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The Role of Adolescent Health in Adult SES Outcomes

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Abstract:
This paper explores the effects of adolescent health and adolescent mental health on long-term socioeconomic outcomes in the United States. Within-twin estimations are employed to overcome the bias generated by unobserved family background and genetic traits. The results indicate that poor adolescent health reduces long-term health, earnings, and household income. Accounting for life-cycle effects suggests that the effect of poor adolescent health on household income and earnings increases over the life cycle. Finally, we demonstrate that the effects on income are a consequence of the persistence of adolescent health on future health.

Keywords: adolescent health, adult SES, twins

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1 Introduction

Experiencing poor health before reaching adulthood can deprive an individual of achieving their full earnings and heath potential, thereby leading to the persistence of poverty across generations. For example, empirical studies find that children born to families with lower socioeconomic status (SES) are less healthy (Case, Lubotsky, and Paxson 2002; Currie and Hyson 1999), potentially disadvantaging them later in life. Estimating the impact of child and adolescent health on long-run SES outcomes is however challenging for a number of reasons, including the presence of unobservable factors that might affect child and adolescent health and adult SES outcomes.

This paper employs a novel dataset and within-twin estimations to explore the effect of adolescent health and adolescent mental health on long-run SES outcomes.[1] Specifically, this paper uses a nationally representative sample of twins from the Midlife Development in the United States (MIDUS) dataset. Within-twin estimations are used to overcome the bias generated by unobserved family background and genetic traits. We find that twins with poor adolescent health earn significantly less and are less healthy as adults compared to their siblings.

This paper contributes to the literature examining the role of early-life factors, such as child health, in adult SES outcomes (Case, Lubotsky, and Paxson 2002; Smith 2009a). Because adolescent health is related to many potential factors that are determinants of adult SES, such as genetic endowments and parental investments, sibling-fixed effects have been employed to account for these unobservable or difficult-to-measure variables (Almond, Chay, and Lee 2005; Smith 2009a). While within-sibling estimates account for unobservable family heterogeneity, there remains a concern that variation between siblings might be endogenous as well. For example, earlier-born siblings tend to receive more parental resources than later born siblings, implying that the correlation between child health and adult SES outcomes might be a consequence of greater resource allocation (Price 2008; Behrman, Pollak, and Paul 1982; Powell and Steelman 1995). Consequently, recent studies have relied on twin-fixed effects, either in main specifications or as robustness checks, to estimate the effect of birth weight (Royer 2009; Xie, Chou, and Liu 2017) and adolescent health (Lundborg, Nilsson, and Rooth 2014) on long-run SES outcomes.

Besides investigating the relationship between early-life health and adult SES outcomes using a unique dataset, this paper makes a number of contributions to the literature, in particular with respect to the study by Lundborg, Nilsson, and Rooth (2014). First, we investigate a broad range of effects, including household income and adult health, as well as earnings and education. In addition to understanding the effect of adolescent health

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more comprehensively, exploring a broad range of SES outcomes sheds light on a new finding in the literature – that the effects on income are a consequence of the persistence of adolescent health on adult health. Second, we estimate both household income and male earnings, which sheds light on the role of matching outcomes, finding that matching outcomes play an important role in the income effects of adolescent health. Finally, while Lundborg, Nilsson, and Rooth (2014) employ within-twin estimations as a robustness check, and find consistent but slightly smaller results compared to within-sibling estimations, we employ within-twin estimations and perform a number of further robustness checks to mitigate endogeneity concerns. In particular, we control for birth order, birth weight, and indicator variables for taller and heavier than twin during childhood in the within-twin estimations, and we restrict the sample to exclude twin pairs that exhibit heterogeneity, including twins that (1) reported not having the same height as children (excluding opposite-sex twins), (2) reported not having the same weight as children (excluding opposite-sex twins), (3) were separated before 16 years old, and (4) reported having different childhood playmates.

While the inclusion of birth weight in the MIDUS dataset represents an important opportunity to assess the robustness of within-twin estimations, it also has implications with respect to the interpretation of the results and the corresponding policy implications. That is, because health is persistent, variation in early-life health might be driven by variation in health at birth, implying that studies exploring the role of child and adolescent health might misattribute the effect of early-life health. Controlling for birth weight thus distinguishes between the role of health at birth and early-life health. While studies investigating the role of birth weight in adult SES outcomes motivate public policy interventions aimed at supporting *in utero* development, distinguishing between effects of health at birth and child health is essential in determining if policies should also support child and adolescent health as well.

This paper exploits variation in adolescent health and adolescent mental health across twins to identify the effects of early-life health on adult SES outcomes. The results demonstrate that poor adolescent health significantly reduces adult health, earnings, and household income, while poor adolescent mental health significantly reduces adult health and earnings. In general, the within-twin estimates tend to be smaller than the ordinary least squares (OLS) estimates, with the exception of the adult health outcomes, which are similar to the OLS estimates. Moreover, while adolescent health affects education in the OLS estimates, the effect disappears after controlling for twin-fixed effects. Exploring life-cycle effects suggests that the effect of poor adolescent health on household income and earnings increases over the life cycle, though specific health conditions are mitigated over time. This paper finds that there are not significant differences in the role of early-life health across respondents from different SES. Finally, we demonstrate that adult health is a potential channel in which adolescent health bears on adult income.

2 Background

This paper is more generally related to the literature exploring the role of early-life health in adult SES outcomes. Using the Panel Study of Income Dynamics (PSID) Child Development Supplement, Case, Lubotsky, and Paxson (2002) find a strong correlation between childhood health, particularly childhood chronic conditions and household income, which becomes more pronounced as children age. Moreover, using the 1958 British birth cohort study, Case, Fertig, and Paxson (2005) find that children with more chronic conditions had lower educational attainment, poorer health, and lower earnings (between the ages 23 and 42), even after controlling for parental background factors such as education and income.

