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Mental and physical health impairments at the transition to college: Early patterns in the education-health gradient

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Abstract

Part of the education-health gradient may be related to inequalities in the transition from high school to college by health impairment status. In this paper, we use the National Longitudinal Survey of Youth 1997 to investigate the link between health impairments beginning prior to high school completion and college-going, distinguishing between individuals with mental, physical, or multiple health impairments and between enrollment in 2-year and 4-year postsecondary institutions. We find that individuals with mental impairments or multiple impairments are less likely to initially enroll in 4-year postsecondary institutions than individuals without health impairments, controlling on background and high school preparation. We also find evidence that advanced math course-taking in high school, an important step on the pathway to a 4-year college for all students, does not provide students with mental impairments the same return as students without health impairments. We discuss implications for policy to address educational inequalities in health.

Going to college is a key step along the pathway to a healthy life (Mirowsky and Ross, 2015; Link and Phelan, 1995; Montez et al., 2012; Rogers et al., 2010; Schieman and Koltai, 2017). In part, the gap in health by education represents a reproduction of health inequalities that begin well before entry into higher education (Lynch and von Hippel, 2016; Alvarez-Galvez, 2016). Research has found that students who report better health and health behaviors in adolescence are more likely to transition to a postsecondary institution after high school (Haas and Fosse, 2008; Jackson, 2009; Bauldry et al., 2016). But what role do different kinds of health impairments play in this health selection?[1] Individuals with health impairments are federally protected from discrimination in education, yet they have lower levels of educational attainment than individuals without health impairments, which lead to gaps in health, civic, and labor force outcomes later in life (Brault, 2012; Janus, 2009; Shandra, 2017; Fleming and Fairweather, 2012). Students with health impairments may be disadvantaged in making the transition from high school to college, contributing to health selection into higher education.

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[1]The Americans with Disabilities Act (ADA) defines a disability as “a physical or mental impairment that substantially limits one or more major life activities.” Both “disability” and “health impairment” are used in the literature (Wells et al., 2003). We use “health impairment” because it is consistent with both the ADA definition and the NLSY97 questionnaire.

In this study, we analyze whether students with health impairments enroll in postsecondary institutions at rates similar to students without health impairments and consider three elements of the transition. First, we distinguish between individuals with physical, mental, or multiple health impairments (both mental and physical impairments) because students with health impairments are a heterogeneous group with diverse symptoms and needs that may be associated with postsecondary enrollment. Second, we consider the level of postsecondary institution students initially enroll in because students who start out at 4-year postsecondary institutions are better positioned to earn a bachelor's degree than those who begin at 2-year schools. Lastly, we examine the role of students' academic preparation in high school, including their high school grades and course-taking, because inequalities in academic preparation may account for differences in postsecondary enrollment between students with and without health impairments.

Our aim is to understand if students with certain kinds of health impairments are disadvantaged during the transition to post-secondary institutions and if high school preparation explains this disadvantage. The National Longitudinal Study of Youth 1997 (NLSY97) uniquely makes this analysis possible for a nationally representative sample because of its combination of detailed education and health data. NLSY97 is one of the few national surveys that asks respondents to report on multiple types of health impairments, which allows us to capture individuals who have both mental and physical impairments, and measures cognitive abilities, high school preparation, and the type of first postsecondary enrollment. Examining the differences in initial postsecondary enrollment by health impairment type informs research by isolating the role of health selection into higher education, giving us a better understanding of why educational attainment predicts mental and physical health outcomes. We additionally examine the mediating role of taking advanced courses in high school because access to these courses may serve as a policy lever to assist students with health impairments to successfully transition to college.

1. The transition to college

A crucial juncture in the pathway to a college degree is the transition from high school to college, when access to schooling becomes more expensive and competitive. There are a number of factors that shape students' postsecondary plans, including admissions standards, family resources, academic preparation, living arrangements, cost, and academic environments. Although those who initially enroll in 4-year colleges are best positioned to persist to a second year and eventually graduate with a bachelor's degree, 2-year postsecondary institutions may be easier to transition to for students with financial, academic, or certain health-related limitations. Two-year schools can provide avenues to bachelor's degrees; however, students who start at community colleges are more likely to earn only a subbaccalaureate degree, such as an associate's degree or a certificate, or to leave without any credentials (Kane and Rouse, 1995; Brint and Karabel, 1989). Any education beyond high school can improve health outcomes, but risk of mortality, physical functioning and health status all improve with each additional year of postsecondary education (Montez et al., 2012; Ross and Mirowsky, 1999). Where one starts their postsecondary education has important implications for future educational, labor market,

civic and health outcomes, and students with health impairments may be disadvantaged in their initial entry into college.

Some research has found that students with health impairments have lower rates of any college enrollment than students without health impairments (Sanford et al., 2011; Shandra and Hogan, 2009; Fairweather and Shaver, 1990). However, knowledge gaps in this area of research remain. Estimates using the National Longitudinal Transition Study (NLTS2), a sample that only includes students who received special education services in high school, show that students with health impairments attend 4-year post-secondary institutions at lower rates and 2-year postsecondary institutions at higher rates when compared to aggregate statistics from the general population of high school graduates (Sanford et al., 2011). However, it is important to recognize that special education placement is determined by more than just having a health impairment; socioeconomic status, race/ethnicity, gender and school characteristics all impact special education placement for students who do and do not have health impairments (Morgan et al., 2015; Sullivan and Bal, 2013; Skiba et al., 2016). Therefore, the NLTS2 population is not representative of students with health impairments. In fact, the proportion of high school graduates in special education programs in 2009 is half the proportion that reported health impairments in NLSY97 (9% vs. 18%) (Nord et al., 2011).

