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Stress of university students before and after campus closure in response to COVID-19

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Abstract

Due to the COVID-19 pandemic, universities were forced to adopt a remote learning model, which introduced a number of stressors into college students' everyday life and study habits. The current study investigates if students' study-related stress increased after the pandemic's onset and how individual and contextual factors moderate this potential stress increase. Longitudinal survey data about students' stress levels and self-efficacy in self-regulation were collected before and after the onset of the COVID-19 pandemic at a public university ($N = 274$). Regression analysis results show an overall increase in study-related stress levels after the onset of the pandemic. Students with self-efficacy in self-regulation reported lower stress increases; students with higher mental health impairment and limited time for coursework reported larger stress increases. To address students' stress levels and strengthen coping resources, universities should consider providing students with resources to improve their self-regulation and time-management skills.

KEYWORDS

college students, COVID-19, longitudinal data, mental health, stress

1 | INTRODUCTION

The ongoing COVID-19 pandemic, caused by the novel coronavirus SARS-CoV-2, has had a tremendous impact on the learning activities of college students in the United States. For the purpose of this paper, we define the “onset of COVID-19 in the United States” as March 10, 2020, which is the date when the World Health Organization officially declared COVID-19 to be a pandemic (World Health Organization, 2020). Shortly after this date, universities closed their campuses and shifted courses to an online format, which introduced additional challenges and required students to quickly adapt their study habits. Furthermore, shelter-in-place orders affected the daily activities of entire families and created new responsibilities for students, such as home-schooling siblings or grocery shopping for family and community members that were in higher risk groups of experiencing adverse effects of exposure to the virus. These major changes in students' lives, together with uncertainty about when campuses would reopen again, created additional potential sources of stress.

Previous research has shown that high levels of stress and psychological distress of university students have become increasingly prevalent on college campuses (Robotham, 2008; Stolzenberg et al., 2020). Whereas momentary stress and challenges can be beneficial for successful learning (eustress), high levels of constant stress are related to disruptions in academic progress, drop out, and failure (Mahmoud et al., 2012; Pierceall & Keim, 2007; Struthers et al., 2000; Zajacova et al., 2005). With this in mind, both university administrations and the general public have been interested in how students have been reacting to the many changes related to the pandemic.

With unique pre- and post-data on measures of students' stress, we investigated if undergraduate students at a large diverse public university in Southern California experienced increased levels of study-related stress after the outbreak of COVID-19 in the United States and the shift to remote learning during spring quarter 2020. We use the term *study-related stress* to refer to stress that is associated with coursework, procrastination, and study/life balance. We also investigated which individual and contextual characteristics moderated potential higher levels of stress in spring quarter 2020, controlling for pre-pandemic levels of stress in winter quarter 2020. Hereby, we were particularly interested in identifying important resources that could buffer against stress increases during the pandemic, and if certain student groups were at higher risk to experience stress increases than others.

1.1 | Individual characteristics and daily stress experiences

Stress can be defined as “a particular relationship between the person and the environment that is appraised by the person as taxing or exceeding his or her resources” (Lazarus & Folkman, 1984, p. 19). In other words, stress is the interaction between a demanding and challenging context and the individual's perception of either being able to master or being overwhelmed by these challenges. Thus, not every person will perceive a situation as equally stressful. Individual skills and trait-like characteristics, such as high-general self-esteem, can buffer against experiencing stress in daily life, including high general self-esteem (Juth et al., 2008; Moksnes et al., 2010; Zuckerman, 1989) and academic self-efficacy (Bandura, 1977; Edwards et al., 2010; Pierceall & Keim, 2007; Zajacova et al., 2005). Speaking more broadly, developmental psychology research has shown that self-regulation and self-control are central for behavior and (mental) health outcomes across the life span (Baines & Wittkowski, 2013; Reiss et al., 2014). On the other hand, higher levels of psychological distress, such as depressive symptoms and anxiety, have been shown to be related to higher levels of reported stress among college students (Beiter et al., 2015; Mahmoud et al., 2012).

Research about college students' stress levels across different demographic groups, such as gender or socioeconomic background, has yielded a less consistent picture. Some scholars have found higher stress levels among female college students, compared to male students (Beiter et al., 2015; Mahmoud et al., 2012). Zuckerman (1989), in contrast, found no differences between men and women in the total number of stressful events they reported, but found that women reported more stressful events related to social interactions and family, whereas men reported more stressful events in competitive situations. Regarding socioeconomic background, Turner and

Avison (2003) found that people of a lower socioeconomic status reported more stressful events in daily life than people of a higher socioeconomic status. Other scholars have found no differences in stress experienced between first-generation and non-first-generation college-going students (Garriott & Nisle, 2018; Sy et al., 2011).

1.2 | Stressful life events

Along with individual characteristics that are related to experiencing stress, researchers have found that certain situations and life events are highly likely to cause stress for the majority of people, especially situations involving life transitions, situations of high level ambiguity, and situations of low perceived controllability (Sarafino & Smith, 2011). Within the context of education, normative educational transitions that cause major changes in students' learning environments, such as the transition from junior to senior high school or from high school to college, are stressful situations that require students to cope and adjust to new settings (Blyth et al., 1983; Compas et al., 1986; Taylor et al., 2014). An open question is if students experience a nonnormative educational transition, such as the shift to remote learning and other changing life circumstances related to the pandemic, as stressful.

