



# COVID-19 and changes in college student educational expectations and health by disability status<sup>☆</sup>

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## ABSTRACT

This study examines the implications of the coronavirus pandemic for college students' health and education, with special attention to variation by disability status. Disaster research supports the hypothesis that students with disabilities will experience higher-than-usual levels of pandemic-related stress, which could lead to re-evaluations of their educational expectations and declines in health. We evaluate this hypothesis by modeling changes in students' (1) mental and physical health and (2) educational expectations during the first year (spring of 2020 to spring of 2021) of the pandemic, using survey data collected from a population-based sample of college students in the state of Indiana. Although we observe across-the-board declines in both domains, students with disabilities were especially vulnerable. Mediation analyses suggest that differential exposure to financial and illness-related stressors is partially to blame, explaining a significant portion of the group differences between students with and without disabilities. We interpret these results as evidence of the unique vulnerabilities associated with disability status and its wide-ranging importance as a dimension of social stratification.

The COVID-19 pandemic is a social disaster with profound implications for social inequities in life chances. Prior research—including work featured in the pages of this journal—has documented racial/ethnic and socioeconomic disparities in COVID-19 prevalence and death (Clouston et al., 2021; Luck et al., 2022; Muñoz-Price et al., 2020; Perry et al., 2021), educational and disability-based differences in COVID-19-related rates of unemployment and under-employment (Ku & Brantley, 2020; Lee et al., 2021), rural-urban differences in the labor market effects of the COVID-19 pandemic (Brooks et al., 2021), and gender differences in disease outcomes, housing insecurity, and care responsibilities (Calarco et al., 2021; Landivar et al., 2020; Wade et al., 2021). While these (and other) studies leave little doubt that the pandemic has exacerbated existing inequities, they have mostly evaluated broad impacts across the adult population, leaving open questions about the pandemic's effects within more finely grained population subgroups.

In this article, we evaluate the implications of the coronavirus

pandemic for college students, with special attention to variation in outcomes based on disability status and type. We focus in particular on cognitive, learning, mental health, and neurodevelopmental conditions (or what are sometimes referred to as “mental disabilities”), as these are the most common forms of disability in college student populations (Leake, 2015). Studies of disasters support the general hypothesis that students with disabilities,<sup>1</sup> like other marginalized groups, will experience higher levels of pandemic-related stress (see, e.g., Stough & Ilan, 2018; Willigen et al., 2002) and, in turn, more pronounced declines in educational expectations and health. We consider this hypothesis by modeling perceived changes in students' mental and physical health and educational expectations during the first year (spring of 2020 to spring of 2021) of the pandemic. Our design allows us to (1) characterize differences by disability status in students' responses to the COVID-19 pandemic in the domains of education and health; and (2) evaluate stress-based explanations for why such differences emerged. We situate

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<sup>1</sup> Disability advocates differ in their preferences for people-first (students with disabilities) versus identity-first (disabled students) language (Association of University Centers on Disabilities, 2022). We use people-first language throughout this manuscript and acknowledge that some readers may have a different language preference.

this work in conversation with long-standing social scientific interest in inequities in higher education and with an emerging sociological literature on disability as a dimension of stratification (Jenkins, 1991; Lund et al., 2020; Shifrer, 2013).

## 1. Background

### 1.1. Disasters and inequities

In spring 2020, institutions of higher education scrambled to adjust to the epidemiological realities of the COVID-19 pandemic. Students on residential campuses were asked to leave campus housing and courses abruptly shifted to online modes of instruction. Though the effects of these changes were widely felt (Browning et al., 2021; Jones et al., 2021), they hit economically disadvantaged students particularly hard (Aucejo et al., 2020; Rodríguez-Planas, 2020). Students from disadvantaged backgrounds were more likely to experience difficulties in the shift to online learning due to increased family responsibilities, less reliable internet access, a higher likelihood of contracting COVID-19 (Rodríguez-Planas, 2020), and an uptick in food and housing insecurity (Goldrick-Rab, 2021; Soldavini et al., 2020). These stressors may have had consequences for students' educational expectations, with less advantaged students reporting greater uncertainty about enrollment plans and their chances of college completion than their more advantaged peers (Aucejo et al., 2020).

That the effects of the pandemic have varied should not be surprising. Disaster research provides compelling evidence that natural and social disasters—and the circumstances surrounding them—exacerbate existing social inequities (Fothergill & Peek, 2004; Laska & Morrow, 2006; Tierney, 2014). In the literature on environmental disasters, researchers have observed pronounced inequities based on marginalized statuses in rates of injury and death (Tierney, 2011; Zoraster, 2010), property loss (Fussell et al., 2010), job loss (Zottarelli, 2008), and psychological distress (Galea et al., 2007). Similar patterns have been observed during economic recessions (Benach et al., 2022), which demographers and others have linked to widening health inequities and growing gaps in mortality between less and more advantaged groups (Heggebø et al., 2019; Maynou & Saez, 2016).

Most of the research on inequities during disasters focuses on variation based on race/ethnicity, gender, and socioeconomic status (Stough & Ilan, 2018). In this article, we shift attention away from traditional dimensions of stratification and toward an additional axis of inequality that is particularly relevant to college students: disability status. Although disability status can be conceptualized as an individual characteristic, medical sociologists and sociologists of disability more often view it as a social characteristic resulting from physical, economic, and social barriers that restrict access to valued goods and experiences (Chennat, 2019; Jenkins, 1991; Mauldin & Brown, 2021; Naples et al., 2019; Shifrer & Frederick, 2019). This conceptualization positions disability status alongside race/ethnicity, class, and gender as a key dimension of stratification (see, e.g., Maroto et al., 2018; Mauldin & Brown, 2021; Shandra, 2018; Shifrer & Frederick, 2019).

Disabilities increase risk during natural disasters for several reasons: because they may make it more difficult to take self-protective actions (e.g., to move quickly to a safe location) (Van Willigen et al., 2002); because they may make sheltering and/or evacuation experiences more stressful (Peek & Fothergill, 2008); because of their association with economic hardship (Altman et al., 2020; Drew, 2015); because of disaster-related disruptions to necessary support and health services (Tierney, 2019); and because of the stigma, discrimination, and increased social isolation that people with disabilities face (Emerson et al., 2021; Mithen et al., 2015; Peek & Stough, 2010). The end result is typically a higher rate of injury and death (Stough and Kelman 2018), and worse mental health outcomes (Shiba et al., 2021), for those with disabilities. Although the COVID-19 pandemic differs from natural disasters in important ways (e.g., fewer threats to physical safety), it, too,

increased economic hardship, disrupted access to support and health services, and increased social isolation (see, e.g., Witteveen & Velthorst, 2020).

### 1.2. Disability and the COVID-19 pandemic

Research on the general adult population offers good reason to believe that the COVID-19 pandemic, as with other large-scale social disasters, exacerbated disability-based inequities. In the United Kingdom, adults with disabilities were more likely than non-disabled adults to work reduced hours, report time away from work, and experience financial stress in the first three months of the pandemic (Emerson et al., 2021). In the U.S., adults with disabilities reported disproportionately high levels of depression and suicidal ideation, stress associated with chronic health conditions, emotional or physical abuse from others, lack of access to health care, social isolation, food insecurity, and housing instability (Okoro et al., 2021). People with disabilities also faced heightened health risks associated with discontinuities in medical care provision, an increased risk of contracting COVID-19 because of comorbid conditions, less access to supportive social networks, and more difficulty accessing resources such as delivery meals because of financial precarity (Lund et al., 2020).