Using the NLSY97, Shandra and Hogan (2009) found that young adults with health impairments are less likely to enroll in any college than those without health impairments. However, the scope of their study did not include the structural features of the transition related to whether students enroll in a 2-year or 4-year college. Additionally, the analyses do not account for differences between students with mental or physical impairments and the existence of multiple impairments. This study builds upon prior research by examining the factors that contribute to inequality in 2-year and 4-year postsecondary enrollment for individuals with different kinds of (and multiple) health impairments.

1.1. Types of health impairments and college enrollment

Students with health impairments have diverse experiences in educational institutions related to the type of health impairment. For example, among students who participated in special education programs in high school, rates of attendance at any post-secondary institution range from 31.3% for students with multiple health impairments to 70.8% for students with visual impairments (Sanford et al., 2011). When disaggregated by institution type, only 8% of students with multiple impairments attend 4-year post-secondary institutions, compared with 42.7% of students with visual impairments (Sanford et al., 2011). Treating individuals with health impairments as one group masks the heterogeneity of experiences within educational institutions, and possibly obfuscates important inequalities associated with different kinds of health impairments.

Scholars categorize health impairments as “apparent” and “non-apparent,” “visible” and “invisible,” and “non-cognitive” and “cognitive” to separate the diverse experiences of physical versus mental impairments (e.g. Adams and Proctor, 2010; Fuller et al., 2009; Olney and Brockelman, 2003). Physical impairments include sensory, orthopedic and other non-cognitive impairments. Students with these impairments may face physical barriers to

their education, such as access to learning materials and instructional strategies designed for students without physical limitations, which may shape both their preparation for and expectations of going to college (Fuller et al., 2009; Adams et al., 2014). Physical impairments often emerge during childhood and symptoms are generally stable, thus students with these limitations may have knowledge of the learning strategies and accommodations they require to be successful in high school and beyond (Fuller et al., 2009). In making college decisions, students with physical impairments may choose a school based on its disability-related resources, including accessible classrooms, learning materials for the visually or hearing impaired, and other accommodations. Generally, these resources are more readily available at 4-year than 2-year post-secondary institutions (Brinckerhoff et al., 2002). We expect that there will be differences in 2-year and 4-year college enrollment between individuals without health impairments and those with physical impairments.

Mental impairments include learning disabilities, depression and emotional disorders, and other cognitive impairments (Brinckerhoff et al., 2002; Olney and Brockelman, 2003). The barriers to education for individuals with mental impairments are different than for those with physical impairments. Students may need more time to process concepts and complete assignments, and, in the case of learning disabilities, may require visual aids, written materials, extra instruction or alternative assessments to be successful in high school and college (Fuller et al., 2009). Understanding what educational accommodations these students require is challenging because symptoms of mental impairments manifest in a more individualistic way and may be less stable across the life course than physical impairments (Fuller et al., 2009). Postsecondary plans for students with mental impairments may be shaped by the need for flexibility in schedules and a more relaxed academic environment, which is more common at 2-year than 4-year schools (Fuller et al., 2009; Brinckerhoff et al., 2002). However, transferring from a 2-year to 4-year school is another hurdle on the pathway to completing a bachelor's degree.

Additionally, students with mental impairments may face attitudinal barriers to continuing their education from high school counselors, teachers, parents and peers who perceive they lack the intellectual capacity to succeed in higher education (Shandra and Hogan, 2009; Shifrer, 2013). Many students with mental impairments, including learning disabilities, have the cognitive abilities to succeed in school (Grunau et al., 2002). Some simply need material to be presented to them and assessments to be administered and evaluated in ways that are appropriate for their needs. We consider students' cognitive abilities to compare otherwise similar students with mental, physical, or no health impairments. We expect that there will be differences in 2-year and 4-year college enrollment between individuals with mental impairments and both individuals without health impairments and individuals with physical impairments.

Not only is understanding variation in the type of impairment necessary for unpacking the relationship between education and health, individuals with multiple kinds of health impairments may be doubly disadvantaged in their participation in higher education, with the negative effects of both physical and mental impairments weighing them down. Other nationally-representative surveys that track students' pathways from high school to college and include questions about health impairments only give respondents the option of

reporting one impairment, the one that impacts them the most. A major strength of NLSY97 for studying health impairments is that respondents report on both mental and physical impairments. Individuals with physical impairments are particularly susceptible to developing mental impairments during adolescence and the transition to adulthood (Kessler et al., 2005), which changes their educational needs during an important time for college preparation. We consider 2-year and 4-year post-secondary participation for individuals who reported both physical and mental impairments and expect that these students will be the most disadvantaged on the pathway from high school to higher education.

One of the strengths of this study is being able to locate the emergence of health impairments before high school graduation to make stronger claims about the role of health selection into higher education. Many studies on students with health impairments in college only consider if the health impairment was present in college. This definition of the study population is problematic in two ways. First, there is evidence that students who had health impairments earlier in life do not report them later, possibly to avoid stigma associated with their impairments (Thoits, 2016). In fact, over half of students who were in special education programs in high school do not report having a health impairment two years after graduation (Wagner et al., 2005). Although they may no longer claim to have a health impairment, these students may still be disadvantaged in the transition to college due to their experiences in high school or before. Second, college students with health impairments may not have had these health impairments until after they graduated from high school or entered college. Thus, any conclusions about the effects of high school preparation or college access for these individuals are limited. In our study, we only consider health impairments reported before high school graduation so we can draw stronger inferences about the transition from secondary schools to higher education. In particular, we are interested in assessing the role of high school academic preparation as a possible policy lever to support students with health impairments during the transition to college.

