Social Science & Medicine xxx (2017) 1–8

Contents lists available at ScienceDirect

Social Science & Medicine

journal homepage: www.elsevier.com/locate/socscimed

Short communication

Does more education cause lower BMI, or do lower-BMI individuals become more educated? Evidence from the National Longitudinal Survey of Youth 1979

Rebecca Benson, M.P.H., Ph.D. [a, *], Paul T. von Hippel, M.Stat., Ph.D. [b], Jamie L. Lynch, Ph.D. [c]

[a] Department of Epidemiology and Public Health, University College London, 1-19 Torrington Place, London WC1E 6BT, United Kingdom
[b] LBJ School of Public Affairs, University of Texas at Austin, 2315 Red River, Box Y, Austin, TX 78712, United States
[c] Department of Sociology, St. Norbert College, Boyle Hall 454, 100 Grant Street, De Pere, WI 54115, United States

ARTICLE INFO

Article history:
Received 19 November 2016
Received in revised form
12 March 2017
Accepted 19 March 2017
Available online xxx

Keywords:
BMI
Education
Obesity
Selection

ABSTRACT

More educated adults have lower average body mass index (BMI). This may be due to *selection*, if adolescents with lower BMI attain higher levels of education, or it may be due to *causation*, if higher educational attainment reduces BMI gain in adulthood. We test for selection and causation in the National Longitudinal Survey of Youth 1979, which has followed a representative US cohort from age 14–22 in 1979 through age 47–55 in 2012. Using ordinal logistic regression, we test the selection hypothesis that overweight and obese adolescents were less likely to earn high school diplomas and bachelor's degrees. Then, controlling for selection with individual fixed effects, we estimate the causal effect of degree completion on BMI and obesity status. Among 18-year-old women, but not among men, being overweight or obese predicts lower odds of attaining higher levels of education. At age 47–48, higher education is associated with lower BMI, but 70–90% of the association is due to selection. Net of selection, a bachelor's degree predicts less than a 1 kg reduction in body weight, and a high school credential does not reduce BMI.

1. Introduction

Compared to less educated adults, more educated adults have lower average body mass index (BMI) and a lower risk of overweight and obesity. Does this suggest that education has a *causal* effect on BMI, overweight, and obesity? Or does it suggest a *selection* process, whereby adolescents with lower BMI are more likely to reach higher levels of education?

There are theoretical arguments for both causation and selection. On the causal side, education is thought to increase individuals' "learned effectiveness" (Mirowsky and Ross, 2003), making them more likely to believe weight is within their control and more knowledgeable about behaviors that restrain weight gain. Education also leads to more secure, autonomous, higher paying work, making healthy foods more affordable (Drewnowski, 2010, 2004) and reducing the stress that can lead to emotional eating. Further, the economic security of such work frees up "cognitive bandwidth" from meeting basic needs to enable prioritization of behaviors such as a healthful diet and regular exercise (Mullainathan, 2013; Polivy et al., 2005).

Theories of selection note that low-BMI children tend to have higher grades and test scores, and better chances of completing secondary and tertiary education. This is partly because low-BMI children tend to come from socioeconomically advantaged families, but socioeconomic variables explain only half of the association between BMI and academic attainment (Crosnoe, 2007; von Hippel and Lynch, 2014). Other possible explanations include personality traits such as future orientation (Bruce et al., 2011; Smith et al., 2005; Weller et al., 2008), the cognitive benefits of physical activity on academic performance (Castelli et al., 2007; Hillman et al., 2006; Kramer and Erickson, 2007), and negative perceptions about high-BMI children and adolescents (Kenney et al., 2015) which can impair academic performance and self-concept (Crosnoe, 2007).

It can be difficult to distinguish empirically between causation and selection. Because selection depends in part on social processes that are difficult to observe, it is unlikely that covariates can control

* Corresponding author.
E-mail addresses: rebecca.benson@ucl.ac.uk (R. Benson), paulvonhippel@austin.utexas.edu (P.T. von Hippel), jamie.lynch@snc.edu (J.L. Lynch).

http://dx.doi.org/10.1016/j.socscimed.2017.03.042
0277-9536/

Please cite this article in press as: Benson, R., et al., Does more education cause lower BMI, or do lower-BMI individuals become more educated? Evidence from the National Longitudinal Survey of Youth 1979, Social Science & Medicine (2017), http://dx.doi.org/10.1016/j.socscimed.2017.03.042

for selection fully (Lynch and von Hippel, 2016). The most persuasive attempts to isolate the causal effect of education have used designs that control for unobservables – for example, by estimating BMI differences between twins or siblings who differ in educational attainment (Amin et al., 2015; Lundborg, 2012), or by using instrumental variables derived from policies that increase educational attainment (Arendt, 2005; Kemptner et al., 2011; Kenkel et al., 2006).

Such attempts to isolate education's causal effect on BMI have produced mixed results. Some studies have found no causal effect (Amin et al., 2015; Arendt, 2005; Lundborg, 2012); others have found causal effects much smaller than a simple regression of BMI on educational attainment would imply (Brunello et al., 2013; Kenkel et al., 2006; Kim, 2016; von Hippel and Lynch, 2014); and one study found a causal effect larger than a simple regression would suggest (Grabner, 2009).