To overcome the potential bias associated with unobserved and difficult-to-measure family factors, recent studies investigating the role of early-life health on later SES have employed sibling-fixed effects. For example, using the PSID, Smith (2009a) finds that (retrospective) poor self-reported health at age 16 had a significant negative effect on earnings during early and mid-adulthood (25–47 years old), while Smith and Smith (2010) find that childhood psychological problems negatively affect income and earnings during early and mid-adulthood. Using public health insurance records for children born in the Canadian province of Manitoba, Currie et al. (2010) find that early childhood problems, particularly mental health problems, negatively affect young adult outcomes, such as the probability of being in grade 12 by age 17, literacy test score in grade 12, and the probability of taking college-preparatory math courses.[2]

While sibling-fixed effects account for time-invariant family factors, several studies argue that there are important unobservable differences between siblings and employ twin-fixed effects to investigate the role of birth weight on adult outcomes. For example, Almond, Chay, and Lee (2005) and Xie, Chou, and Liu (2017) find that, as a consequence of not accounting for twin-fixed effects, the short-run effects of low birth weight are overstated using samples of twins in the United States and Taiwan, respectively. Investigating long-run effects, Black, Devereux, and Salvanes (2007) find that the short-run effects of low birth weight are overstated but the long-run effects (such as education and earnings) are similar in magnitude; whereas, Royer (2009) finds that both the short-run and long-run effects of birth weight are overstated and small (though the effects vary across the birth-weight distribution). Oreopoulos et al. (2008) investigate infant health more broadly, including birth weight, APGAR scores, and gestational length, and investigate the effect on high school completion and social assistance use using a sample of twins from the Canadian province of Manitoba, finding that infant health has significant and lasting effects, but the inclusion of twin-fixed effects significantly reduces the magnitude of the effects.

Most related to our study, Lundborg, Nilsson, and Rooth (2014) explore the effects of adolescent health on adult male labor market outcomes in Sweden. Using sibling-fixed effects, they find that poor health at age 18 had significant negative effects on male earnings and employment. Lundborg, Nilsson, and Rooth (2014) also employ twin-fixed effects as a robustness check, finding that the estimates remain statistically significant but smaller in magnitude. We describe the contribution of our paper relative to previous studies, including Lundborg, Nilsson, and Rooth (2014) in particular, in the Introduction.

3 Empirical Methodology

Consider the following empirical model:

$$y_{ij} = \alpha + \beta H_{ij} + \mathbf{X_{ij}}^{'}\Gamma + \gamma U_{ij} + \epsilon_{ij} \tag{1}$$

where i indexes individuals and j indexes families (or twin pairs), y_{ij} is various SES outcomes of interest, H_{ij} is adolescent health, $\mathbf{X_{ij}}$ is a vector of control variables, U_{ij} is an unobservable (omitted) variable, such as genetic endowments, family background, innate ability (and so on), and ϵ_{ij} is a random error term.

Our objective is to obtain an unbiased estimate of β. However, to the extent that the omitted variable U_{ij} is correlated to H_{ij}, the least-squares estimate of β is biased as it would pick up some of the effects of U_{ij} and attribute them to H_{ij}. Because omitted factors that positively influence y_{ij} are likely positively related to H_{ij}, the least-squares estimate of β is likely to overstate the effect of H_{ij}.

If omitted factors that are related to y_{ij} are family (or twin) specific, that is $U_{ij} = f_j + u_{ij}$ where u_{ij} is uncorrelated with the error term ϵ_{ij}, then the within-sibling (or within-twin) estimator will be unbiased. That is, estimation of the following will produce an unbiased estimate of β.

$$y_{1j} - y_{2j} = \beta(H_{1j} - H_{2j}) + (\mathbf{X_{1j}} - \mathbf{X_{2j}})^{'}\Gamma + (\tilde{\epsilon}_{1j} - \tilde{\epsilon}_{2j}) \tag{2}$$

where "1" and "2" denote one and the other sibling (twin) of a pair, and $(\tilde{\epsilon}_{1j} - \tilde{\epsilon}_{2j}) = (u_{1j} - u_{2j}) + (\epsilon_{1j} - \epsilon_{2j})$ is the random error component. If, on the other hand, u_{ij} is correlated to the error term ϵ_{ij}, then the within-sibling estimator will be biased. While eliminating unobserved family-specific heterogeneity might reduce the degree of bias in the β, this need not be the case under certain circumstances (Griliches 1979). To shed light on this question, let us decompose adolescent health according to endogenous and exogenous components. That is,

$$H_{ij} = \eta U_{ij} + Z_{ij} \tag{3}$$

where U_{ij} is the endogenous component (related to omitted factors) and Z_{ij} is the (independent) exogenous component (related to y_{ij} only through H_{ij}). We can further decompose Z_{ij} into family and individual components $Z_{ij} = g_j + z_{ij}$.

Following Griliches (1979), for the variables U and Z, we define the ratio of variance across families to the total variance as $\rho_U = \sigma_f^2/\sigma_U^2$ and $\rho_Z = \sigma_g^2/\sigma_Z^2$, respectively. We can interpret ρ_U (ρ_Z) as the share of the endogenous (exogenous) component of variation in adolescent health attributed to variation across families. Griliches (1979) demonstrates that the OLS and within-family estimators are the following:

$$\hat{\beta}_{ls} = \beta + \frac{\gamma}{(1+\mu)} \tag{4}$$

$$\hat{\beta}_{fe} = \beta + \frac{\gamma(1-\rho_U)}{(1-\rho_U) + \mu(1-\rho_Z)} \tag{5}$$

where $\mu = \sigma_Z/\sigma_U$ is the ratio of the variation in exogenous to endogenous components of variation in adolescent health. In general, the direction of bias for the within-family estimator is similar to the direction of bias for the least-squares estimator, implying that the within-family estimator would arguably overstate the effect of adolescent health. Equations (4) and (5) demonstrate that the within-family estimator produces a less biased estimate of β than the least-squares estimator whenever the share of the endogenous exceeds the share of the exogenous component in variation in adolescent health attribution to variation across families (that is, $\rho_U > \rho_Z$).

While previous studies generally contend that the within-family estimates are generally less biased than least-squares estimates, within-family estimations are potentially biased due to endogenous heterogeneity within families. Examples of sources of heterogeneity include variation in genetic endowments of siblings and variation in parental resource allocation and treatment in general (Rosenzweig and Wolpin 1988; Geronimus and Korenman 1992). Also, Bound and Solon (1999) argue that differences between siblings in individual traits and their environments are potential sources of bias in estimating returns to schooling. To reduce the bias associated with heterogeneity within families, we employ within-twin estimates. Because twins share similar genetic endowments, parental investments, and family background, within-twin estimates plausibly reduce endogenous variation in adolescent health, thereby increasing the share of variation in adolescent health attributed to exogenous sources, such as childhood sickness. We also provide several robustness checks: (1) controlling for early-life factors, such as birth weight and birth order, and indicator variables for taller and heavier than twin during childhood, (2) excluding twins who reported not having the same height as children (excluding opposite-sex twins), (3) excluding twins who reported not having the same weight as children (excluding opposite-sex twins), (4) excluding twins who separated before 16 years old, and (5) excluding twins who had different childhood playmates.

