Adult Children's Educational Attainment and Parent Health in Mid- and Later-Life

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Objectives: Intergenerational models of adult health contend that children's educational attainments influence the health and well-being of their parents. However, it is unclear how much of this association is confounded by background characteristics that predict both children's educational attainments and parents' subsequent health, particularly in the U.S.

Methods: Data from the National Longitudinal Study of Adolescent to Adult Health Parent Study are used to examine how having no children who completed college influences parents' self-rated health and depressive symptoms. We rely on propensity score methods to more squarely assess this relationship net of potential confounding bias and to test for heterogeneity in the consequences associated with having no children who completed college.

Results: Having no children who completed college is negatively associated with parents' self-rated health and positively associated with depressive symptoms. After statistically balancing differences in background characteristics between groups, these associations remain, though the magnitude of the coefficients is attenuated. Supplemental matching analyses suggest that while the association between children's education and self-rated health might be spurious, the association with depressive symptoms is more robust. Additionally, among parents with the highest propensity for having no children who complete college, the consequences on depressive symptoms are greatest.

Discussion: This study pays particular attention to selection-related concerns surrounding the association between offspring educational attainment and parent well-being in the United States. These findings are important given the call for investments in children's educational opportunities as promoting both the well-being of adult children and their parents.

Keywords: *intergenerational health models, propensity score methods, cumulative inequality*

Higher educational attainment has become an increasingly important predictor of socio-economic and health outcomes (Becker, 2009; Mirowsky & Ross, 2015; Stevens, Armstrong & Arum, 2008). Higher levels of education are associated with higher paying and more autonomous jobs (Becker, 2009; Mirowsky & Ross, 2015; Stevens, et al., 2008), stable marriages (McLanahan, 2004), better neighborhoods (Browning & Cagney, 2003), and better access to health care and healthier lifestyles (Mirowsky & Ross, 2015). All of these factors help explain the positive association between education and health.

In the U.S. in particular, family income inequalities in enrollment and completion of higher education and the relatively high returns to a college degree have resulted in growing educational, income, and health inequalities. Net financial returns to higher education are much higher in the U.S. than the OECD average (OECD, 2020). However, access to higher education has become increasingly stratified by family income in the U.S. Bailey and Dynarski (2011) found that college completion rates increased across U.S. cohorts (born 1961-1964 and 1979-1982) by 4 percentage points for low income cohorts but by 18 percentage points for high income cohorts. These growing family income inequalities in completion of higher education, and the consequences for individual health outcomes in the U.S, have been extensively documented in the research literature (e.g., Jackson & Holzman, 2020; Zajacova & Lawrence, 2018).

Although the effects of an individual's educational attainment on their health have been studied extensively, the effects of adult children's educational attainment on parents' health outcomes have received relatively less attention. The life course perspective's attention to linked lives has led to the more recent development of intergenerational models of adult health, including the social foreground perspective (Wolfe, Bauldry, Hardy & Pavalko, 2018; Zimmer, Hanson, & Smith, 2016). In these intergenerational models of adult health, highly

educated children provide more resources, and impose fewer demands, on their parents. This, in turn, is associated with lower mortality risk (Friedman & Mare, 2014; Wolfe et al., 2018b; Zimmer et al., 2016) and better mental health (Yahirun, Sheehan, & Mossakowski, 2020) for parents.

Although the intergenerational health literature makes the important contribution of adding an attention to linked lives to models of adult health, several questions remain unanswered. For instance, is the association between adult children's educational attainment and parent health purely due to selection factors? Indeed, families with higher socio-economic status (SES) are more likely to have children with higher levels of educational attainment and parents with better health outcomes. As a result, it remains unclear from past studies how much of this association between offspring's educational attainment and parent health is attributable to selection factors, particularly in the U.S. In addition, does this association vary depending on a parent's likelihood of having no children attend college?

Our research uses data from the 2015-17 parent study from the National Longitudinal Study of Adolescent to Adult Health (Add Health) to examine the association between children's educational attainment and parent health. We pay particular attention to selection-related concerns by utilizing several propensity score methods as a means to statistically balance differences in background characteristics between parents with and without children who completed college. In doing so, we attempt to more squarely assess how children's educational attainments influence parents' health and well-being, net of confounding bias. After accounting for selection factors, we then investigate whether the association between children's educational attainment and parent health varies depending on the parent's likelihood of having no children complete college. By testing heterogeneous treatment effects (HTE) in the association between children's educational attainment and parent health, we weigh in on scholarly discussions surrounding cumulative inequality and education.

Background

Theories of Intergenerational Influences on Health

It is well-established that parents' educational attainment has an effect on children's SES and consequently their health. According to the long arm of childhood theory (Hayward & Gorman, 2004), parental SES affects the health risks and health behaviors that children are exposed to early in life. These early exposures have implications for offspring's health in mid- and later-life. Similarly, from a cumulative inequalities perspective, early life disadvantage (due to parents' low SES) leads to the accumulation of disadvantages over time in multiple life domains, including health (Ferraro, Shippee, & Schafer, 2009).

