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High Parental Education Protects Against Changes in Adolescent Stress and Mood Early in the COVID-19 Pandemic

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A B S T R A C T

Purpose: The COVID-19 pandemic has brought dramatic changes to the daily lives of U.S. adolescents, including isolation from friends and extended family, transition to remote learning, potential illness and death of loved ones, and economic distress. This study's purpose is to measure changes in adolescents' perceived stress and mood early in the pandemic.
Methods: The present study drew from a racially and ethnically diverse sample of high school student participants in an ongoing intervention study in the Midwestern U.S., 128 of whom provided reports of their daily stress and mood both before (December 2017 to March 2020) and during (March–July 2020) the COVID-19 pandemic. We expected to see increases in perceived stress, declines in positive mood states, and increases in negative mood states, with larger impacts on individuals from households with lower parental education levels.
Results: Multilevel models revealed increases in perceived stress primarily for adolescents from low/moderate education families during the pandemic. Impacts on mood states also diverged by education: adolescents from low/moderate education households reported feeling more ashamed, caring, and excited than before the pandemic, changes that were not shared by their peers from high education households. Although changes in mood that arose with the onset of the pandemic became less pronounced over time, increased levels of home- and health-related stress stayed high for low/moderate education adolescents.
Conclusions: During the COVID-19 period, we observed disparate impacts on adolescents according to household education level, with more dramatic and negative changes in the emotional well-being of adolescents from low/moderate education households.

IMPLICATIONS AND CONTRIBUTION

Our longitudinal examination of changes in adolescent stress and mood during the COVID-19 pandemic revealed that adolescents from highly educated households were largely protected from increases in stress and changes in mood that their peers from less educated families reported. Findings raise concerns about socioeconomic disparities in adolescent emotional well-being.

The arrival of the COVID-19 pandemic brought changes to the daily lives of those residing in the United States (U.S.) without recent comparison. Most U.S. states instituted states of emergency, with most K-12 schools transitioning to virtual learning. Many businesses transitioned to remote operations and furloughed workers or reduced their hours, with other "essential" businesses continuing to operate. Altogether the pandemic and associated mitigation efforts had broad and concerning impacts for families' finances and health: a record number of individuals made new unemployment claims [1] and surveys of adults

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identified high rates of food insecurity and poor mental health days, in particular among parents [2,3].

Researchers and policymakers who focus on youth and families immediately voiced concern about how these disruptions would affect young people, with many speculating that adolescents would experience increases in stressors and mental health problems [4]. In addition to dealing with stressors more directly related to the virus (e.g., contracting the virus, taking care of a sick loved one, losing a family member or friend to COVID-19) and its economic impacts (i.e., financial strain), adolescents might experience stress related to the transition to online learning, isolation from friends, and extensive time spent with their immediate family, often in close quarters. Other concerns have been raised about the disruption of services some students receive at school, including access to healthy meals and mental health services [5], which could contribute to financial strain or psychological distress.

Past research has established that major events, like natural disasters, can have negative effects on young people's stress response, mental health, and adjustment both shortly and several years after the event [6,7]. The amount, severity, and intensity of exposure have been associated with risk for adjustment problems and mental health symptoms [8,9]. There is also evidence that individual resources, strong family relationships, and community supports are important protective factors [6,10] that can serve as a much-needed buffer to promote adolescent resilience in times of stress; they may also be disturbed or inaccessible during times of crisis. Despite the importance of studying adolescent stress and well-being during this time, data that directly measure the well-being of children or adolescents during the COVID-19 pandemic in the U.S. have remained scarce. Early evidence documented increases in perceived stress among college-aged individuals [11] and young adults [12]. Impacts on mental health symptoms have been identified both within [13,14] and outside [15] the U.S. But few studies have directly surveyed high school students and, to our knowledge, none have measured their perceived stress or mood states both before and during the pandemic.