1.3 | COVID-19 pandemic and students' stress experience

With all this being said, dealing with the threat and uncertainty of the COVID-19 pandemic was likely to cause stress for many people (Bavel et al., 2020; Garfin et al., 2020). Recent public statistics on mental health in the United States have already shown an increase in psychological distress and a decrease in people's well-being during the lockdown in response to the COVID-19 pandemic (Center for Disease Control and Prevention [CDC], 2020a, 2020b; Sibley et al., 2020). First empirical findings further indicate that college students in the United States increasingly suffered from stress and anxiety during the COVID-19 pandemic (Charles et al., 2021; Son et al., 2020; Wang et al., 2020). However, none of these studies have used longitudinal data, including stress or mental health measures from the same sample of students before and after the onset of the COVID-19 pandemic in the United States, to investigate the change in students' stress experience.

Many universities have taken necessary measures in response to the outbreak of COVID-19, which caused immense disruption in the daily structure of the lives of university students. In the United States, campuses began to close and the vast majority of residential students were forced to move back to their parents' home or find another place to live off campus with little notice. All lectures, discussions, presentations, group work, office hours, and other academic activities were moved to a virtual format and campus resources (e.g., libraries or other study places) were no longer available for students. Sports events, club activities, and other extracurricular activities could not continue normally because most facilities on and around the campus were closed. Social gatherings were canceled to follow social distancing recommendations and prevent the spread of the virus. Students faced uncertainty over when campuses would resume normal in-person operations again and how remote learning would affect their academic performance. Additionally, many students had to take on new responsibilities (such as homeschooling their siblings, caring for family members, or working for pay to support their family), which reduced the time they had available to invest in their university coursework. Thus, the outbreak of COVID-19 created a situation that university students would likely perceive as stressful.

1.4 | The current study

We used longitudinal survey data from a large, highly diverse public university in Southern California that is on the quarter system, which includes winter (January–March) and spring (April–June) terms. We investigated the extent

to which students' study-related stress changed after the outbreak of the COVID-19 pandemic and after the university implemented measures in response to the pandemic. The closure of campus housing and facilities and the shift from all classes to a virtual format caused new and challenging situations for all students during the 2020 spring quarter. These changes drastically impacted the structure of students' learning environments and their daily academic and nonacademic activities. Situations like these, with high ambiguity and low controllability, are often perceived as stressful life events (Sarafino & Smith, 2011). However, the campus also instituted measures in hopes to mitigate student stress, such as encouraging faculty to make finals optional and allowing students to take courses as pass/no pass that would fulfill academic requirements.

In this study, we first investigated the extent to which students reported more stress because of coursework, procrastination, and their study/life balance after the campus moved to an online format in response to the outbreak of COVID-19. We also explored which factors moderated this potential increase in stress. Based on prior theoretical conceptualization that posits that the interaction of a situation and individual is the central element of stress (Lazarus & Folkman, 1984), we focus on both individual and contextual characteristics related to an increase in stress at the beginning (April), the middle (May) and the end (June) of the 2020 spring quarter, relative to prior reports of stress in the middle (February) of the 2020 winter quarter. We hypothesize that students will report higher levels of stress linked to coursework, procrastination, and study/life balance in spring 2020 compared to winter 2020 (Hypothesis 1).

Second, we investigated if academic self-efficacy in self-regulation was associated with an increase in stress. Researchers have shown that academic self-efficacy buffers perceived stress in college students (Edwards et al., 2010; Pierceall & Keim, 2007; Zajacova et al., 2005). With the shift to virtual classes and drastic changes in students' learning conditions, students were required to self-regulate, organize, and facilitate their learning activities in the context of new environments. We therefore expect that students with higher levels of self-efficacy in self-regulation will experience lower levels of stress after the outbreak of COVID-19 and the shift to online classes in spring 2020, controlling for pre-pandemic levels of stress in winter quarter 2020 (Hypothesis 2).

Third, we explored the relationship between students' pre-existing psychological distress and stress brought on with the COVID-19 pandemic. Research has shown that anxiety and depression are positively associated with psychological stress among college students (Beiter et al., 2015; Mahmoud et al., 2012). Accordingly, we expect students with higher levels of initial psychological distress to experience higher levels of stress linked to coursework, procrastination, and study/life balance in spring 2020, controlling for pre-pandemic levels of stress in winter quarter 2020 (Hypothesis 3).

Fourth, we investigated if students with new responsibilities had increased study-related stress. The pandemic not only affected the living situation of the students themselves, but also their entire families. Because of the closure of schools in California, the order to shelter in place, and the increase of unemployment, many students also acquired new responsibilities (e.g., home-schooling siblings, or working for pay to support familial financial obligations). These new responsibilities could conflict with the time and energy that students have left for their university coursework. We expect that students with less time and effort left for studying after taking care of other responsibilities will show a higher increase in stress linked to coursework, procrastination, and study/life balance from winter 2020 to spring 2020 (Hypothesis 4).

