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Disparities in mentoring and mental health problems of U.S. college students in science and engineering during the COVID-19 pandemic

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ABSTRACT

This study examines the relationships between mentoring support and mental health problems (i.e. depression and anxiety) among college students in science and engineering in the United States during the COVID-19 pandemic. Descriptive results from a nationwide survey of 2352 undergraduates (from 43 institutions in 25 states), indicate that students who identified as women, underrepresented racial/ethnic minorities, of lower socioeconomic status (SES), and persons with disabilities reported higher levels of mental health problems at the beginning of the COVID-19 pandemic (early summer 2020). Structural equation modelling results indicate that student perceptions of instrumental and psychosocial mentoring support were positively associated with mentoring satisfaction (MS), which in turn was negatively associated with their mental health problems. Moderation analysis findings show that the relationship between MS and mental health problems is stronger for low-SES and non-disabled students. Implications for research and efforts to address the mental health problems of college students are discussed.

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Mentoring; higher education; COVID-19; science; engineering; mental health

Introduction

The COVID-19 pandemic has affected the learning and well-being of college students across the globe (e.g. Olson et al., 2021; Savitsky et al., 2020). During the period of social distancing and school closure, advisors or mentors of college students were expected to continue mentoring and supporting their students via various means such as video conferencing (Browne, 2021; Chang et al., 2020). However, the patterns and quality of mentoring experiences during the pandemic remains unclear, especially among students from historically underrepresented groups in science and engineering (S&E) fields, including women, underrepresented racial/ethnic minorities (URMs; Blacks/Hispanics/Native Americans in the United States context), students of

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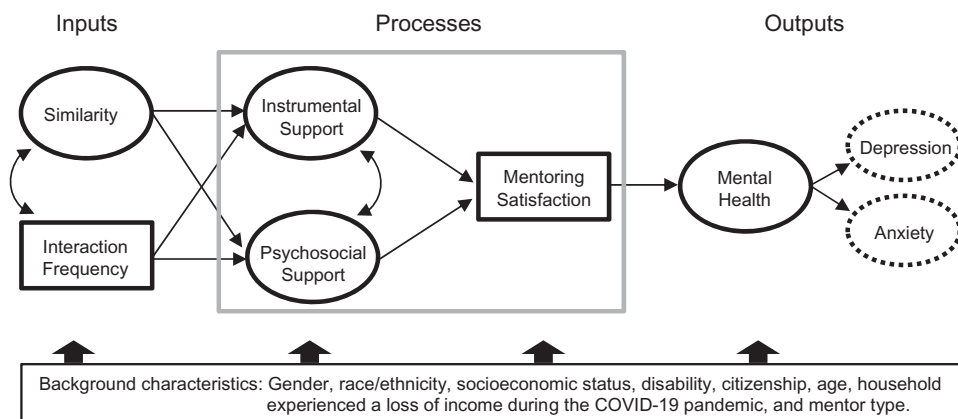


Figure 1. A MIPO model.

lower socioeconomic status (SES), and persons with disabilities. No study to date has explored whether mentoring support plays a role in mitigating negative pandemic impacts on the mental health of college students. Building on a social-psychological model of mentoring support (Eby et al., 2013), this study conducts a nationwide survey to investigate the mentoring experiences and mental health of S&E college students in the U.S. and how perceived mentoring support relates to their mental health during the COVID-19 pandemic.

Theoretical framework and relevant literature

A social-psychological model of mentoring

In the literature on mentoring, a social-psychological model of mentoring input-process-output (MIPO; Eby et al., 2013; Hernandez, 2019) offers a useful theoretical framework for studying the interrelationships among mentoring support and mental health of college students during the COVID-19 outbreak. As posited by the MIPO model, a range of correlated antecedent or background characteristics of the mentee, mentor, or both (i.e. Inputs) are expected to influence the quality of mentoring (i.e. Processes), which are in turn expected to affect mentee outputs (i.e. Outcomes; see Figure 1). Two central and relevant components of mentorship quality are (1) perceived instrumental support and (2) perceived psychosocial support. Instrumental mentoring support refers to mentee perceptions of mentor behaviours that facilitate their goal attainment, such as academic and professional development, whereas psychosocial mentoring support refers to mentor behaviours that promote mentees' personal and social emotional development (Kram, 1985).

For a mentee to reap the benefits of mentorship, frequent interpersonal interaction with their mentor is needed (Liang et al., 2008). Individual demographic characteristics, including gender, race/ethnicity, SES, as well as mentor–mentee demographic match (i.e. surface-level similarity), may influence interactions and perceptions of mentorship (Harrison et al., 1998). However, perceived deep-level mentor–mentee similarity—referring to similarity in attitudes, beliefs, and values between mentee and mentor—tend to demonstrate a strong relationship with perceived

instrumental and psychosocial mentoring support (Eby et al., 2013). Several meta-analytic reviews found that perceptions of instrumental and psychosocial mentoring relate to mentoring satisfaction (MS), which in turn predicts a wide range of mentee psycho-social outcomes (Allen et al., 2004; Eby et al., 2013).

Benefits of student mentoring on mental health

While the evidence on the impacts of student mentoring during the COVID-19 pandemic is still emerging, a large body of pre-pandemic studies in both higher education and other settings have documented that mentors can play a significant role in promoting positive mental health in their mentees (e.g. Eby et al., 2008, 2013). For example, a multidisciplinary meta-analysis concluded that mentoring was negatively correlated with mentees' psychological distress (including depression, anxiety, and life dissatisfaction; Eby et al., 2008). The effect size was 0.06, indicating a small effect (Eby et al., 2008). Another more recent interdisciplinary meta-analysis found that the negative effects of perceived instrumental and psychosocial mentoring support on psychological strain measures (such as burnout, loneliness, and distress) were stronger than the negative effects of mentor–mentee relationship quality on psychological strain (effect size 0.12 vs. 0.08; Eby et al., 2013).

Both theory and empirical evidence indicate that quality mentorship can reduce mentees' negative emotions and improve their mental health through various mechanisms. Instrumental mentoring support can lead to higher academic and job performance, which could benefit the mental health of mentees as they may experience increased academic or career self-efficacy, as well as enhanced satisfaction with the mentorship (Allen et al., 2004). Psychosocial support provided by mentors can directly address negative feelings or concerns of mentees, which helps lower their levels of stress and anxiety in school or at work (Eby et al., 2008). Furthermore, prior studies found that high quality, long term, and supportive relationships with their mentors provide mentees with more social resources to adaptively cope with life challenges, which eventually leads to positive affective well-being, better mental health, and persistence in S&E fields, particularly for students from historically underrepresented groups (Eby et al., 2013; Hernandez et al., 2020).