For U.S. adolescents, the stress of living through a pandemic may have been compounded by additional stressful events occurring in the Spring and Summer of 2020. In late May, protests against police violence and white supremacy erupted across the country following the murder of George Floyd; these nationally salient events were described as stressful by the majority of adolescents surveyed by the American Psychological Association [16]. These events could also lead to increased stress and negative emotion among adolescents.

Methods

Although there has been copious speculation about the consequences that the COVID-19 pandemic may have for adolescents, few studies have the longitudinal data to empirically test these hypotheses. Here we leverage data from an ongoing study, including pre- and pandemic data on stress levels, sources of stress, and mood states, to examine the varied impacts of the COVID-19 pandemic—and the events of Spring 2020 more broadly—on a racially and ethnically diverse sample of 128 high school students. Given the varied social and economic impacts of the pandemic on families, we expected that impacts of the pandemic on adolescents would also vary. Most centrally, although we expected all youth to be affected by some of the common experiences of the pandemic (e.g., increased social isolation), we anticipated that youth from families with lower levels of parental education would face greater economic and health impacts of the pandemic, resulting in comparatively higher stress and negative mood states.

Participants

Participants were recruited from an ongoing, longitudinal intervention (The intervention consists of an ethnic–racial identity development intervention, the *Identity Project*, and an academic identity curriculum that supports student learning about postsecondary education and career options (Appendix A).) study [17] that enrolled students from two suburban high schools, one public and one private, in the Midwestern U.S. over several academic years (Appendix A). Study participation was open to all English-speaking students in their first year of high school. Our sample includes data from both students actively involved in data collection and students who had previously provided follow-up data and were invited to provide additional data about their experiences of the pandemic via questionnaire report. The present study included respondents who provided two time points of stress and mood data—both prior to the pandemic's onset (December 2017 to March 7, 2020) and during the pandemic data collection period (March 17 to July 31, 2020), yielding an analytic sample of 128 adolescents ($M_{age} = 15.22$, $SD_{age} = .62$; 62% female; 52% ethnic–racial minority, 48% white; Table 1).

Procedure

Participants completed stress and mood state questionnaires before and during the COVID-19 pandemic, as part of an ongoing study. Prepandemic, participants were asked to complete daily diary entries across five consecutive days. The pandemic data were collected in one of two ways. Adolescents who were actively participating in data collection during the spring of 2020 were asked to provide daily stress and mood data via diaries completed once weekly for several weeks between March and May 2020 (N = 22). For participants who had previously completed follow-up measures, we collected mood and stress reports at a single timepoint (between May and July 2020;

Table 1
Descriptive statistics

Variable	Mean (SD) or number (%)
	N = 128
Female	79 (62%)
Age (range 13–17 years)	15.22 (.62)
Grade	
Ninth	26 (20%)
Tenth	65 (51%)
Eleventh	37 (29%)
Racial–ethnic minority	67 (52%)
Highest level of parental education	
High school or some college	22 (17%)
Bachelor's or some graduate	41 (31%)
Completed graduate education	66 (51%)
Randomized Controlled Trial (RCT) condition	
Intervention	66 (52%)
Control	62 (48%)
School	
Public	94 (73%)
Private	34 (27%)

$N = 106$). These additional data were collected in an effort to survey as many of our study participants as possible about their experiences during the pandemic (without adding undue burden via repeated diary completion). Participants were compensated for each measure completed (Appendix A). The Northwestern University Institutional Review Board approved all procedures.

Measures

Perceived stress. Perceived stress was assessed by asking participants to rate how stressful (0 = *Not at all stressful*; 3 = *Very stressful*) they found each of 11 sources of stress that day. Based on the results of a principal components analysis, these were averaged and standardized into composites reflecting either school/social stressors (homework, tests/presentations, sports/clubs, peers; $\alpha = .62$) or home/health stressors (romantic (Our decision to include romantic stressors in the home/health composite was empirically informed, as both pre- and pandemic, adolescents' perceived romantic stress had higher item-test correlation with the home/health composite than with the school/social composite.), family, work, schedule, mental health, physical health, current events; $\alpha = .76$).