Finally, we investigated whether first-generation college-going students reported a higher increase of stress in academic areas than non-first-generation college-going students. Overall, prior research has not shown higher stress levels among first-generation college-going students (Garriott & Nisle, 2018; Sy et al., 2011). Nevertheless, it is a growing concern that first-generation college-going students might face even more obstacles during the shift to remote learning than non-first-generation college-going students (education post, 2020; The Chronicle of Higher Education, 2020). Research has shown that college students with lower socioeconomic background struggle more in online courses (Xu & Jaggars, 2014), partly because of their lower self-regulation skills in online settings (Williams & Hellman, 2004), but also because of lower quality connectivity to the internet, limited access to study space, and other major life demands. Because many first-generation college-going students belong to families with

lower economic resources, it is likely that first-generation college-going students encountered more responsibilities that required them to help in their home and community, as well as reduced access to powerful and reliable information technology resources. Taken together, these circumstances are likely to impede students' engagement in online classes and the ability to balance school work and other responsibilities—creating even more challenging and stressful situations for first-generation college-going students. Therefore, we hypothesize that first-generation college-going students will show higher levels of stress linked to coursework, procrastination, and study/life balance in spring 2020, controlling for pre-pandemic levels of stress in winter quarter 2020 (Hypothesis 5).

2 | METHODS

2.1 | Sample

We used data from an ongoing longitudinal study at a large, highly diverse public university in Southern California. The study was designed to investigate undergraduate's experiences and success and was approved by the university's Institutional Review Board (IRB). In all, 1275 undergraduate students consented to participate in the longitudinal study. Data collection began in September 2019, before the start of classes. A subsample of 312 students participated in an in-depth version of the study, which required them to complete short surveys on a weekly basis across the 2019–2020 academic year. All surveys were administered online.

In the present study, we used survey data from four different time points. The first measurement point took place in the middle of winter quarter 2020 (February 2020), before cases of COVID-19 existed on campus of the university where data was collected, before cases started to increase rapidly in Southern California, and before the university closed the campus and moved all classes to a virtual format. The second, third, and fourth time points took place at the beginning (April), middle (May), and end (June) of the 2020 spring quarter. Attrition across the academic year was 22%. We included data on $N = 274$ students who participated in the in-depth version of the study across the winter 2020 and spring 2020 quarters. Altogether, 69% of this subsample were female and 56% were first-generation college-going students. Students in the sample had diverse racial and ethnic backgrounds consisting of 38% Asian/Asian American students, 34% Hispanic students, 14% white/non-Hispanic students, and 12% other or undeclared racial and ethnic backgrounds. Participating students were freshmen (71%) and juniors (29%). Before campus closed in response to the outbreak of COVID-19, 73% of students in the sample lived on campus. Table 1 shows the proportion of female students, first-generation college-going students, and students from different racial and ethnic backgrounds in the study sample, as well as in the population of undergraduate students at the university as a whole.

TABLE 1 Student characteristics of study participants and the overall undergraduate student population at the study site

Variable	Study sample (%)	Undergraduate student population (%)
Female	69	56
First-generation college-going student	56	51
Asian/Asian American	38	34
Hispanic	34	26
White/non-Hispanic	14	13
Other racial and ethnic background	12	21

2.2 | Measures

2.2.1 | Stress

Three items adapted from the University Stress Scale by Stallman and Hurst (2016) were included in surveys at all four time points (February 2020, April 2020, May 2020, June 2020). These items asked how often in the past 7 days students experienced stress because of (a) academic/coursework, (b) procrastination, and (c) study/life balance. Students responded to these questions on an 8-point scale from 0—*never* to 7—*every day*.

2.2.2 | Psychological distress

The K10 screening scale for nonspecific psychological distress by Kessler et al. (2002) was administered in a survey at the beginning of the 2020 winter quarter. The questions asked about the presence of different symptoms such as lethargy, hopelessness, and depression (e.g., Over the last 30 days, how often did you feel tired out of no good reason?). Students responded to these items on a 5-point Likert scale from 1—*none of the time* to 5—*all of the time*. A sum score across all 10 items was generated for each student as an indicator for individual psychological distress. In prior research, a score of 24 or higher on this scale is considered as an indicator for the presence of a serious mental illness (Kessler et al., 2010).

2.2.3 | Self-efficacy in self-regulation

At the beginning of the 2020 spring quarter, students were asked five items to rate how good they will be at regulating and organizing their studying in online courses. Items stem from the College Students Self-Assessment Survey (CSSAS; Farr et al., 2011). Two example items are: “How good will you be at scheduling your time to accomplish your tasks in online courses in this quarter?” and “How good will you be in studying for online courses even when there are other things to do in this quarter?” Students responded to these questions on a 7-point Likert scale from 1—*not at all good* to 7—*exceptional*. A mean across all five items was used as indicator for students' self-efficacy in self-regulation skills. The internal consistency of this short scale was high with $\alpha = 0.89$.