Given the importance of the college years for social and emotional development (Seal et al., 2011), we expect to observe equal or more pronounced inequities in the effects of COVID-19 among college students. Even before the COVID-19 pandemic, college students with disabilities faced additional barriers to academic success and worse mental health than their non-disabled peers (Heiman, 2006; Herbert et al., 2014; McLeod et al., 2019). During the COVID-19 pandemic, students with disabilities encountered additional challenges associated with the changing nature of instruction and shifts in their interpersonal environments. Students with cognitive and learning disabilities struggled to adapt to the new instructional modalities and the associated expectations from instructors (Courtenay & Cooper, 2021; Meleo-Erwin et al., 2021). Students on the autism spectrum had particular challenges navigating the complexity of online webinars (Monahan et al., 2020), and students with mental health problems reported heightened anxiety stemming from concerns about physical distancing requirements and reduced access to care (Wilson et al., 2020). In short, prior research provides ample support for the general hypothesis that the early stages of the COVID-19 pandemic disproportionately disrupted the educational plans and health of students with disabilities.

### 1.3. Stress exposure as an explanation

We highlight two key types of stressors that may explain observed variation in changes in educational expectations and physical and mental health based on disability status: financial stressors and illness-related stressors. Overall, college students have reported high levels of concern about contracting the virus themselves, family members getting sick, increases in course workloads, lack of clarity about academic expectations, and mental distress (Tasso et al., 2021). The limited existing evidence on this confluence of stressors suggests that these concerns are heightened among students with disabilities.<sup>2</sup> Zhang et al. (2020) conducted a survey at the University of Washington in spring 2020 that included a small sample of students with disabilities ( $n = 24$ ), about half of whom had vision or hearing impairment and most of whom reported mental health conditions. In their study, students with disabilities reported more concerns about courses going online and the implications for their degree progress, as well as greater exposure to stressors, including income loss and tension in the household. Similarly, based on a survey at a large, southeastern public university in the United States,

<sup>2</sup> Similar patterns have been observed for general population of adults with disabilities (Okoro et al., 2021).

Soldavini et al. (2020) found that college students with disabilities reported higher levels of food insecurity than their nondisabled peers during the spring 2020 semester.

We extend these few analyses in two complementary ways: by (1) incorporating a large sample of students with a wide range of cognitive, learning, and mental health conditions; and (2) formally evaluating whether financial and illness-related stressors mediate the relationship between disability on the one hand, and perceived changes in students' educational expectations and health on the other. As we explain below, we use data that were collected from a large sample of college students during the spring 2021 semester. Although the 2020-21 academic year did not involve the same abrupt shift in instructional modalities as spring 2020, many institutions continued to provide much of their instruction in an online or hybrid format, and social activities on college campuses remained disrupted.

#### 1.4. Research questions

Following from this background, we pose three interrelated research questions:

1. *Do changes in educational expectations and perceived changes in physical and mental health in the early years of the COVID-19 pandemic differ by disability status?* We expect to find that students who reported disabilities experienced greater reductions in educational expectations, more uncertainty about their future educational attainments, and larger declines in physical and mental health, than students who did not report disabilities.
2. *Do changes in educational expectations and physical and mental health differ based on the specific disability?* We anticipate that these patterns will hold across cognitive, learning, mental health, and neurodevelopmental conditions given the multiple (and sometimes overlapping) challenges students with these disabilities experience.
3. *Can differences in COVID-related changes based on disability status be explained by differences in exposure to financial and illness stressors?* We expect differences in COVID-related changes to be attenuated when adjustments are made for students' stress exposures.

## 2. Data and methods

Our analysis is based on data from an online survey of college students at ten Indiana colleges and universities conducted in spring 2021. The survey was designed to evaluate differences in educational, occupational, and health outcomes between students with an autism spectrum disorder and neurotypical students. Because the sample of neurotypical students included a high proportion of students who reported a disability, we are also able to consider differences in outcomes based on disability status more generally defined. The survey was originally scheduled for administration in March 2020, when most colleges and universities sent students home and shifted to online instruction. Owing to the disruptions occasioned by the pandemic, we rescheduled survey administration to February and March 2021. The timing of our data collection allows us to examine how students' lives changed during the first year of the pandemic.

### 2.1. Sample

The study sample was selected in two stages: In the first stage, we selected institutions in the state of Indiana that were: (1) public or private not-for-profit, and (2) Associate's, Baccalaureate, Master's, or Doctoral universities. These criteria omit special-focus institutions such as seminaries and for-profit business schools. Based on these criteria, 46 institutions were eligible for the study. We further restricted the sample by size of institution, leaving out smaller schools (enrolled students  $\leq 3000$ ) that would not contribute enough students to meaningfully evaluate variation in outcomes across institutions. After this restriction,

16 institutions were eligible for the study. We contacted relevant administrators and directors of disability services offices at each campus; 13 agreed to participate, including three campuses of Indiana's community college network.<sup>3</sup> By spring 2021, three of the institutions decided that they could no longer participate due to administrative challenges, leaving us with seven 4-year universities and three 2-year colleges.

In the second stage, at each participating institution, we invited two samples of students: (1) all students who were registered for disability accommodations based on autism and (2) a 20% probability sample of general population students. Students on the autism spectrum who were registered with disability services were sampled with certainty to ensure adequate cell sizes. The sample was restricted to undergraduate students between the ages of 18–24 who were enrolled at the institution as of January 2021. High school and dual credit students were excluded. At nine of the ten institutions, the campus disability services office distributed survey invitations to registered students on our behalf and the Indiana Center for Survey Research distributed survey invitations to students in the general sample. One institution distributed the survey to both sets of students.

Survey invitations were distributed by email. The initial survey invitation included study information and a survey link (personalized, for students in the general sample; anonymous, for students in registered samples). Students received up to four messages, consisting of the initial survey invitation and up to three reminders. The survey was administered between February and April 2021, with the timing of survey invitations and reminders varying slightly across institutions to accommodate differing term dates and spring break schedules.

The overall response rate for the general samples was 15.7%, with a range of 5.7%–32.5% across institutions. The registered samples had an overall response rate of 24.3% and the range was 8%–83%. The cooperation rate was approximately 86%, meaning that 86% of the students who opened the recruitment email message and clicked on the survey link went on to complete the entire questionnaire. Comparisons of respondents and non-respondents—which were only possible for the general sample due to the way the survey was administered—revealed small differences with respect to racial/ethnic composition, age, and class standing, but more pronounced differences in terms of gender identity (men in the general sample responded at significantly lower rates than women) and GPA (students with higher GPAs are over-represented). This form of differential nonresponse would bias our estimates if the relationships between disability status and our outcomes were conditional on gender and/or students' GPA (Groves & Couper, 1998). Supplementary analyses—involving a series of by-gender and by-GPA interactions—suggest this is unlikely to be the case.