Daily mood. Mood state on the days of measurement was reported via items adapted from the Positive and Negative Affect Schedule [18]. Participants were asked to rate how much they had been feeling each mood that day (0 = *None at all*; 3 = *Very*). Principal components analysis identified three mood state composites: negative social-evaluative (NSE) (lonely, ashamed, embarrassed, judged, guilty, rejected; $\alpha = .78$), negative nonsocial (sad, nervous, tired, angry, frustrated; $\alpha = .64$), and positive (calm, excited, happy, caring, proud, energetic; $\alpha = .72$). Day-level composites were created by averaging and standardizing across the individual mood state items (Table S1).

Parent education. Students reported the education level of each of their primary caregivers on a five-point scale (1 = *High school*; 5 = *Completed graduate education*). Nearly half of our sample reported that at least one caregiver had completed a graduate degree. We categorized the group that had at least one parent with a graduate degree as "highly educated" and tested whether adolescents with highly educated parents reported a different experience of the pandemic than their peers from less highly educated families (Exploratory analyses confirmed the appropriateness of this median split, with low and moderate SES adolescents reporting similar impacts of the pandemic; when a categorical variable was tested, estimated pandemic-related changes for adolescents from high, but not low, education households, were significantly different from those for moderate education adolescents.).

Pandemic timing. We estimated the average effect of the pandemic period with an indicator variable that is set to 1 for all dates on or after March 13, 2020. This start date corresponds to the onset of stay-at-home orders in the Midwestern area in which data were collected; from this point forward, participants also experienced entirely virtually learning. We also created a variable to reflect pandemic timing in weeks since pandemic onset; this variable, which is set to 0 for all dates prior to March 13, 2020, allows us to test whether reports of stress and mood changed linearly over the data collection period, alongside a quadratic term that allows us to estimate a rate of change over time (time since pandemic onset, squared). Of note, this method accounts for *time since pandemic onset* for each response obtained, but not every student provides data more than once during the pandemic period.

Results

Analytic strategy

Our analytic sample consisted of 996 diaries from 128 participants. The mean number of responses per person was 5.35 (SD = 3.84). Analyses were conducted in Stata 14 and employed a pre–post design to estimate whether each outcome of interest changed across the pandemic period. Our preferred model specification is a two-level model that nests daily diaries within participants [19] and uses individual clustering to account for repeated sampling from each participant. Separate models were run for each stress and mood composite; we tested whether parent education level (hereafter, "high" and "low/moderate" household education) moderated the effects observed by interacting an indicator variable for high education with the variables for the onset of the pandemic, time since pandemic onset, and time squared since pandemic onset. Follow-up analyses modeled these associations with individual stressors and moods. Covariates included respondent age, sex, and race/ethnicity as well as intervention condition, school, and day of the week.

Alternate model specifications were considered, including a student fixed effects model and several sensitivity analyses that excluded students from the smaller school site; excluded those who provided pandemic data via survey rather than repeated diary data (Figure S1); modeled household education with three categories (low, moderate, and high) rather than with an indicator for "high"; and tested whether intervention condition moderated the findings for our outcomes of interest. As the overall pattern of results was consistent throughout, results are presented only for our primary model specification.

Adolescent stress

Our models estimated a large but imprecise decrease in stress related to school and peers ($b_{\text{pandemic}} = -.81$, SE = .43, $p < .10$) that was not moderated by household education. In contrast, we observed a significant 1.5 SD increase in home/health-related stress among adolescents in low/moderate education households—a more than fourfold increase relative to prepandemic levels (Table 2; Figure 1) that did not decline across the pandemic period. This increase in stress was not shared by adolescents living in high education households. Among home/health-related stressors, adolescents in low/moderate education households reported significant increases in family ($b_{\text{pandemic}} = 1.67$, SE = .33, $p < .001$) and mental health-related stress ($b_{\text{pandemic}} = .88$, SE = .28, $p < .01$) that were not shared by their peers in high education households (estimates of −.11 SD and .03 SD, respectively, both $p > .20$).