1.2. High school preparation and college enrollment

Although the Individuals with Disabilities in Education Act (IDEA) protects students with health impairments in primary and secondary schools, there may still be inequalities in their academic preparation for college. Access to advanced math coursework and good grades in high school are important predictors of college entry and whether a student will initially enroll in a 4-year school (Adelman, 2007; Fletcher, 2015), but high schools may reproduce health inequalities by excluding students with health impairments from advanced courses (Nord et al., 2011; Shifrer et al., 2013). Students with health impairments who do take advanced coursework in high school may not receive the academic support they need to equally benefit from advanced coursework. If they receive the appropriate accommodations, students with health impairments placed in more challenging coursework have higher grades, reading competency, motivation, and test scores than students with health impairments in lower-level courses (Salend and Duhaney, 1999). Without extra support, students with health impairments in advanced courses may not receive the same skill development and college preparation of students without health impairments (DeSimone and Parmar 2006; Berry, 2006).

We assess if gaps in 2-year and 4-year college enrollment between students with and without health impairments and with different types of health impairments operate through differences in high school preparation, including grades and advanced math course-taking. We expect that limited academic preparation will account for part of the gap in college attendance. However, students with health impairments that do have access to advanced math coursework may not enjoy the same returns of these courses to college attendance. Thus, there may still be unequal rates of college attendance for individuals with health impairments who have comparable high school preparation.

1.3. The present study

Our guiding research questions for this study are: Are there gaps in enrollment in 2-year and 4-year postsecondary institutions between high school graduates with physical, mental or multiple health impairments and without health impairments, controlling on family background and cognitive abilities? Does high school preparation, including grades and advanced math course-taking, account for any remaining gaps in college attendance by health impairment status? Do students with health impairments receive similar benefits of taking advanced math as students without health impairments in predicting 2-year and 4-year postsecondary enrollment?

2. Data and methods

2.1. Sample

We use data from 15 Rounds (1997–2011) of NLSY97, a nationally representative sample of people who were born between 1980 and 1984 living in the United States. The first round of interviews was when respondents were between the ages of 12 and 18 and the last round included in this study was when respondents were between the ages of 27 and 33. The first round also consisted of parent reports of respondents' background, health status, and family economic situation. The original sample in round 1 included 8984 respondents. We restricted our analytic sample to high school graduates or GED recipients who had valid measures of health impairment status (N = 7643).

2.2. Measures

Initial College Enrollment—Our dependent variable is a categorical measure of the first type of college enrollment from survey responses on monthly enrollment in postsecondary institutions asked during each survey round. The measure indicates whether the respondent entered a 2-year college, a 4-year college or no college by 2011.[2] The youngest NLSY97 high school graduates were in the high school class of 2002, so our enrollment window gives them at least nine years after high school to enroll in any postsecondary institution, allowing for the possibility of nontraditional pathways into college during early adulthood.[3] We only

[2]Health impairment status was not associated with sample attrition. Additionally, being in the "no enrollment" category, for those who never reported enrolling in a postsecondary institution, was not associated with sample attrition.

[3]Less than 2% of the sample initially enrolled in a postsecondary institution more than nine years after high school graduation. The proportion of students in this group does not significantly differ by health impairment status. Limiting the postsecondary enrollment window to only nine years after high school graduation for all NLSY97 sample members produces consistent results.

considered a student to have enrolled in a postsecondary institution if the enrollment period lasted more than two months.[4]

Health Impairment Status—The key independent variable for our analysis is a measure of having a health impairment prior to high school graduation. We constructed this measure based on a series of questions that ask whether the respondent ever had a learning or emotional condition, sensory limitation or physical impairment.[5] In the first round, parents answered these questions. In rounds 6, 11, 12, and 13, the respondents answered the same questions themselves. We placed those who ever indicated having a health impairment into three groups: those with a mental impairment (learning or emotional), those with a physical impairment (physical or sensory), [6] and those who report multiple health impairments (both a mental and physical health impairment). For each health impairment reported, the respondents were also asked to report the age that the condition was first noticed. With this information, along with the birthdate and the date of high school graduation, we calculated whether the health impairment began prior to high school completion. Respondents whose health impairments began after graduating from high school were not considered to have a health impairment for our analyses (N = 191).

High School Preparation—We include two measures of academic preparation in high school from students' survey responses.[7] First, we include an indicator for taking advanced math, defined as a math course higher than Algebra II.[8] Second, we include a measure of high school grades. We convert the reported letter grades into a continuous scale in which 0 indicates "mostly F's" and 4 indicates "mostly A's."

Background Controls—Our first control is a measure of cognitive ability. During the first round of NLSY97, respondents took the Armed Services Vocational Aptitude Battery (ASVAB) test, which assesses math knowledge, reasoning skills, reading comprehension, and word knowledge. We use the percentile rank score to account for the different ages of respondents at the time of the test to allow for comparability across respondents. We also control on three family background indicators: parents' highest level of education (parent report of their highest degree completed ranging from 0 [less than a high school diploma] to 4 [advanced degree]), family structure (whether or not the respondent reported living with

[4]In an ancillary analysis, we examined differences in the timing of initial postsecondary entry by health impairment status. Students with a mental impairment on average initially enroll in postsecondary institutions 5 months later than students without a health impairment. However, due to sample size and length restrictions, we decided not to include this analysis in our final paper. These analyses are available upon request.