Mental health of college students during the COVID-19 pandemic

A growing body of evidence documenting the negative impacts of the COVID-19 pandemic on the mental health of college students has been reported from different parts of the world. Fruehwirth et al. (2021), for example, documented that in a large university in North Carolina the prevalence of moderate-to-severe anxiety of college freshmen increased from 18.1% before the pandemic to 25.3% 4 months after the COVID-19 pandemic began, whereas the prevalence of moderate-to-severe depression significantly increased from 21.5% to 31.7%. Several more studies also reported high levels of anxiety, depression, and stress among college students from different countries, including China (Cao et al., 2020), Israel (Savitsky et al., 2020), and Poland (Rogowska et al., 2020). One of the largest scale cross-national studies to date, which

analysed survey data from ~30,000 college students living in 62 nations across six continents, found that about two in every five students worldwide reported experiencing anxiety and frustration during the COVID-19 pandemic (Aristovnik et al., 2020). Alarming, studies indicated that students from certain demographic groups including women, sexual/gender minorities, racial/ethnic minorities, and those from low-income backgrounds reported higher levels of mental health problems during the COVID-19 pandemic (e.g. Aristovnik et al., 2020; Fruehwirth et al., 2021; Olson et al., 2021; Savitsky et al., 2020).

Several plausible reasons may explain the heightened levels of negative emotions among college students globally during the COVID-19 pandemic. Social distancing measures, such as stay-at-home orders, quarantines, and school closures implemented in response to the COVID-19 outbreak by many countries and higher education institutions likely increased students' feelings of social isolation and loneliness, which might have negatively affected their mental health (Fruehwirth et al., 2021). The academic stress of many college students was worsened due to the abrupt change from in-person to remote learning (Olson et al., 2021). Some studies also found that many college students' experienced higher levels of stress, anxiety, and depression that were associated with their fear and worry about the dangers of COVID-19 for themselves, their loved ones, and the community in general (Son et al., 2020).

Challenges and developments in student mentoring engendered by the COVID-19 pandemic

Before and during the pandemic, advisors and/or mentors of college students were an important source of their academic and social-emotional support. During the COVID-19 pandemic, however, mentors of students (e.g. faculty, staff, or peers) also had many disruptions to their livelihood and faced challenges adapting to a changing work environment. Mentors may neglect or reduce their supportive behaviours (Chang et al., 2020, 2021), especially if mentoring is not a priority in their work or organisations. Various social distancing measures, such as school closures and gathering restrictions, may also result in the difficulty of building and maintaining mentor–mentee relationships with little or no in-person interactions (Smith & Johnson, 2020).

The COVID pandemic has both created many challenges for student mentoring and brought some unanticipated promising developments in mentoring for college students. The rapid digital transformation of teaching activities in higher education triggered by the pandemic have facilitated the widespread use of computer-mediated communication (CMC) technology, such as Zoom and Microsoft Teams, for mentoring (Chang et al., 2020). Virtual meetings, either one-on-one or in a group, are easily arranged and may occur more frequently between mentors and mentees as commute and room reservations are not necessary (Browne, 2021). Moreover, many higher education institutions began utilising CMC technology and social media platforms to create mentoring programs and foster mentoring networks for their students (Pfund et al., 2021). The limited number of pre-pandemic studies on virtual mentoring showed that mentees can learn and benefit from mentoring support via electronic interactions, even without traditional in-person meetings (e.g. de Janasz & Godshalk, 2013).

To date, however, no study has investigated the linkage between mentoring support and mental health of college students, especially among historically underrepresented and underserved students.

The present study

This study was launched to examine the mentoring experiences and mental health of undergraduates in S&E fields, as well as how perceived mentoring support and satisfaction associate with mental health problems during the early stage of COVID-19 pandemic. There were two major reasons for focussing on college students in S&E fields. First, pre-pandemic evidence has documented that undergraduates in S&E, especially among underrepresented students such as women in engineering fields, tended to report higher levels of stress, anxiety, and depression than their peers in non-S&E fields (Posselt & Lipson, 2016). Second, mentoring is typically more prevalent and frequent in S&E undergraduate programs, which customarily include many supervised laboratory activities and research projects (Chang et al., 2020). Therefore, if mentoring could mitigate mental health problems, even with a small or moderate magnitude, it should be more likely to be detected among S&E undergraduates. Four specific research questions (RQs) are examined in this study:

1. Whether and to what extent the mentoring experiences (i.e. mentoring inputs and processes) and mental health problems differ across demographic subgroups?
2. Whether and to what extent the perceived deep-level mentor–mentee similarity and mentor–mentee interaction frequency are associated with perceptions of instrumental and psychosocial mentoring support?
3. Whether and to what extent perceived instrumental and psychosocial mentoring support, as well as satisfaction with mentoring relate to mental health?
4. Whether and to what extent do demographic characteristics moderate the relationship between MS and mental health?

Methods

Participants and procedure

The data for this study was collected as part of a nationwide survey through an online platform—Qualtrics—from 3 June 2020 to 22 June 2020. Forty-three institutions of higher education (out of 469 invited) in 25 U.S. states agreed to participated in this study. Survey invitations were emailed to the undergraduate students through deans and associate deans from colleges of S&E. Informed consent from participants was obtained electronically prior to their participation in the survey. A total of 3567 undergraduate students participated in the survey. After excluding respondents who reported not having a mentor/advisor on campus in the spring of 2020 ($n=4$) or did not respond to the mental health questions ($n=1211$), the final analytic sample consisted of 2352 undergraduate students in S&E fields.

Our analytic sample included a demographically diverse group of students (shown in Table 1). In particular, 46.6% were women, 16.8% were from historically URM groups in

Table 1. Background characteristics of survey participants ($N = 2352$).

	<i>n</i>	%
Gender		
Man*	991	42.1
Woman	1097	46.6
Other gender/did not report	264	11.2
Race/ethnicity		
White*	1221	51.9
Black/Hispanic/Native American	395	16.8
Asian	359	15.3
Other race/did not report	377	16.0
SES		
High SES (8–10)	516	21.9
Mid SES (6–7)	984	41.8
Low SES (1–5)	620	26.4
Did not report	232	9.9
Disability status		
Non-disabled*	1760	74.8
Disabled	360	15.3
Did not report	232	9.9
Citizenship status		
U.S. citizen/permanent resident*	2041	86.8
International student	67	2.8
Did not report	244	10.4
Age		
18–22	1763	75.0
23+	352	15.0
Did not report	237	10.1
Household member experienced a loss of income		
Yes	1083	46.0
No*	1016	43.2
Did not report	253	10.8
Primary mentor		
Faculty*	1350	57.4
Staff	299	12.7
Peer (senior students or graduate students)	539	22.9
Other	164	7.0

Note. SES ($M = 6.34$; $SD = 1.71$) and age ($M = 21.36$, $SD = 3.05$) were continuous covariates. The missing values for these two variables were dummy coded (1 = missing, 0 = non-missing) and treated as control variables in the model. The remaining background characteristics were categorical covariates. *represents the reference group in each categorical covariate. The remaining groups in each categorical covariate were coded 1 and 0. [Table A2](#) shows the control relationships between all the background characteristics and primary measures in the full SEM.

S&E (i.e. Black/Hispanic/Native American), 15.3% were Asian, 26.4% were of low-SES, 15.3% identified as having a disability, 2.8% were international students, 75.0% were in the age group 18 to 22, and 46.0% reported having a household member who experienced a loss of employment/income since the COVID-19 pandemic began. With respect to the primary mentor of the participants, 57.4% were faculty members, 12.7% were staff members, 22.9% were their peers (senior students or graduate students), and 7.0% were other types of mentors.

