

Numerous studies have demonstrated the association of childhood socioeconomic position and adult height. Many have suggested the use of adult height as a marker of overall childhood well-being. However, few studies have examined the relationship between child/adolescent socioeconomic position and adult height in a racially/ethnically diverse cohort. Using the National Longitudinal Study of Adolescent Health, we examined the association of child/adolescent SEP (maternal education and maternal report of household income) and measured adult height in a diverse cohort of US adolescents/young adults. We found a positive gradient effect of maternal education on height in the overall population and in White and Mixed race males and females; no such gradient existed in Hispanic, Asian, or Black males or females. Only in Mixed race females was household income positively associated with height. These findings emphasize the need to recognize differential effects of socioeconomic status on height in different racial/ethnic and gender subpopulations.

1. Introduction

Though adult height is largely predicted by genetics, there is ample evidence that environmental factors play a role. Classic studies dating back to the late 1800s established mid-parental height as highly predictive of the height of offspring, thus providing evidence for the influence of genetics (Galton, 1885; Pearson and Lee, 1903). Studies today have successfully begun to map particular genes that influence height (McEvoy and Visscher, 2009). However, the recognition of secular increases in height across diverse cohorts has provided evidence that genes alone cannot fully explain trends in individual measures of height (Komlos, 2007). A number of environmental factors influencing height have been identified including maternal health, child's nutrition, history of childhood illness, and childhood socioeconomic position (SEP) (Victora et al., 2008; Bozzoli et al., 2009; Li et al., 2004; Kuh and Wadsworth, 1989).

A growing body of literature has demonstrated the influence of childhood socioeconomic factors on adult height (Peck and Lundberg, 1995; Peck and Vagero, 1987; Perkins et al., 2011). Studies to date have examined cohorts in developing and developed countries (Meyer and Selmer, 1999; Webb et al., 2008; Subramanian et al., 2011) and have used a number of different markers of childhood SEP (Tucker-Seeley and Subramanian, 2010). As the evidence linking childhood SEP and height has grown, there has also been increasing interest in height as a potential proxy for

Abbreviations: Add Health, National Longitudinal Study of Adolescent Health; SEP, socioeconomic position.

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http://dx.doi.org/10.1016/j.ehb.2012.06.003

early childhood conditions—both social and physiologic. If height were a reliable measure of overall childhood conditions, adult height as a measure could obviate the need for long-term longitudinal studies examining the influence of childhood conditions on adult health outcomes. However, it is unclear if adult height has equal meaning across different racial/ethnic and gender groups in different countries.

Despite the large number of studies examining the association between childhood SEP and adult height, questions remain regarding the relationships in certain US populations. In particular, no studies of which we are aware have examined the association between child/adolescent SEP and adult height in US racial/ethnic groups beyond Whites and Blacks. The National Longitudinal Study of Adolescent Health (Add Health) provides a diverse population of young adults in which to examine the association of child/adolescent SEP and adult height. Add Health is a US-based nationally representative cohort of students in grades 7–12 at baseline (Wave I collected in 1994–1995). Participants have been followed prospectively across four waves of data collection to date (Wave II collected in 1995–1996, Wave III collected in 2001–2002, Wave IV collected 2007–2008).

The objective of our study was to determine if child/adolescent SEP measured by maternal education and maternal report of household income (at Wave I when participants were aged 12–19 years) has similar associations with adult height (at Wave III when participants were aged 19–26 years) in males and females of different races/ethnicities (i.e. are the associations of SEP and adult height modified by gender and race/ethnicity?).

2. Population and methods

2.1. Study population

This study uses data from Waves I (collected in 1994–1995 when participants were aged 12–19 years, $n = 20{,}745$) and III (collected in 2001–2002 when participants were aged 19–26 years, $n = 15{,}197$) of Add Health, a nationally representative longitudinal study of adolescents originally sampled from schools, the primary sampling unit (Harris et al., 2009). Schools were sorted by size, school type, census region, level of urbanization, and the percentage of the student body that is White prior to sampling. Implicit stratification and systematic sampling methods were used to ensure the sample was representative of all US schools (Harris et al., 2009). All of the students within a chosen school were asked to participate in an In-School survey (the In-School survey was collected only once, at baseline—Wave I) and all were eligible for the In-Home survey (In-Home surveys were performed prospectively at Waves I–IV and are ongoing). Students were stratified by gender and grade and then randomly selected for the Wave I In-Home survey. Students who were seniors in high school (i.e. in their final year of high school) at the time of Wave I were not eligible for the Wave II In-Home survey but were eligible for subsequent In-Home surveys. Non-seniors at the time of Wave I were eligible for all subsequent In-Home surveys. The final In-Home Sample in Wave I ($n = 20{,}745$) was derived from 132 schools. This sample was made up of, on average, 200 students per school with the exception of the 16 schools in which the entire student body was sampled. The sample included specific over-samples including an over-sample of Puerto Rican, Chinese, and Cuban adolescents and Black adolescents from high-education families.

Of the 20,745 participants in Wave I, 15,197 were reached and agreed to participate in Wave III. (Please see Chantala et al. for further information regarding the reasons for attrition as well as for information about response bias.) Of the 15,197 Wave III participants, 14,322 had sample weights. These 14,322 participants with longitudinal weights made up our initial sample population. We then excluded those individuals missing data on key variables or with implausible values. We excluded the 133 participants who were missing data on height at Wave III. Participants with weight less than 50 pounds or greater than or equal to 500 pounds were excluded due to concerns about implausibility as well as the potential for a condition that might affect both height and weight. Additional exclusions were those missing household size ($n = 670$) as it was needed to calculate one of our markers of SEP and race/ethnicity ($n = 11$). There was considerable overlap in those missing values for particular variables (i.e. those missing information on one variable often were missing information on additional variables). The total excluded due to missing data (after having excluded those missing sampling weights) was 814. Due to concern about the heterogeneity in our outcome variable, height, among foreign-born participants, we additionally eliminated foreign-born subjects from our analysis (Rosenbaum, 2005). After excluding all participants with missing values described above, an additional 1141 foreign born participants remained, and were therefore excluded. After excluding these participants, we were left with a core sample of $N = 12{,}367$.

The response rate for the parent questionnaire was 85% for the child-specific data. Of those who participated, a number of parent respondents refused to provide information regarding household income or maternal education leaving 23% of our final sample with no information on household income and 13% of our final sample without information on maternal education. To decrease bias due to listwise deletion (King et al., 1998), we imputed both maternal education and maternal report of household income by Gaussian normal regression imputation method (further details provided below). After our imputation of parental variables and all exclusions our final sample contained 12,367 adolescents and young adults.

2.2. Study variables

2.2.1. Outcome variable

2.2.1.1. Adult height. Our primary outcome variable was adult height (in.) objectively measured as part of the Wave III In-Home study protocol when participants were aged 19–26.