[5]On the survey, respondents note the type of health impairment within the broad categories of physical, learning, and emotional. We exclude individuals who had mental retardation from all analyses (N = 32).

[6]Following other research with similarly worded questions (Owings and Stocking, 1985), we don't consider individuals who reported only a vision difficulty (N = 989) because the question does not stipulate that the issue is not corrected by glasses and more respondents claimed to have a vision difficulty than other research suggests.

[7]A subsample of NLSY97 has transcript data available. Due to sample size restrictions for the sample of students with health impairments, we chose not to exclude respondents without transcript data. Analyses using transcript reports of grades and course-taking display similar patterns as those we observe. Additionally, the subsample of respondents with both self-reported grades and course-taking and transcript data have similar indicators regardless of the source.

[8]Some students with health impairments may have taken advanced math before their impairment was first noticed. About 5% of mental impairments and 6% of physical impairments were first noticed between the ages of 16 and 18, during the junior or senior years of high school when most students take advanced math courses. Our results about the relationship between health impairment status and advanced math course-taking in predicting postsecondary enrollment are consistent if we exclude these individuals from the analysis, do not consider their math course-taking, or do not consider them to have a health impairment.

both biological parents during the base year), and base year household income (parent report). All analyses control for respondents' gender, race/ethnicity, and age at the base year.

2.3. Analytic plan

We begin our analysis with an examination of baseline differences across the four categories of health impairment status: no health impairment, a physical health impairment, a mental health impairment and multiple health impairments. We then use multinomial logistic regression to estimate the effects of health impairment status on three types of postsecondary enrollment: none, first enrolled in a 2-year postsecondary institution, or first enrolled in a 4-year postsecondary institution. Because coefficients from multinomial logistic regressions (log odds) cannot be accurately compared across models or subsamples (Mood, 2010; Norton et al., 2004; Long and Freese, 2014), we report the average marginal effects (AMEs) for all models, which represent how the average probability of an outcome changes with a one-unit change in the predictor. AMEs, unlike log odds, are independent from the base probability of an outcome, and thus can be compared across models because they are not susceptible to the same unobserved heterogeneity concerns (Mood, 2010).

We nest our AME models, first controlling on race, gender, age, family background and cognitive ability. Then, we assess the role of high school academic preparation. We are particularly interested in how much the inclusion of measures of high school preparation changes the gap in enrollment between students with and without health impairments. Finally, we test models with interactions between health impairment status and advanced math coursework. We present these interaction results graphically. The interaction models may be found in Appendix A. All analyses use sample weights to adjust for the sampling design and nonresponse and multiple imputation using chained equations to fill in any missing data on independent variables.

3. Results

Table 1 presents the means and proportions of our measures for the full sample and by health impairment status. We do see a gap in the type of initial college enrollment between those with and without health impairments. As indicated by the first few rows of the table, individuals with any health impairment have lower rates of 4-year postsecondary enrollment and higher rates of not attending a postsecondary institution than individuals without health impairments. The rates of initially enrolling at 2-year postsecondary institutions are similar across groups.

There are also gaps between individuals with physical, mental, and multiple health impairments. Individuals who reported a mental impairment are more likely to not enroll in a postsecondary institution and less likely to initially enroll in a 4-year post-secondary institution than individuals with only a physical impairment. Individuals with multiple health impairments have even lower rates of enrollment in 4-year postsecondary institutions than individuals with only a mental impairment. These bivariate results highlight the importance of considering the type of health impairment along with the type of postsecondary institution when studying college enrollment gaps between individuals with and without health impairments.

The next few rows of the table show that student background characteristics are similar across health impairment groups, except for two notable exceptions. Significantly fewer persons with mental impairments or multiple impairments lived with both biological parents. Also, those with mental impairments and multiple impairments on average had lower cognitive abilities (as indicated by their ASVAB score) than both individuals without health impairments and individuals with physical impairments. Both of these factors may explain the lower rates of 4-year college going for individuals with mental or multiple health impairments.

The last section of the table shows the relationship between heath impairment status and high school preparation for college. Students with a mental impairment have lower grades than students without health impairments and students with physical impairments. Students with any health impairment are less likely to have taken advanced math in high school than students without health impairments, but students with mental impairments and multiple impairments have the lowest rates of advanced math course-taking. These bivariate results suggest that high school graduates with health impairments are on average less prepared to enter postsecondary institutions than those without health impairments. Those with a mental impairment, especially when combined with a physical impairment, have the lowest levels of academic preparation for college during high school. Next, we turn to multivariate models to assess if the health impairment gaps in college enrollment are due to background differences, operate through high school preparation, or independently predict postsecondary enrollment.

Table 2 reports AMEs from multinomial logistic regressions predicting individuals' initial postsecondary enrollment. The findings from model 1 suggest that the unequal rates of college attendance by health impairment status extend beyond differences in family background and cognitive ability. Gaps are especially wide between young adults with mental impairments and those without health impairments. We observe a 4.7 percentage point lower probability of initially enrolling in a 4-year postsecondary institution among high school graduates who have a physical impairment compared to graduates who do not have a health impairment with otherwise similar families and cognitive skills. The disadvantage is even larger for individuals with a mental impairment (7.7 percentage points) or with multiple impairments (11.7 percentage points). Individuals with a mental impairment on average have a 4.8 percentage point higher probability of not enrolling in a postsecondary institution compared to students without health impairments. Individuals with multiple impairments on average have a 6 percentage point higher probability of not enrolling in college than students without health impairments. As suggested by the bivariate descriptive statistics shown in Table 1, there are no significant differences in 2-year college enrollment by health impairment status.