What has received less attention is the effect of adult children's educational attainment on their parents' health. A life course perspective emphasizes the interdependence of parent and child trajectories over time and points to the possible links between offspring attainment and parent outcomes (see, e.g., Gilligan, Karraker, & Jasper, 2018). The social foreground perspective predicts that adult children who attain higher levels of education have greater resources which they can use to improve the health and well-being of their parents (Torssander, 2013; Wolfe et al., 2018; Zimmer, et al., 2016). This represents a divergence from human capital models which conceptualize education as a resource benefitting the individual (Becker, 2009). The social foreground perspective also builds on fundamental cause theory (Link & Phelan, 1995) by highlighting how more highly educated individuals have access to more, and better-quality, resources that benefit not only their own health, but also the health of their parents (Zimmer et al., 2016).

Several specific mechanisms have been proposed to link adult children's educational attainment and parent health. First, intergenerational transfers, both from adult children to their parents and from parents to their adult children, are associated with offspring's

educational attainment and parents' health outcomes and may causally link the two. The role played by these transfers, however, depends on the type of transfer (i.e., financial, instrumental, emotional) and the direction (i.e., upward or downward). Overall, most research finds that offspring with lower levels of education provide fewer upward transfers to their parents (McGarry & Schoeni, 1995; Smith-Greenaway, Brauner-Otto, & Axinn, 2018) and are in greater need of assistance from their parents (McGarry & Schoeni, 1995). In general, this pattern of transfers is negatively associated with parent health (Mao, Silverstein, Prindle, & Chi, 2020; Thoits, 2011).

Other explanations for the relationship between offspring educational attainment and parent health point to the role of parental worrying, the stigma associated with poor child outcomes, and also the effect of adult children's efforts to promote a healthy lifestyle for their parents. Adult children with lower levels of education are on average in a more precarious economic situation and therefore may induce greater parental worrying. Worrying leads to reduced sleep and other poor health outcomes (Beck et al., 2001; Seidel et al., 2018). In addition, parents may feel that poor outcomes among their adult children, including lower levels of educational achievement, reflect poorly on their parenting and may be stigmatizing for middle and higher SES parents in particular, negatively impacting parent well-being (Goldman, 2019; Greenfield & Marks, 2006). Finally, more highly educated children may promote healthier lifestyles in their parents both by providing their parents with health-related resources (e.g., healthy foods, access to high-quality medical care) and by modeling healthy behaviors (e.g., not smoking, exercising regularly) (Friedman & Mare, 2014; C. Lee, 2018).

Based on this rich theoretical underpinning for the association between children's educational attainment and parent health, scholars have argued that greater investments should be made in the educational opportunities available to young people as a way of improving their parents' health outcomes (Zimmer et al., 2016). Findings from this literature

have also been used to weigh in on the longstanding generational equity debate (Preston, 1984). More specifically, scholars have concluded that different generations are not in competition for resources, but rather that resources directed to the younger generation can benefit the older generation as well (Friedman & Mare, 2014). The implications for policy and theory that emerge from the intergenerational health literature hinge on the assumption that the association between adult offspring's education and parent health is causal.

Selection and Intergenerational Models of Health

Although it is possible that the association between offspring's educational attainment and parent health is causal, another possibility is that the association between these factors may be due entirely to selection. Parents who are at greatest risk of poor health outcomes are, on average, from lower SES families, less likely to be married, more likely to have pre-existing health problems and risky health behaviors, and less likely to have the cultural capital needed for adeptly navigating educational and medical institutions. These factors predispose an individual to poor health and also increase the likelihood of lower levels of educational attainment among their offspring. Some of the factors, particularly measures of SES, have been controlled for in previous analyses, but the regression and hazard models of observational data that make up the majority of past studies do not attempt to estimate how much of the association between offspring education and parent health is attributable to selection factors (see Yahirun, Sheehan, and Mossakowski [2020] for an exception). By comparing the association between children's educational attainment and parent health in samples that have and have not been matched based on their propensity to have college-educated children, we can estimate the proportion of the association due to selection factors. It is possible that once the characteristics distinguishing those families with some college-educated adult children from those families with no college educated adult children are

accounted for, no statistically significant association between adult children's educational attainment and parent health will remain.

Some studies have accounted for selection factors in their analyses of intergenerational health in contexts outside the U.S., with some finding that at least part of the association between children's education and parent health is causal (De Never & Fink, 2018; Ma, 2019; Torrsander, 2013), and others finding no statistically significant causal relationship overall (Lundborg & Majlesi, 2018). Torssander (2013) analyzed parents' death risk in Sweden using parent sibling fixed effects models. These models account for some selection factors by "holding constant" genetic factors shared among siblings that could account for both their offspring's educational attainment and their own health outcomes. Other studies used an instrumental variable approach with quasi-experimental data to estimate the causal effects of children's schooling on parent health (De Neve & Fink, 2018; Lundborg & Majlesi, 2018; Ma, 2019). These studies capitalized on educational reforms to estimate the causal effects of children's education on parents' health outcomes. They were able to account for the effects of unobserved selection factors associated with both children's educational attainment and parent health outcomes. However, none of these studies examined the causal effects of children's education on parent health in the context of the U.S.