### 2.2. Questionnaire

Study respondents completed a survey questionnaire implemented through Qualtrics. The questionnaire included close-ended and open-ended items adapted from several existing surveys of college students and young adults, including the National Survey of Student Engagement (NSSE) and the National Longitudinal Study of Adolescent to Adult Health (Add Health). Autism-specific questions were drawn from existing surveys or, in some cases, were written specifically for this study. Because the survey was conducted during the COVID-19 pandemic, we added an optional module of questions specific to students' experiences during the pandemic. Most students (84%) opted into the COVID-19 module, and we adjust for the slight differences between those who did and did not using inverse-probability weights (Seaman & White, 2013). These are the questions on which we focus in our analysis.

<sup>3</sup> The relevant administrators included directors/vice presidents of academic or student affairs, presidents/provosts/chancellors, and directors of institutional data offices, depending on the administrative structure of institution.

Just under 2400 respondents ( $n = 2395$ ) completed the module and had complete data on all analysis variables.

### 2.3. Measures

We focus on disability status and three domains of student experience as they were affected by the COVID-19 pandemic: educational plans, self-reported changes in physical and mental health, and stressors (financial and illness-related).

**Disability status.** In the first part of our analysis, students were coded as having a disability if they reported a diagnosis of depression, post-traumatic stress disorder (PTSD), anxiety, attention deficit disorder (ADD/ADHD), a learning disability, and/or some other mental health condition. While not ignoring the possibility that physical or sensory impairments (e.g., blindness or an orthopedic condition) also placed students at a disadvantage during the pandemic (see, e.g., [Soria et al. 2020](#)), such conditions were relatively rare in our sample, leaving us with little power to detect meaningful differences relative to nondisabled students. Because this study is a part of a larger project that is focused on autism spectrum disorder as a determinant of college success, we maintained a separate variable indicating whether respondents were either in the registered sample or reported an autism spectrum diagnosis (students who were on the spectrum and reported a disability were coded into the “on the spectrum” group). To investigate possible differences by disability type, we re-ran our analysis using a disaggregated measure of disability status (0 = no diagnosis, 1 = a mental health diagnosis, 2 = ADD/ADHD or a learning disability, 3 = a mental health diagnosis and ADD/ADHD or a learning disability; 4 = autism spectrum disorder).<sup>4</sup> We present results from both sets of analyses below.

**Educational expectations.** To ascertain information about students’ educational expectations, we asked respondents how their college plans had changed since spring 2020, whether and how their educational expectations had changed, and whether they felt more or less certain that they would achieve their expected level of education. We used answers to these questions to create indicators of changes in educational uncertainty (1 = more certain of educational expectations, 2 = less certain, 3 = no change since the start of the pandemic) and changes in educational expectations (1 = expect to obtain more education, 2 = expect to obtain less education, 3 = no change). We focus on negative outcomes (less certainty and lower expectations since the start of the pandemic) in both cases because positive changes were rare. The complete text of the questions and responses used to derive these measures is given in Appendix Table 1.

**Perceived changes in health.** Respondents also reported whether their physical health had “gotten worse, improved, or stayed about the same” during the first year (2020–2021) of the pandemic, with a comparable question for mental health. We treat these reports as conceptually equivalent to change scores because they capture change over time in each variable ([Allison, 1990](#)), with the change representing a change in perceptions of health. In presenting results from our analyses, we concentrate on reports of perceived declines in health since the start of the pandemic, because relatively few students reported improvements during this period.

**Stressors.** We asked about a wide range of financial and illness-related stressors. Questions related to financial stressors included whether respondents had become more concerned about being able to pay for college education (1 = yes, 0 = no), whether they had become more concerned about finding a job after completing college (1 = more concerned, 2 = less concerned, 3 = no change), whether they and/or a member of their family had been laid off or furloughed during the pandemic (1 = yes, 0 = no), whether they or a member of their family had taken a pay cut during the pandemic (1 = yes, 0 = no), how worried

they had been about having enough to eat (1 = never worry, 2 = sometimes worry, 3 = often worry), and how worried they had been about having a place to live (1 = never worry, 2 = sometimes worry, 3 = often worry). Questions regarding illness-related stressors included whether they or a family member had contracted COVID-19 (1 = yes, 0 = no for both measures), whether a family member had died from COVID-19 (1 = yes, 0 = no), and how worried they were about friends, family, or themselves getting COVID-19 (1 = never worry, 2 = sometimes worry, 3 = often worry).

**Covariates.** To adjust for potentially relevant pre-pandemic differences, all models included measures of respondent’s self-reported race/ethnicity (1 = non-Hispanic White, 2 = non-Hispanic Black, 3 = Hispanic, 4 = non-Hispanic Asian/Pacific Islander, 5 = other/multiple), parental education (highest of either parent, expressed in years), subjective social status, gender identity (1 = male, 2 = female, 3 = other), age (in years), and high school GPA. Subjective social status was measured on a ten-point scale, with lower values indicating less advantage relative to other young people in the US and higher values indicating more advantage ([Adler et al., 2000](#)).

### 2.4. Modeling strategy

Multinomial logistic regression models were fit for each outcome,  $Y$ , where  $Y$  reflects *perceived change over time* in the focal variable (i.e., mental health, physical health, educational expectations, and educational certainty).<sup>5</sup> Models were fit sequentially, beginning with a baseline specification that included indicators of disability status and the sociodemographic and academic controls listed above. We then refit the baseline model twice: once after adding illness-related stressors (our first set of mediators) and a second time after also incorporating financial stressors (our second set of mediators). Cross-model comparisons were used to evaluate changes across model specifications in the focal estimates ([Mize et al., 2019](#)). This strategy allowed us to additively decompose the “total effect” associated with disability status (as observed in our baseline model) into “direct” and “indirect” components, with indirect effects operating through students’ stress exposures and direct effects operating via alternative pathways.<sup>6</sup> All of the estimates we present are weighted (to adjust for non-random selection into the optional COVID module) and in the metric of probabilities (i.e., predicted probabilities and average marginal effects (AMEs)) to facilitate interpretation.

In supplementary analyses, we assessed the sensitivity of our estimates by (1) employing alternative definitions of disability status (i.e., our alternative five-category measure of disability that differentiates between mental health conditions and learning disabilities); and (2) investigating potential issues related to endogeneity.<sup>7</sup> For the latter, we

<sup>5</sup> Variance estimates are clustered at the school level. In auxiliary analyses, we refit our models using multilevel mixed effects regressions, with students nested within institutions. The estimates obtained were virtually identical to our single-level estimates, and likelihood ratio tests comparing the two-level models to their one-level counterparts could not reject the null that they were equivalent.

<sup>6</sup> We use the language of mediation analysis (i.e., total effects, direct effects, and indirect effects) as shorthand, but we caution against drawing strong causal conclusions based on observational data. To make a causal argument, assumptions regarding unobserved and treatment-induced confounding would have to be met ([VanderWeele, 2015](#)).

<sup>7</sup> Although not formally necessary given the way our dependent variables were measured ([Allison, 1990](#)), we also constructed measures of mental and physical health during high school using retrospective reports provided by a random subset of respondents ( $n = 2071$ ). We used these measures in supplementary models to adjust for pre-pandemic differences, by disability status, in students’ mental and physical health. The estimates we obtained were generally consistent with those reported below but had wider confidence intervals due to the reduced sample size. See Appendix Figures A1 and A2 for more information.