The measures of high school preparation in model 2 significantly decrease the magnitude of the differences in the probability of 4-year college enrollment between individuals with and without health impairments. Even with the attenuation of these gaps, disadvantages remain for individuals with mental and multiple health impairments. The gap in the probability of initial 4-year college enrollment between individuals with physical impairments and without health impairments mainly operates through high school preparation. Almost half of the

association between having a mental impairment and 4-year college enrollment and more than one-third of the association between having multiple health impairments and 4-year college enrollment is explained by high school preparation. However, individuals with a mental impairment still on average have a 3.2 percentage point higher probability of never enrolling in college and a 4.1 percentage point lower probability of initially enrolling in a 4-year postsecondary institution than individuals without health impairments. The remaining gap in 4-year college enrollment between individuals with multiple impairments and no health impairments is almost twice the remaining gap for individuals with a mental impairment (7.5 percentage points).

As other research has found, advanced math course-taking is particularly important in predicting 4-year college enrollment; individuals who took these courses on average have a 14 percentage point advantage in 4-year college enrollment over individuals who took lower levels of math in high school. These findings suggest that much, but not all, of the inequality in college enrollment rates between individuals with and without health impairments stems from inequalities in educational opportunities that reach back into high school.

Since high school course-taking appears to be an important part of the transition from high school to college for individuals with health impairments, we investigated how returns to taking advanced math in high school may differ by health impairment status. The final step in our analysis adds an interaction term for health impairment status and advanced math coursework to model 2, displayed graphically as the predicted probabilities of no college enrollment, 2-year college enrollment and 4-year college enrollment for an average sample member with a physical impairment, a mental impairment, multiple impairments and no health impairments. Fig. 1a displays the predicted probabilities of initial postsecondary enrollment for those who did not take advanced math and Fig. 1b displays the predicted probabilities of initial postsecondary enrollment for those who took advanced math in high school. In Fig. 1a, the gaps in college enrollment by health impairment status are minimal. There are no significant differences in college enrollment by health impairment status for students who didn’t take advanced math in high school.

In contrast, we do observe significant enrollment gaps by health impairment status among individuals who took advanced math, shown in Fig. 1b. Individuals without a health impairment who took advanced math have a 0.55 predicted probability of initially attending a 4-year postsecondary institution. Among individuals with health impairments who took advanced math, those with a physical impairment have a 0.46 predicted probability, those with a mental impairment have a 0.40 predicted probability and those with multiple impairments have a 0.34 predicted probability of initially attending a 4-year postsecondary institution. The predicted probability of enrolling in a 4-year school is higher for both individuals with and without health impairments who took advanced math, compared to those who didn’t, but the gap is smaller for individuals with a mental impairment. For individuals without health impairments, the predicted probability of initially enrolling in a 4-year postsecondary institution for those who took advanced math is 0.25 higher than those who did not take advanced math. The gap is only about 0.10 for individuals with a mental impairment. These results suggest that taking advanced math in high school improves the chances of initially enrolling in a 4-year postsecondary institution for all students, but it does

not make up for the setback in the probability of college-going experienced by students with health impairments.

4. Discussion

Adults with health impairments are a disadvantaged group in the U.S., and their disparities in work, health, civic participation and other outcomes can be linked to lower rates of college going and educational attainment (Brault, 2012; Sanford et al., 2011; Shandra, 2017; Fleming and Fairweather, 2012). Although research has shown that health can impact educational attainment, little research has examined the role of selection into higher education because of health impairments in the education-health gradient. This is the first study to our knowledge to use nationally representative data to investigate differences in 2-year and 4-year post-secondary enrollment outcomes for individuals with different types of impairments, including multiple health impairments.

Our findings suggest that individuals with health impairments are disadvantaged in their postsecondary enrollment. Low rates of 4-year college enrollment for high school graduates with physical impairments may be due to their poorer high school preparation. Strikingly, those with mental and multiple health impairments are less likely to initially enroll in 4-year schools than individuals without health impairments, even when background, cognitive skills, and high school preparation are held constant. Advanced math coursework, an important aspect of college preparation during high school, predicts 4-year college going for all students, but students with mental impairments appear to benefit less from the demanding coursework than students without health impairments. Thus, there is evidence that selection into higher education is related to health impairment status, especially among those with mental impairments. These findings raise three major themes for discussion.

First, postsecondary enrollment patterns differ among high school graduates with physical, mental and multiple health impairments. Research that does not consider differences between these types of students has found that gaps in postsecondary enrollment between individuals with and without health impairments mainly operate through family background and high school preparation (Shandra and Hogan, 2009). However, we found that mental impairments, especially when combined with physical impairments, block students along the pathway to college even when background, cognitive abilities and high school preparation are taken into account. Studies that do not distinguish between mental and physical health impairments conceal important differences in disadvantage by health impairment type. In particular, it is important to examine the negative effects of mental health impairments in the education pipeline. Other studies of college students with health impairments find that students who report learning problems are less likely to enroll in college or persist to a degree (Elman et al., 2014) and individuals with mental impairments have worse academic performance during the first year of college than individuals with physical impairments (Carroll et al., 2016). Locating the emergence of these health impairments before leaving high school provides a firmer basis for the health selection argument; high school graduates with mental impairments are disproportionately excluded from higher education.