Propensity score models are particularly appropriate methods for dealing with selection issues in the U.S. where there have not been recent broad scale educational reforms which would create a natural experiment of the sort analyzed in other countries (De Neve & Fink, 2018; Lundborg & Majlesi, 2018; Ma, 2019). Moreover, compared with other methods geared towards addressing potential confounding bias (e.g., instrumental variable models; fixed effects regression), propensity score models also allow us to estimate how much of the overall association between children's educational attainment and parent health is in fact due to observable selection factors. Additionally, if we do find that the effect of offspring

educational attainment on parents' health is robust even after accounting for observable background characteristics, we can test the role of hidden (i.e., unobservable) bias (Rosenbaum, 2002). Indeed, other studies have used propensity score models in the analysis of an individual's own educational attainment and their health outcomes (Greenfield, Akincigil, and Moorman 2020); however, we are not aware of any study that has used propensity score models to investigate selection issues in intergenerational models of health in the U.S. Most U.S. studies include potential confounding variables as controls, but we argue that our analysis makes a unique contribution by including a wider range of confounding variables, including measures of parent health before children complete their schooling, and by estimating how much of the relationship between children's education and parent health is explained by confounding factors.

Cumulative Inequality and Parent Health

Once selection factors are addressed in analyzing the association between children's educational attainment and parent health, the question of variation in the magnitude (and even the direction) of the association arises. Life course scholars have examined adult health disparities and connected them to family socio-economic disadvantage, with those from lower SES families falling further behind those from higher SES families over time (Ross & Wu, 1996; Shuey & Willson, 2008). Cumulative Disadvantage theory predicts that individuals starting off with fewer socio-economic resources will be exposed to more adversities and greater risks than those starting off in a relatively more advantaged position (Dannefer, 2003). An implication of this accumulation of disadvantage is that health disparities between lower and higher SES individuals will grow with age. Ferraro et al. (2009) further elaborate that the disadvantages associated with lower SES are transmitted intergenerationally. Although much of the focus of previous research has been on the downward transmission of disadvantage, our focus is on how children's attainments can also

put their parents at greater risk of poor health outcomes. The stratification multilevel method (Brand, Xie, & Jann, 2012) allows us to analyze how the association between children's educational attainment and parent health varies based on the parent's likelihood of having no children complete college. Using this method, we can weigh in on how children's educational attainment may have disparate consequences for parent health depending on the parent's socio-economic background (i.e., their propensity to have no children complete college).

Data

Data for this study come from the Add Health Parent Study (AHPS). Beginning in 1994-95 (Wave I), Add Health collected data on over 20,000 adolescents in grades 7-12, as well as data from their parents, peers, and school administrators. Respondents have been re-interviewed four times since then, with the most recent round of interviews occurring in 2016-18, when approximately 12,000 respondents ages 33-43 were re-interviewed. Central to the present study, Add Health also re-interviewed a probability sample of 2,013 Wave I parents in 2015-17 when they were ages 50-80 and gathered information about their current health, financial status, children's educational outcomes, among many other topics. Parents were eligible for this study if (1) they were not deceased or incarcerated at the time of the sampling and (2) they were the biological parent, adoptive parent, or stepparent of a Wave I Add Health respondent who was not deceased at the time of the sampling (Eischen et al., 2019).

The weighted AHPS sample is a probability sample of parents of a nationally representative sample of adolescents in 1995. Preliminary comparisons with other nationally representative datasets indicate that the AHPS sample is comparable to the 2014 Health and Retirement Study and the 2014 National Health and Nutrition Examination Survey samples, but is slightly more socio-economically advantaged and healthier (Oi et al., 2018). A majority

of the respondents in the parent sample are women because Add Health targeted the female head of the household for the Wave I parent survey based on evidence that mothers are more familiar with children's activities and characteristics (Harris & Hotz, 2020). Our study uses data from 1,681 of these parent respondents who have no missing data and who have valid sample weights.

Health-related outcomes (2015-17 follow-up)

Most studies of the association between children's education and parent health have used parent mortality as the measure of health (Friedman & Mare, 2014; Torssander, 2013; Wolfe et al., 2018; Wolfe et al., 2018b; Zimmer et al., 2016). We selected self-rated health and depressive symptoms as the measures of parent health in our analysis to broaden the measures of parent health investigated in the intergenerational health literature. Self-rated measures of health have been established as valid indicators of objective health status (Maddox & Douglass, 1973) and depressive symptoms are a common measure of mental health (see Yahirun, Sheehan, and Mossakowski [2020] as an example of one study in the intergenerational health literature that uses depressive symptoms as the outcome). *Self-rated health* is a continuous measure based on whether respondents believe their health is (1) poor, (2) fair, (3) good, (4) very good, or (5) excellent. The indicators used to measure *depressive symptoms* are a subset of the CES-D scale (Radloff, 1977) indicating how often (ranging from (1) never or rarely to (4) most or all of the time) during the past seven days respondents reported they could not shake off the blues; felt depressed; were happy (reverse coded); felt sad; and felt life was not worth living. We sum the responses to these questions to create a measure for depressive symptoms, where higher values reflect more depressive symptoms (Cronbach's $\alpha = 0.794$). Previous research has demonstrated such abbreviated versions of the CES-D scale to be accurate assessments of depressive symptoms among older adults