2.2.4 | Lack of time and energy for coursework

At the beginning of the 2020 spring quarter, students were asked one item about how much time and energy they will have for their university classes after taking care of other important activities/responsibilities in the 2020 spring quarter. Students responded to this item on a 7-point Likert scale ranging from 1—*not nearly enough time and energy* to 7—*more than enough time and energy*. Scores of this item were recoded; higher scores indicate that students have less time and energy left for their studying.

2.2.5 | First-generation college-going student status

First-generation college-going student status was obtained from student registrar data from the university. The variable is coded binary with 1—*first-generation college-going student status* and 0—*non-first-generation student status* (a 1 was assigned when none of the students' parents obtained a college degree).

2.2.6 | Gender

Students' self-reported gender (1=female, 0=male) was included as a covariate in each model.

2.3 | Statistical analyses

We used the statistical software Mplus, Version 8.4 (Muthen & Muthen, 1998–2017) to run statistical analyses. To investigate if students' stress (linked to coursework, procrastination, and study/life balance) increased from winter 2020 to spring 2020, we compared the means of all measurement time points. To further investigate which individual and contextual factors predicted elevated levels of stress in spring 2020, controlling for pre-pandemic levels of stress in winter quarter 2020, we used three OLS regression models. In all three models, T1 stress measures were included as predictors of stress measures at T2, T3, and T4 to control for initial individual differences in perceived stress. Since the models control for prior reported levels of stress, our analysis can be thought of as in effect estimating changes or increases in stress before and during the pandemic. In the text that follows, we discuss regression estimates of T2–T4 outcomes, controlling for prior T1 stress levels, as indicative of increases or changes in student stress level.

In Model 1, we investigated the increase in stress linked to coursework. Stress linked to coursework at the beginning of spring (April) 2020, the middle of spring (May) 2020, and the end of spring (June) 2020 were used as outcome variables. We included stress linked to coursework measured before the outbreak of COVID-19 in winter (February) 2020 as a predictor of the stress outcomes in spring quarter 2020. To investigate the predictive effect of individual and contextual characteristics on the increase of students' stress linked to coursework at the beginning of spring (April), middle of spring (May), and end of spring (June) 2020, we additionally included information about students' first-generation college-going student status, their gender, their psychological distress, their self-efficacy in self-regulation, and insufficient time and energy for studying as predictors in the model. Model 2 and Model 3 used the same modeling approach. Model 2 included measures on stress linked to procrastination, and Model 3 included measures on stress linked to students' study/life balance.

We used the full information maximum likelihood approach (FIML) to deal with missing data. This approach is preferable to traditional approaches, such as listwise deletion. Because no observations are deleted, the statistical power of models remain unaffected (Enders, 2010).

3 | RESULTS

3.1 | Increase in stress over time

Students reported more stress linked to coursework ($M = 5.01$, $SD = 1.89$), compared to stress linked to their study/life balance ($M = 4.26$, $SD = 2.09$) or procrastination ($M = 3.47$, $SD = 2.37$), in winter quarter (February) 2020 (see Figure 1). Further results showed an increase in stress in all three areas from winter quarter 2020 to the beginning (April) of spring quarter 2020 (stress linked to coursework $M = 5.58$, $SD = 2.13$; stress linked to study-life balance $M = 5.36$, $SD = 2.13$; stress linked to procrastination $M = 4.54$, $SD = 2.49$). Over the course of spring quarter 2020, students' stress linked to coursework, study/life balance, and procrastination decreased slightly, but remained at a higher level than winter quarter 2020. Results from the Wald χ^2 test revealed that the increase from winter quarter 2020 to the beginning of spring quarter 2020 was statistically significant in all three areas (stress linked to coursework: $\chi^2(1, N = 253) = 16.5$, $p < 0.01$; study/life balance: $\chi^2(1, N = 253) = 49.0$, $p < 0.01$; and procrastination: $\chi^2(1, N = 253) = 36.7$, $p < 0.01$). Even if stress in all areas slightly decreased over spring quarter 2020, comparisons of the means showed that students still reported statistically significant higher levels of stress at the end of the

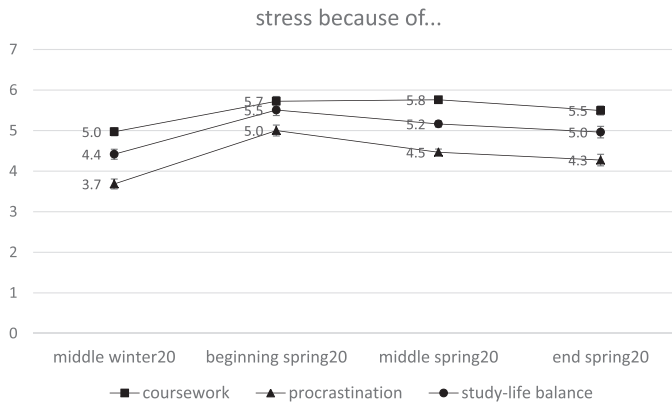


FIGURE 1 Stress because of coursework, procrastination, and study/life balance in winter 2020 and spring 2020, error bars indicate the standard errors

spring quarter 2020 than in winter quarter 2020 (stress linked to coursework: $\chi^2 (1, N = 240) = 12.4, p < 0.01$; study/life balance: $\chi^2 (1, N = 240) = 12.3, p < 0.01$; and procrastination: $\chi^2 (1, N = 240) = 13.1, p < 0.01$).