Moderation by ethnic–racial minority status. We also investigated whether the effects observed differed by ethnic–racial minority status. We found that perceived school/social stress decreased significantly during the pandemic for white adolescents from high education households ($b_{\text{pandemic}} = -2.17$, SE = .96, $p < .05$), whereas it increased for white adolescents from low/moderate education households ($b_{\text{pandemic}} = 1.25$, SE = .38, $p < .01$). No

Table 2
Impacts on daily stress composites, by household education level

	School/social stress		Home/health stress	
	Low/moderate	High	Low/moderate	High
Pandemic impact	−.50 (.67)	−.99 (.57)	1.50* (.51)	.01 (.33)
Time (in weeks) since onset	−.03 (.13)	.08 (.10)	−.14 (.11)	.02 (.06)
Time (in weeks) since onset^2	.00 (.00)	.00 (.00)	.00 (.00)	.00 (.00)

All models include an indicator for parental education and control for respondent sex, age, race/ethnicity, intervention condition, day of week, and school site.
*$p < .05$; $p < .01$; $p < .001$.

change in school/social stress was observed during the pandemic for ethnic–racial minority adolescents, regardless of household education. The changes observed for home/health-related stress were not moderated by ethnic–racial minority status.

Adolescent mood

Negative emotions. Parental education moderated the pandemic's impact for NSE emotions: at the onset of the pandemic, adolescents from low/moderate education households reported an increase of more than 1.1 SD in NSE emotions (Table 3). In turn, models also showed a substantial decline in levels of NSE emotions reported by adolescents from low/moderate education households over the remainder of the data collection period; a significant, positive rate of change was identified as well, reflecting a decline in NSE emotions that was steepest immediately following the pandemic's onset and slowed over the weeks that followed. In contrast, adolescents from high education households did not show a significant increase in NSE emotions at the pandemic's onset or a significant change in levels of NSE emotions over time. Follow-up analyses that considered individual emotions (Table S2) revealed that adolescents from low/moderate education households were significantly more likely than those from high education households to report feeling ashamed following the pandemic's onset ($b_{\text{interaction}} = 1.46$, SE = .65, $p < .05$). Follow-up analyses also identified a significant increase in loneliness at the onset of the pandemic that was not moderated by parent education ($b_{\text{interaction}} = -.55$, SE = .67, $p > .20$; Figure 2). We did not observe a significant change in adolescents' reports of negative nonsocial emotions. Among individual mood states, adolescents from high education households report feeling significantly less anger than prepandemic, a change that was not shared by their peers residing in low/moderate education households ($b_{\text{interaction}} = 1.31$, SE = .54, $p < .05$).

Positive emotions. Household education also moderated adolescents' reports of changes in positive emotions during the pandemic period. Reports of positive mood increased significantly among adolescents in low/moderate education households, whereas they decreased significantly for adolescents in high education households ($b_{\text{interaction}} = -1.13$, SE = .30, $p < .001$; Table 3). Among individual emotions, a significant increase in caring was observed at the onset of the pandemic only among adolescents from low/moderate education households. Although adolescents from low/moderate education households reported a significant increase in excitement, their peers in high education