compared to the full scale (Andersen, Malmgren, Carter & Patrick, 1994). By using self-rated health and depressive symptoms as our outcome measures of parent health, we are able to estimate the effects of children's education on parent health at younger parental ages than studies of parent mortality.

Children's educational attainment (2015-17 follow-up)

During the most recent round of parent interviews, parents were asked about the educational attainments of all of their children. Following the justification raised by Yahirun, Vasireddy, and Hayward (2020) that there is recent research evidence of the growing importance of a college degree for health outcomes in the U.S., we focus on the distinction between completing a college degree and lower levels of education. We measure children's educational attainments as a dichotomous variable indicating that none of the respondent's children had completed college (*no children completed college*), with parents with a least one child who completed college in the reference category.

Background controls (Wave I unless noted otherwise)

Demographic, family, social-psychological, health, and community characteristics that are associated both with the likelihood of the respondents' children graduating from college and with parent health are included in the analysis. Demographic controls for parent respondents include a measure indicating that the respondent is *female*, as well as the respondent's *age* (in years). Race and ethnicity are operationalized via five mutually-exclusive measures, including being: non-Hispanic *white*; of *Hispanic* origin; non-Hispanic *black*; non-Hispanic *Asian*; and non-Hispanic *other* racial group. Socioeconomic controls include a measure for the parent respondent's *educational attainment* (in years). We also control for whether

parents reported receiving welfare (*welfare receipt*), being *unemployed*, or having trouble paying bills (*bill problems*).

Parents' familial characteristics have important consequences for their children's educational attainment (McLanahan & Percheski, 2008) and their own health (Umberson & Thomeer, 2020). We include three mutually-exclusive measures indicating that the parent is *single*, *married*, or *widowed/divorced/separated*. The number of past marriage-like relationships is assessed via three mutually-exclusive measures indicating that the respondent had *no past marriage-like relationship*, only *one past marriage-like relationship*, or *more than one past marriage-like relationship*. We also control for the gender composition of their children: whether the respondent has *no girls*, *some girls*, or *all girls*.

We include a range of past social-psychological and health-related measures for the parent respondents, including whether they reported ever having five or more drinks on one occasion during the past month (*binge drink*). We also control for whether respondents *smoke*. Several dichotomous measures indicating different health problems are included, such as *obesity*, *migraine headaches*, *allergies*, *asthma* or emphysema, *alcoholism*, *diabetes* and being *disabled*. A control for past *self-rated health* is also included and operationalized in a similar manner as our outcome measure. Additionally, two binary measures indicating that the respondent had been diagnosed with *depression* at some point prior to the Wave I interview and that they are generally *unhappy* are included. By including measures of self-rated health and depression diagnosis at Wave I, we are able to predict self-rated health and depressive symptoms at the most recent wave, net of past self-rated health and depression.

Parent expectations for their children and their engagement in their child's school have implications for children's educational achievement (Gonzalez-Pienda et al., 2002) and potentially for the parents' health, given the importance of future expectations (Hitlin & Johnson, 2015) and productive engagement (Kail & Carr, 2017) for adult health. A

dichotomous measure indicating whether parents were a *member of a parent/teacher organization* is included as well as three dichotomous measures assessing parents' level of disappointment if their child does not graduate from college. Parents are classified as either *not disappointed*, *somewhat disappointed*, or *very disappointed*.[1]

Neighborhood quality impacts both children's educational attainment (Alexander, Entwisle, & Olson, 2014) and adult health outcomes (Weden, Carpiano, & Robert, 2008). We include two binary measures for whether there is a *trash problem* or a *drug problem* in the neighborhood, as well as dichotomous measures indicating that the respondent would *like to move away from their neighborhood* and that they *chose their neighborhood for the schools.* *Urban* is a binary measure indicating that respondents lived in an urban residence. *Neighborhood disadvantage* is based on the average of four census tract measures indicating the percentage of: adults unemployed; households receiving public assistance; families below the poverty line; and households headed by a single mother (Cronbach's $\alpha = 0.896$).