Measures

Mental health problems

Depression and anxiety are two of the most common mental health problems in both higher education and the general population. To measure the mental health problems of college students during the COVID-19 pandemic, we used the Patient Health

Questionnaire for Depression and Anxiety (PHQ-4; Kroenke et al., 2009). The mental health problems scale asked participants if in the last 7 days they experienced: (1) feeling down, depressed, or hopeless (*depression*); (2) having little interest or pleasure in doing things (*depression*); (3) not being able to stop or control worrying (*anxiety*); and (4) feeling nervous, anxious, or on edge (*anxiety*). The response options include: 'not at all (1)', 'several days (2)', 'more than half the days (3)', and 'nearly every day (4)'. This mental health problems measure was constructed by a second order confirmatory factor analysis with two first-order factors (depression and anxiety) and two indicators of each first-order factor. The construct validity of the scale suggested good model fit ($RMSEA < 0.01$, $CFI = 1.00$, $TLI = 1.00$, $SRMR < 0.01$), and the standardised factor loadings of the items ranged from 0.81 to 0.93 (Hu & Bentler, 1999; Schermelleh-Engel et al., 2003). The Cronbach's alpha was estimated at 0.89. The mean and standard deviation of this measure collected by this and previous studies are provided in Table A1.

Perceived instrumental mentoring support

The scale of perceived instrumental mentoring support included four survey questions: 'after the COVID-19 outbreak, my primary mentor provided more/less support to help me (1) finish my assignments/projects; (2) improve my writing skills; (3) prepare for my presentations; and (4) explore my career options' (Marie Taylor & Neimeyer, 2009; Ortiz-Walters & Gilson, 2005). The 5-point Likert scale for perceived instrumental mentoring support ranged from -2 (*much less support*) to 2 (*much more support*). The mean was -0.20 and the standard deviation was 0.82 . The construct validity of this scale suggested good model fit ($RMSEA = 0.07$, $CFI = 0.99$, $TLI = 0.99$, $SRMR < 0.01$), and the standardised factor loadings of the items ranged from 0.76 to 0.88 (Hu & Bentler, 1999; Schermelleh-Engel et al., 2003). The Cronbach's alpha was estimated at 0.91 . The mean and standard deviation of this measure collected by this and previous studies are provided in Table A1.

Perceived psychosocial mentoring support

The scale of perceived psychosocial mentoring support also included four survey questions: 'after the COVID-19 outbreak, my primary mentor provided more/less support to encourage me to (1) discuss my concerns about academic projects; (2) pursue my learning interests; (3) work towards my career goals; and (4) talk about my anxiety in career' (Marie Taylor & Neimeyer, 2009; Ortiz-Walters & Gilson, 2005). The 5-point Likert scale for perceived psychosocial mentoring support ranged from -2 (*much less support*) to 2 (*much more support*). The mean was -0.02 and the standard deviation was 0.86 . The construct validity of this scale suggested good model fit ($RMSEA < 0.01$, $CFI = 1.00$, $TLI = 1.00$, $SRMR < 0.01$), and the standardised factor loadings of the items ranged from 0.77 to 0.92 (Hu & Bentler, 1999; Schermelleh-Engel et al., 2003). The Cronbach's alpha was estimated at 0.91 . The mean and standard deviation of this measure collected by this and previous studies are provided in Table A1.

Mentoring satisfaction

The construct of MS was assessed by asking student mentees: 'how satisfied were you with the support you received from your primary mentor during this past spring 2020 semester?' The scale ranged from 1 (*extremely dissatisfied*) to 9 (*extremely satisfied*). The mean was 6.93 and the standard deviation was 2.14.

Perceived deep-level mentor–mentee similarity

The construct of perceived deep-level mentor–mentee similarity was measured by asking respondents to rate how much they agree with the following four statements: 'my primary mentor and I generally: (1) share similar interests; (2) look at things in much the same way; (3) hold similar values; and (4) analyse problems in a similar way' (Ensher & Murphy, 1997; Ortiz-Walters & Gilson, 2005). The 4-point Likert scale for these four indicators ranged from 1 (*not at all agree*) to 4 (*strongly agree*). The construct validity of this scale suggested good model fit (RMSEA = 0.04, CFI = 0.99, TLI = 0.99, SRMR < 0.01), and the standardised factor loadings of the items ranged from 0.75 to 0.86 (Hu & Bentler, 1999; Schermelleh-Engel et al., 2003). The Cronbach's alpha was estimated at 0.87. The mean and standard deviation of this measure collected by this and previous studies are provided in Table A1.

Mentor–mentee interaction frequency

To capture the mentor–mentee interaction frequency, students were asked five questions to compare the changes in interaction frequency with their primary mentor from prior to during the COVID-19 pandemic via: (1) face-to-face; (2) video conferencing; (3) email; (4) phone; and (5) social media. The options include '*much less hours* (–2)', '*less hours* (–1)', '*about the same hours* (0)', '*more hours* (1)', and '*much more hours* (2)'. The responses to the five questions/types of interaction were summed (possible range –10 to +10) to defined changes in mentoring interaction frequency during the COVID-19 pandemic. The average sum score for changes in interaction frequency was –2.21 and the standard deviation was 3.69.

Background characteristics

Several measured background characteristics of students include gender, race/ethnicity, SES, disability status, citizenship status, age, household experienced a loss of employment income since the COVID-19 outbreak, and mentor type were collected and included as covariates in the statistical models. To measure student's SES, we employed the MacArthur Scale of Subjective Social Status (Adler et al., 2000), which is a self-reported scale from 1 (people who have the least money, least education, and worst jobs or no job) to 10 (people who have the most money, most education, and best jobs). The mean was 6.34 and the standard deviation was 1.71. Another type of SES measure, household member experienced a loss of income during the COVID-19 pandemic (United States Census Bureau, 2020), was also collected to reflect on students' financial challenges created by the crisis of COVID-19 pandemic. Disability status included six disability types: hearing, vision, cognition, mobility, self-care, and independent living (Centers for Disease Control and Prevention, 2020). Students with any of these difficulties were considered as having a disability for this study. For the

mentor type, students were asked to report the primary mentor with whom they learn/work most closely, such as faculty, staff, peer (senior students or graduate students), and others. Except for the SES measure and age, the rest of background characteristics were treated as categorical covariates. The reference group for each categorical covariate are stated in [Table 1](#).

Analytic strategies

Structural equation modelling (SEM) was employed to test our conceptual model depicted in [Figure 1](#). Before performing the SEM models, the skewness and kurtosis for all the measures were checked. All the skewness and kurtosis values ranged from -1.20 to 1.34, falling within the acceptable ranges (skewness: from -3 to +3; kurtosis: -10 to +10) in SEM (Griffin & Steinbrecher, 2013). Although 155 participants (out of 2352) were identified as potential outliers identified using the Mahalanobis approach in *Mplus* 8.6 (Muthén & Muthén, 1998–2017), we found the SEM results were very stable, consistent, and close even when these 155 cases were included. Hence, we retained all 2352 students in the analysis. Prior to conducting our study, we performed an *a priori* Monte Carlo simulation, which also confirmed that the sample size could provide sufficient power (>0.80) to detect small effect size (standardised coefficient = 0.05) among the focal variables in the conceptual model. Given that students nested within universities and states, to evaluate the data dependency issue, we checked the intraclass correlation coefficients (ICCs) for all our variables. The ICCs of our variables range from 0.001 to 0.044 and from 0.002 to 0.025 when students are nested within colleges and states, respectively. These ICCs do not exceed .05 so the dependency issue could be neglected (Huta, 2014).