<sup>4</sup> Further disaggregation of disability status was not possible due to concerns about cell sizes.



**Table 1**  
Descriptive statistics.

	Full sample	Neurotypical students	Students with disabilities	Students on the spectrum	F-statistic (df = 2, 2393)	p-value
Declining mental health	49.26	41.89	62.92	51.86	49.03	<.01
Declining physical health	33.55	29.42	40.44	43.52	15.49	<.01
Less certain of educational plans	12.68	10.51	15.64	25.24	9.06	<.01
Lower educational expectations	10.37	9.33	12.45	8.85	2.59	.08
Race/ethnicity						
Non-Hispanic White	71.41	66.93	78.16	90.27	31.01	<.01
Non-Hispanic Black	4.41	4.80	3.81	2.96	0.85	.43
Hispanic	7.39	7.83	6.98	2.78	3.03	.05
Non-Hispanic Asian/Pacific Isl.	11.88	15.83	5.49	0.00	168.50	<.01
Other/Multiple	4.92	4.62	5.56	3.99	0.56	.57
Gender identity						
Male	34.74	42.64	18.34	51.50	89.32	<.01
Female	63.18	56.56	77.73	40.23	67.84	<.01
Other	2.08	0.80	3.93	8.27	11.60	<.01
US born	88.68	85.30	94.58	94.15	30.24	<.01
Years at institution						
First	31.85	31.73	31.04	43.39	2.05	.13
Second	25.92	26.10	26.12	19.88	0.83	.44
Third	23.16	22.25	25.16	19.98	1.43	.24
Fourth	17.13	18.19	15.54	12.64	1.99	.14
Five or more years	1.94	1.73	2.15	4.12	0.70	.50
Age	20.13 (1.41)	20.08 (1.36)	20.20 (1.46)	20.27 (1.77)	1.93	.15
Parental education in years	16.11 (2.50)	16.18 (2.50)	15.92 (2.49)	16.81 (2.43)	5.89	.00
Subjective social status growing up	6.59 (1.56)	6.78 (1.49)	6.24 (1.60)	6.51 (1.64)	31.25	<.01
High school GPA	3.69 (0.42)	3.74 (0.38)	3.63 (0.48)	3.55 (0.45)	18.02	<.01

Note: Means (and standard deviations) are given for continuous variables; percentages are reported for categorical variables. F-statistics were obtained from adjusted Wald tests testing the null that the sub-group estimates are indistinguishable outside of sampling error. All estimates are weighted to adjust for selection into the analytic sample.  $n = 2395$ . See text for more details.

carried out a simulation exercise in which we evaluated how many students with a mental health condition would have had to have experienced onset *because of the pandemic* in order to change our inferences regarding disability. If the number returned by the simulation was plausibly low, it would raise concerns about simultaneity bias and the internal validity of our estimates (Li & Frank, 2020). We describe these additional analyses in more detail after presenting our main results.

### 3. Results

#### 3.1. Bivariate analyses

Table 1 presents weighted descriptive statistics, with separate estimates for the full sample, non-disabled neurotypical students, students with mental disabilities, and students on the autism spectrum. Differences across subgroups were evaluated using adjusted Wald tests. Of the 2395 students in our analytic sample, 71 (3%) were identified as being on the autism spectrum and 804 (34%) reported another cognitive, learning, or mental health condition (21% of students reported more than one diagnosis).<sup>8</sup> Overall, 49.3% of respondents said their mental health declined during the first year of the pandemic, 33.6% said their physical health got worse, 12.7% said they became less certain about their educational plans, and 10.4% said their educational expectations were lower than they were before the pandemic. Sub-group differences across these items were substantively large and significant ( $p < .01$ ) in three out of four cases, with educational expectations providing the

exception ( $F_{2,2393} = 2.59$ ,  $p = .08$ ).

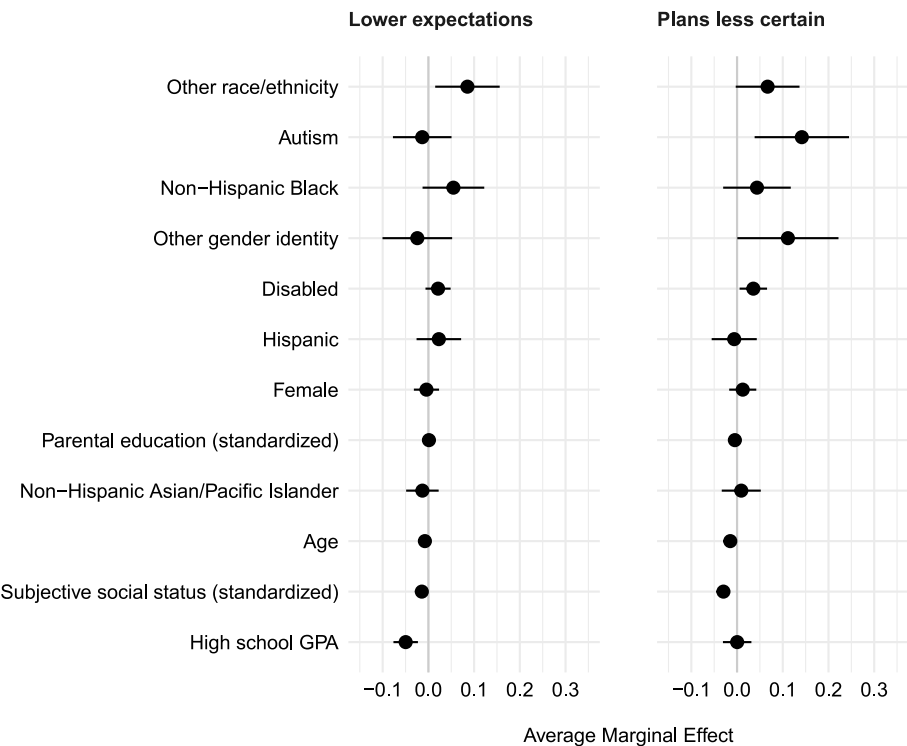
In terms of demographics, neurotypical students were more likely to belong to a minority group than students with disabilities ( $F_{1, 2394} = 35.22$ ,  $p < .01$ ) and students on the spectrum ( $F_{1, 2394} = 39.69$ ,  $p < .01$ ), and were less likely to be US born ( $F_{1,2394}^{neurotypical \ v \ ASD} = 8.82$ ,  $p < .01$ ;  $F_{1,2394}^{ASD \ v \ disabled} = 58.96$ ,  $p < .01$ ). Although the sample as a whole was disproportionately female (63.2%), students on the spectrum (51.5%) were more likely to be male ( $F_{1,2394}^{ASD \ v \ neurotypical} = 35.22$ ,  $p < .01$ ;  $F_{1,2394}^{ASD \ v \ disabled} = 35.22$ ,  $p < .01$ ). They also tended to come from more highly educated families ( $F_{1,2394}^{ASD \ v \ neurotypical} = 4.37$ ,  $p < .05$ ;  $F_{1,2394}^{ASD \ v \ disabled} = 8.51$ ,  $p < .01$ ). These patterns are broadly consistent with research on gender gaps in college attendance (DiPrete & Buchmann, 2013), and mirror what we know about the epidemiology of autism (Durkin et al., 2010; Lai et al., 2015; Newschaffer et al., 2007).