Analytic strategy

We rely on propensity score methods as a means to address selection-related concerns surrounding the association between children's educational attainments and parent health (Guo & Fraser, 2015). Propensity score methods attempt to mitigate observable differences in background characteristics between treated and controlled respondents – in this case, parents with no children who completed college (the treatment group) and parents with at least one child who completed college (the control group). To do so, we first regress the treatment variable on the set of background controls via logistic regression and retain the predicted

[1] This measure pertains solely to the Add Health respondent. Thus, while in some cases it is not possible to explicitly measure parents' educational expectations for all of their children, this measure gives at least some indication about parent's outlook for their offspring.

probabilities (or propensity scores)[2]. The predicted probabilities can range from 0 to 1 and represent one's propensity for having no children who completed college. After restricting our sample to respondents who fall within the region of common support – that is, the range of propensity scores where treated and controlled respondents overlap – we utilize kernel matching (kernel: Gaussian; bandwidth: 0.06) to estimate our primary matched sample. This kernel matching algorithm matches each treated respondent with each controlled respondent, and weights are assigned to controlled respondents depending on how close their propensity score is to the treated respondent (for more detail about the propensity score matching method, please see Appendix A). Although the role of selection could also be examined with a multivariable regression model that includes controls for observable confounders, propensity score methods accomplish this goal while also increasing our confidence that controlled respondents actually resemble those in the treatment group in terms of their observable background characteristics.

After matching, we assess balance in the background controls by calculating the standardized differences for each respective variable between treated and controlled respondents. A conventional threshold for balance is a standardized difference below |.20| (Porter & Vogel, 2014), while a more sensitive threshold of |.10| is also recommended (Austin, 2009). After ensuring that balance is achieved, we then separately regress our measures of self-rated health and depressive symptoms on our indicator that no children completed college in our propensity-weighted sample to examine these associations net of differences in background characteristics between groups. In these models, we also include a control for self-rated health and depression diagnosis at Wave I, respectively, so as to partially control for stable differences in these health-related measures.

[2] We considered a range of approaches for estimating our propensity scores, including using higher order terms as well as incorporating a range of interaction terms. Regardless of our propensity score specification approach, we found our results to be consistent with those presented here.

We also consider whether the overall pattern of results varies by one's propensity to have no children who completed college. This is accomplished by utilizing the stratification multilevel method developed by Brand, Xie, and Jann (2012), which is an extension of propensity score methods geared towards assessing treatment effect heterogeneity. Respondents are first sorted into balanced strata based on their propensity score. In our data, four balanced strata were estimated so that we could ensure there were a sufficient number of respondents within each group. Stratum 1 – that is, those with the lowest propensity for the treatment (i.e., having no children who completed college) – includes respondents whose propensity score falls between .04 and .20. The propensity for the treatment increases across the stratum rank, as propensity scores in each stratum range from: .20-.40 (stratum 2); .40-.60 (stratum 3); and .60-.92 (stratum 4). Thus, those in stratum 4 have the greatest propensity for having no children who completed college. Within each stratum, the treatment effect is estimated, and these coefficients represent the level-1 estimates. To test for HTE across the strata, we then use a variance-weighted least squares regression to regress the level-1 estimates on the stratum rank, thus yielding a linear estimate of how the magnitude of the treatment effect changes across strata.

Results

Table 1 reports the means, proportions, and standardized differences of all variables for treated and controlled respondents in both the unmatched and matched samples. In the unmatched sample, there are several notable differences between treated and controlled respondents, as evident by the large standardized differences in covariates. For instance, parents with no children who completed college (i.e., the treatment group) report, on average, fewer years of schooling compared to the control group. Those in the treatment group were also more likely to receive welfare, be unemployed, and experience bill problems compared

to parents with children who attained a college degree. They were also more likely to report lower self-rated health and being a smoker. In the matched sample, however, the differences in background characteristics between treated and controlled respondents are noticeably attenuated, and all standardized differences fall below |.10|.

[Table 1 about here]

With the differences in background characteristics statistically balanced in the matched sample, we examine the associations between having no children who completed college and subsequent self-rated health and depressive symptoms. Table 2 reports the coefficients from Ordinary Least Squares (OLS) regression models using both the unmatched and matched samples. In the unmatched sample, having no children who completed college is associated with a .270 decrease in self-rated health ($p < .001$). In the matched sample, having no children who completed college remains negatively associated with self-rated health (i.e., -.136; $p < .05$); however, the coefficient is reduced in magnitude by approximately 49% [(-.270-.136)/-.270]. Similarly, having no children who completed college is associated with a .758 increase in depressive symptoms in the unmatched sample ($p < .001$). Furthermore, this association remains in the matched sample, although the coefficient is reduced by roughly 41% (.447; $p < .05$). To further aid interpretation, Figure 1 displays the predicted self-rated health and depressive symptoms scores for each group from both the unmatched and matched samples.

As previously described, one advantage of kernel matching is the ability to retain the entire sample of results, thus increasing the generalizability of the findings. At the same time, including all respondents in the matched sample also potentially means that poorer matches are included in the analysis. With this in mind, we replicated our analyses using several different matching algorithms. Details about these analyses can be found in Appendix A; here, we briefly summarize the overall pattern of results from these additional analyses.

When using alternative matching methods, the effect of having no children who completed college on self-rated health is attenuated to marginal significance (and in some instances, non-significance). Thus, this association is potentially spurious. In the case of depressive symptoms, the association is more robust across alternative matching algorithms.