Our first SEM (Model 1.1; see [Figure 1](#)) investigated the interrelationships between mentoring inputs, processes, and mental health problems. All the measures in the structural model were controlled for students' background characteristics. Next, we contrasted fit of our conceptual model relative versus two alternative models that treated instrumental and psychosocial mentoring support as a single global construct (Model 1.2) or treated mentor instrument support, psychosocial support, and satisfaction as a single global construct (Model 1.3). The best fitting SEM (i.e. Model 1.1) was carried forward.

In the second series of SEMs, we tested individual moderating effect of gender (Model 2), race/ethnicity (Model 3), SES (Model 4), disabilities (Model 5), and loss of income (Model 6) on the relationship between MS and mental health problems by adding an interaction term between MS and each of these demographic characteristics to Model 1.1. All the SEMs were performed in *Mplus* 8.6 (Muthén & Muthén, 1998–2017). The model fit could be considered acceptable when RMSEA was no more than .08, CFI and TLI were no <0.95, and SRMR was smaller than 0.10 (Hu & Bentler, 1999; Schermelleh-Engel et al., 2003).

The rate of missingness ranged from 0% to 13.7% across the study variables. Missing value analysis was conducted using Little's missing completely at random test (Little, 1988). The Expectation-Maximization estimated statistics (χ^2 [$df = 222$] = 242.27, $p = .17$) indicates that data were consistent with missing completely at random. We also ran Model 1.1 for two different samples to address the concern for the variable

Table 2. Reliabilities, descriptive statistics, and correlations among latent and observed variables ($N = 2352$).

	1	2	3	4	5	6
1. Mental health problems	(0.89)					
2. Instrumental support	-0.16*	(0.91)				
3. Psychosocial support	-0.13*	0.70*	(0.91)			
4. Mentoring Satisfaction	-0.19*	0.47*	0.53*	(n/a)		
5. Deep-level similarity	-0.09*	0.22*	0.26*	0.43*	(0.88)	
6. Interaction frequency	-0.11*	0.48*	0.42*	0.26*	0.08*	(n/a)
Number of items	4	4	4	1	4	1
Mean of item means	2.11	-0.20	-0.01	6.93	2.93	-2.21
Mean of item variances	1.09	0.68	0.74	4.56	0.65	13.60

Correlations were estimated in SEM, given that mental health problems, perceived instrumental mentoring support, perceived psychosocial mentoring support, and perceived deep-level mentor–mentee similarity were latent constructs. Cronbach's α coefficients in parentheses along the diagonal. n/a = not applicable. * $p < .001$.

with 13.7% missing information. One was with the full sample ($N = 2352$), and the other was using the partial sample (i.e. the remaining 86.3% non-missing sample; $N = 2030$). Both SEM results were very close and consistent. Hence, all the sample ($N = 2352$) was finally kept in the SEM analyses, and full information maximum likelihood approach was utilised in *Mplus* 8.6 to improve the estimation due to the missing data (Li & Lomax, 2017; Muthén & Muthén, 1998–2017).

Results

Descriptive statistics

The descriptive results, reliability and correlations for the primary variables are shown in Table 2. The data indicated that college students in our study experienced symptoms of depression and anxiety, on average, several days in a week ($M = 2.11$; $SD = 1.05$). As expected, the mentoring support variables were positively correlated with each other, whereas the correlations between mentoring support variables and mental health problems were negative and small.

Measurement model

Before testing RQs derived from the conceptual model, we constructed a measurement model to test the validity of four major latent constructs: mental health problems, perceived instrumental mentoring support, perceived psychosocial mentoring support, and perceived deep-level mentor–mentee similarity. The results indicated that the model fits the empirical data well ($RMSEA = 0.05$; $CFI = 0.97$; $TLI = 0.97$; $SRMR = 0.03$) and the standardised factor loadings ranged from 0.75 to 0.97 (Hu & Bentler, 1999; Schermelleh-Engel et al., 2003). Overall, these measures provided acceptable construct validities.

Structural models

Figure 2 shows the structural model results from estimating the interrelationships among mentoring support and mental health of college students, controlling for

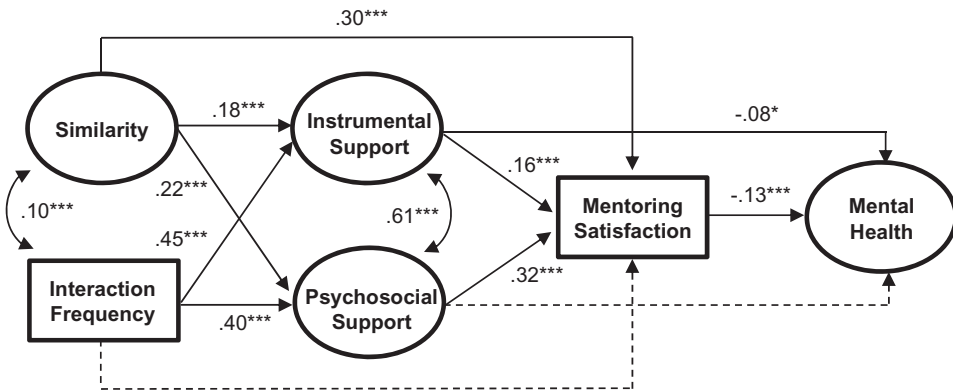


Figure 2. Structural model results of interrelationships between mentoring and mental health for STEM undergraduates during the COVID-19 pandemic ($N = 2352$). Latent construct = oval; observed variable = rectangle. All variables were controlled for the covariates including gender, race and ethnicity, SES, disability, age, citizenship status, loss of income during the pandemic, and primary mentor. The reference group of each categorical covariate are stated in Table 1. Values are standardised path coefficients. Dashed paths are not statistically significant. R^2 for similarity = 0.07; R^2 for mentoring frequency = 0.03; R^2 for instrumental support = 0.29; R^2 for psychosocial support = 0.24; R^2 for MS = 0.41; R^2 for mental health = 0.24. * $p < .05$, ** $p < .01$, *** $p < .001$.

students' background characteristics (see the full results in Table A2). For reasons of clarity, all the background characteristics, factor loadings for each latent construct, and uniquenesses were not shown in the figure. The model provided a good fit (RMSEA = 0.03; CFI = 0.97; TLI = 0.96; SRMR = 0.04), suggesting that the conceptual model (Figure 1) was largely supported by the empirical data (Hu & Bentler, 1999; Schermelleh-Engel et al., 2003).