While focusing on twins and excluding twins with observable heterogeneity reduces within-family heterogeneity, there is still the possibility of unobservable factors (e.g. motivation, risky behavior) that are correlated with adolescent health and adult SES outcomes. Fletcher and Lehrer (2011) use genetic markers as instruments to assess endogeneity concerns of family-fixed effects in the role of health in academic performance, finding that differences in health across siblings cannot be treated as random. Fletcher and Lehrer (2011) find that the family-fixed effects (including among twin pairs) estimates are several orders of degree of magnitude smaller than IV, and the former are statistically insignificant (though sample size is a concern in the twin estimations). While the outcomes and independent variables of interest are dissimilar to the present study, the general conclusions of Fletcher and Lehrer (2011) suggest that the within-twin estimates represent a lower bound of the true effects of adolescent health on adult SES outcomes.

4 Data

The data are from the first wave of the Midlife Development in the United States (MIDUS) survey.[3] The MIDUS is a nationally representative survey of 7,108 noninstitutionalized English-speaking individuals aged 25–74 in the United States in 1995/1996.[4] Of the 7,108 individuals, 1,914 are twins that were part of the MIDUS Twin Screener Data – the first nationally representative sample of twins ascertained randomly via telephone. MIDUS includes a rich set of socioeconomic and demographic characteristics, such as age, race, marriage, education, family income, individual earnings, family background, and various health outcomes.

The primary independent variables of interest, adolescent physical health and mental health, are measured according to respondent's self-reported health status at age 16 using the standard 5-point scale (excellent, very good, good, fair, or poor).[5] Following Smith (2009a), the adolescent health (mental health) variable is a dummy equal to 1 if the respondent reports excellent or very good physical health (mental health) at age 16, and 0 if otherwise (good, fair, or poor).[6] Moreover, MIDUS includes information on birth weight (a commonly used measure of health at birth),[7] which permits estimating the effect of adolescent health conditional on health at birth. Other explanatory variables include age (dummies), race, gender, marriage, birth order (first-born or second-born twin), birth weight, and indicator variables for tall and heavier when children.

The dependent variables include measures of education, income, earnings, and adult health, which are described below.

Educational attainment is a categorical variable, including 12 categories ranging from no school/some grade school to Ph.D. Education, which is categorized into the following categories: less than high school graduation, high school graduation, some college (no BA degree), and college degree. Following Jaeger (1997), years of schooling are imputed from the 12 educational attainment categories.

Household income is before-tax annual income in the past 12 months for all members of the family.[8] Approximately 86% of men in the twin sample are employed, of which the vast majority are full-time workers, while approximately 50% of women work full-time. The analysis of earnings is restricted to men with positive earnings.[9] Both household income and earnings categories and log household income and earnings are used as outcomes.

Adult health outcomes include self-reported health, presence of chronic conditions, and mental health. Self-reported health is the response to the question: "how would you rate your health these days?" ranging from

0 ("the worst possible health") to 10 ("the best possible health"). Self-reported health has been shown to be a strong predictor of mortality and morbidity (Idler and Benyamini 1997 survey the literature). Mental health is a dummy variable equal to 1 if the respondent reports excellent or very good mental health, and 0 if otherwise (good, fair, or poor). Chronic condition is a dummy indicating whether the respondent experienced or had been treated for at least 1 chronic condition among 29 conditions (e.g. asthma, bronchitis, high blood pressure, etc.) in the past 12 months. Following Smith (2009a), we also construct dummies indicating whether the respondent had a chronic condition rated minor (e.g. hypertension) or severe (e.g. cancer).

Table 1 reports summary statistics for the sample of twins (1,856) and subsample of same-sex twins (1,374) used in the analysis.[10] The number of observations may differ due to missing values for the corresponding variables. Table 1 demonstrates that the sample of twins is similar to the subsample of same-sex twins in terms of demographics and socioeconomic measures. The average age was 45 years old, around 94% were white, 44% were male, 72% were married at the time of the survey, 30% graduated high school, 31% attended college (no BA degree), and 28% had college degree. Moreover, 88% and 78% of the respondents reported excellent or very good adolescent health and mental health, respectively.[11] The average household income was $53,156 (10.89 in logs), the average earnings category for men was between $25,000 and 25,999 (category 24), and the average earnings for male full-time workers was $31,571 (10.53 in logs). On average, respondents reported an adult health around 8 (on a 10-point scale), 65% reported excellent or very good mental health as adults, and 74% reported having at least one chronic condition.

Table 1: Summary statistics.

	Twins			**Same-sex twins**		
	Mean (1)	**SD** (2)	**Within-twin SD/Overall SD** (3)	**Mean** (4)	**SD** (5)	**Within-Twin SD/Overall SD** (6)
Age	44.907	12.058		44.621	12.085	
White	0.936	0.244		0.932	0.252	
Male	0.441	0.497	0.42	0.422	0.494	
Married	0.721	0.449	0.51	0.724	0.447	0.50
High school graduate	0.299	0.458	0.40	0.305	0.460	0.35
Some college	0.309	0.462	0.47	0.314	0.464	0.43
College degree	0.277	0.448	0.29	0.265	0.442	0.25
Years of education	13.422	2.391	0.41	13.393	2.365	0.38
Father high school graduate	0.522	0.500		0.526	0.499	
Birth weight (g)	2,460.823	642.641	0.33	2,409.054	643.393	0.31
Adolescent health	0.878	0.328	0.38	0.878	0.327	0.36
Adolescent mental health	0.777	0.416	0.35	0.779	0.415	0.36
Income outcomes						
Ln HH income	10.881	0.978	0.60	10.869	0.985	0.59
Earnings category, men	24.244	5.680	0.48	24.214	5.828	0.47
Earnings category –FT, men	25.494	4.013	0.55	25.386	4.180	0.55
Ln earnings, men	10.360	0.784	0.50	10.356	0.813	0.49
Ln earnings – FT, men	10.526	0.568	0.57	10.515	0.586	0.57
Adult health outcomes						
Self-reported health	7.668	1.567	0.64	7.699	1.555	0.61
Mental health	0.654	0.476	0.59	0.650	0.477	0.57
Chronic condition	0.736	0.441	0.53	0.737	0.441	0.50
Minor condition	0.719	0.450	0.54	0.715	0.452	0.52
Severe condition	0.128	0.334	0.45	0.131	0.337	0.46

Notes: The sample of twins and subsample of same-sex twins include 1,856 and 1,374 individuals. Columns (3) and (6) report the ratio of the within-twin standard deviations to the overall standard deviations.

Table 1 also demonstrates that there is significant within-twin variation in adolescent health and adolescent mental health. Specifically, within-twin variation accounts for 38% and 35% of the overall variation in adolescent health and adolescent mental health. Similarly, within-twin variation accounts for 60% and 64% of the overall variation in household income and adult health (and so on for other covariates).