Table 2 provides a correlation matrix of students' background characteristics by first-generation college-going student status, gender, and ethnic background with nonspecific psychological distress, self-efficacy in self-regulation, having not enough time and energy for coursework, and perceived stress in all three areas for all four measurement points. It is important to note that first-generation college-going students more often reported having not enough time and energy for their coursework after taking care of other responsibilities in spring 2020.

3.2 | Individual and contextual characteristics related to the increase in stress

Tables 3–5, provide the results of OLS regression analyses in Mplus. Table 3 includes the results about increased stress linked to coursework. Students with higher levels in coursework-related stress in winter 2020 (before the outbreak of COVID-19 in California) also reported higher levels of stress linked to coursework at the beginning ($\beta = 0.28, SE = 0.07, p < 0.05$), middle ($\beta = 0.33, SE = 0.07, p < 0.05$), and end of spring 2020 ($\beta = 0.33, SE = 0.07, p < 0.05$). Students who did not have enough time and energy for their coursework after taking care of other responsibilities reported a higher coursework-related stress at the beginning of spring 2020 ($\beta = 0.26, SE = 0.07, p < 0.05$), controlling for pre-pandemic levels of stress in winter quarter 2020. We therefore conclude that students with less time and energy for coursework had a higher stress increase toward the beginning of spring 2020. Insufficient time was not predictive of an increase in coursework-related stress toward the middle and end of spring quarter 2020. Higher levels of nonspecific psychological distress predicted a larger increase in coursework-related stress toward the middle of spring 2020 ($\beta = 0.23, SE = 0.07, p < 0.05$). First-generation college-going students had a slightly higher increase in coursework-related stress toward the end of spring 2020, compared to non-first-generation college-going students ($\beta = 0.14, SE = 0.06, p < 0.05$). Female students did not have a higher or lower increase in coursework-related stress than male students. Self-efficacy in self-regulation was also not related to an increase in coursework-related stress.

Table 4 provides results about increased stress linked to procrastination. Again, students with higher levels in procrastination-related stress in winter 2020 reported higher levels of procrastination-related stress at the beginning ($\beta = 0.47, SE = 0.05, p < 0.05$), middle ($\beta = 0.48, SE = 0.05, p < 0.05$), and end ($\beta = 0.38, SE = 0.06, p < 0.05$) of spring quarter 2020. After controlling for prior levels of procrastination-related stress, first-generation college-

TABLE 2 Correlation matrix of students' background characteristics, psychological distress, self-efficacy in self-regulation, time and energy for coursework and stress

	Psy. distress	Self-regulation	No time/energy	T1 cw. stress	T2 cw. stress	T3 cw. stress	T4 cw. stress	T1 pr. stress	T2 pr. stress	T3 pr. stress	T4 pr. stress	T1 s/l. stress	T2 s/l. stress	T3 s/l. stress	T4 s/l. stress
FG student	-0.07	0.01	0.18	-0.11	0.08	0.06	0.13	-0.06	0.10	0.01	0.00	0.01	0.10	-0.03	0.11
Female	0.09	0.11	0.07	0.06	0.02	0.10	0.00	0.14	0.02	0.10	0.04	0.13	0.09	0.17	0.03
Asian	-0.04	-0.01	0.01	0.06	0.10	0.01	0.04	0.00	0.10	0.02	-0.09	0.06	0.05	0.01	0.08
Hispanic	-0.08	-0.04	0.10	-0.04	-0.04	-0.01	0.06	0.06	0.05	0.03	0.13	-0.01	0.00	-0.03	0.06
White	0.16	0.09	-0.02	-0.03	0.03	0.05	-0.03	-0.06	-0.09	0.00	-0.04	-0.05	0.02	0.08	-0.06
Other ethn.	0.10	-0.10	-0.06	0.08	-0.01	0.07	0.01	0.03	0.03	0.03	0.08	0.09	-0.02	0.07	0.04

Note: Bold font $p < 0.05$.

Abbreviations: Asian, Asian American; Cw stress, stress linked to coursework; FG student, first-generation college-going student; Hispanic, Hispanic/Latin American; No time/energy, not enough time and energy for coursework after taking care of other responsibilities; Other ethn., Other ethnicity; Pr stress, stress linked to procrastination; Psy. distress, nonspecific psychological distress; Self-regulation, self-efficacy in self-regulation; s/l stress, stress linked to study/life balance; White, White/non-Hispanic.