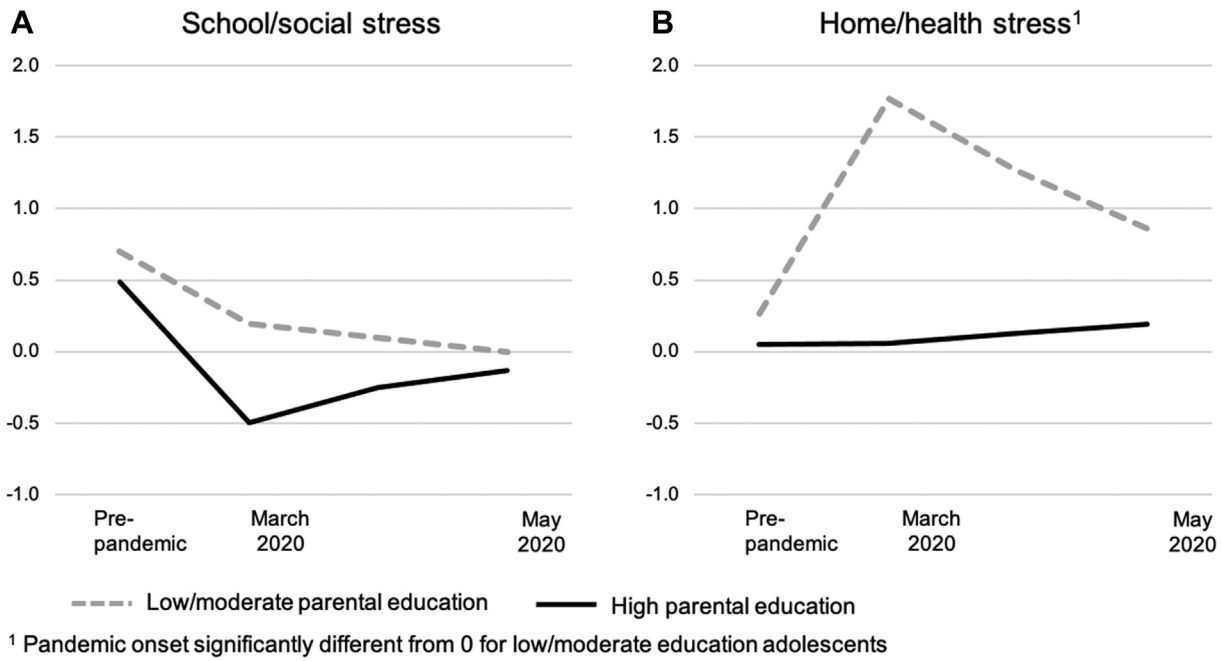

Figure 1. Perceived stress composites during the pandemic period, by parental education. (A) Homework, tests/presentations, sports/clubs, peers ($\alpha = .62$). (B) Romantic, family, work, schedule, mental health, physical health, current events ($\alpha = .76$). All models include an indicator for high SES and control for respondent sex, age, race/ethnicity, intervention condition, school, and day of the week.

Table 3
Impacts on daily mood composites, by household education level

	NSE		Negative nonsocial		Positive	
	Low/moderate	High	Low/moderate	High	Low/moderate	High
Pandemic impact	1.13* (.56)	−.15 (.32)	.49 (.50)	−.26 (.34)	.72** (.23)	−.40* (.19)
Time (in weeks) since onset	−.27** (.08)	.05 (.06)	−.08 (.08)	.04 (.06)	−.11 (.06)	.16** (.06)
Time (in weeks) since onset^2	.01*** (.00)	.00 (.00)	.00 (.00)	.00 (.00)	.01 (.00)	−.01* (.00)

All models include an indicator for parental education and control for respondent sex, age, race/ethnicity, intervention condition, day of week, and school site.
*$p < .05$.
**$p < .01$.
***$p < .001$.

households reported a significant decrease in excitement ($b_{\text{interaction}} = -1.21$, SE = .33, $p < .001$) at the onset of the pandemic (Figure 2).

Moderation by ethnic–racial minority status. When we tested for moderation of pandemic impacts by ethnic–racial minority status, we observed no differences in the overall pattern of effects described above.