5 Empirical Findings

Table 2–Table 6 report both pooled OLS and twin fixed effects (FE) estimates of the effects of adolescent health and mental health on adult socioeconomic outcomes. The estimations control for gender, marital status, and educational attainment for all outcomes, except for education. Additionally, the OLS estimations control for age-fixed effects and race. Standard errors are clustered at the family level in all regressions.

5.1 Education

Panels A and B of Table 2 present the effects of adolescent health and mental health on adult education using both OLS and FE, respectively. The results suggest that men are more likely to have some college and college degree and complete more years of schooling. The OLS estimates suggest positive and significant associations between adolescent health (adolescent mental health) and education: respondents with excellent or very good health (mental health) are 7 (5) and 5 (5) percentage points more likely to have some college and college degree, respectively, and attain 0.4 (0.3) more years of schooling. However, the effects of adolescent health and mental health on all education outcomes are statistically insignificant after controlling for twin-fixed effects. This suggests that the observed relationship between adolescent health and education might be explained by unobserved genetic or family effects that are correlated with both health and education.

Table 2: Effects of adolescent health and mental health on education outcomes (all twins).

Dependent variable:	Some college		College degree		Years of education	
	OLS (1)	**FE (2)**	**OLS (3)**	**FE (4)**	**OLS (5)**	**FE (6)**
Panel A:						
Health	0.074**	0.004	0.051*	–0.007	0.396**	0.106
	(0.037)	(0.038)	(0.031)	(0.034)	(0.165)	(0.173)
Male	0.078***	0.058*	0.095***	0.100***	0.402***	0.264*
	(0.026)	(0.035)	(0.024)	(0.033)	(0.126)	(0.160)
Observations	1856	1856	1856	1856	1856	1856
Panel B:						
Mental health	0.049*	0.017	0.048**	0.038	0.292**	0.141
	(0.028)	(0.029)	(0.024)	(0.025)	(0.130)	(0.147)
Male	0.078***	0.057*	0.092***	0.096***	0.394***	0.254*
	(0.026)	(0.035)	(0.024)	(0.033)	(0.126)	(0.151)
Observations	1856	1856	1856	1856	1856	1856

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors (clustered at the family level) are in parentheses. OLS regressions control for gender, age-fixed effects, and race; FE regressions control for gender.

5.2 Household Income and Earnings

Table 3 reports the effects of adolescent health and mental health on household income using both OLS and FE. Because adolescent health and mental health do not appear to bear on education after controlling for twin-fixed effects and education is an important determinant of income and earnings, the household income and earnings regressions control for education.[12] When education is not included in the regressions, the coefficients for adolescent health and mental health are nearly identical, suggesting that education is not an important channel through which adolescent health and mental health affect household income.[13]

Table 3: Determinants of household income (all twins).

Dependent variable: Ln household income				
	OLS	**FE**	**OLS**	**FE**

	(1)	(2)	(3)	(4)
Adolescent health	0.258***	0.212*		
	(0.076)	(0.117)		
Adolescent mental health			0.101*	0.034
			(0.056)	(0.072)
Married	0.753***	0.692***	0.748***	0.692***
	(0.054)	(0.068)	(0.054)	(0.069)
Male	0.143***	0.132*	0.152***	0.145*
	(0.045)	(0.079)	(0.045)	(0.077)
High school	0.321***	0.161	0.319***	0.174
	(0.085)	(0.150)	(0.085)	(0.129)
Some college	0.620***	0.282*	0.621***	0.303**
	(0.086)	(0.145)	(0.087)	(0.131)
College degree	0.878***	0.538***	0.888***	0.561***
	(0.085)	(0.160)	(0.086)	(0.148)
Observations	1648	1648	1648	1648

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors (clustered at the family level) are in parentheses. OLS regressions also control for age-fixed effects and race. Sample includes only individuals with positive household income.

Column (2) of Table 3 demonstrates that education is an important determinant of household income, even after controlling for twin-fixed effects. Specifically, compared to high school dropouts, a college degree (some college) increases household income by 54% (28%). The results also show that married respondents and men have higher household incomes. The results in column (4) of Table 3 are consistent, suggesting that education, marriage, and gender are important determinants of household income.

Table 3 also demonstrates that adolescent health is an important determinant of income, even after controlling for education. The OLS coefficients are slightly larger than FE, but the differences are not statistically significant. OLS estimates suggest that good adolescent health increases household income by 26%, while the FE estimates suggest that it increases household income by 21%. On the other hand, Column (4) of Table 3 demonstrates that adolescent mental health is not an important determinant of income.

Table 4 reports the effects of adolescent health and mental health on male earnings and household income using OLS and FE. Panel A reports the results for same-sex male twins, while Panel B reports the results for the restricted sample that includes only full-time workers. Using OLS and FE (respectively), Panel A demonstrates that good adolescent health increases earnings by around 27% and 24%, whereas good adolescent mental health increases earnings by around 25% and 20%.[14] Similarly, using FE, good adolescent health (mental health) increases earnings by 1.9 (1.3) income categories, which corresponds to $1,900 ($1,300) higher earnings.

Table 4: Effects of adolescent health and mental health on household income and earnings (same-sex male twins).

	Health		**Mental health**	
	OLS (1)	**FE (2)**	**OLS (3)**	**FE (4)**
Panel A: All same-sex male twins				
Dependent variable:				
Ln individual earnings	0.273**	0.243*	0.250***	0.198**
	(0.130)	(0.138)	(0.082)	(0.090)
Observations	488	488	488	488
Earnings category	1.897**	1.875*	1.588**	1.279*
	(0.949)	(1.078)	(0.614)	(0.724)
Observations	488	488	488	488
Ln household income	0.317***	0.258*	0.033	0.008
	(0.154)	(0.146)	(0.103)	(0.122)
Observations	530	530	530	530
Panel B: Full-time same-sex male twins				
Dependent variable:				
Ln individual earnings	0.144*	0.141	0.219***	0.141*
	(0.085)	(0.086)	(0.068)	(0.078)
Observations	430	430	430	430
Earnings category	1.279**	1.266*	1.210***	1.094**
	(0.584)	(0.653)	(0.503)	(0.618)
Observations	430	430	430	430

Controls				
Education	Yes	Yes	Yes	Yes
Married	Yes	Yes	Yes	Yes

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors (clustered at the family level) are in parentheses. Number of observations is indicated below the corresponding standard errors. OLS regressions also control for age-fixed effects and race. Sample includes only same-sex male twins with positive earnings and income.

Panel B demonstrates that, among the subsample of full-time workers, good adolescent health increases earnings by around 14% using OLS, while the coefficient is insignificant using FE.[15] In terms of income categories, good adolescent health increases earnings by 1.3 income categories using both OLS and FE. Good adolescent mental health increases earnings by 22% and 14% using OLS and FE, respectively. Finally, using OLS and FE, good adolescent mental health increases earnings by 1.2 and 1.1 income categories, which corresponds to $1,200 and $1,100 higher earnings, respectively.