TABLE 3 Regression model to predict stress linked to coursework at the beginning, middle, and end of spring quarter 2020

Independent variables	Beginning spring quarter (April 2020)		Middle spring quarter (May 2020)		End spring quarter (June 2020)	
	β	SE	β	SE	β	SE
First-generation college-going student	0.08	0.06	0.11	0.06	0.14	0.06*
Female	-0.01	0.06	0.09	0.06	-0.02	0.06
Coursework-related stress winter 2020	0.28	0.07**	0.33	0.07**	0.33	0.07**
Psychological distress	0.11	0.07	0.23	0.07**	0.13	0.07
Self-efficacy in self-regulation	-0.001	0.07	0.02	0.08	-0.01	0.08
No time and energy for coursework	0.26	0.07**	0.12	0.07	0.14	0.08
R^2	0.22		0.27		0.20	

Note: $N = 274$.

* $p < 0.05$.

** $p < 0.01$.

going students ($\beta = 0.14$, $SE = 0.06$, $p < 0.05$), and students who had not enough time and energy left for their coursework ($\beta = 0.14$, $SE = 0.07$, $p < 0.05$) reported a higher increase in procrastination-related stress from winter 2020 to the beginning of spring 2020, but not for later time points in the spring quarter. Self-efficacy in self-regulation had a buffering effect on the increase in procrastination-related stress from winter 2020 toward the middle ($\beta = -0.17$, $SE = 0.07$, $p < 0.05$), and end of spring 2020 ($\beta = -0.21$, $SE = 0.08$, $p < 0.05$). Female students did not have a higher or lower increase in procrastination-related stress than male students.

Table 5 shows results about increased stress linked to study/life balance. Again, students with higher levels in study/life balance-related stress in winter 2020 reported higher levels of study/life balance-related stress at the beginning ($\beta = 0.38$, $SE = 0.06$, $p < 0.05$), middle ($\beta = 0.40$, $SE = 0.06$, $p < 0.05$), and end ($\beta = 0.34$, $SE = 0.06$, $p < 0.05$) of

TABLE 4 Regression model to predict stress linked to procrastination at the beginning, middle, and end of spring quarter 2020

Independent variables	Beginning spring quarter (April 2020)		Middle spring quarter (May 2020)		End spring quarter (June 2020)	
	β	SE	β	SE	β	SE
First-generation college-going student	0.14	0.06*	0.05	0.06	0.08	0.06
Female	-0.04	0.06	0.08	0.06	0.02	0.06
Procrastination-related stress winter 2020	0.47	0.05**	0.48	0.05**	0.38	0.06**
Psychological distress	0.07	0.06	0.08	0.06	0.13	0.06*
Self-efficacy in self-regulation	-0.13	0.07	-0.17	0.07*	-0.21	0.08**
No time and energy for coursework	0.14	0.07*	0.03	0.07	-0.14	0.08
R^2	0.34		0.32		0.23	

Note: $N = 274$.

* $p < 0.05$.

** $p < 0.01$.

TABLE 5 Regression model to predict stress linked to study/life balance at the beginning, middle, and end of spring quarter 2020

Independent variables	Beginning spring quarter (April 2020)		Middle spring quarter (May 2020)		End spring quarter (June 2020)	
	β	SE	β	SE	β	SE
First-generation college-going student	0.09	0.06	-0.002	0.06	0.11	0.06
Female	0.02	0.06	0.13	0.06*	-0.04	0.06
s/l balance-related stress winter 2020	0.38	0.06**	0.40	0.06**	0.34	0.06**
Psychological distress	0.13	0.06*	0.18	0.07**	0.21	0.07**
Self-efficacy in self-regulation	-0.14	0.07*	-0.03	0.08	0.07	0.08
No time and energy for coursework	0.18	0.07**	0.03	0.08	0.15	0.08
R^2	0.35		0.28		0.26	

Note: $N = 274$.

* $p < 0.05$.

** $p < 0.01$.

spring quarter 2020. Furthermore, students with higher levels of nonspecific psychological distress had higher increases in study/life balance-related stress from winter 2020 toward the beginning ($\beta = 0.13$, $SE = 0.06$, $p < 0.05$), middle ($\beta = 0.18$, $SE = 0.07$, $p < 0.05$), and end ($\beta = 0.21$, $SE = 0.07$, $p < 0.05$) of spring quarter 2020. Self-efficacy in self-regulation had a buffering effect on the increase in stress linked to study/life balance only toward the beginning of spring 2020 ($\beta = -0.14$, $SE = 0.07$, $p < 0.05$). Not having enough time and energy left for coursework was a positive predictor for an increase in study/life balance-related stress toward the beginning of spring 2020 ($\beta = 0.18$, $SE = 0.07$, $p < 0.05$), but not toward later time points.

4 | DISCUSSION

As predicted, our results showed an increase in study-related stress among undergraduate college students from winter 2020 to spring 2020 (Hypothesis 1). It was previously known that normative transitions in education (e.g., the transition from high school to college) are stressful events for adolescents and young adults that require coping and adjustment to new challenges and environments (Blyth et al., 1983; Compas et al., 1986; Taylor et al., 2014). Our results show that students also perceived the nonnormative transition of changed living and learning environments in college during the COVID-19 pandemic, as challenging and stressful. Individual and contextual characteristics were associated with increases in stress, but these factors differed in their relationship to stress in the three observed areas.

