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U.S. agricultural university students' mental well-being and resilience during the first wave of COVID-19: Discordant expectations and experiences across genders

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Abstract

The coronavirus disease 2019 (COVID-19) pandemic's first wave led to declining mental health and life satisfaction outcomes for college students, especially women. While women in undergraduate agricultural programs outperformed men academically prior to and during the pandemic, the achievement may have come at personal cost, especially for those women with fewer personal and environmental resiliency resources. Our research objective was to expand on personal, social, and environmental factors linked with lower mental health and life satisfaction scores for students in agriculture during the pandemic. We measured the influence of such factors across gender-based mental health and life satisfaction outcomes. Our data were collected from 2030 students using an on-line survey across six land-grant university college of agriculture in agriculturally as many distinct regions of the United States. We estimated OLS and Ordered Probit models of their mental health and life

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satisfaction self-assessments. Our findings reveal students' mental health and life satisfaction were reduced due to a paucity of personal (e.g., less future orientation or graduate school aspirations, food and housing insecurity, and personal health risks) and environmental (e.g., lower quality on-line learning experiences, isolation, family health risk, discrimination experiences) resiliency resources. Our results suggest women were more likely than men to be adversely affected by reduced resiliency resources. These findings suggest university emergency response policies need to address students' needs for housing and food security, on-line course development and delivery, tele health and mental health resources, broad social inclusion and diversity to decrease risk of female attrition and support all students in agricultural degree programs.

The first wave of the coronavirus disease 2019 (COVID-19) pandemic severely disrupted the Spring 2020 academic semester across the United States as over two million college students were abruptly sent home (Johnson et al. 2020). Classes moved online, dorm rooms were vacated, food halls closed, and activities and clubs went virtual or were canceled altogether. Unlike localized natural disasters (e. g., hurricanes, blizzards) or crises (e.g., campus shootings), this event caused a nationwide challenge to the ability of faculty and students to engage in teaching and learning. Throughout the pandemic, health experts and researchers monitoring student mental health reported students experienced increased isolation and life disruption resulting in a higher likelihood of depression, anxiety, and suicidal thoughts (Giuntella et al., 2021; Holman et al., 2020; Rudenstine et al., 2021; The Healthy Minds Network and ACHA, 2020).[1] These results are consistent with student self-reports of higher anxiety and depression during the Spring 2020 pandemic restrictions (Amendola et al., 2021; Rudenstine et al., 2021).

The extent and manner in which the pandemic impacted individual student's mental health, long-term academic performance, professional ambitions, and overall well-being is likely shaped by their personal and environmental (socio-ecological) resilience capacity. The social-psychological literature defines resilience as an individual's positive adaptation to adverse events and trauma (Di Maggio et al., 2016), while the socio-ecological resilience framework examines individual resilience as a function of personal characteristics and environmental circumstances (Ensor et al., 2021). Individuals may display resilient behaviors in one environment

(e.g., living with their nuclear family and succeeding in a difficult class), but be less resilient in a different environment (e.g., failing a difficult class while living on their own). Major environmental stressors, including natural disasters and security threats, typically worsen mental health in entire communities, yet some individuals or sub-groups are less impacted than others (Ensor et al., 2021). In particular, men and women can be affected differently depending on the type of event or trauma they endure (Rudenstine et al., 2021).

The objective of this study is to examine the impact personal, social, and environmental factors have on students' self-assessment of mental health and life satisfaction during the first wave of the COVID-19 pandemic. Specifically, we explore underlying social and environmental measures of resilience and associated resources that comprise such measures. We collected data collected from an online survey of over 2000 undergraduate students in Colleges of Agriculture across six land grant universities. Agricultural students are the focus of the analysis—providing a unique opportunity to examine the impact of the COVID-19 pandemic from the perspective of students from diverse settings that include rural and urban areas. We measure relationships among housing and food security, social support and concerns, race and ethnicity, location, and overall remote learning experience. Recently published studies suggest that despite continuing to perform well academically (Engelhardt et al., 2020; Kiesel et al., 2021), women may have also incurred greater psychological stress (e.g., Amendola et al., 2021; Rudenstine et al., 2021). Women may be more adaptable to adversity in the short run but at a significant cost in terms of their mental health and life satisfaction. Ultimately, this may alter their long-term ambitions and goals. To examine this issue among college of agriculture students, we disaggregate and compare findings by gender to explore whether women were disproportionately affected by the pandemic.