RQ1. Disparities in mentoring support and mental health problems

Our SEM results indicate some demographic differences in mentoring support and mental health problems existed among S&E undergraduates in the U.S. during the COVID-19 pandemic (see Table A2). Compared to men, women showed a slightly lower level of MS (see Table A2 for full details), as well as moderately higher levels of mental health problems. Compared with their White peers, Asian students showed a slightly lower level of perceived deep-level mentor–mentee similarity, but a slightly higher level of perceived psychosocial mentoring support; however, no differences were found between White students and their peers from historically URM groups. Student SES was associated with a range of outcomes, such that a one standard deviation increase in SES scale is associated with a 0.12 standard deviation increase in perceived deep-level mentor–mentee similarity, a 0.11 standard deviation increase in mentor–mentee interaction frequency, a 0.08 standard deviation increase in perceived instrumental mentoring support, and a 0.22 standard deviation decrease in mental health problems. Compared with their non-disabled peers, students with disabilities showed a strongly higher level of mental health problems. For those students whose household member experienced a loss of employment income since the COVID-19 pandemic began, they showed a slightly lower level of interaction frequency with their primary mentor and a slightly higher level of mental health problems.

RQ2 & RQ3. Interrelationships among mentoring support and mental health problems

As hypothesised, the perceived deep-level mentor–mentee similarity and mentor–mentee interaction frequency exhibited positive associations with perceptions of instrumental and psychosocial mentoring support, after controlling for background characteristics (see estimated coefficients in [Figure 2](#)). Furthermore, mentees' perceived deep-level mentor–mentee similarity, perceived instrumental mentoring support, and perceived psychosocial mentoring support exhibited small-to-moderate positive associations with MS, after controlling for background characteristics. MS in turn negatively predicted mental health problems. In addition to MS, the SEM results revealed that perceived instrumental mentoring support had a direct, small negative association with mental health problems, whereas the relationship between perceived psychosocial mentoring support and mental health was not statistically significant. Overall, 24% of total variance in mental health problems could be explained by the factors and covariates in the model (medium-to-large effect; Cohen, 1988).

RQ4. Moderation effects of student demographics

Lastly, to examine whether the mentoring quality has differential effects on mental health problems for different student subgroups, we tested the moderating effects of demographic characteristics on the negative relationship between MS and mental health problems. In a series of SEMs, interaction term(s) between MS and each demographic background were added to predict mental health problems. SES and disability status moderated the negative relationship between MS and mental health problems respectively (see full results in [Table A3](#)). To ease interpretation of moderating effect for SES, we analysed and presented the categorical SES results. As shown in [Figure 3](#), the negative association between MS and mental health problems was significantly stronger for low-SES students, compared with their high-SES counterparts, indicating that the benefits of mentoring support on mental health were larger for students of lower SES status during the COVID-19 pandemic. However, the negative relationship between MS and mental health problems was weaker for students with disabilities, compared with their non-disabled peers.

Discussion

During the global COVID-19 pandemic, many college students are experiencing learning disruptions, social isolation, as well as economic and health issues that have a negative impact on their well-being and mental health. If unaddressed in a timely manner, the mental health problems of college students may continue to increase and could lead to long-lasting negative impacts on their social/emotional competencies, academic success, and career readiness. Adding to a rapidly growing body of evidence (e.g. Aristovnik et al., 2020; Fruehwirth et al., 2021), our study found that undergraduates in S&E programs across the U.S. experienced depressive and anxiety symptoms, on average, several days in a week. Consistent with prior studies, our results also indicated that students from historically underrepresented groups in S&E fields, including women, those of low-SES status, and those experiencing financial hardship affected by

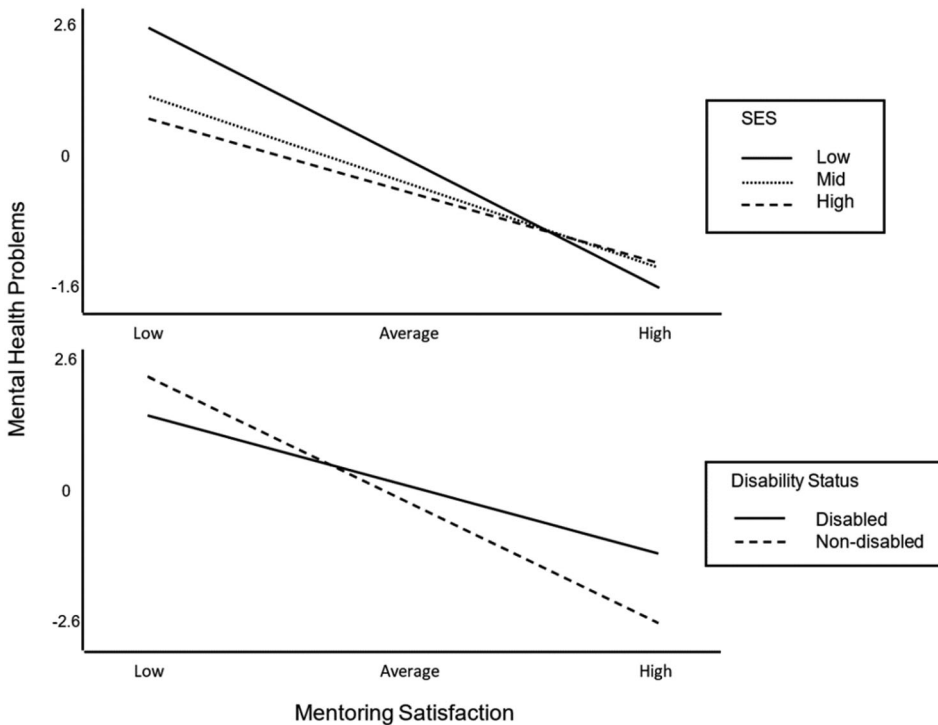


Figure 3. Simple slopes between MS and mental health problems with SES and disability status. X-axis = standardised MS ($M = 0$, $SD = 1$). Y-axis = standardised factor score of mental health problems ($M = 0$, $SD = 1$) estimated through its measurement model in the second series of SEMs.

the pandemic, reported more mental health problems. Our data also extended this body of literature on health disparities by showing that college students with disabilities, compared with their non-disabled counterparts, reported higher level of mental health problems.

Undoubtedly, mental health issues are widespread among college students during this special period. It is a parallel pandemic in higher education systems. While educators and public health professionals seek strategies and solutions, our study offered evidence that mentoring support for students could help mitigate the mental health problems on college campuses. In particular, our analyses demonstrated that the deep-level mentor–mentee similarity and mentor–mentee interaction frequency were positively associated with perceptions of instrumental and psychosocial mentoring support. Furthermore, higher levels of perceived instrumental and psychosocial mentoring support were associated with higher level of MS, which in turn was negatively associated with mental health problems. Importantly, our results uncovered that perceived instrumental mentoring support also exhibited a direct negative relationship with students' mental health problems. Prior studies have suggested that learning disruptions and economic recession created by the COVID-19 crisis were associated with higher levels of academic stress and lower levels of job search self-efficacy among college students (e.g. Chang et al., 2021; Olson et al., 2021). Therefore, instrumental support offered by mentors, such as guidance on completing academic assignments/

projects and advice on career development, could have a profound positive impact on students' mental health.

One important set of findings of our study showed that perceived levels of mentoring support and the mentoring benefits on mental health were varied by student SES. On the one hand, higher SES students reported higher levels of mentoring support, compared with their lower SES peers, raising the issue of inequality in the access to supportive mentorship in higher education institutions. On the other hand, lower SES students benefit more from having positive mentorship on their mental health, compared with their higher SES counterparts. Similar to many recent studies (e.g. Aristovnik et al., 2020), lower SES students in our study reported higher levels of mental health problems, compared with their higher SES peers. During the COVID-19 pandemic, lower income students and their family members were also likely to confront tremendous personal and financial challenges. Thus, positive mentorship on campus may represent one important source of support that can help address negative emotions and improve mental health for socioeconomically disadvantaged students in the time of crisis. However, it is an equity concern that lower SES students in our study reported lower levels of mentoring interaction and instrumental support.