#### 3.2. Multivariate models of COVID-related changes

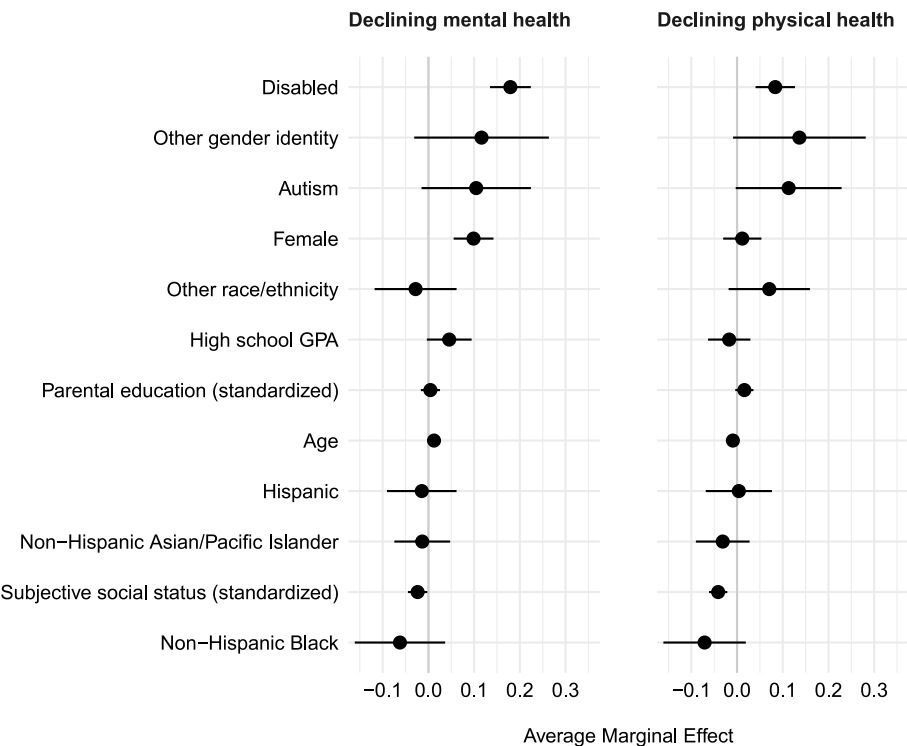
Figs. 1 and 2 present estimates—expressed in terms of AMEs and 95% confidence intervals—from our baseline model relating disability status to changes in students' educational expectations (Fig. 1) and mental and physical health (Fig. 2). Results for students' background characteristics—including race/ethnicity, gender identity, parental education, age, subjective social status, and high school GPA—are also provided to facilitate useful comparisons, with estimates arranged vertically along the y-axis from largest (most positive) to smallest (most negative).

As a group, students with disabilities were no more or less likely to downgrade their educational expectations compared to nondisabled/neurotypical students (predicted probability = .118 versus .097; AME = .021;  $p = .13$ ), but they were significantly more likely to express increased uncertainty about their expected level of schooling (predicted

<sup>8</sup> The National College Health Assessment estimates that roughly 35% of college students report anxiety that interferes with their academic performance, 10% report ADD/ADHD, and 26% report depression (Oswalt et al., 2020). The numbers in our sample—which we provide in Appendix Table A2—are generally similar.



**Fig. 1.** Average marginal effects on the probability of lowering educational expectations or reporting increased educational uncertainty since the start of the COVID-19 pandemic. Solid circles provide point estimates; attached line segments give 95% confidence intervals. Reference categories for categorical predictors are Neurotypical/no disability (Disabled, Autism); Male (Other gender identity, Female); Non-Hispanic White (Other race/ethnicity, Hispanic, Non-Hispanic Asian/Pacific Islander, Non-Hispanic Black). See text for more details.



**Fig. 2.** Average marginal effects on the probability of reporting declining mental or physical health since the start of the COVID-19 pandemic. Solid circles provide point estimates; attached line segments give 95% confidence intervals. Reference categories for categorical predictors are Neurotypical/no disability (Disabled, Autism); Male (Other gender identity, Female); Non-Hispanic White (Other race/ethnicity, Hispanic, Non-Hispanic Asian/Pacific Islander, Non-Hispanic Black). See text for more details.

probability = .145 versus .110; AME = .036;  $p < .05$ ). They were also more likely to report a decline in mental health (predicted probability = .608 versus .429 among neurotypical students; AME = .179;  $p < .01$ ), and more likely to characterize their physical health as worse than before the pandemic started (predicted probability = .386 versus .303;

AME = .084;  $p < .01$ ).

Similar patterns are evident for students on the autism spectrum, whose predicted probabilities of increased educational uncertainty (.252), worsening mental health (.534), and worsening physical health (.415) were all higher than the corresponding estimates for neurotypical

students (AMEs = .142, .105, and .113;  $p < .01$  for the first outcome;  $p < .10$  for the second two outcomes). These differences did not extend to students' educational expectations—the probability of reporting lower expectations was roughly equivalent for students on the spectrum (.083) and neurotypical students (.097) (AME = -.013;  $p = .68$ ).

We can put these probabilities into perspective by comparing them to estimates for other sociodemographic groups. In our sample, women (.527) were more likely than men (.428) to experience a decline in mental health (AME = .099;  $p < .01$ ), African Americans (.151) were more likely than Whites (.096) to lower their educational expectations (AME = .055;  $p < .10$ ), and socioeconomically disadvantaged students (1 SD below the mean on subjective social status) were more likely (.377) than their more advantaged (1 SD above the mean) classmates (.294) to report a decline in physical health (AME = .040;  $p < .01$ ). In only one of these cases—the estimates for African Americans in the model predicting changes in educational expectations—do these estimates exceed the probabilities we recovered for students on the spectrum and students with disabilities, though the differences were not significant at the  $p < .05$  level.

### 3.3. Students' stress exposures as mediators

The estimates shown in Figs. 1 and 2 highlight differences in how college students responded to the first year of the COVID-19 pandemic. Although declines in educational certainty, mental health, and physical health were common across sub-groups, students with disabilities were especially vulnerable. In this section, we consider whether, and to what extent, students' stress exposures explain the group differences we have observed thus far.

Table 2 presents AMEs from a series of nested models. Estimates from the baseline model, given in the first column (M1), are the same as those presented above. Model 2 (M2) adds measures of illness-related stressors and model 3 (M3), our fully specified model, makes additional adjustments for financial stressors. To formally compare AMEs across models, we calculated cross-model differences and standard errors using the framework proposed by Mize et al. (2019). If differences in stress exposures *do not* explain the relationship between disability status and our outcomes, the cross-model differences given in the final three columns (i.e., M1 – M2, M2 – M3, and M1 – M3) should be indistinguishable from zero. Conceptually, this would be akin to saying that financial and illness-related stressors are not mediators on the path from disability status to health and/or educational expectations.