Table 4 also sheds light on the role of matching outcomes in the link between adolescent health and household income. Positive assortative matching suggests that in addition to higher individual earnings, good adolescent health would also correspond to matching with partners that also have higher individual earnings, thereby increasing household income through matching outcomes. In particular, comparing the impact of adolescent health on earnings with the impact on household income permits disentangling the impact on male earnings and earnings of the spouse (or more generally the income of the household excluding male earnings). To this end, using the FE estimates, we calculate mean household income and earnings for the corresponding samples used in the household income and earnings regressions, which are $67,508 (household income) and $31,571 (earnings). Consequently (at the mean), a 26% increase in household income would correspond to a $17,552 increase in income, while a 24% increase in earnings would correspond to a $7,577 increase in income. Thus, we can infer that the increase in male earnings represents around 43% of the increase in household income, suggesting a significant role of matching outcomes.

Our estimates of the impacts of adolescent health on household income and earnings are generally smaller than the corresponding estimates reported in Smith (2009a).[16] Using within-sibling estimations, Smith (2009a) estimates that the effect on household income is 24%, while we find that the corresponding effect is 17% using within-twin estimations and similar sample restrictions (males and females aged 25–47). Similarly, Smith (2009a) estimates that the effect on male and female earnings is 25%, while we find that the corresponding effect is 19% using within-twin estimations and similar sample restrictions. Thus, we find that not accounting for genetic traits and heterogeneity within family might produce biased estimates, though the extent of the bias appears modest.

5.3 Adult Health

Table 5 and Table 6 report the effects of adolescent health and mental health on adult health using both OLS and FE, respectively. The regressions use the full sample of twins (columns 1 and 2) and the subsample of same-sex twins (column 3). The subsample of same-sex twins are further divided into males (column 4) and females (column 5).

Table 5: Effects of adolescent health on adult health.

Sample of analysis:	**OLS All twins (1)**	**FE All twins (2)**	**FE Same-sex twins (3)**	**FE Same-sex male twins (4)**	**FE Same-sex female twins (5)**
Dependent variable:					
Self-reported health	0.452***	0.573***	0.377*	0.017	0.727**
	(0.123)	(0.177)	(0.202)	(0.223)	(0.314)
Observations	1,746	1,746	1,304	550	754
Mental health	0.240***	0.262***	0.279***	0.293***	0.282***
	(0.035)	(0.050)	(0.059)	(0.090)	(0.076)
Observations	1,850	1,850	1,402	596	806
Chronic condition	–0.102***	–0.090**	–0.103**	–0.098	–0.124**
	(0.028)	(0.041)	(0.044)	(0.079)	(0.052)
Observations	1750	1750	1308	550	758
Minor condition	–0.107***	–0.083**	–0.097*	–0.099	–0.127**
	(0.029)	(0.042)	(0.049)	(0.079)	(0.056)
Observations	1,750	1,750	1,308	550	758

Severe condition	–0.024	–0.057	–0.006	–0.049	0.021
	(0.025)	(0.040)	(0.051)	(0.068)	(0.074)
Observations	1,750	1,750	1,308	550	758
Controls					
Education	Yes	Yes	Yes	Yes	Yes
Married	Yes	Yes	Yes	Yes	Yes
Gender	Yes	Yes	–	–	–

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors (clustered at the family level) are in parentheses. Number of observations is indicated below the corresponding standard errors. OLS regressions also control for age-fixed effects and race.

Table 6: Effects of adolescent mental health on adult health.

Sample of analysis:	**OLS All twins (1)**	**FE All twins (2)**	**FE Same-sex twins (3)**	**FE – men Same-sex male twins (4)**	**FE – women Same-sex female twins (5)**
Dependent variable:					
Self-reported health	0.364***	0.195	0.137	0.076	0.186
	(0.092)	(0.125)	(0.137)	(0.197)	(0.187)
Observations	1,746	1,746	1,304	550	754
Mental health	0.322***	0.302***	0.317***	0.353***	0.300***
	(0.027)	(0.041)	(0.046)	(0.067)	(0.062)
Observations	1,850	1,850	1,402	596	806
Chronic condition	–0.091***	–0.063*	–0.097**	–0.128*	–0.074
	(0.024)	(0.033)	(0.039)	(0.067)	(0.046)
Observations	1,750	1,750	1,308	550	758
Minor condition	–0.091***	–0.064*	–0.074*	–0.127*	–0.035
	(0.025)	(0.035)	(0.042)	(0.071)	(0.052)
Observations	1,750	1,750	1,308	550	758
Severe condition	–0.039*	–0.057*	–0.068*	–0.143***	–0.017
	(0.021)	(0.032)	(0.038)	(0.055)	(0.053)
Observations	1,750	1,750	1,308	550	758
Controls					
Education	Yes	Yes	Yes	Yes	Yes
Married	Yes	Yes	Yes	Yes	Yes
Gender	Yes	Yes	–	–	–

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors (clustered at the family level) are in parentheses. Number of observations is indicated below the corresponding standard errors. OLS regressions also control for age-fixed effects and race.

In general, adolescent health is a significant determinant of adult health, with the exception of the probability of having at least one severe chronic condition. More specifically, individuals with good adolescent health have better self-reported health (0.6 health categories), are more likely to report excellent or very good mental health (26 percentage points), are less likely to have at least one chronic condition (9 percentage points), and are less likely to have at least one minor chronic condition (8 percentage points). The coefficients are in general similar using OLS and FE, in both the full sample of twins and the subsample of same-sex twins. There are notable gender differences, however, as the impact is larger among women for self-reported health, and it is larger for chronic condition and minor condition but the differences are statistically insignificant.

Similarly, adolescent mental health is a significant determinant of adult health, with the exception of self-reported health. More specifically, individuals with good adolescent mental health are more likely to report excellent or very good mental health (30 percentage points), are less likely to have at least one chronic condition (6 percentage points), are less likely to have at least one minor chronic condition (6 percentage points), and are less likely to have at least one severe chronic condition (6 percentage points). The coefficients are in general similar using OLS and FE, in both the full sample of twins and the subsample of same-sex twins. There are notable gender differences, however, as the impact is larger among men for chronic condition, minor condition, and severe condition, but the differences are statistically insignificant.