When examining the differential effects of mentoring support on mental health by disability status, our results uncovered a worrisome pattern. Specifically, the negative association between MS and mental health problems is weaker for students with disabilities than for their non-disabled counterparts. This finding calls attention to the urgent need for understanding how to better support students with disabilities, who reported much higher levels of mental health problems. To put in perspective, while women reported mental health problems 0.15 standard deviations higher than men, the mental health gap between students with and without disabilities was twice as large, that is 0.30 standard deviations. It is possible that some special needs of students with disabilities were not sufficiently addressed by the mentors. Leaders and educators in higher education institutions should commit to ensure that all students with disabilities have equal access to quality mentorship, particularly in times of crisis. Mentors should be provided pre- and post-match training and institutional support/resources to provide necessary accommodations and culturally responsive mentorship in addressing the needs of students with disabilities (Garinger et al., 2015). Effective mentors should develop competencies that promote and maintain communication, align mentor–mentee expectations, assess their mentee's understanding, address equity and inclusion, foster independence, and promote the mentee's professional development (Pfund et al., 2006).

Limitations and directions for future research

Our study results need to be interpreted with some cautionary limitations. First, our survey participants, despite being a demographically diverse student sample in S&E fields from a large number of institutions and states, are not representative of the college student population in the U.S. The generalisability of the findings, therefore, may be limited. Given that each learning field has its own unique characteristics, future research should examine the interrelationships of mentoring support and mental

health among college students in other academic disciplines (e.g. social science) and with a representative student sample. Second, the mental health scale used in this study focussed on the symptoms of depression and anxiety. There may be other important indicators of mental health or psychological well-being, such as burnout, loneliness, and distress, that were not examined in this study. In future work with a richer set of mental health measures, it is vital to explore how mentoring support has a positive impact on various mental health outcomes.

Third, it is important to note that our study design was cross-sectional and non-experimental. Causal relationships between mentoring support and mental health of college student could not be established, though our models controlled for an extensive set of demographic characteristics. Future research should employ longitudinal, experimental or quasi-experimental designs to isolate the causal impacts of student mentoring on mental health. Fourth, the survey data of this study were collected in June 2020, an early stage of the global COVID-19 pandemic, and did not assess the impact of the pandemic in each local context directly (e.g. variations in state or local isolation, stay-at-home, or other relevant policies). The patterns of student mentoring and the mental health problems of college students might be very different in mid- or late-stages of the pandemic. Future research surveying college students in the later stage of the pandemic should further examine the role of pandemic-relevant individual and context variables (e.g. students' perceptions about the pandemic, overall support from peers) in the association between mentoring support and mental health. Finally, we acknowledge our data were collected from a self-reported questionnaire, which may have potential reporting bias and reliability issues.

Implications for practice

Despite limitations, our study presents a rich set of robust results on the negative relationship between mentoring support and mental health problems among S&E undergraduates during the COVID-19 pandemic, which have important practical implications. While providing the professional mental health help to student mentees is not expected by mentors (e.g. faculty, staff, & peer mentors), our study suggests that mentors still play an important role in supporting the well-being of their mentees during the COVID-19 pandemic. One important finding of our study showed that the more satisfied students felt about their mentors' support, the less depression and anxiety they may experience. Given the increased risk of challenges for S&E undergraduates during the COVID-19 pandemic (Saw et al., 2020), this finding indicates that a supportive relationship between mentor and mentee may buffer against psychological distress and promote mental health in this critical period and perhaps also during non-pandemic times. In order to foster a better mentor-mentee relationship, at least two efforts should be considered according to our study, which are instrumental support and psychosocial support.

Our study suggests that instrumental support is essential for students' perceived MS and their well-being. It is possible that this pandemic may present more challenges in students' academic settings, like procrastination or low engagement in school tasks, rather than in their other life domains. Therefore, it is important for

mentors to regularly check-in with their mentees' academic progress and performance during both crisis and non-crisis times. For example, the mentors may encourage the mentees to come into discuss various topics like the completion of assignment, the skills for project presentation, or the plans for future career development. Moreover, if further specific guidance is needed, mentors may also connect their mentees to other academic- or career-related centers on campus. Furthermore, there is growing evidence that mentors can learn to improve the quality of support provided to mentees (Pfund et al., 2006, 2015) and mentees can improve their ability to successfully navigate mentoring relationships to receive support they need most (Branchaw et al., 2020) received through deliberate training. Developing new skills to provide and receive support may be particularly important and impactful for students from historically underrepresented groups in S&E fields (Hernandez et al., 2020).

On the other hand, the support from the mentors should not only be focussed on the academic area but should also be carried via the supportive psychosocial vein during both pandemic and non-pandemic times. As suggested by our study, although mentors' psychosocial support was not directly related to students' mental health, it was positively correlated to MS. Such finding indicates that mentors should take care of their mentees' psychological needs in their communications and virtual meetings. For example, mentors should reach out to the mentees more often to increase their relatedness, which in turn may promote the closeness between mentor and mentee. Therefore, students may feel more comfortable in discussions and less negative emotions like shame and embarrassment when asking questions and suggestions. In addition, when criticism is needed, mentors should embed confidence in their mentee's ability to improve, provide care, and make it constructive (Fong et al., 2018). Therefore, mentees will perceive the good intention of the mentor and experience hope as a feedback receiver, which may produce higher satisfaction towards their mentor-mentee relationship.

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No potential conflict of interest was reported by the authors.

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Appendix

Table A1. Summary mean and standard deviation scores for the measures used in previous studies.

	<i>M</i>	<i>SD</i>
Mental health problems		
The present study: 6/3–22, 2020 ^a	2.11	1.05
U.S. Census Bureau (2020): 6/4–23, 2020 ^b	1.94	1.03
Instrumental support		
The present study ^c	–0.20	0.82
Marie Taylor & Neimeyer (2009) ^d	–0.06	0.62
Ortiz-Walters & Gilson (2005) ^e	0.13	0.99
Psychosocial support		
The present study ^f	–0.01	0.86
Marie Taylor & Neimeyer (2009) ^g	0.52	0.87
Ortiz-Walters & Gilson (2005) ^h	0.76	0.82
Deep-level similarity		
The present study ⁱ	2.93	0.81
Ensher & Murphy (1997) ^j	3.09	0.52

Note: *M* = mean. *SD* = standard deviation. For the purpose of comparison, all the means and standard deviations of previous studies were converted into the same point Likert scales as this study. ^{a,b,i}Four-point Likert scale; ^{c,d,f,g,j}Five-point Likert scale; ^{e,h}Seven-point Likert scale; ^{a,i}U.S. undergraduate student sample; ^bU.S. general adult sample; ^{c,f}Changes in support; ^{d,e,g,h}Cross-sectional support.

Table A2. Standardised path coefficients for model 1.1.