Together, financial and illness-related stressors account for between 15% and 37% of the group differences we observed in our baseline models [(M1 – M3)/M1], with estimates varying by outcome and subgroup comparison. Exposure to illness-related stressors appears to have been especially consequential for students with disabilities (explaining  $[(0.026/.179) \times 100\%]$  15% of the AME we obtained from our model predicting mental health and  $[(0.024/.084) \times 100\%]$  29% of the AME from our model predicting physical health), whereas financial stressors played a relatively more important role for students on the autism spectrum (accounting for  $[(0.031/.113) \times 100\%]$  27% of the group difference we observed with respect to physical health and  $[(0.027/.142) \times 100\%]$  19% of the difference we observed with respect to educational uncertainty). All of these cross-model differences are significant at the  $p < .05$  level or better, indicating that the null hypothesis of no mediation can be rejected.

### 3.4. Variation across types of disabilities

Do the patterns reported above hold across different cognitive, learning, mental health, and neurodevelopmental disabilities? We investigated this question by re-parameterizing our models. Specifically, we disaggregated our measure of disability status into five categories: (1) non-disabled, neurotypical students ( $n = 1520$ ); (2) students with a mental health diagnosis (depression, PTSD, anxiety, or other mental

health condition) ( $n = 577$ ); (3) students with a learning disability (ADD/ADHD or other learning disorder) ( $n = 84$ ); (4) students with a mental health diagnosis *and* a learning disability ( $n = 143$ ); and (5) students with an autism spectrum disorder ( $n = 71$ ). To maintain adequate cell sizes, the last of these categories includes students who may (or may not) have also had a mental health diagnosis and/or learning disability.<sup>9</sup>

Fig. 3 presents AMEs and 95% confidence intervals from our models relating specific types of disability status to changes in students' educational expectations and mental and physical health since the start of the pandemic. Non-disabled, neurotypical students serve as the reference category in each plot. Because they are similar to the results from previous figures, we do not include estimates for students' background characteristics—but all models included our full set of controls.

There are at least two results worth emphasizing. First, students with learning disabilities (predicted probability = .225) and students on the spectrum (predicted probability = .253) were more likely than other groups to report reduced certainty in their educational expectations (as indicated in the rightmost plot), outpacing neurotypical students (predicted probability = .110) and students with a mental health diagnosis (predicted probability = .139) by significant margins ( $p < .05$  in all cases). This is a departure from the previous results, where group differences in uncertainty were less pronounced. Second, students with a mental health diagnosis—or a mental health diagnosis *and* a learning condition—were the most likely to report declines in mental and physical health during the pandemic. The differences relative to non-disabled, neurotypical students (as indicated by the AMEs in the two leftmost plots) were generally large and significant. In short, students who were already vulnerable in the academic and health domains became more so during the pandemic.

### 3.5. Timing of diagnosis

We suspect that most disabled students in our sample were diagnosed prior to the pandemic, or that their disability diagnosis would have occurred even in the absence of the pandemic, but this need not be the case for everyone. A decline in mental health brought on by the pandemic could account for at least some of the disabilities (particularly mental health conditions) respondents reported, putting us at risk of endogeneity bias.<sup>10</sup> Ideally, we would have information on date of onset, which would allow us to reclassify (as non-disabled) students whose disability was plausibly the *result* of the pandemic. Unfortunately, this information was not collected. As an alternative, we carried out a simple simulation exercise in which we (1) randomly selected successively larger groups of respondents with a disability *and* declining mental health; and (2) reassigned them to the neurotypical, non-disabled group before refitting our models. This allowed us to evaluate how many students with disabilities would have had to have experienced onset after the pandemic in order to change our results.

Estimates from our model predicting changes in mental health are given in Fig. 4. The x-axis gives the percentage of disabled students that was reassigned as a part of the simulation and the y-axis gives the average AME across replications (we repeated each simulation 100 times), with positive values indicating that disabled students had a higher probability of reporting declines than non-disabled, neurotypical

<sup>9</sup> Of the 71 students in our sample who are on the spectrum, 55 (77.5%) reported at least one other condition. The most common condition reported was an anxiety disorder (57.6%), followed by depression (46.6%), ADD/ADHD (45.0%), other mental health conditions (17.0%), PTSD (10.0%), and learning disorders (4.4%). See Appendix Table A2 for more details.

<sup>10</sup> This form of endogeneity is presumably less of a concern in our models predicting changes in educational expectation and changes in physical health, and for the estimates we produce for students who reported an autism spectrum disorder.

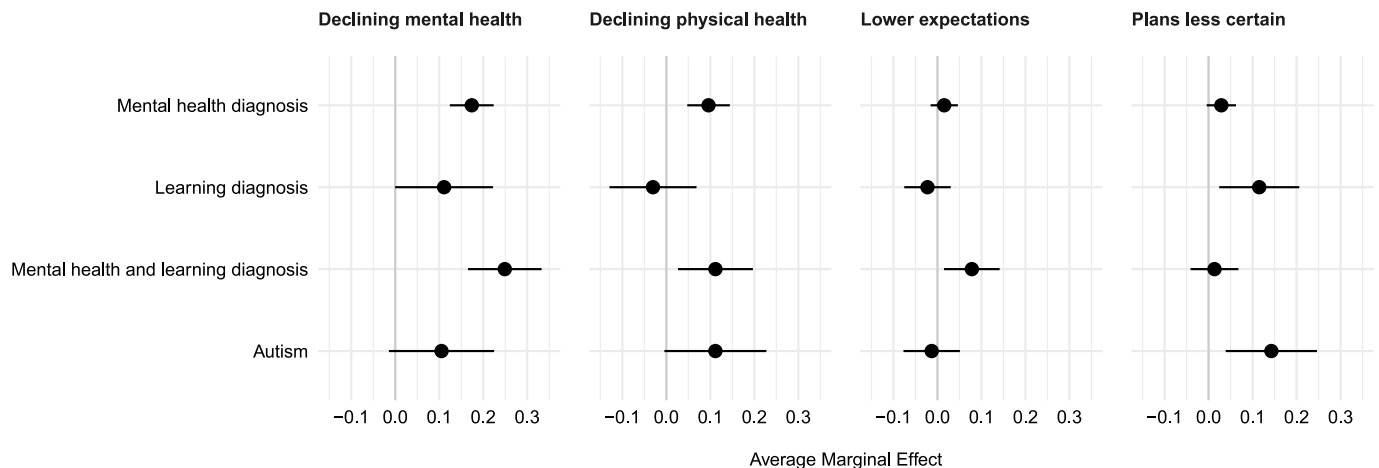
**Table 2**

Cross-model comparisons of average marginal effects from nested models.