As predicted, self-efficacy for self-regulation had a buffering effect on students' increase in stress after the outbreak of COVID-19 and campus closure in spring 2020 (Hypothesis 2). This effect was mainly found for stress linked to procrastination. The closure of the university campus and the shift to online courses caused major changes in students' learning environment; it created new demands for undergraduates to establish their own study routines and schedules in less-structured learning settings off campus. The ability to plan, organize, and monitor one's own study process is central for successful learning in any instructional environment, and is also particularly important in less structured settings (Hoyle & Dent, 2018; Zimmerman, 1990). Procrastination, instead, is linked to ineffective use of time and inadequate competencies to self-regulate one's academic engagement (Ferrari, 2001; Zhao et al., 2019). Students with higher self-efficacy for self-regulation have been found to show less procrastinating behavior (Klassen et al., 2008). Our results were consistent with these findings and showed that students' self-efficacy for self-regulation skills was an important individual resource to limit procrastination-

related stress in online learning settings during the pandemic. To support students in developing this individual resource, universities and course instructors should actively teach students how to better self-regulate their learning (see Jaggars & Xu, 2016).

As predicted, prior psychological distress was related to an increase in stress linked to study/life balance toward the middle and end of spring 2020 (Hypothesis 3). This finding can be understood by considering its similarities to work/life balance. Work/life balance—parallel to study/life balance among college students—can be described as the equity in time and satisfaction people have for their life roles in work-related and personal areas (Kalliath & Brough, 2008). Other definitions further emphasize the importance of perceived autonomy and control over the demands of different life roles needed for a positive work/life balance (Fleetwood, 2007; Kalliath & Brough, 2008). Because of the state-wide stay-at-home orders and closures of cultural facilities, gyms, and other sites for social gatherings, students inevitably experienced drastic changes in their leisure and social activities. Previous research has indicated that a poor work/life balance of college students is related to symptoms of stress, anxiety, and depression (Klassen et al., 2008). Our results show that students who had higher levels of psychological distress before the pandemic reported an even higher increase in stress associated with their study/life balance in spring 2020. How students' stress and mental health relate reciprocally in times of the pandemic will be an important field for further research. In addition, our research shows that having insufficient time and energy left for studying had a moderating effect on the increase in all three types of stress at the beginning of spring 2020 (Hypothesis 4). Lazarus and Folkman (1984) defined stress as a result of facing challenging situations and not having the appropriate resources to master these challenges, which we see exemplified in the students in our study. At the beginning of the quarter, students faced multiple new challenges related to the COVID-19 pandemic, including leaving their dorms, managing new responsibilities, and adjusting to the online learning environment and altered living situation. Therefore, students who reported not having enough time and energy for studying after taking care of other important responsibilities most likely had insufficient individual resources to cope with the multiple challenges they were confronting. An imbalance between individual resources and challenges is consistent with the observed increase in all three stress areas from winter 2020 to the beginning of spring quarter 2020. Having insufficient time and effort left for studying was not statistically relevant for stress in the middle and end of the quarter. This might be a result of an adjustment process to new living and learning environments as they became more accustomed to remote learning and their living situations. Alternatively, it might be related to the campus encouraging students who were feeling stress to take courses to pass/fail that term. The small decrease in stress levels across the spring quarter supports this speculative interpretation, which requires further research.

Contrary to our hypothesis, first-generation college-going students did not report a higher increase in stress overall compared to non-first-generation college-going students (Hypothesis 5). We based our hypothesis on the assumption that first-generation college-going students might encounter even more challenging situations during the COVID-19 pandemic, related to more responsibilities at home besides coursework and fewer resources and support for studying in their home environment. Results pointed to a slightly higher increase in stress linked to procrastination toward the beginning of spring 2020 and in stress linked to coursework toward the end of spring 2020, but overall results did not reveal a pattern of larger stress increases among first-generation college-going students across stress areas and time points. This could either be a result of the fact that first-generation college-going students did not encounter more challenging situations during the COVID-19 pandemic. Alternatively, this finding could point to the fact that first-generation college-going students are more experienced and better at coping with highly demanding and challenging situations related to their studying. First-generation college-going students often encounter more challenging situations during their college years, because they work for pay and commute from housing off campus more often compared to non-first-generation college-going students (Inkelas et al., 2007; Strayhorn, 2007). These experiences might make first-generation college-going students more resilient and more capable of coping with challenging study environments.