Variable relationships	β	(SE)
Measurement models		
Similarity 1 $\leftarrow$ Similarity factor	0.76***	(0.01)
Similarity 2 $\leftarrow$ Similarity factor	0.85***	(0.01)
Similarity 3 $\leftarrow$ Similarity factor	0.83***	(0.01)
Similarity 4 $\leftarrow$ Similarity factor	0.74***	(0.01)
Instrumental support 1 $\leftarrow$ Instrumental support factor	0.83***	(0.01)
Instrumental support 2 $\leftarrow$ Instrumental support factor	0.91***	(0.01)
Instrumental support 3 $\leftarrow$ Instrumental support factor	0.92***	(0.01)
Instrumental support 4 $\leftarrow$ Instrumental support factor	0.76***	(0.01)
Psychosocial support 1 $\leftarrow$ Psychosocial support factor	0.84***	(0.01)
Psychosocial support 2 $\leftarrow$ Psychosocial support factor	0.91***	(0.01)
Psychosocial support 3 $\leftarrow$ Psychosocial support factor	0.89***	(0.01)
Psychosocial support 4 $\leftarrow$ Psychosocial support factor	0.78***	(0.01)
Depression 1 $\leftarrow$ Depression factor	0.81***	(0.01)
Depression 2 $\leftarrow$ Depression factor	0.93***	(0.01)
Anxiety 1 $\leftarrow$ Anxiety factor	0.91***	(0.01)
Anxiety 2 $\leftarrow$ Anxiety factor	0.92***	(0.01)
Depression factor $\leftarrow$ Mental health factor	0.89***	(0.02)
Anxiety factor $\leftarrow$ Mental health factor	0.86***	(0.02)
Structural models		
Hypothesised relationships		
Instrumental support factor $\leftarrow$ Similarity factor	0.18***	(0.02)
Psychosocial support factor $\leftarrow$ Similarity factor	0.22***	(0.02)
Instrumental support factor $\leftarrow$ Interaction frequency	0.45***	(0.02)
Psychosocial support factor $\leftarrow$ Interaction frequency	0.40***	(0.02)
MS $\leftarrow$ Instrumental support factor	0.16***	(0.03)
MS $\leftarrow$ Psychosocial support factor	0.32***	(0.03)
MS $\leftarrow$ Similarity factor	0.30***	(0.02)
MS $\leftarrow$ Interaction frequency	0.03	(0.02)
Mental health factor $\leftarrow$ MS	-0.13***	(0.03)
Mental health factor $\leftarrow$ Instrumental support factor	-0.08*	(0.04)
Mental health factor $\leftarrow$ Psychosocial support factor	0.04	(0.04)
Similarity factor $\leftrightarrow$ Interaction frequency	0.10***	(0.02)
Instrumental support factor $\leftrightarrow$ Psychosocial support factor	0.61***	(0.02)
Control relationships		
Similarity factor $\leftarrow$ Women	0.05	(0.05)
Similarity factor $\leftarrow$ Other gender	-0.11	(0.16)
Similarity factor $\leftarrow$ Asian	-0.20**	(0.06)
Similarity factor $\leftarrow$ Black/Hispanic/Native American	-0.02	(0.06)
Similarity factor $\leftarrow$ Other race/didn't report	-0.02	(0.09)
Similarity factor $\leftarrow$ Age	0.04	(0.05)
Similarity factor $\leftarrow$ Age (didn't report)	0.62	(0.39)
Similarity factor $\leftarrow$ International student	-0.18	(0.13)
Similarity factor $\leftarrow$ Citizenship status (didn't report)	-0.10	(0.25)
Similarity factor $\leftarrow$ Disabilities	-0.06	(0.06)
Similarity factor $\leftarrow$ Disabilities (didn't report)	-0.15	(0.32)
Similarity factor $\leftarrow$ SES	0.12**	(0.04)
Similarity factor $\leftarrow$ SES (didn't report)	0.26	(0.48)
Similarity factor $\leftarrow$ Loss of income	-0.08	(0.05)
Similarity factor $\leftarrow$ Loss of income (didn't report)	-0.16	(0.21)
Similarity factor $\leftarrow$ Staff mentor	-0.17**	(0.07)
Similarity factor $\leftarrow$ Peer mentor	.025***	(0.05)
Similarity factor $\leftarrow$ Other mentor	-0.72***	(0.08)
Interaction frequency $\leftarrow$ Women	-0.05	(0.04)
Interaction frequency $\leftarrow$ Other gender	-0.02	(0.15)
Interaction frequency $\leftarrow$ Asian	-0.05	(0.06)
Interaction frequency $\leftarrow$ Black/Hispanic/Native American	-0.01	(0.06)
Interaction frequency $\leftarrow$ Other race/didn't report	-0.02	(0.08)
Interaction frequency $\leftarrow$ Age	0.07	(0.05)
Interaction frequency $\leftarrow$ Age (didn't report)	0.35	(0.37)
Interaction frequency $\leftarrow$ International student	0.25*	(0.13)

(continued)

Table A2. Continued.