	(M1) Controls only	(M2) M1 + illness stress.	(M3) M2 + fin. stress.	Cross-model differences		
				M1 – M2	M2 – M3	M1 – M3
<b>A. Disabled vs neurotypical</b>						
Worse mental health	0.179*** (0.023)	0.153*** (0.023)	0.146*** (0.023)	0.026*** (0.005)	0.007* (0.004)	0.033*** (0.006)
Worse physical health	0.084*** (0.022)	0.060*** (0.022)	0.053** (0.022)	0.024*** (0.005)	0.007* (0.004)	0.030*** (0.006)
Lower educational expectations	0.021 (0.014)	0.019 (0.014)	0.014 (0.014)	0.002 (0.002)	0.005* (0.003)	0.007** (0.003)
Less certain of expectations	0.036** (0.015)	0.032** (0.016)	0.028* (0.015)	0.004 (0.003)	0.004 (0.003)	0.007* (0.004)
<b>B. ASD vs neurotypical</b>						
Worse mental health	0.105* (0.061)	0.094 (0.060)	0.066 (0.058)	0.011 (0.012)	0.028** (0.012)	0.039** (0.016)
Worse physical health	0.113* (0.059)	0.108* (0.060)	0.078 (0.057)	0.005 (0.012)	0.031** (0.013)	0.035** (0.016)
Lower educational expectations	−0.013 (0.033)	−0.016 (0.032)	−0.028 (0.028)	0.002 (0.004)	0.012 (0.008)	0.014 (0.009)
Less certain of expectations	0.142*** (0.053)	0.137*** (0.053)	0.110** (0.048)	0.005 (0.006)	0.027** (0.013)	0.032** (0.014)

Note: Outcomes are listed in rows in the leftmost column of the table. Panel A provides AMEs and differences in AMEs—after adding each set of mediating variables—for the comparison of disabled students versus neurotypical students. Panel B provides the same information for students on the spectrum. All models include measures of respondents' race/ethnicity, gender, age, high school GPA, parental education, and subjective social status. Standard errors are given in parentheses.  $n = 2395$ . See text for more details.

\*\*\* $p < .01$ ; \*\* $p < .05$ ; \* $p < .10$  (two-tailed test).



**Fig. 3.** Average marginal effects using a disaggregated measure of disability status. Solid circles provide point estimates; attached line segments give 95% confidence intervals. Neurotypical/no disability or mental health condition is the reference category throughout. See text for more details.

students. Not unexpectedly, estimates decrease monotonically as the number of reassigned students grows increasingly large, but they only approach 0 under extreme (and, we would argue, unrealistic) conditions. Even if 20 percent of disabled students who reported declines in mental health were reclassified as non-disabled and neurotypical (under the assumption that their disability began after the pandemic), we would still observe a positive and substantively meaningful effect (mean AME = 0.081; mean 95% confidence interval = 0.035–0.127). This provides a useful lower bound for the estimates reported earlier and offers assurance that our estimates are not an artifact of endogenous changes in disability status.

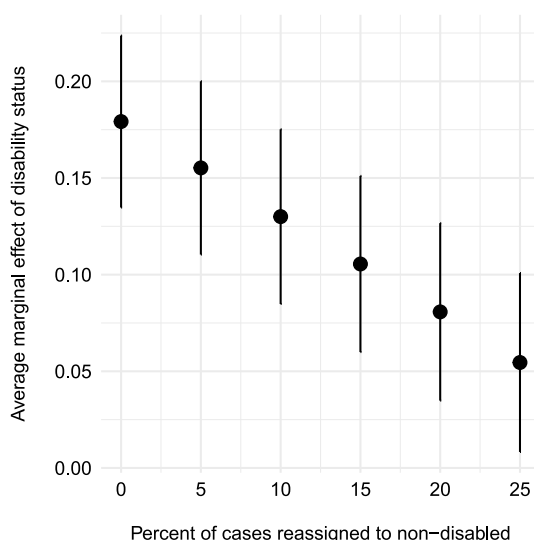
#### 4. Discussion

The purpose of our study was to evaluate the association of disability status with college students' responses to the COVID-19 pandemic and to evaluate the extent to which the association is attributable to financial and illness-related stressors. Consistent with expectations, we observed

that students with disabilities were more likely to report increased uncertainty about achieving their expected level of education, with some variation by disability type. This could have important downstream consequences. Students with less certain educational plans perform more poorly in school than others (Gutman et al., 2012), suggesting another way that the pandemic has increased the educational vulnerability of disabled college students. Notably, the decline in educational certainty associated with disability status was larger than that associated with all other major sociodemographic characteristics except race.

In addition, we observed that students with disabilities were more likely to report declines in physical and mental health during the pandemic than non-disabled, neurotypical students. These declines were particularly pronounced among students with a mental health diagnosis (with or without a learning disability). This result runs counter to a longitudinal study of college students in Canada, which reported greater or equal increases in psychological distress among students without prior mental health concerns (Hamza et al., 2021), but is broadly consistent with prior disaster research which links pre-existing





**Fig. 4.** Estimated effect of disability status on changes in mental health under alternative assumptions about timing of onset. Successively larger groups of students with disabilities and declining mental health were reclassified as non-disabled, neurotypical under the assumption that at least some of the mental health conditions in our sample were the result of the pandemic. Solid circles provide point estimates averaged across 100 replications; line segments give 95% confidence intervals. Positive values indicate that declines in mental health were more likely for students with disabilities as compared to non-disabled, neurotypical students. See text for more details.

vulnerabilities to a wide range of post-disaster outcomes (see, e.g., Fothergill & Peek, 2004; Laska & Morrow, 2006; Tierney, 2019).

The observed declines in educational certainty and health were, to a meaningful degree, attributable to variation in students' stress exposures. In particular, illness-related stressors—illness of self, family members, or worries about the same—were implicated in changes in physical and mental health for students with disabilities, whereas financial stressors predominated for students on the spectrum. These findings underscore the importance of stress exposures during the pandemic as proximate mechanisms for inequality (Bambra et al., 2020). Disability status—like other dimensions of stratification—shapes students' experiences with COVID-related stressors, placing them at greater or lesser risk of negative educational and/or health outcomes.

Pursuing these findings further will require data on other potential mediators. Our survey included several measures of stressors in two key life domains—finances and illness—but did not have good measures of social isolation or pandemic-induced changes to students' social networks. If it did, we suspect those measures would have contributed additional explanatory power. We know from prior research that students with disabilities are more isolated and tend to have fewer friends than other students (Bruefach & Reynolds, 2021; Francis et al., 2019). Given evidence

that social isolation increased more during the first part of the pandemic among people who had fewer friends (Kovacs et al., 2021), it seems reasonable to expect that students with disabilities experienced more profound social isolation during that part of the pandemic as well.

Information about how successfully institutions pivoted to provide services to students with disabilities—which our data do not include—would also be useful. Research indicates that many institutions struggled to continue accommodations to students with disabilities during the early stages of the pandemic. A study of information about COVID-19 on New York college websites, for example, found that many institutions did not provide easy access to information about disability accommodations associated with the pandemic (Meleo-Erwin et al., 2021). That finding mirrors more general evidence that student disability services often are not well-publicized and may be difficult for students to locate and access (Viesel et al., 2020). For students with disabilities, lack of access to information on accommodations likely added significant stress burden.