Next, this paper explores whether the effect of adolescent health on household income and earnings can be explained through its effect on adult health. To this end, we add controls for contemporaneous health and health 10 years prior to the survey to the within-twin regressions using household income and earnings as dependent variables.[17] The results (not reported) indicate that health 10 years prior to the survey is not a significant determinant of income and earnings, whereas contemporaneous health is a significant determinant of income and earnings. Adding these controls reduces the effect of adolescent health on household income from 21% to 18% and does not significantly alter the effect on earnings (the significance of the coefficients are similar). The results therefore suggest that future health might be a channel linking adolescent health and income, though it does not appear to be the main channel.

5.4 Heterogeneous Effects

This section investigates whether adolescent health effects depend on the age or parental education of the individual. For example, adverse effects of a negative adolescent health shock might be transitory in nature, implying that SES outcomes of an individual experiencing a negative health shock might converge to that of their twin later in life. Moreover, more affluent parents might dampen the effects of adolescent health shocks by allocating more resources to the affected child.

To this end, this section interacts adolescent health and mental health with dummy variables indicating that respondents (i) are younger than the sample median (aged 43) and (ii) have fathers with at least high school diploma.[18] Table 7 reports the interaction terms between adolescent health and mental health with the indicator variables described above using FE. Column (1) indicates that adolescent health generally plays a slightly less important role for younger individuals but the interaction terms are not statistically significant, while column (2) indicates that mental health generally plays a slightly less important role for younger individuals and the interaction terms are significant in one instance (household income). Columns (3) and (4) both indicate that the effect of adolescent health and mental health do not depend on the education of the father.

Table 7: Heterogeneous effects of adolescent health and mental health (FE) (all twins).

	Heterogeneity by age		**Heterogeneity by parental education**	
Independent variable:	**Health ***	**Mental health ***	**Health ***	**Mental health ***
	Dummy for age <43	**Dummy for age <43**	**Dummy for father with at least high school diploma**	**Dummy for father with at least high school diploma**
	(1)	**(2)**	**(3)**	**(4)**
Dependent variable:				
Ln HH income	–0.134	–0.298**	–0.250	0.076
	(0.181)	(0.141)	(0.191)	(0.146)
Earnings category, men	–2.122	–1.252	0.044	1.382
	(2.099)	(1.421)	(1.927)	(1.390)
Ln individual earnings, men	–0.365	–0.234	–0.068	0.209
	(0.291)	(0.197)	(0.268)	(0.193)
Self-reported health	–0.428	–0.340	0.360	–0.054
	(0.309)	(0.244)	(0.323)	(0.248)
Mental health	0.013	0.024	0.132	0.089
	(0.093)	(0.073)	(0.101)	(0.077)
Chronic condition	–0.097	–0.064	–0.153	–0.076
	(0.093)	(0.073)	(0.100)	(0.077)
Minor condition	–0.084	–0.067	–0.154	–0.068
	(0.095)	(0.075)	(0.102)	(0.078)
Severe condition	–0.063	–0.036	0.017	–0.010
	(0.075)	(0.044)	(0.079)	(0.060)
Controls				
Education	Yes	Yes	Yes	Yes
Married	Yes	Yes	Yes	Yes
Gender	Yes	Yes	Yes	Yes
Health	Yes	–	Yes	–
Mental health	–	Yes	–	Yes

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors (clustered at the family level) are in parentheses. Table presents the estimates of interactions between adolescent health (or adolescent mental health) and dummy variables for age <43 and father with at least high school diploma using all twin pairs.

5.5 Life-Cycle Effects

Because the role of adolescent health appears to depend on the age of the individual, this section investigates life-cycle effects in greater detail. In particular, we exploit variation in the age of respondents to estimate age-specific effects of adolescent health, thereby shedding light on the role of adolescent health over the life cycle. Because the data does not follow individuals over time, a limitation of the analysis is that it cannot distinguish between differential effects over the life cycle and differential effects across cohorts. To this end, adolescent health is interacted with dummy variables indicating whether the respondent is aged 25–34, 35–45, and 46+ at the time of the survey.[19]Table 8 reports the coefficient estimates for income (Panel A) and health outcomes (Panel B) using FE.

Table 8: Effects of adolescent health on SES outcomes by age groups (all twins).

Panel A: Income			
Dependent variable:	Ln HH income	Earnings category, Men	Ln individual earnings, men
Age (25–34) × AH	–0.027	1.409	0.101
	(0.189)	(1.556)	(0.192)
Age (35–45) × AH	0.357**	1.707	0.231
	(0.211)	(1.558)	(0.182)
Age (46+) × AH	0.263*	2.679	0.418*
	(0.157)	(1.955)	(0.250)
Observations	1,648	488	488
Panel B: Health			
Dependent variable:	Self-reported health	Mental health	Chronic condition
Age (25–34) × AH	0.402	0.222**	–0.214**
	(0.341)	(0.077)	(0.086)
Age (35–45) × AH	0.403	0.292***	–0.029
	(0.271)	(0.081)	(0.074)
Age (46+) × AH	0.810***	0.263***	–0.058
	(0.276)	(0.083)	(0.059)
Observations	1,746	1,850	1,750
Panel B: Health Cont'd			
Dependent variable:	Minor condition	Severe condition	
Age (25–34) × AH	–0.187**	–0.130*	
	(0.091)	(0.078)	
Age (35–45) × AH	–0.031	–0.058	
	(0.074)	(0.056)	
Age (46+) × AH	–0.058	–0.011	
	(0.059)	(0.062)	
Observations	1,750	1,750	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors (clustered at the family level) are in parentheses. Table presents FE coefficients using all twin pairs. Regressions control for education, married, and gender. AH refers to adolescent health. Age (25-34) is a dummy variable equal to 1 if the respondent is between the ages of 25 and 34 at the time of the survey, and so on.

While there are several theories linking childhood health and later SES outcomes, there are no clear predictions in terms of whether the effects will increase or decrease over the life cycle (see Case, Lubotsky, and Paxson (2002) for a review of the literature). For example, life course models posit that childhood health has lasting effects on SES outcomes, both directly through persistence of health into adulthood and indirectly through bearing on educational outcomes and the acquisition of labor market skills, which in turn bear on later SES outcomes (Kuh and Wadsworth 1993). Another strand of research argues that child health is a function of their fetal environment, such as in utero nutrition, which in turn is responsible for chronic conditions later in life (such as heart disease) and SES outcomes (Barker 1995). In sum, the effect of poor childhood health might increase over the life cycle if it significantly constrains the acquisition of skills and cognitive development which in turn bears on future health and SES outcomes, whereas the effect might decrease if poor health can be overcome or at least mitigated over the life cycle.