Mental health is a topic that is particularly relevant to the sociological literature because social and structural factors shape the emergence and escalation of mental health issues (McLeod, 2015). Experiences in school can worsen mental health (Milkie and Warner, 2011; Dupéré et al., 2012), which can in turn decrease students' academic achievement and educational opportunities (McLeod et al., 2012). In this study, we found some evidence that inequalities in mental health are reproduced both in students' academic preparation for college and their 4-year postsecondary institution enrollment. By further understanding the structural forces within schools that shape the reciprocal relationship between education and mental health, we may be able to support schools in changing the unequal trajectories of students with mental health impairments.

The second theme is related to the role of high school preparation in postsecondary enrollment patterns for individuals with health impairments. High school preparation explains the lower rates of enrollment in 4-year colleges for individuals with physical impairments, and explains about half of the association with mental impairments and about one-third of the association with multiple health impairments. Despite stipulations in IDEA that require all individuals to be taught in the "least restrictive environment," students with health impairments in some schools may still face obstacles in gaining access to learning opportunities that prepare them to enter 4-year colleges. Research on students placed in special education has found that taking general education courses, instead of self-contained special education courses, boosts individuals' opportunities to go to college (Lombardi et al., 2013). Our study underscores the importance of taking advanced college preparatory courses. Individuals with learning disabilities are less likely to have access to these courses, even when controlling on prior academic achievement (Shifrer et al., 2013), possibly because of stigma associated with teachers' perceptions of their abilities (Shifrer, 2013). The Supreme Court recently debated what level of educational improvement IDEA should require of schools for students with health impairments (*Endrew F.* v. *Douglas County School Board*, Case No. 15–827). Our results suggest that an important set of indicators concerns access to college preparatory courses.

The last theme for discussion is about how our findings provide more evidence that health impacts education, and that it is worth looking at school processes to understand possible policy levers to intervene in the production of health disparities. Numerous studies have found that people with more education have better self-rated health, physical functioning, mental health and risks of mortality (Ross and Wu, 1995; Montez et al., 2012), but fewer consider the health impairment status of individuals as they move through the college pipeline. If the individuals that make it into college, especially 4-year colleges, disproportionately are without health impairments, then the effects of education on health are partly due to selection into 4-year colleges. One possible limitation to our analyses is that we only consider postsecondary attendance in early adulthood. It is possible that individuals with health impairments enter 4-year colleges later in the life course than those without health impairments, however delayed entry into postsecondary education is a risk factor for degree completion (Bozick and DeLuca, 2005). Our findings suggest that improving access to higher education among individuals with health impairments – especially mental impairments – might be an important step to disrupt the reproduction of inequalities in health.

Despite the strengths in how we measure health impairment status, there are also limitations. First, we consider an adolescent to have a health impairment if the parent or the adolescent reported it at any time before high school graduation. Thus, individuals who only had a temporary health impairment are mixed with those with a persistent health impairment. Other studies have found that persistent health impairments are more detrimental to educational attainment than temporary health impairments (Mann and Honeycutt, 2014; Lee and Jackson, 2015). Second, we do not consider the severity of the health impairment in our analysis. Other studies have found that negative associations between educational attainment and health impairment are mainly for those with serious health impairments, and not for mild health impairments (Shandra and Hogan, 2009). Due to small cell sizes, we were not able to estimate whether the health impairment was limiting the respondent at the time of high school graduation, nor could we take into account the severity of the health impairment, and also estimate effects of different types of impairments. Finally, we do not consider the age of health impairment onset (other than ensuring the health impairment was first noticed before high school graduation). We lack the statistical power to do so because the majority of physical impairments emerged before or during elementary school and the majority of mental impairments emerged during or after elementary school. However, other research has found that, particulatly for mental health, individuals with health impairments are disadvantaged in their edicational experiences regardless of when the impairment emerged (McLeod and Fettes, 2007; Cheadle and Goosby, 2010).

Our health impairment categories no doubt combine individuals who only had the health impairment in childhood with those whose impairment emerged later and people who have mild symptoms with those whose conditions are severe. This heterogeneity probably attenuates our estimates to be conservative. Furthermore, we do not know if our respondents with health impairments were enrolled in special education programs at any time during their schooling or if they ever received accommodations to assist with their learning. Despite these limitations, we did find gaps in college access for individuals with health impairments that are important to consider within both academic work and policy.

As researchers continue to study and refine the link between education and health, data sources with rich indicators of both health and education will become more important. Currently, data sources designed to study health are missing important detail on schooling and educational processes, such as course-taking, college enrollment patterns, and grades. Data sources designed to study educational processes often have limited measures of mental and physical health status. The disjointed nature of available data requires researchers to make compromises on the health or education indicators used, limiting the possible theoretical, methodological, and policy-related impacts of their research. Our study describes gaps in postsecondary enrollment by health impairment status, and suggests a possible policy lever in math course-taking, but future research from new data sources may be able to refine these associations.

In this paper, we find an early pattern in the education-health gradient; young adults with health impairments are disadvantaged in the transition from high school to college. Our results suggest a set of potential policy levers – encouraging access to quality advanced coursework – to address the health gradient in education and to potentially mitigate the

educational gradient in health over the life course. Our findings also suggest that students with mental impairments (including those who have accompanying physical impairments) face additional barriers to initially enrolling in 4-year postsecondary institutions. Improving college access, especially in 4-year postsecondary institutions, for individuals with mental impairments should be a priority.