[Table 2 about here]

[Figure 1 about here]

We next turn to examine the heterogeneous effects of having no children who completed college on parent health. Table 3 presents the level-1 and level-2 estimates for having no children who completed college on parents' self-rated health and depressive symptoms. Recall that the level-1 estimates represent the treatment effect within each stratum, while level-2 – the test for heterogeneous effects – represents the change in treatment effects as stratum rank increases (i.e., as the propensity to have no children complete college increases).

[Table 3 about here]

Beginning with self-rated health, all of the estimates within each stratum are in the expected direction; however, they do not approach statistical significance. Moreover, the level-2 slope for self-rated health is also not significant, thus suggesting that the effect of having no children who completed college on self-rated health does not vary by one's propensity. As for depressive symptoms, a statistically significant estimate is observed in stratum 4, which suggests that having no children who completed college is associated with a .804 increase in depressive symptoms among those with the highest propensity for the treatment. Perhaps most notable, however, is the significant level-2 estimate, which suggests that a unit-increase in stratum rank is associated with a .278 increase in the effect of having no children who completed college on parents' depressive symptoms. As a means to further contextualize these heterogeneous effects, Figure 2 displays both the individual stratum

estimates as well as the level-2 slope for depressive symptoms. The figure shows that as propensity score stratum rank increases, so too does the magnitude of the treatment effect. Stated differently, the positive association between having no children who completed college and parents' depressive symptoms appears to be strongest among those with the greatest propensity for having children with no college degrees.

[Figure 2 about here]

Conclusion and Discussion

Growing educational and income disparities in the U.S. have sparked increased concern regarding the consequences of growing inequalities for other life domains, especially health (Jackson & Holzman, 2020). Intergenerational models of adult health draw attention to the implications of growing educational and income inequalities for the health of individuals and their parents. This attention to offspring's influence on parent health is consistent with the life course perspective's attention to linked lives and the interdependence of parent and child life trajectories (see, e.g., Gilligan, et al., 2018). However, past research on the effects of children's educational attainment on parent health in the U.S. has not been able to address the question of thow much of this association is due to confounding selection factors. In this paper we ask: can we explain the entire association between adult children's educational attainment and parent health by background characteristics that are associated with both offspring educational attainment and parent health? Secondly, to what extent does this association vary by one's propensity to have no college-educated children?

We use propensity score methods to address the extent to which the association between children's educational attainment and parent health is spurious and due to background characteristics that predict both offspring's educational attainment and parent health. In our kernel-based matched sample (i.e., our most generalizable sample), we find that the association remains statistically significant but is reduced in magnitude by 41% (for

parents' depressive symptoms) to 49% (for parents' self-rated health). Yet, when using alternative matching algorithms, we find that the effect of children's educational attainment on parent's self-rated health is reduced to marginal significance at best. The relationship between children's education and parent's reports of depressive symptoms, however, was more robust across matching algorithms. Indeed, this is among the first studies we know of to use propensity score methods to evaluate the role played by selection factors in the association between offspring educational attainment and parent health in the U.S. As such, our goal was to provide a comprehensive assessment of the role that observable confounders play in these relationships. Our analysis makes a contribution to the intergenerational health literature by (1) adding a wider range of potential confounders than previous studies, (2) estimating how much of the association is explained by selection factors, and (3) including measures of parent depression and self-rated health before offspring completed their education.

To further analyze potential HTE, we use the stratification multilevel method to investigate to what extent the association between children's educational attainment and parent health varies depending on the parent's propensity to have no college educated children. Although we did not find significant variation across propensity levels in the association between having no children complete college and self-rated health, we did find that the positive association with parent's depressive symptoms was strongest among those with the greatest propensity for having no children complete college (i.e., the most disadvantaged parents in the sample). This supports cumulative disadvantage and cumulative inequality accounts of the accumulation of disadvantage with age (see, eg, Dannefer, 2003; Ferraro et al., 2009). This also provides evidence to support the upward intergenerational transmission of disadvantage as a mechanism contributing to the accumulation of disadvantage and widening health disparities with age.

These results lend qualified support to policies proposed in the literature that would increase educational opportunities as a means of improving health outcomes in older generations (Zimmer et al., 2016), particularly if the policy is targeting adult mental health outcomes. The results also support Friedman and Mare's (2014) contention that concerns over generational equity are largely misplaced. Despite long-standing claims that the interests of different generations are at odds (Preston, 1984), this research shows that different generations are in fact interdependent. Indeed, investments in educational opportunities have the potential to not only increase the individual's SES and health, but also the mental health of their parents and particularly the mental health of low SES parents.

Although our research contributes an analysis of how much of the association between children's education and parent health in the U.S. is attributable to selection factors, it is not without limitations. First, propensity score models account for observed sources of heterogeneity in the population. This means that omitted variables could bias the results. Second, this analysis only analyzes the extent to which selection factors can account for the association between offspring education and parent health. It does not analyze the possible pathways linking these variables, but we think this is an important direction for future research.