Discussion

This study directly surveys a panel of U.S. high school students about their stress and mood both before and during the COVID-19 pandemic, an approach that allows us to identify several impacts of the experience of living through the pandemic and events of 2020. First, and somewhat contrary to our hypotheses, we did not observe universally adverse effects of the pandemic on stress and mood states. Rather, we saw an increase in some forms of stress and mood and a decrease or no change in others, with effects varying by type of stressor and mood state as well as by household education. Specifically, during the COVID-19 pandemic we observed an increase in home- and health-related stress but a trend toward lower school-related stress. Overall, it appears that the transition to virtual learning may have brought a reduction in the daily demands that many high school students face, consistent with early evidence that high school students spent less time on virtual learning than a typical school day [20]. In contrast, adolescents reported a large increase in home- and health-related stress, a composite that encompasses the types of stress that were expected to increase during the shutdown; our results are consistent with these anticipated impacts [4].

The most concerning finding was that the burden imposed by COVID-19 was borne unequally by parental education level, with adolescents from low/moderate education households reporting an overall more negative set of impacts than their high education peers. Specifically, we found that adolescents in low/moderate education households experienced a fourfold increase in home- and health-related stress at the start of the pandemic, largely driven by increases in stress related to family and mental health, that was not shared by their peers in high education households. This disparity extended beyond reported stress, to adolescent reports of their mood states. Adolescents from low/moderate education households reported an overall increase in both NSE and positive emotions, including feeling more ashamed, caring, and excited than before the pandemic, whereas their peers residing in high education households reported decreases in anger and excitement. This divergence in excitement following pandemic onset is challenging to interpret. With increases in both caring and excitement reported by participants from low/moderate education households and decreases in anger and excitement reported by those in high education households, we speculate that these changes in mood may reflect impacts on arousal [21], with adolescents from low/moderate education households exhibiting increases in alertness and attention to pandemic-related events following the pandemic's onset.

The differences observed by household education underscore the unequal economic and daily life impacts of the pandemic. There is evidence that the impacts of the COVID-19 pandemic were borne unequally by household education: the majority of adults with graduate degrees transitioned to work from home, with very few experiencing layoffs [22]. Less-educated workers experienced higher rates of disruptions to employment, with some experiencing a reduction in income and others forced to choose between exposure to the virus via in-person work or forgoing income [2,22]. These differences reflect higher odds of experiencing either economic or health risk for those in households in which parents are unable to work remotely, which could contribute to elevated levels of perceived stress about family, work, or health.

Pandemic timing

One of our key findings was that the pandemic's onset was associated with some changes in adolescent well-being that, when we accounted for time since onset, began to fade within a few weeks of the initial stay-at-home orders. We note that this study's design includes repeated sampling during the pandemic period for only a portion of participants; however, this pattern was even more pronounced in sensitivity analyses that included only this subset of repeatedly sampled participants (Figure S1). We are also unable to distinguish between the passage of time since pandemic onset and the shift from virtual learning to summer break, which began approximately 12 weeks after pandemic onset. Nonetheless, while some initial impacts were estimated to dissipate with time, others remained at their newly elevated levels. The high levels of home- and health-related stress and elevated levels of caring reported by adolescents in low/moderate households persisted through mid-2020.

Implications

This study adds to the literature that documents disparities in the changes that occurred during the COVID-19 pandemic according to household education level [2,22]. Parental education level reflects an aspect of family socioeconomic status (SES) both in its own right and through its association with occupation and household income [23]. Our findings echo others, both within and outside the U.S., that found lower SES [15] and the number of