Variable relationships	β	(SE)
Interaction frequency $\leftarrow$ Citizenship status (didn't report)	0.03	(0.24)
Interaction frequency $\leftarrow$ Disabilities	-0.01	(0.06)
Interaction frequency $\leftarrow$ Disabilities (didn't report)	0.20	(0.31)
Interaction frequency $\leftarrow$ SES	0.11**	(0.03)
Interaction frequency $\leftarrow$ SES (didn't report)	-0.06	(0.46)
Interaction frequency $\leftarrow$ Loss of income	-0.12**	(0.05)
Interaction frequency $\leftarrow$ Loss of income (didn't report)	-0.10	(0.20)
Interaction frequency $\leftarrow$ Staff mentor	-0.11	(0.06)
Interaction frequency $\leftarrow$ Peer mentor	-0.22***	(0.05)
Interaction frequency $\leftarrow$ Other mentor	0.15	(0.08)
Instrumental support factor $\leftarrow$ Women	0.03	(0.04)
Instrumental support factor $\leftarrow$ Other gender	0.19	(0.14)
Instrumental support factor $\leftarrow$ Asian	0.04	(0.06)
Instrumental support factor $\leftarrow$ Black/Hispanic/Native American	0.02	(0.05)
Instrumental support factor $\leftarrow$ Other race/didn't report	-0.05	(0.08)
Instrumental support factor $\leftarrow$ Age	0.03	(0.05)
Instrumental support factor $\leftarrow$ Age (didn't report)	0.32	(0.34)
Instrumental support factor $\leftarrow$ International student	0.35**	(0.11)
Instrumental support factor $\leftarrow$ Citizenship status (didn't report)	0.11	(0.22)
Instrumental support factor $\leftarrow$ Disabilities	-0.09	(0.05)
Instrumental support factor $\leftarrow$ Disabilities (didn't report)	-0.15	(0.28)
Instrumental support factor $\leftarrow$ SES	0.08*	(0.03)
Instrumental support factor $\leftarrow$ SES (didn't report)	-0.06	(0.42)
Instrumental support factor $\leftarrow$ Loss of income	-0.05	(0.04)
Instrumental support factor $\leftarrow$ Loss of income (didn't report)	0.00	(0.18)
Instrumental support factor $\leftarrow$ Staff mentor	0.01	(0.06)
Instrumental support factor $\leftarrow$ Peer mentor	-0.27***	(0.05)
Instrumental support factor $\leftarrow$ Other mentor	-0.34***	(0.08)
Psychosocial support factor $\leftarrow$ Women	0.04	(0.04)
Psychosocial support factor $\leftarrow$ Other gender	-0.08	(0.14)
Psychosocial support factor $\leftarrow$ Asian	0.15**	(0.06)
Psychosocial support factor $\leftarrow$ Black/Hispanic/Native American	0.11	(0.06)
Psychosocial support factor $\leftarrow$ Other race/didn't report	0.09	(0.08)
Psychosocial support factor $\leftarrow$ Age	-0.05	(0.05)
Psychosocial support factor $\leftarrow$ Age (didn't report)	-0.14	(0.35)
Psychosocial support factor $\leftarrow$ International student	0.05	(0.12)
Psychosocial support factor $\leftarrow$ Citizenship status (didn't report)	0.05	(0.23)
Psychosocial support factor $\leftarrow$ Disabilities	-0.10	(0.06)
Psychosocial support factor $\leftarrow$ Disabilities (didn't report)	0.12	(0.29)
Psychosocial support factor $\leftarrow$ SES	0.03	(0.03)
Psychosocial support factor $\leftarrow$ SES (didn't report)	0.04	(0.43)
Psychosocial support factor $\leftarrow$ Loss of income	0.01	(0.04)
Psychosocial support factor $\leftarrow$ Loss of income (didn't report)	-0.03	(0.18)
Psychosocial support factor $\leftarrow$ Staff mentor	0.06	(0.06)
Psychosocial support factor $\leftarrow$ Peer mentor	-0.12*	(0.05)
Psychosocial support factor $\leftarrow$ Other mentor	-0.33***	(0.08)
MS $\leftarrow$ Women	-0.10**	(0.04)
MS $\leftarrow$ Other gender	0.03	(0.12)
MS $\leftarrow$ Asian	0.00	(0.05)
MS $\leftarrow$ Black/Hispanic/Native American	0.09	(0.05)
MS $\leftarrow$ Other race/didn't report	-0.09	(0.07)
MS $\leftarrow$ Age	0.07	(0.04)
MS $\leftarrow$ Age (didn't report)	0.36	(0.33)
MS $\leftarrow$ International student	-0.10	(0.11)
MS $\leftarrow$ Citizenship status (didn't report)	0.26	(0.20)
MS $\leftarrow$ Disabilities	-0.06	(0.05)
MS $\leftarrow$ Disabilities (didn't report)	-0.31	(0.26)
MS $\leftarrow$ SES	-0.01	(0.03)
MS $\leftarrow$ SES (didn't report)	-0.13	(0.39)
MS $\leftarrow$ Loss of income	0.05	(0.04)
MS $\leftarrow$ Loss of income (didn't report)	0.03	(0.17)

(continued)

Table A2. Continued.

Variable relationships	β	(SE)
MS $\leftarrow$ Staff mentor	-0.05	(0.05)
MS $\leftarrow$ Peer mentor	0.05	(0.05)
MS $\leftarrow$ Other mentor	-0.35***	(0.08)
Mental health factor $\leftarrow$ Women	0.30***	(0.05)
Mental health factor $\leftarrow$ Other gender	0.46**	(0.16)
Mental health factor $\leftarrow$ Asian	0.03	(0.06)
Mental health factor $\leftarrow$ Black/Hispanic/Native American	0.18**	(0.06)
Mental health factor $\leftarrow$ Other race/didn't report	0.02	(0.09)
Mental health factor $\leftarrow$ Age	0.02	(0.05)
Mental health factor $\leftarrow$ Age (didn't report)	-0.14	(0.39)
Mental health factor $\leftarrow$ International student	0.05	(0.13)
Mental health factor $\leftarrow$ Citizenship status (didn't report)	-0.20	(0.28)
Mental health factor $\leftarrow$ Disabilities	0.84***	(0.06)
Mental health factor $\leftarrow$ Disabilities (didn't report)	0.30	(0.38)
Mental health factor $\leftarrow$ SES	-0.22***	(0.04)
Mental health factor $\leftarrow$ SES (didn't report)	0.40	(0.59)
Mental health factor $\leftarrow$ Loss of income	0.18***	(0.05)
Mental health factor $\leftarrow$ Loss of income (didn't report)	-0.41	(0.52)
Mental health factor $\leftarrow$ Staff mentor	-0.03	(0.07)
Mental health factor $\leftarrow$ Peer mentor	0.02	(0.06)
Mental health factor $\leftarrow$ Other mentor	-0.17	(0.09)

Note: β = standardised path coefficients. SE = standard error. MS = mentoring satisfaction. SES = socioeconomic status. * $p < .05$, ** $p < .01$, *** $p < .001$. Given that the three mentoring process measures are strongly correlated, we also tested two alternative models (models 1.2 and 1.3) to confirm the current model 1.1. In model 1.2, we considered the 8 items from the perceived instrumental support and perceived psychosocial support scales should load on the one factor (mentoring support). The results showed a poor fit model 1.2 (RMSEA = 0.06; CFI = 0.85; TLI = 0.84; SRMR = 0.06), which was worse than the model fit of model 1.1 (RMSEA = 0.03; CFI = 0.97; TLI = 0.96; SRMR = 0.04). In model 1.3, based on Eby et al. (2013) and descriptive results in Table 2, perceived instrumental support, perceived psychosocial support, and MS are highly correlated. We can also consider the nine items from these three measures could load on one factor (mentoring processes). The results also indicated a poor fit (RMSEA = 0.07; CFI = 0.86; TLI = 0.83; SRMR = 0.05), which was also worse than the model fit of model 1.1 (RMSEA = 0.03; CFI = 0.97; TLI = 0.96; SRMR = 0.04). Hence, the current conceptual model (model 1.1) was better supported by the empirical evidence.

Table A3. Results for the moderating effects of demographic characteristics on the relationship between MS and mental health ($N = 2352$).

	β	(SE)
Gender		
Women $\times$ MS	-0.04	(0.08)
Race and Ethnicity		
Asian $\times$ MS	0.06	(0.08)
Black/Hispanic/Native American $\times$ MS	-0.10	(0.08)
SES (Continuous)		
SES $\times$ MS	0.38***	(0.09)
SES (Categorical)		
Low SES $\times$ MS	-0.17*	(0.09)
Mid SES $\times$ MS	-0.04	(0.09)
Disabilities		
Disabled $\times$ MS	0.18**	(0.07)
Household experienced a loss of income during the pandemic		
Loss of Income $\times$ MS	0.02	(0.07)

Note: β = standardised path coefficients. SE = standard error. MS = mentoring satisfaction. SES = socioeconomic status. Except for the path from the newly created interaction term to mental health problems, the SEM model including the covariates remained the same as shown in Figure 2. The reference groups for gender, race, and ethnicity, SES (categorical), disability, and loss of income were men, men $\times$ MS, white, white $\times$ MS, high SES, high SES $\times$ MS, non-disabled, non-disabled $\times$ MS, non-loss of income, and non-loss of income $\times$ MS, respectively. For clarity, the results for the 'did not report' group in each demographic background were not reported.

* $p < .05$, ** $p < .01$, *** $p < .001$.