In sum, our research weighs in on a persistent concern in the intergenerational health literature: to what extent is the association between offspring education and parent health spurious and to what extent does it vary by propensity to have no college-educated children? Our propensity score model results for parents' self-rated health do not rule out the possibility that the association is spurious, once background selection factors are accounted for. However, a statistically significant association between children's education and parents' depressive symptoms persists even after background selection factors are accounted for. Parents report better mental health when at least one of their children completed college.

Moreover, parents with the greatest propensity to have no college-educated children experienced the strongest association between children's low level of educational attainment and depressive symptoms (but not self-rated health). Our research adds to the growing literature identifying the advantages of a college degree including individual economic mobility (Becker, 2009), marital outcomes (McLanahan, 2004), health (Ross & Wu, 1996), and well-being (Bauldry, 2015). The results lend support to a call for public investments in educational opportunities as a means of not only improving the socio-economic and health outcomes of one generation, but also the mental health outcomes of their parents and low-SES parents in particular.

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Table 1. Weighted Bivariate Statistics and Standardized Differences between Respondents with and without Children who Completed College

Table 2. OLS Regression Estimates of Not Having Children who Completed College

Table 3. Heterogeneous Treatment Effects of Having No Children Who Completed College on Parents' Self-Rated Health and Depressive Symptoms

Figure 1. Predicted Self-rated Health and Depressive Symptoms Scores by Children's Educational Attainment

Figure 2. Heterogeneous Treatment Effects of Having no Children who Completed College on Depressive Symptoms

Table 1. Weighted Bivariate Statistics and Standardized Differences between Respondents with and without Children who Completed College

		Unmatched Sample			Matched Sample		
Variable		**No Children Completed College**	**Some Children Completed College**	**|Std. Diff.|**	**No Children Completed College**	**Some Children Completed College**	**|Std. Diff.|**
Demographic Characteristics							
	Female	0.964	0.965	0.003	0.966	0.968	0.013
	Age	39.852	42.041	0.386	39.947	40.160	0.038
	White	0.671	0.778	0.241	0.682	0.678	0.009
	Hispanic	0.133	0.096	0.119	0.135	0.144	0.027
	Black	0.165	0.094	0.212	0.153	0.140	0.037
	Asian	0.012	0.023	0.088	0.012	0.011	0.006
	Other	0.019	0.010	0.082	0.018	0.026	0.058

Socioeconomic Background						
Educational Attainment (Years)	12.609	14.779	0.837	12.687	12.787	0.042
Welfare Receipt	0.133	0.044	0.318	0.113	0.104	0.027
Unemployed	0.099	0.033	0.270	0.083	0.082	0.004
Bill Problems	0.216	0.130	0.229	0.206	0.226	0.049
Familial Characteristics						
Single	0.085	0.024	0.272	0.072	0.070	0.008
Married	0.669	0.783	0.258	0.681	0.696	0.033
Widowed/Divorced/Separated	0.246	0.193	0.128	0.247	0.234	0.031
No girls	0.216	0.156	0.155	0.210	0.178	0.082
Some Girls	0.635	0.670	0.072	0.637	0.658	0.043
All Girls	0.149	0.174	0.070	0.153	0.164	0.032
No past relationships	0.043	0.024	0.103	0.041	0.032	0.047
One past Relationship	0.630	0.755	0.274	0.639	0.664	0.051
More than one past Relationship	0.328	0.221	0.241	0.320	0.304	0.034
Social-Psychological and Health-Related Measures						

Binge Drink	0.160	0.116	0.129	0.154	0.171	0.046
Smoke	0.413	0.187	0.508	0.403	0.393	0.021
Obesity	0.186	0.186	0.001	0.190	0.200	0.026
Migraine Headaches	0.300	0.236	0.146	0.291	0.292	0.002
Asthma	0.117	0.069	0.163	0.106	0.111	0.015
Alcoholism	0.041	0.014	0.164	0.033	0.037	0.019
Diabetes	0.037	0.030	0.043	0.036	0.034	0.010
Disabled	0.053	0.039	0.068	0.053	0.055	0.005
Self-Rated Health	3.427	3.829	0.406	3.431	3.450	0.019
Depression	0.133	0.088	0.145	0.129	0.131	0.006
Unhappy	0.042	0.025	0.095	0.039	0.041	0.013
Community Characteristics and Involvement						
Member of a Parent/Teacher Organization	0.192	0.442	0.559	0.197	0.207	0.025
Chose their Neighborhood for the Schools	0.426	0.550	0.250	0.430	0.437	0.015
Trash Problem	0.544	0.432	0.226	0.540	0.545	0.009

Drug Problem	0.475	0.332	0.295	0.476	0.469	0.014
Like to move away from their neighborhood	0.516	0.411	0.212	0.509	0.494	0.031
Urban	0.564	0.539	0.051	0.559	0.546	0.027
Neighborhood Disadvantage	10.452	7.014	0.519	10.131	9.870	0.036
Disappointment Regarding Child's Education						
Not Disappointed	0.234	0.102	0.358	0.227	0.199	0.068
Somewhat Disappointed	0.418	0.417	0.002	0.426	0.439	0.027
Very Disappointed	0.349	0.481	0.272	0.348	0.363	0.031
Sample Size	647	1,034		629	961	

Note: Matched sample excludes 18 treated respondents and 73 controlled respondents who fall out of the region of common support. Matched sample generated via kernel matching (kernel: Gaussian; bandwidth: .06).