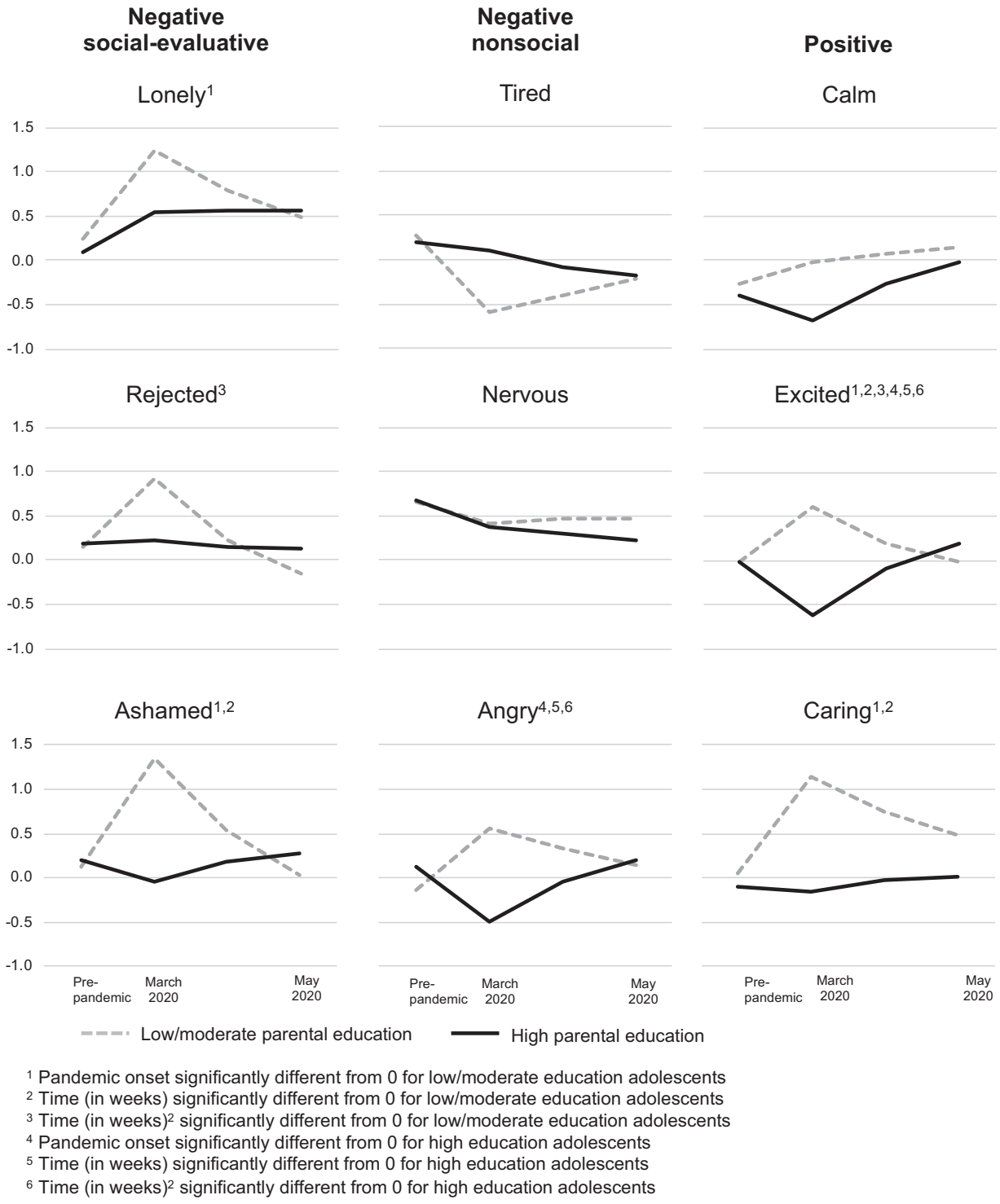

Figure 2. Individual moods during the pandemic period, by parental education. Note. All models include an indicator for high SES and control for respondent sex, age, race/ethnicity, intervention condition, school, and day of the week.

household disruptions associated with COVID-19 [24] to have disproportionate impacts on perceived stress and symptoms of depression and anxiety. In the present study, household education appears to have played a large role in whether adolescents reported increases in stress or negative mood. Based on the specific stressors that adolescents in low/moderate education households reported, it is possible that concerns about family finances or health risk contributed to worse mood and emotional

well-being [25]. Given that the burden of the pandemic period was borne unequally, social policies may be poised to alleviate key sources of stress that disproportionately affected lower SES households. Ongoing or expanded support in the form of nutritional assistance, access to health insurance, and income replacement could help to relieve pandemic-related financial or health stress for more families.