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Appendix A. Coefficients from multinomial logistic regressions predicting initial postsecondary enrollment with an interaction between health

impairment status and advanced course-taking in model 3 [Base category is no enrollment]

	Model 2			Model 3		
OUTCOME	**No Enrollment**	**2-Year**	**4-Year**	**No Enrollment**	**2-Year**	**4-Year**
Health Impairment Type (Ref. no impairment)						
Physical		−.077 (.141)	−.254 (.168)		−.108 (.166)	−.123 (.219)
Mental		−.148 (.104)	−.370 ** (.136)		−.028 (.115)	−.0973 (.168)
Multiple		−.189 (.182)	−.623 * (.265)		−.243 (.197)	−.488 (.299)
Age		−.024 (.023)	−.025 (.027)		−.025 (.023)	−.027 (.027)
Race (Ref. White)						
Black		.645 *** (.093)	1.348 *** (.113)		.650 *** (.094)	1.358 *** (.113)
Latino		.734 *** (.095)	.635 *** (.122)		.742 *** (.095)	.648 *** (.123)
Asian		1.063 ** (.354)	1.257 *** (.372)		1.062 ** (.354)	1.259 *** (.371)
Other		.631 * (.248)	.528 (.293)		.625 * (.248)	.519 (.294)
Female (Ref. Male)		.450 *** (.069)	.473 *** (.081)		.450 *** (.069)	.472 *** (.082)
Highest Parent Education		.355 *** (.037)	.559 *** (.041)		.356 *** (.037)	.558 *** (.041)
Household Income		.000 ** (.000)	.000 *** (.000)		.000 ** (.000)	.000 *** (.000)
Lives with Both Parents (ref. Doesn't)		.161 * (.073)	.420 *** (.086)		.164 * (.073)	.421 *** (.086)
ASVAB Percentile		.020 *** (.002)	.038 *** (.002)		.020 *** (.002)	.038 *** (.002)
High School Preparation						
GPA		.335 *** (.052)	1.001 *** (.065)		.335 *** (.052)	.998 *** (.065)
Took Advanced Math (Ref. Didn't take)		.124 (.084)	1.034 *** (.089)		.183 * (.093)	1.150 *** (.010)
INTERACTIONS						
Physical-Took Advanced Math					.088 (.316)	−.238 (.346)
Mental-Took Advanced Math					−.663 ** (.255)	−.933 *** (.267)
Multiple-Took Advanced Math					.367 (.531)	−.259 (.635)
Constant		−2.442 *** (.373)	−6.695 *** (.460)		−2.459 *** (.373)	−6.725 *** (.461)
BIC	13671			13005		

Note: Robust standard errors in parentheses.

*** $p < .001$,

** $p < .01$, and

* $p < .05$.

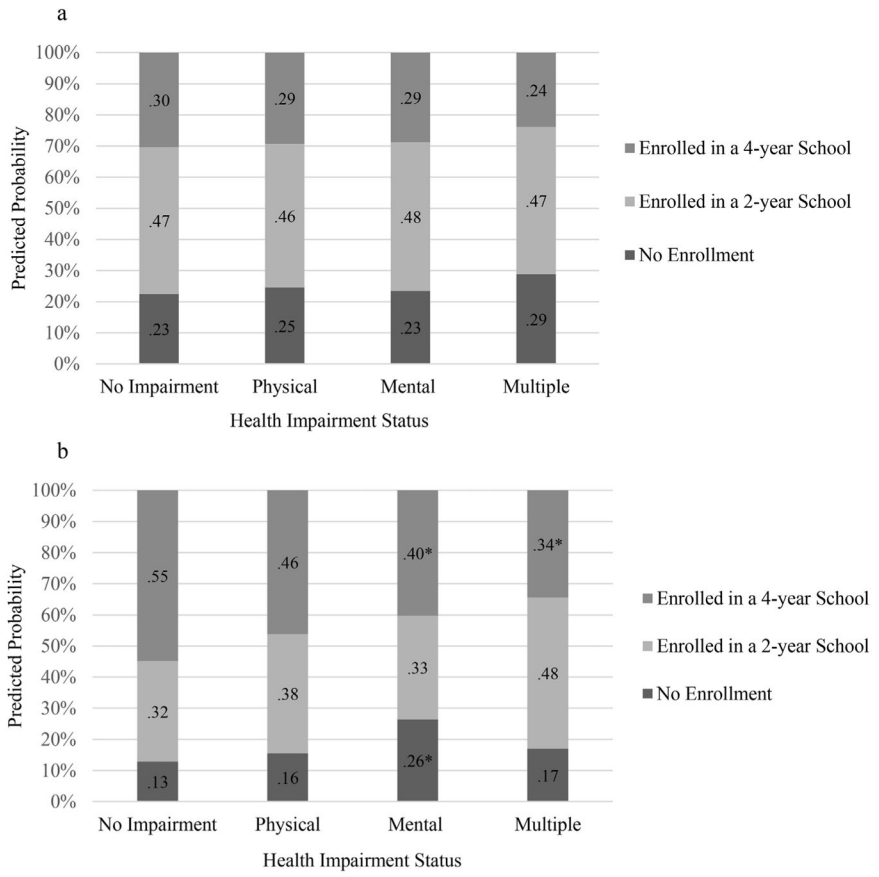

Fig. 1.

a) Predicted probability of postsecondary enrollment by health impairment status for those who didn't take advanced math.