Table 2. OLS Regression Estimates of Not Having Children who Completed College

	Unmatched				Matched			
Outcome	*b*	SE	*T-value*		*b*	SE	*T-value*	
Self-Rated Health	-0.270	0.060	-4.468	***	-0.136	0.069	-1.981	*
Depressive Symptoms	0.758	0.152	4.983	***	0.447	0.193	2.317	*

Sample Size: 1,590 (629 Treated; 961 Controlled)

Note: SE = standard error. Models predicting self-rated health and depressive symptoms include control for self-rated health and depression diagnosis at Wave I, respectively. All models include the Add Health sample weights. Matched sample generated via kernel matching (kernel = Gaussian; bandwidth = .06). Coefficients in the matched sample represents the average treatment effect on the treated (ATT). Bootstrapped standard errors were estimated for the matched sample across 1,000 replications.

* $p < .05$, ** $p < .01$, *** $p < .001$ (two-tailed tests)

Table 3. Heterogeneous Treatment Effects of Having No Children Who Completed College on Parents' Self-Rated Health and Depressive Symptoms

	Self-Rated Health		Depressive Symptoms		
Propensity Score Strata (Level-1)	*b*	SE	*b*		SE
Stratum 1: (40 treated; 360 Controlled)					
Propensity Score: (.04 - .2)	-0.244	0.155	-0.043		0.248
Stratum 2: (136 treated; 310 Controlled)					
Propensity Score: (.2-.4)	-0.042	0.124	0.099		0.240
Stratum 3: (197 treated; 192 Controlled)					
Propensity Score: (.4-.6)	-0.210	0.110	0.435		0.297
Stratum 4: (256 treated; 99 Controlled)					
Propensity Score: (.6-.92)	-0.173	0.116	0.804	*	0.348
Level-2 Slope					
Stratum	-0.007	0.059	0.278	*	0.131

Note: SE = standard error. Models predicting self-rated health and depressive symptoms include control for self-rated health and depression diagnosis at Wave I, respectively.

* $p < .05$, (two-tailed tests)

Figure 1. Predicted Self-rated Health and Depressive Symptoms Scores by Children's Educational Attainment

Figure 2. Heterogeneous Treatment Effects of Having no Children who Completed College on Depressive Symptoms

Figure 1

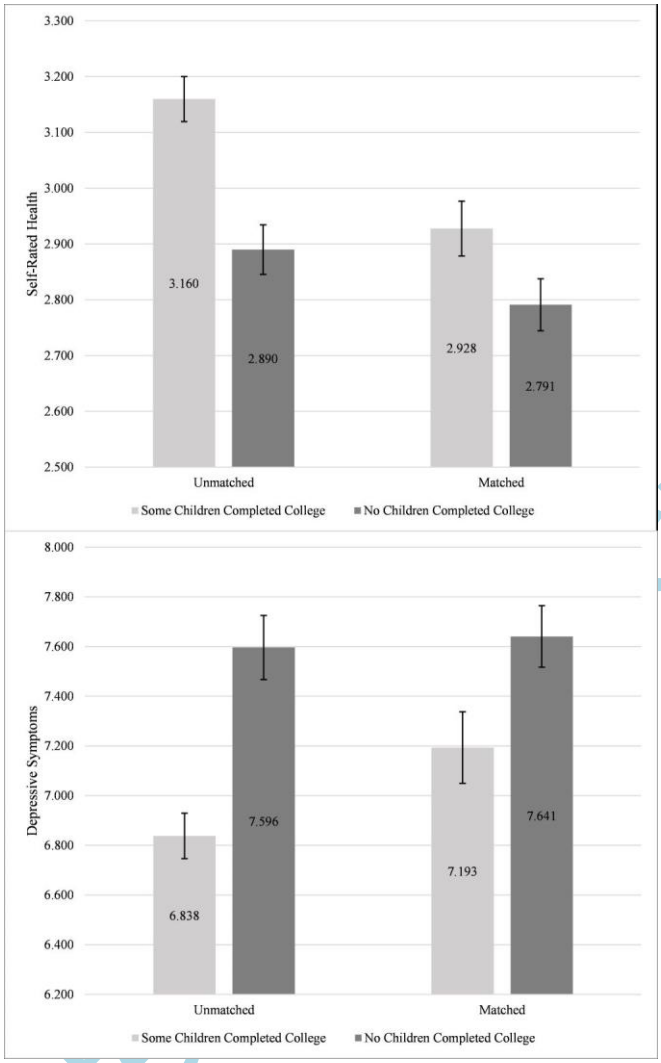

Figure 2