Post hoc analyses of our data showed that first-generation college-going students reported having less access to a study place that allowed them to focus on coursework (first-generation college-going students: $M = 4.14$,

$SD = 1.79$; non-first-generation students: $M = 4.80$, $SD = 1.89$, $t(224) = 2.71$, $p < 0.01$), and less access to a computer or other device to work on coursework in the 2020 spring quarter (first-generation college-going students: $M = 6.22$, $SD = 1.32$; non-first-generation students: $M = 6.54$, $SD = 1.12$, $t(224) = 1.98$, $p < 0.05$). Additional analyses further showed that first-generation college-going students and non-first-generation college-going students did not differ in the total amount of responsibilities besides their coursework (first-generation college-going students: $M = 2.60$, $SD = 1.23$, non-first-generation college-going students: $M = 2.41$, $SD = 1.32$, $t(205) = 1.07$, $p > 0.050$). The most frequent reported new responsibilities for both first-generation college-going students and non-first-generation college-going students occurred in the areas of *shopping/errands*, *household chores*, *caring for others*, *teaching others*, and *working*. But nevertheless, first-generation college-going students reported having less time and energy left for their coursework in spring 2020 (first-generation college-going students: $M = 3.87$, $SD = 1.50$; non-first-generation students: $M = 3.33$, $SD = 1.50$, $t(225) = 2.73$, $p < 0.05$).

We used additional stepwise regression analyses to investigate if insufficient time and energy would mediate an effect of first-generation college-going student status on stress increase (see Tables S1–S3). We first included only demographic background variables and time 1 stress measures as predictors in the regression models, and added measures on insufficient time and energy, and psychological predictors in a second step. Results did not indicate different patterns of the effect of first-generation college-going student status on stress increase before controlling for time constraints for coursework and further psychological predictors. Further research is needed to better understand the challenges and coping strategies of first-generation college-going students during the COVID-19 pandemic.

Overall, our results showed that study-related stress levels of students increased after the outbreak of the COVID-19 pandemic. On a scale from 0—*never* to 7—*every day*, students reported about a one-point increase in experiencing stress linked to coursework, procrastination, and study/life balance. This increase is roughly equivalent to an individual experiencing stress one more day per week in the 2020 spring quarter, compared to winter 2020. This increased stress level slightly leveled off across the spring quarter, pointing to students' adjustment to the changed living and learning environment. However, students' stress levels did not return to the pre-pandemic stress levels of winter 2020. Our findings indicate that increased stress was not only caused by course format or content, but also by living context and other new responsibilities—particularly at the beginning of the spring quarter. It is therefore important to support college students in developing the necessary time and task management competencies that could help them better cope with highly challenging situations, like the pandemic. For example, universities have recently been experimenting with behavioral interventions designed to improve time and task management competencies (Yeo et al., 2020). Self-efficacy for self-regulation was a protective factor for stress linked to procrastination. Universities and instructors could also actively teach self-regulation skills to promote students' individual resources in challenging learning environments. In addition, universities and instructors could be encouraged to adopt institutional practices during the pandemic that were responsive to student circumstances (such as modified classwork requirements and grading regimes).

5 | LIMITATIONS AND FUTURE RESEARCH

We investigated students' stress in academic areas over the course of two quarters (winter 2020 and spring 2020). Results showed an increase in stress after the outbreak of COVID-19 and the university's response to the pandemic. High-stress levels over a sustained period can impact students' performance and health (Pierceall & Keim, 2007; Shields, 2001; Struthers et al., 2000). Future research should investigate the potential consequences of increased stress on students' long-term academic performance and well-being. Additionally, research should focus on changes in students' stress over a longer period of time to investigate if students' stress levels decrease again to pre-pandemic levels after they adapt to the online learning setting and changes in their daily life conditions during later stages of the pandemic.

We used data from a diverse undergraduate sample at a large public university in Southern California. Our sample consisted of students from diverse ethnic and socioeconomic backgrounds (see Table 1). It is important to recognize, however, that the sample is not representative of students across the country and findings cannot be generalized across all undergraduate students in the country, since students select and are selected into a college setting, institutions differed in their responses, and local pandemic-related conditions varied. Furthermore, the majority of participants were freshmen and the participants were all part of a large public university in Southern California, which may introduce other confounding conditions. However, our study design allowed us to address important questions and concerns about students' mental health and coping during the pandemic with empirical longitudinal data from a university with a highly diverse student body. These findings that observe student stress before and during a pandemic add highly relevant information to the literature about students' experiences and coping with exogenous environmental stressors, even if the generalizability of our findings is not possible. Further research is needed to replicate our findings with samples drawn from other settings and during different environmental conditions.

6 | CONCLUSION

Students experienced an increase in study-related stress after the outbreak of the COVID-19 pandemic, the related campus closure, and the shift to virtual classes in March 2020. Contextual and individual characteristics moderated this increase. Universities and instructors could actively teach students' self-regulation and time management skills to strengthen their coping resources for nonnormative transitions, such as the changes and challenges related to the COVID-19 pandemic. Future research should investigate long-term changes in students' stress over more than one academic quarter after the outbreak of COVID-19, as well as potential impacts of an increased stress level on students' academic performance and health over time.

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CONFLICT OF INTERESTS

The authors declare that there are no conflict of interests.

PEER REVIEW

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to their containing information that could compromise the privacy of research participants.

ETHICS STATEMENT

This study was carried out in accordance with the Institutional Review Board (IRB) at the University of California, Irvine. The protocol was approved by the Institutional Review Board (IRB) at the University of California, Irvine (#HS: 2018-4646). All subjects gave informed consent in accordance with the Human Research Protections IRB guidelines.

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