



## Education and obesity at age 40 among American adults

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### ABSTRACT

Although many have studied the association between educational attainment and obesity, studies to date have not fully examined prior common causes and possible interactions by race/ethnicity or gender. It is also not clear if the relationship between actual educational attainment and obesity is independent of the role of aspired educational attainment or expected educational attainment. The authors use generalized linear log link models to examine the association between educational attainment at age 25 and obesity (BMI  $\geq 30$ ) at age 40 in the USA's National Longitudinal Survey of Youth 1979 cohort, adjusting for demographics, confounders, and mediators. Race/ethnicity but not gender interacted with educational attainment. In a complete case analysis, after adjusting for socioeconomic covariates from childhood, adolescence, and adulthood, among whites only, college graduates were less likely than high school graduates to be obese (RR = 0.69, 95%CI: 0.57, 0.83). The risk ratio remained similar in two sensitivity analyses when the authors adjusted for educational aspirations and educational expectations and analyzed a multiply imputed dataset to address missingness. This more nuanced understanding of the role of education after controlling for a thorough set of confounders and mediators helps advance the study of social determinants of health and risk factors for obesity.

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### Introduction

Educational attainment appears to be inversely related to obesity (e.g., McLaren, 2007), in both women and men of several races/ethnicities in developed countries and, increasingly, in developing countries. However, these studies vary greatly in how they measure educational attainment and for which covariates they adjust. To the best of our knowledge, no study has adjusted for a rigorous set of potential socioeconomic confounders and mediators, considered effect measure modifiers, and addressed potential other explanations when calculating the risk ratio for education and obesity in a nationally representative sample.

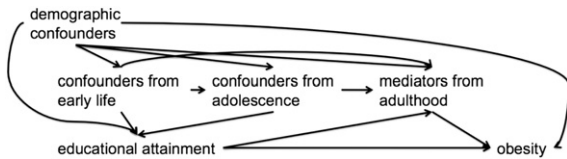
First, the relationship between educational attainment and obesity may be confounded by potentially important demographic factors and factors from childhood and adolescence that are not often measured and analyzed but are associated with both educational attainment and obesity and merit inclusion in the model as

covariates (Fig. 1). These include potential confounders from childhood and adolescence such as parental educational attainment (Chevalier, 2004; Keane & Wolpin, 2001) and other measures of childhood socioeconomic position (Adler & Rehkopf, 2008; Kitagawa & Hauser, 1973), intelligence (Yu, Han, Cao, & Guo, 2010), where the individual grew up (Kimbrow, Bzostek, Goldman, & Rodríguez, 2008; McLaren, 2007; Wang & Beydoun, 2007) and level of acculturation (Ahn, Juon, & Gittelsohn, 2008; Chandola, Clarke, Morris, & Blane, 2006; Cutler & Lleras-Muney, 2006; Gordon-Larsen, Harris, Ward, & Popkin, 2003; Mirowsky & Ross, 1998). Additionally, adult socioeconomic factors (Chandola et al., 2006; Cutler & Lleras-Muney, 2006), adult family structure (e.g., marital status, children) (Bogossian et al., 2012; Brown, 2011; Luoto, Männistö, & Raitanen, 2011), and geography (Lovasi, Hutson, Guerra, & Neckerman, 2009; Wang & Beydoun, 2007) may mediate the relationship between education and obesity (Fig. 1). Education is often used to measure general socioeconomic status, but other components of socioeconomic status (e.g., income, wealth) may also be relevant (Chevalier, 2004; Keane & Wolpin, 2001; McLaren, 2007; Parsons, Power, Logan, & Summerbell, 1999; Sobal & Stunkard, 1989).

Second, gender and/or race/ethnicity may modify the relationship between education and obesity (Note that this cannot be

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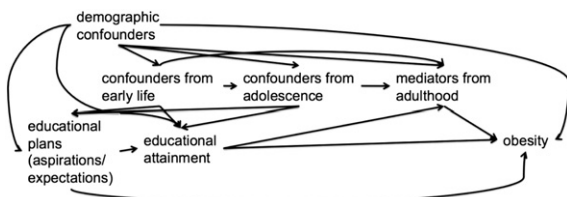
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**Fig. 1.** The hypothesized relationships between educational attainment, obesity, potential confounding variables, and potential mediating variables.

visualized in Fig. 1, except to say that the relations between the variables may be different by race/ethnicity and/or gender). For example, across many European countries, an inverse association between educational tertile and body mass index (BMI) was observed for women, with less consistent results among men (Molarius, Seidell, Sans, Tuomilehto, & Kuulasmaa, 2000). In the United States (US), similar trends were observed by gender; among women, further differences by race/ethnicity were observed (Kahn & Williamson, 1991).