These limitations aside, our analysis provides some of the first data on how college student experiences during the first year (2020–2021) of the pandemic differed based on disability status. Overall, our findings support other calls for more attention to the unique needs of college students with mental disabilities (Shifrer, 2013). Even before the pandemic, this group of students reported less favorable academic and social outcomes than their peers (McLeod et al., 2019). The pandemic exacerbated these inequities in ways that are likely to have long-term implications for their educational and occupational attainments. To mitigate these inequities, institutions should reconsider the structure and content of supports for disabled students, the strategies they use to deliver them, and the steps they take to reach students who choose not to disclose their disabilities to college support offices (Kranke et al., 2013). Integrated support services that address the full array of challenges that students with mental disabilities face—including, but not limited to, illness- and finance-related stressors brought on by the pandemic—may be especially effective in this regard.

#### Authors statement

Contributions to the study were divided as follows. Halpern-Manners: Conceptualization, Methodology, Formal analysis, Writing-Original draft preparation, Visualization, Supervision, Funding acquisition. McLeod: Conceptualization, Writing-Original draft preparation, Supervision, Funding acquisition. Anderson: Writing-Review & Editing, Data Curation. Ekl: Writing-Review & Editing.

#### Ethical statement

We have no financial or personal relationships with other people or organizations that could inappropriately influence or bias the work described herein.

## Appendix

**Table A1**

Question wording for outcome measures

Question wording (in italics) and response options
<i>Do you feel more or less certain that you will achieve your expected level of education than you did before the coronavirus (COVID-19) pandemic began?</i>
I feel more certain that I will achieve my expected level of education
I feel less certain that I will achieve my expected level of education
I feel about the same
<i>Have you expectations for the highest level of education you would complete changed since the coronavirus (COVID-19) pandemic began?</i>
No
Yes

(continued on next page)

**Table A1** (continued)

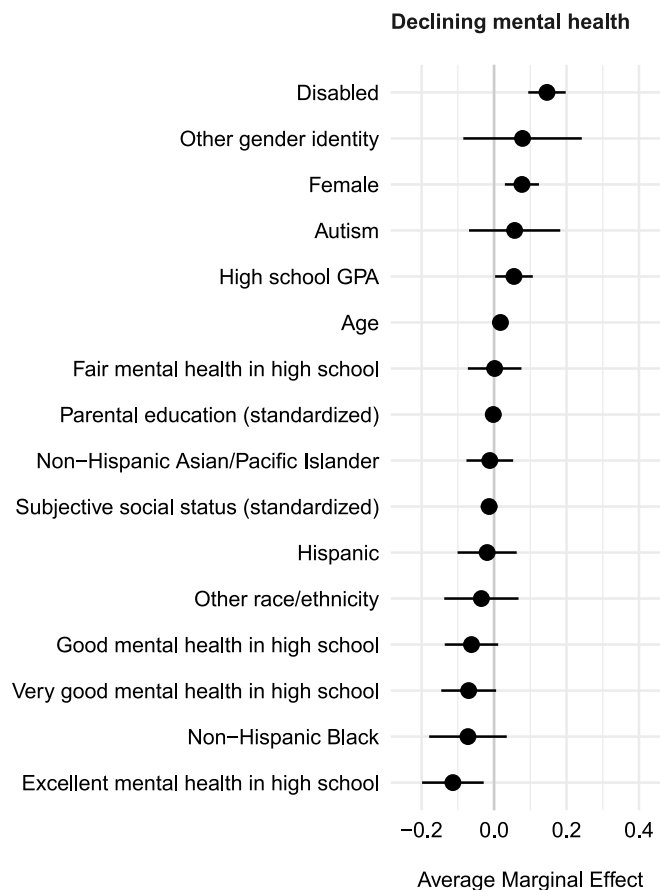
Question wording (in italics) and response options
<i>[If yes] How have your expectations changed?</i>
I now expect to achieve a higher level of education than I did before the pandemic
I now expect to achieve a lower level of education than I did before the pandemic
<i>Would you say that your overall physical health has improved, gotten worse, or stayed about the same since the COVID-19 pandemic began?</i>
My physical health has improved
My physical health has gotten worse
My physical health has stayed about the same
<i>Would you say that your overall mental health has improved, gotten worse, or stayed about the same since the coronavirus (COVID-19) pandemic began?</i>
My physical health has improved
My physical health has gotten worse
My physical health has stayed about the same

**Table A2**

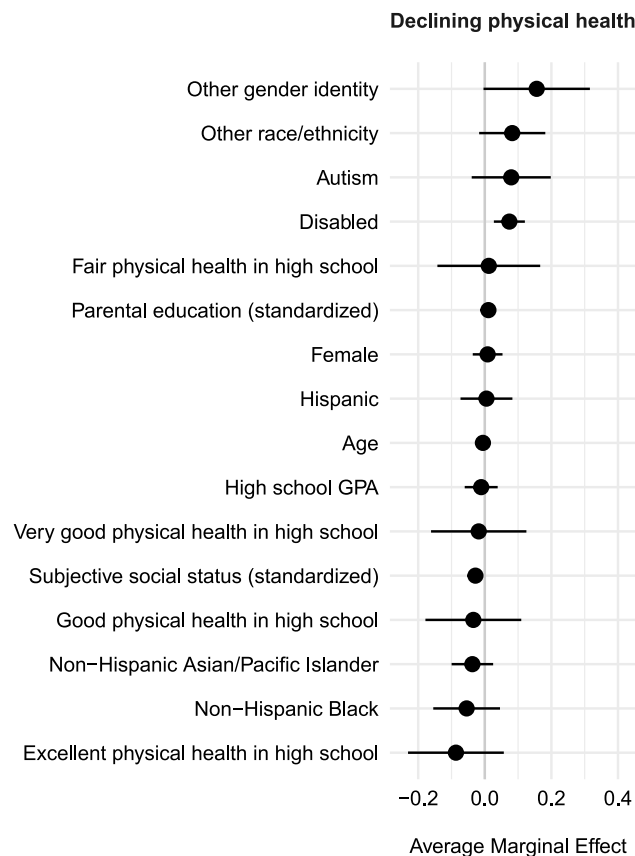
Mental disabilities by subgroup

	FullSample	Students with disabilities	Students on the spectrum
Anxiety disorder	26.82	74.63	57.59
Depression	21.79	60.66	46.55
PTSD	3.52	9.58	9.96
ADD/ADHD	9.92	25.48	44.97
Learning disorder	1.62	4.42	4.37
Other mental health disorder	4.13	10.77	16.96

Note: All estimates are weighted and presented in terms of percentages.



**Appendix Fig. A1.** Average marginal effects on the probability of reporting declines in mental health, after adjusting for mental health in high school. Solid circles provide point estimates; attached line segments give 95% confidence intervals. Reference categories for categorical predictors are Neurotypical/no disability (Disabled, Autism); Male (Other gender identity, Female); Non-Hispanic White (Other race/ethnicity, Hispanic, Non-Hispanic Asian/Pacific Islander, Non-Hispanic Black). See text for more details.



**Appendix Fig. A2.** Average marginal effects on the probability of reporting declines in physical health, after adjusting for physical health in high school. Solid circles provide point estimates; attached line segments give 95% confidence intervals. Reference categories for categorical predictors are Neurotypical/no disability (Disabled, Autism); Male (Other gender identity, Female); Non-Hispanic White (Other race/ethnicity, Hispanic, Non-Hispanic Asian/Pacific Islander, Non-Hispanic Black). See text for more details.

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