The results indicate that, in terms of long-run income and earnings, adolescent health plays a more and more important role over the life cycle. Specifically, adolescent health does not appear to bear on income and earnings for individuals aged 25–34. On the other hand, for individuals aged 35–45, good adolescent health increases household income and male earnings by 36% and 23%, respectively (the latter is statistically insignificant), while for individuals aged 46+ it increases household income and male earnings by 26% and 42%, respectively. In terms of adult health, the effect of adolescent health on self-reported health is most pronounced later in life (aged 46+), the effects on all conditions (chronic, minor and severe) are most pronounced early in life (25–34), and the effect of adolescent health on mental health is constant over the life cycle.[20] The results are therefore consistent with childhood health constraining the acquisition of skills and generating increasing effects over the life cycle, while certain health conditions seem to be mitigated over the life cycle.

6 Robustness Checks

In this section, we address various concerns with within-family estimations. First, additional controls are introduced in the estimations. Second, the effects are re-estimated for smaller samples of twins, wherein twins exhibiting more observable differences are excluded.[21] Table 9 and Table 10 present the results.

While within-twin estimations account for common genetic endowments and parental investments, it is possible that within-twin variation in genetic endowments might be linked to both variation in both adolescent health and adult SES outcomes, thereby biasing the adolescent health coefficients. For example, previous studies have shown that birth weight is an important factor for various SES outcomes, such as education, income, physical growth, and behavioral development (Behrman and Rosenzweig 2004; Black, Devereux, and Salvanes 2007; Gupta, Deding, and Lausten 2013). Moreover, birth order, even among twins, has also been shown to be an important determinant of infant and child health, as well as socioeconomic outcomes (Almond, Chay, and Lee 2005; Black, Devereux, and Salvanes 2007; Oreopoulos et al. 2008). We include additional covariates, including birth weight and birth order as well as indicator variables for taller or heavier than twin during childhood, to reduce endogeneity concerns, as well as disentangle the effect of the primary independent variable of interest (adolescent health) and these related factors. While the results demonstrate that birth order is an important determinant of adolescent health variable, birth weight and being taller and heavier than twin as children are not significant determinants.[22] Table 9 demonstrates that the coefficient estimates of adolescent health are consistent after controlling for the covariates described above, suggesting that adolescent health exerts an effect on later life outcomes independent of these other covariates.

Table 9: Robustness checks – Effects of adolescent health on SES outcomes after the inclusion of various controls (all twins).

Additional covariates:	**Birth order**	**Birth weight**	**Taller when children**	**Heavier when children**
	(1)	**(2)**	**(3)**	**(4)**
Dependent variable:				
Ln HH income	0.185*	0.223*	0.228*	0.242**
	(0.111)	(0.123)	(0.120)	(0.121)
Observations	1,610	1,534	1,224	1,224
Earnings category, men	1.625*	2.131**	1.874*	2.072*
	(0.965)	(0.906)	(1.079)	(1.110)
Observations	480	426	488	488
Ln individual earnings, men	0.221*	0.232*	0.243*	0.269*
	(0.134)	(0.121)	(0.138)	(0.142)
Observations	480	426	488	488
Self-reported health	0.573***	0.608***	0.382*	0.380*
	(0.181)	(0.186)	(0.202)	(0.203)
Observations	1,708	1,524	1,302	1,302
Mental health	0.260***	0.277***	0.274***	0.274***
	(0.051)	(0.054)	(0.060)	(0.060)
Observations	1,810	1,606	1,372	1,372
Chronic condition	–0.088**	–0.089*	–0.105**	–0.100**
	(0.042)	(0.046)	(0.045)	(0.044)
Observations	1,712	1,528	1,306	1,306

Minor condition	–0.084*	–0.091*	–0.095**	–0.089**
	(0.049)	(0.048)	(0.046)	(0.045)
Observations	1,712	1,528	1,306	1,306
Severe condition	–0.048	–0.065	–0.006	–0.005
	(0.040)	(0.045)	(0.051)	(0.051)
Observations	1,712	1,528	1,306	1,306
Controls				
Education	Yes	Yes	Yes	Yes
Married	Yes	Yes	Yes	Yes
Gender	Yes	Yes	Yes	Yes

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors (clustered at the family level) are in parentheses. The table presents FE coefficients of adolescent health using all twin pairs. Taller when children is a dummy variable equal to 1 if the respondent reported being taller than the twin during childhood, and heavier when children is a dummy variable equal to 1 if the respondent reported being heavier than the twin during childhood.

As a further robustness check, we exclude twins who report not having the same height as children (excluding opposite-sex twins), report not having the same weight as children (excluding opposite-sex twins), report separation before the age of 16, or report having different childhood playmates. Table 10 demonstrates that the results are robust to the various restrictions.

Table 10: Robustness checks – Effects of adolescent health on SES outcomes after various sample restrictions.

***Sample restriction*:**	**Main results (all twins) (1)**	**Exclude twins different height when children (2)**	**Exclude twins different weight when children (3)**	**Exclude twins separated before 16 (4)**	**Exclude twins never had same playmates (5)**
Dependent variable:					
Ln HH income	0.212*	0.250**	0.215*	0.184*	0.254***
	(0.117)	(0.130)	(0.129)	(0.111)	(0.123)
Observations	1,648	1,014	1,044	1,566	1,552
Earnings category, men	1.875*	1.785*	1.918*	2.062**	2.406**
	(1.078)	(1.043)	(1.161)	(0.971)	(0.947)
Observations	488	432	420	472	476
Ln individual earnings, men	0.243*	0.235*	0.271*	0.238*	0.291**
	(0.138)	(0.143)	(0.158)	(0.138)	(0.133)
Observations	488	432	420	472	476
Self-reported health	0.573***	0.358	0.347*	0.635***	0.636***
	(0.177)	(0.223)	(0.211)	(0.185)	(0.180)
Observations	1,746	1,078	1,104	1,658	1,644
Mental health	0.262***	0.285***	0.248***	0.277***	0.260***
	(0.050)	(0.070)	(0.068)	(0.051)	(0.052)
Observations	1,850	1,134	1,158	1,754	1,736
Chronic condition	–0.090**	–0.109*	–0.082	–0.087*	–0.095**
	(0.041)	(0.055)	(0.051)	(0.045)	(0.042)
Observations	1,750	1,078	1,104	1,662	1,648
Minor condition	–0.083**	–0.100*	–0.082*	–0.080*	–0.088**
	(0.042)	(0.057)	(0.049)	(0.047)	(0.043)
Observations	1,750	1,078	1,104	1,662	1,648
Severe condition	–0.057	–0.054	–0.021	–0.057	–0.064
	(0.040)	(0.051)	(0.052)	(0.042)	(0.040)
Observations	1,750	1,078	1,104	1,662	1,648
Controls					
Education	Yes	Yes	Yes	Yes	Yes
Married	Yes	Yes	Yes	Yes	Yes
Gender	Yes	–	–	Yes	Yes

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors (clustered at the family level) are in parentheses. The table presents FE coefficients of adolescent health. Column (1) uses the full sample (except for male earnings), while columns (2) and (3) use same-sex twins and exclude twins that did not report same height and weight during childhood, and columns (4) and (5) use all twins and exclude twins that reported being separated before 16 and never having same playmates during childhood, respectively.