These designs are improvements over approaches using only covariates to address selection. However, limitations remain. Studies taking advantage of policy changes often have limited generalizability because relevant policy changes affect only specific cohorts and levels of education. For example, increasing the age when children are permitted to leave high school is unlikely to affect college completion. In the case of twin studies, the very fact of discordant levels of education may suggest all unobservable differences are not controlled (Gilman and Loucks, 2014; Kaufman, 2013).

A simpler approach is to use individual fixed effects (FE) to control for the selection of lower-BMI individuals into higher education (von Hippel and Lynch, 2014). This approach looks for intra-individual changes in BMI, by comparing an individual's BMI before and after a change in education status, This approach has two advantages. Firstly, it is applicable whenever longitudinal data extend from adolescence into adulthood. Secondly, it controls for both observed and unobserved confounders of the association between education and BMI. The FE approach does not control for time-varying confounders, but these may be less concerning since the timing of educational transitions is somewhat predictable.

Using individual FEs, a recent study estimated that three-quarters of the association between educational attainment and adult BMI was due to selection, and one-quarter was due to causation (von Hippel and Lynch, 2014). That study, however, was limited to a relatively recent cohort—the 1997 cohort of the National Longitudinal Study of Youth (NLSY97)—which had only reached age 29 by the time of the study. In this study we replicate the FE analysis in data from an older cohort—the 1979 cohort of the National Longitudinal Study of Youth (NLSY79). It is plausible that selection on BMI might be less pronounced for a cohort that grew up before the obesity epidemic. It is also plausible that the causal effect of education on BMI might be larger for a cohort that has reached middle age and given the benefits of education a chance to accumulate.

2. Methods

2.1. Data

The NLSY79 is a complex random sample of the non-institutionalized US population born 1956–1964. The NLSY79 oversampled Hispanics, blacks, and low-income whites, and our analyses compensate for the oversampling using sample weights. The NLSY79 also includes a military sample, which we excluded due to a limited follow-up period.

Starting at ages 14–22, NLSY79 participants were interviewed annually from 1979 until 1994, and in alternate years thereafter. The most recent data available for analysis were collected in 2012, when participants were aged 48–56 years. Our complete-case analysis included 5521 women and 5319 men.

Dependent variable. BMI was calculated from self-reported height and weight (kg/m^2). Height was collected in 1981, 1982, 1985, and from 2006 onwards. For respondents who were over 20 in 1985, 1985 height was carried forward until 2004; for younger respondents, 2006 height was used between 1986 and 2004. Although there is downward bias in self-reported BMI, the bias is small for adolescents and adults under 60 years (Kuczmarski et al., 2001; Sherry et al., 2007). Using thresholds defined by researchers using comparable data (Ball et al., 2009) we deleted 287 extreme values of height (<0.8 m or >2.7 m), weight (>980 lbs), and BMI (<14 kg/m^2 or >55 kg/m^2).

Independent variable. We measured education with a three level ordinal variable: less than high school diploma or equivalent, high school diploma or equivalent, and bachelor's degree or higher.

Control variables. Several variables may have relationships with both education and BMI. For example, pregnancy or marriage may cause young adults to terminate their education; conversely, young adults may choose to delay marriage and pregnancy until education is complete. Because childbearing and marriage are associated with weight gain among women (Gore et al., 2003; Teachman, 2016), these events could be either confounders or mediators of the education-BMI relationship. We therefore fitted models with and without the following time-varying covariates: marital status, coded as never married, currently married, and previously married; a binary indicator of biological, adopted, or step children in the home; and for women, a binary variable for having been pregnant. Additionally, we controlled for parental education in cross-sectional models, measured in completed years of education of the most highly educated parent.

2.2. Analytic strategy

All analyses were stratified by sex because the association between education and BMI is stronger for women, and some control variables, such as pregnancy history, only apply to women. Small cell sizes precluded stratified analysis by race/ethnicity, but descriptive figures showing BMI trajectories for Hispanics, blacks, and whites are available in the online appendix.

Our first analysis asked whether overweight adolescents were less likely to complete higher levels of education. We limited the sample to the youngest NLSY79 participants, who, in the first survey round to include height and weight (1981), were aged 17 or 18 and yet to earn a high school diploma ($n = 1095$ & 1220 complete cases for women and men respectively). We used weight status at age 17 or 18 to predict educational attainment at age 47 or 48 in ordinal logistic regression models. Because few adolescents were obese ($n = 66$) we combined overweight and obese into a single category, using age-specific International Obesity Taskforce definitions (Cole et al., 2007).

We established the magnitude of the association between education and BMI in middle age by fitting the following weighted least-squares (WLS) regression at age 47 or 48, the oldest age of observation for the youngest sample members:

$$E(BMI_i) = \beta_0 + \beta_1 noHS_i + \beta_2 bach_i + \ldots \quad (1)$$

BMI_i is the BMI of individual i. The variables for education are $noHS_i$ which is 1 for individuals without a high school diploma and 0 otherwise, while $bach_i$ is 1 for individuals with a bachelor's degree and 0 otherwise. The reference category is adults whose highest qualification is a high school diploma. β_1 represents the predicted BMI difference between adults with and without high school diplomas while β_2 is the difference between adults with