Third, the role of educational attainment may reflect educational aspirations—how much education an individual hopes to achieve—and/or educational expectations, or how much education an individual expects to achieve (Fig. 2 demonstrates how these variables may be related to the other measures identified in Fig. 1). Educational aspirations reflect internal motivation and perceived self-efficacy, influence of parents, role models, and peers, perceived value of additional years of education, school climate, neighborhood context, and social norms (Bandura, Barbaranelli, Caprara, & Pastorelli, 2001; Jacob & Wilder, 2008; Kao & Tienda, 1998; Rumbaut, 2005). It is possible that the relationship between educational attainment and obesity observed elsewhere is an artifact of the type of people who seek higher amounts of education. Educational expectations, on the other hand, are realistic aspirations (Jacob & Wilder, 2008) shaped by structural forces that limit or extend the amount of education an individual receives, including an individual's socioeconomic and racial/ethnic background, family support, peer norms, school experiences, and neighborhood setting (Beattie, 2002; Cheng & Starks, 2002; Jacob & Wilder, 2008; Museus, Harper, & Nichols, 2010). Similarly, it is possible that the previously documented relationship between educational attainment and obesity is an artifact of the phenomenon that the same social factors that limit educational attainment may also limit the attainment of positive health outcomes. Both educational aspirations (Kao & Tienda, 1998) and educational expectations (Jacob & Wilder, 2010) are associated with educational attainment. We also note that these are disparities in educational aspirations and educational expectations by race/ethnicity and gender. For example, minority youth often have lower educational aspirations and are less likely to achieve the educational level to which they aspire (Kao & Tienda, 1998). And while men used to expect to achieve more education than women, now the reverse is true (Jacob & Wilder, 2010).



**Fig. 2.** The hypothesized relationships between educational aspirations, educational expectations, educational attainment, obesity, potential confounding variables, and potential mediating variables.

The National Longitudinal Survey of Youth (NLSY) 1979 cohort offers a unique opportunity to test three related hypotheses: 1) prior studies of the relationship between educational attainment and obesity may have been confounded because potentially important social factors were not included in their models; 2) interactions by race/ethnicity and/or gender may affect the adjusted relationship between educational attainment and obesity; and 3) the association between educational attainment and obesity is independent of any relationship between educational aspirations and/or educational expectations and obesity.

In particular, we hypothesize that: 1) there will be an inverse association between educational attainment and obesity that will be attenuated when confounders and mediators from across the life course are included in the model; 2) the association between educational attainment and obesity may be stronger among whites and/or women; and 3) the association between educational attainment and obesity will be attenuated and may be erased after controlling for educational aspirations and educational expectations.

## Methods

The 1979 National Longitudinal Survey of Youth is a nationally representative cohort study that recruited 14–21 year-old American males and females in 1979 and collected data annually until 1994 and then biennially through in-person and telephone interviews. A complex multistage sampling approach randomly sampled households in the United States, screened for eligible participants, and oversampled blacks, Hispanics, economically disadvantaged non-Hispanic non-black youth, and individuals serving in the military (CHRR, 2008). Seventy-seven percent of respondents remained alive, eligible, and participating through 2008 (7757 respondents of 9964 eligible) (CHRR, 2008). By further restricting our analytic sample to those individuals who had data for all our variables of interest ( $n = 4527$ ), our final sample consisted of 58.4% of those who were retained through 2008 ( $n = 7757$ ), or 45.4% of the original NLSY sample ( $n = 9964$ ). While this participation proportion appears low, this is not uncommon for prospective cohort studies; one recent Whitehall II study included 44.1% of the original sample (Elovainio et al., 2011), and a recent National Longitudinal Survey of Adolescent Health survey analysis used 43.0% of their original sample (Gordon-Larsen et al., 2003). Furthermore, although attrition from the NLSY is nonrandom, the estimation of socioeconomic factors appears unbiased, and any attrition related to health would most likely bias results toward the null (Quesnel-Vallée & Taylor, 2012). We also looked within our specific dataset to examine the distribution of obesity at an earlier time point among attriters and non-attriters. Among non-attriters (individuals for whom obesity at age 40 was measured), the prevalence of obesity at age 25 was 40.9%; among attriters (people who were not tracked to age 40 and for whom obesity at age 40 was not measured), the prevalence of obesity at age 25 was only 36.3%. This suggests that, if anything, the attriters were slightly healthier than the participants in the sample. The Bureau of Labor Statistics created custom sampling weights to make the sample nationally representative and account for loss to follow-up. The University of California Berkeley Office for the Protection of Human Subjects waived the requirement for formal review of this research because these data are unidentifiable and publicly available.

The outcome of interest was obesity at 40 or 41 years of age. This age cut-off was chosen because it was the oldest age that all members of the cohort had achieved and for which data were available at the time the analyses were completed. Self-reported weight and height measures were regression-calibrated using data from the National Health and Nutrition Examination Survey III

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