Schools can play an important role in preventing the widening of socioeconomic inequalities. Our data do not assess the extent to which student learning was impacted by the shift to virtual learning [26]; given associations between stress and memory, cognition, and other biological mechanisms key to academic functioning [27,28], there is reason for concern that adolescents living in low/moderate education households were at further educational disadvantage compared to their high SES peers. Thus, our findings regarding the negative effects of the pandemic on adolescents' stress and mood, which are compounded for relatively lower SES families, identify one way in which the pandemic could exponentially widen existing academic disparities [29]. Our findings regarding increased stressors and negative emotions for students from lower education households can inform the educational priorities of school systems, for example, in focusing on the mental health and academic needs of their most vulnerable students and those at greatest risk of falling behind in the presence of sustained virtual learning. Similarly, school-based health centers and mental health services may be critical for supporting students who experienced significant stress or loss during the COVID-19 pandemic [30].

These findings also have implications for adolescents' long-term health and well-being. Socioeconomic disparities in both stress and health have been widely documented [31–33]; a pandemic that disproportionately increases stress for adolescents from less educated households may exacerbate those disparities.

There are also associations between several of the individual mood states that were impacted by the pandemic and subsequent stress biology and health. Loneliness has been associated with the dysregulation of key biological stress systems, worse health behaviors, sleep disturbances, and worse physical and mental health outcomes [34–36]. As the increase in loneliness observed during the pandemic was not moderated by household education, these potential health implications may be relevant to those who experienced the COVID-19 pandemic across the socioeconomic spectrum. In contrast, impacts on individual moods that were moderated by household education level may pose health risks to adolescents from low/moderate education households from which their peers living in high education adolescents are spared. The observed increases in feeling ashamed and caring are consistent with research on emotional and social functioning that has identified an association between lower SES and the tendency to focus on more contextual or structural (as opposed to individual) explanations of events [37–39]. That is, adolescents from low/moderate education households in our sample may have been more attuned (and potentially more directly exposed) to the injustice of a pandemic that disproportionately affected more vulnerable Americans, both in disease burden and economic fallout. Although experiences of anger have been associated longitudinally with worse cardiovascular health [40], increases in empathy and better emotion regulation have been associated with beneficial impacts on stress biology [41] and health [42], such that increased feelings of caring could be protective amidst this backdrop of increases in stress and negative mood.

Strengths and limitations

This study has a number of strengths, as well as some limitations. It is the first to our knowledge that obtained stress and mood data from U.S. adolescents both before and during the COVID-19 pandemic. A strength of our study is the racially and socioeconomically diverse sample, yet our relatively small sample size precluded examination of individual ethnoracial groups, which may have distinct experiences of stress about health risk or household finances, given disparities in rates of COVID-19 infection and mortality and variation in the rates of health- and service-sector employment [43,44]. We were also unable to consider whether other aspects of family SES, such as household income or parental occupation, were similarly associated with the disparities we observed during the pandemic period. Furthermore, as our sample comes from two high schools in the Midwestern U.S., it does not include those hit hardest during the pandemic's first wave (i.e., residents of cities in the northeastern U.S.) and therefore may understate its impact. In addition, this study draws on data collected as part of an ongoing intervention study. Although we did not find an association between intervention condition and the findings we reported, we cannot rule out the possibility that the intervention's presence in the school had an impact on adolescent well-being during this time. Finally, as our sample was surveyed during the first 5 months that followed the initial stay-at-home orders, our findings should be interpreted as initial impacts of experiencing the disruption and uncertainty associated with a global pandemic, as well as the social unrest that unfolded in the U.S. during this time. Additional research will be necessary to measure the sustained and long-term impacts of this experience for young people, including the long-term health impacts of these experiences.

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Supplementary Data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.jadohealth.2021.06.012.

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