Finally, while not a robustness check *per se* we also attempt to uncover the sources of heterogeneity in adult SES outcomes across families, which is particularly relevant to policy. To this end, we estimate the family-fixed effect component from the within-twin estimations and regress this variable on family background characteristics, including measures of education and labor market outcomes of the father (dummy variable for High School Diploma and Work for Pay, and Mean Hourly Earnings). Table 3 and Table 4 in the Online Appendix demonstrate that father's education and labor market outcomes are significant predictors of heterogeneity across families.

7 Conclusion

This paper explores the effects of adolescent health and adolescent mental health on long-term socioeconomic outcomes using the Midlife Development in the United States. We employ both OLS and within-twin estimations to overcome the bias generated by unobserved family background and genetic traits. The results demonstrate that poor adolescent health reduces long-term health, earnings, and household income, while poor adolescent mental health reduces long-term health and earnings. Moreover, we find that adolescent health and mental health affect adult health, suggesting that the persistence of adolescent health on adult health can explain the link between adolescent health and income. Comparing the impact of adolescent health on household income with the impact on male earnings suggests that matching outcomes play an important role in the effect of adolescent health on household income. Exploring life-cycle effects suggests that the effect of poor adolescent health on household income and earnings increases over the life cycle, though specific health conditions are mitigated over time.

While within-twin estimations overcome the bias generated by unobserved family background and genetic traits, we also allay some of the concerns associated with within-twin estimations. In particular, we demonstrate that the results are robust to the inclusion of birth weight and birth order as well as indicators for heavier and taller than twin during childhood, and restricting the sample to twin pairs with less observable heterogeneity. To reduce within-twin heterogeneity, we exclude twins that reported (1) not having the same height as children, (2) not having the same weight as children, (3) being separated before the age of 16, and (4) having different childhood playmates and find consistent results. The results therefore suggest that adolescent health and mental health have important and statistically significant effects on long-run SES outcomes, and the results are robust to the inclusion of various covariates including birth weight and birth order, as well as sample restrictions to reduce within-twin heterogeneity.

Notes

1 Several recent studies use family-fixed effects to control for unobservable family characteristics. See, for example, Golberstein, Hirth, and Lantz (2011).
2 An overview of the literature on the role of family background for well-being can be found in Schnitzlein and Wunder (2016).
3 http://www.midus.wisc.edu.
4 See Brim, Baltes, and Bumpass (2013) for an assessment of the representativeness of the MIDUS sample. Compared to the 1995 CPS data, the MIDUS twin sample contains more educated individuals than the general US population. Also, there are more whites in the twins sample (over 90%), compared to the CPS sample (about 85%). While the gender distribution is similar in both data, age distribution is slightly more compressed in the MIDUS twins sample. About 68% and 72% of the CPS and MIDUS twins samples are married, respectively.
5 Each respondent was asked "Now, think about when you were 16 years old. Was your physical health at that time poor, fair, good, very good, or excellent?" and "Was your mental health at that time poor, fair, good, very good, or excellent?"
6 Case, Lubotsky, and Paxson (2002) find that reported health status in children is strongly correlated with children's chronic conditions and Smith (2009b) finds that self-reported childhood health index is correlated with many childhood diseases, including respiratory diseases, heart disease, ear infections, etc.
7 See Durrance and Guldi (2015) among others.
8 To be precise, household income is calculated by adding the own, spouse's, and other family members' wages, social security retirement benefits, government assistance income (e.g. unemployment benefits), and income from other sources (pensions, investments, child support, or alimony). The analysis excludes the few cases in which household income is zero. Individual earnings are before-tax annual personal income in the past 12 months, excluding pensions, investments, or any other financial assistance/income. Both income and earnings are reported in $1,000 intervals between $0 and $100,000 (income above $100,000 is top coded), as well as the mean value of the categories ($500 for first category, $1,500 for second category, and so on). Based on the distribution of top incomes, the MIDUS dataset assigns $125,000 to the top-coded income category of $100,000 or more (there are 166 cases of top coding). To account for skewness of earnings in the estimations, we log transform these mean values.
9 Exploring the effects on earnings of women suggest insignificant effects of adolescent health.
10 Table 1 and Table 2 in the Online Appendix provide summary statistics for various subsamples that correspond to the sample restrictions and demonstrate that adolescent and mental health as well as control variables are very similar across the subsamples.
11 This is similar to the summary statistics for the NHIS and PSID samples used in Case, Lubotsky, and Paxson (2002).

12 We also regress adolescent health on marital status and find very small and statistically insignificant effects on marital status (results available upon request). Moreover, the estimates of adolescent health are unaffected by the inclusion of marital status, suggesting that it does not play an important role in the effects of adolescent health.
13 Specifically, the coefficient for adolescent health is 0.22 (compared to 0.21). The full results are available upon request.
14 We also standardize the 5-point health scale measure such that the coefficient can be interpreted as a standard-deviation increase, and the FE results indicate that a standard-deviation increase in adolescent health increases household income and male earnings by 9% (significant at 5%) and 8% (significant at 10%), respectively.
15 It should be noted that the sample size for earnings for full-time workers is small, and the coefficients are less precisely estimated. While the FE estimate for log earnings among full-time workers is statistically insignificant, we cannot rule out the potential of economically significant effect. Moreover, only 18% of the final sample of working males (38 pairs out of 125 pairs) reported different levels of adolescent health, implying that there is limited variability in health within twins, which would bias statistical inference toward under-rejecting the null hypothesis of zero effects.
16 The estimations reported in this paragraph are not reported and are available upon request.
17 Similar to contemporaneous health, health 10 years prior to the survey is the response to the question, "looking back ten years ago, how would you rate your health at that time?" (ranging from 0 to 10).
18 Around half of the respondents had fathers with at least a high school diploma.
19 Interacting adolescent mental health with dummy variables for age groups yields similar patterns (results available upon request).
20 Case, Lubotsky, and Paxson (2002) also find that the effects of poor childhood health on adult health dissipate with age.
21 The results (available upon request) remain robust for adolescent mental health.
22 Moreover, the results (available upon request) show that gender is strongly correlated with adolescent health. We also allow for non-linear effects of birth weight: dummies indicating birth weight less than 2,000 g, between 2,000 and 2,500 g, and between 2,500 and 3,000 g. None of the dummies are significant.

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