Note: Predicted probabilities were calculated using the sample mean for each variable with coefficients from a model with an interaction between advanced math course-taking and health impairment status. None of probabilities are statistically significantly different between health impairment categories.

b) Predicted probability of postsecondary enrollment by health impairment status for those who did take advanced math.

Note: Predicted probabilities were calculated using the sample mean for each variable with coefficients from a model with an interaction between advanced math course-taking and health impairment status. Significant differences ($p < .01$) between probabilities of enrollment for those with and without health impairments are signified by *.

Table 1

Descriptive statistics by health impairment type and for the full sample.

	None	Physical	Mental	Multiple	Full Sample
Observations	6218	444	761	220	7643
Weighted % of Sample	0.80	0.06	0.11	0.03	
Initial College Enrollment					
None	0.25	0.31*	0.40***^{P}	0.45***^{P}	0.28
Two-Year	0.32	0.34	0.33	0.35	0.32
Four-Year	0.43	0.35**	0.27***^{P}	0.20***^{P,M}	0.40
Background					
Age	14.34	14.33	14.17**	14.32	14.32
	(1.51)	(1.42)	(1.43)	(1.51)	(1.49)
Race					
White	0.66	0.79***	0.77***	0.77***	0.68
Black	0.16	0.09***	0.11***	0.12*	0.15
Latino	0.13	0.08***	0.09***	0.09*	0.12
Asian	0.03	0.02	0.01***	0.01***	0.03
Other	0.03	0.03	0.02	0.02	0.03
Female	0.51	0.39***	0.43***	0.39**	0.49
Highest Parent Education Level	1.92 (1.24)	1.93 (1.12)	1.99 (1.18)	1.89 (1.25)	1.93 (1.22)
Household Income	54370.81 (44640.59)	52391.77 (37568.81)	55137.54 (46403.31)	48195.06 (44246.40)	54140.56 (44446.99)
Lives with Both Parents	0.57	0.55	0.49***	0.41***^{P,M}	0.56
ASVAB Percentile	54.18	54.13	41.43***^{P}	39.53***^{P}	52.32
	(27.76)	(25.87)	(27.98)	(26.25)	(28.01)
High School Preparation					
GPA	2.97 (0.76)	2.85** (0.74)	2.69**^{P} (0.78)	2.75*** (0.74)	2.92 (0.77)
Took Advanced Math	0.46	0.41*	0.28***^{P}	0.20***^{P,M}	0.43

Note: Standard deviations in parentheses. Significant differences ($p < .05$) between a physical impairment and a mental impairment or multiple impairments are represented by ^{P}. Significant differences ($p < .05$) between a mental impairment and multiple impairments are represented by ^{M}. Differences between each impairment type and no impairment are indicated by *** ($p < .001$), ** ($p < .01$), or * ($p < .05$).

Table 2

Average marginal effects from multinomial logistic regressions predicting initial postsecondary enrollment.

	No Enrollment		2-Year		4-Year	
MODEL	**1**	**2**	**1**	**2**	**1**	**2**
Health impairment Type (Ref: No impairment)						
Physical	.027 (.020)	.020 (.020)	.020 (.024)	.011 (.023)	−.047* (.022)	−.030 (.021)
Mental	.048** (.015)	.032* (.015)	.028 (.019)	.009 (.018)	−.077*** (.019)	−.041* (.018)
Multiple	.060* (.027)	.048 (.026)	.057 (.036)	.027 (.035)	−.117** (.040)	−.075* (.036)
Age	.007* (.003)	.004 (.003)	−.001 (.004)	−.002 (.004)	−.006 (.004)	−.001 (.003)
Race (Ref: White)						
Black	−.139*** (.013)	−.127*** (.013)	−.023 (.015)	−.010 (.015)	.162*** (.014)	.137*** (.013)
Latino	−.106*** (.014)	−.102*** (.013)	.083*** (.015)	.082*** (.015)	.023 (.016)	.020 (.015)
Asian	−.195*** (.052)	−.163** (.050)	.065 (.045)	.084 (.045)	.130** (.036)	.079* (.033)
Other	−.088* (.037)	−.087* (.035)	.076* (.038)	.073* (.036)	.012 (.036)	.014 (.032)
Female (Ref. Male)	−.094*** (.009)	−.066*** (.009)	.027* (.011)	.042*** (.011)	.067*** (.010)	.025* (.010)
Highest Parent Education	−.065*** (.005)	−.061*** (.005)	.010 (.006)	.014* (.006)	.056*** (.005)	.048*** (.005)
Household Income	−.000*** (.000)	−.000*** (.000)	−.000 (.000)	−.000 (.000)	.000*** (.000)	.000*** (.000)
Lives with Both Parents (Ref. Doesn't)	−.048*** (.010)	−.036*** (.010)	−.023 (.012)	−.011 (.012)	.071*** (.011)	.047*** (.011)
ASVAB Percentile	−.005*** (.000)	−.004*** (.000)	−.001*** (.000)	.000 (.000)	.006*** (.000)	.004*** (.000)
High School Preparation						

	No Enrollment		2-Year		4-Year	
MODEL	**1**	**2**	**1**	**2**	**1**	**2**
GPA		−.080*** (.007)		−.037*** (.009)		.117*** (.008)
Took Advanced Math (Ref. Didn't take)		−.061*** (.011)		−.083*** (.013)		.144*** (.010)
Observations = 7643						

Note: Standard errors in parentheses.

*** p < .001,

** p < .01, and

* p < .05.