Our results suggest self-assessed mental health of undergraduate women decreased compared to their male peers as their access to resilience resources became more limited. In particular, women considering advanced degrees were most affected by changes in access to resources affecting their personal and environmental resilience. These results suggest a careful consideration and review of available support services, and resources may be most beneficial to mitigate other stressful situations in university settings, such as natural hazards, exposure to violence, or student transitions from high school and community colleges to university and university to the workforce. We find university policies and programs that encourage inclusion, housing and food security, and health resources may be particularly important to supporting student well-being in times of widespread and external shock.

BACKGROUND

Resiliency, mental health, and life satisfaction

Individual measurements of resiliency are associated with life satisfaction and mental health outcomes (Di Maggio et al., 2016; Miller et al., 1996; Stoffel & Cain, 2018). While resiliency does not make individuals immune to mental health challenges, it does decrease mental health adversity from environmental and social shocks (Davydov et al., 2010) like the pandemic. It is important to emphasize that resilience is not a static state. Rather, the resiliency of individuals may differ depending on the type of stress, shock, and setting in which they are experiencing the shock. Larwin et al. (2020) demonstrate that life satisfaction and resilience are correlated components underlying an individual's subjective happiness. Life satisfaction has been linked

to academic achievement, retention, academic satisfaction, and college persistence (Frisch et al., 2005; Karaman et al., 2019). Flinchbaugh et al. (2015) found that resilience plays a mediating role in the impact of hindrance stressors (seen as harmful by an individual) on life satisfaction for students at a midwestern university.

Globally, depression is a leading cause of disability, and suicide is a leading cause of death, for adolescents and young adults aged 15–29 years old (WHO, 2021). Prior to the pandemic public health professionals were already observing increasing rates of depression, anxiety, and suicidal thoughts among young people (Duffy et al., 2019; Leahy et al., 2010; Winzer et al., 2014). These risks were exacerbated during the first wave of the COVID-19 pandemic as almost one in four college students experienced moderate to severe anxiety within 4 months of the first shutdown (Fruehwirth et al., 2021; Zhai & Du, 2020). Importantly, prior to and during the first wave of the pandemic, mental health risks for anxiety and depression were found to be higher for female, black, sexual/gender minority, and low-income students (Amendola et al., 2021; Eisenberg et al., 2013; Fruehwirth et al., 2021; Said et al., 2013).

Mental health is foundational to a human's ability to think, to share feelings, to maintain employment, and to enjoy life (WHO, 2021). This is of concern in higher education settings as students' mental well-being directly affects their ability to learn, to fully participate in their degree program, and may impact their employment and other opportunities after graduation. In the case of undergraduate students in agricultural disciplines, little is known about students' mental health, life satisfaction, and other factors contributing to greater resilience during times of stress, nor of environmental and university factors that may improve their resiliency and related mental health. Brown et al. (2021) examined anxiety during the outbreak of the COVID-19 pandemic for students in several agricultural economics courses. They provided descriptive evidence of heightened student anxiety due to multiple reasons such as academic pressure, new online learning environments, general life uncertainty, health and safety concerns, and financial burdens. However, they did not conduct a deeper investigation into how personal characteristics, environmental resiliency factors, or personal resiliency factors were associated with increased student anxiety. We use insights from the socio-ecological resilience literature to identify factors and resources (see Figure 1) that may affect mental health and life satisfaction at the beginning of the pandemic.

Across the resilience literature, access to economic resources is a household characteristic positively associated with an individual's and a household's ability to overcome external shocks (Abramson et al., 2015; Ensor et al., 2021; Ghanmen et al., 2016). Problematically, income may be confounded with social and physical environmental factors of resilience; as such, disentangling the role of income from other potential factors is critical when trying to understand student success. For instance, for many college students, the pandemic reduced food and housing security. Prepandemic food and housing insecurity risks among college students alone may lead to adverse mental health outcomes. In a study of California college students, food insecurity among college-aged individuals was correlated with higher levels of psychological distress, especially for female students (Becerra & Becerra, 2020). During the pandemic, the disruption caused by campus decisions to restrict or shut food service operations, residences, and other services created additional housing and food insecurity, in addition to other challenges. Students not only needed a safe and secure place to sleep, but due to the closure of libraries and many other public spaces, many also faced new challenges in accessing the high-speed internet and computer technology required for the new learning environment (Lederer et al. 2021).

Existing research on mental health and resiliency suggests students with stronger family and social support networks were likely to experience lower levels of psychological stress during
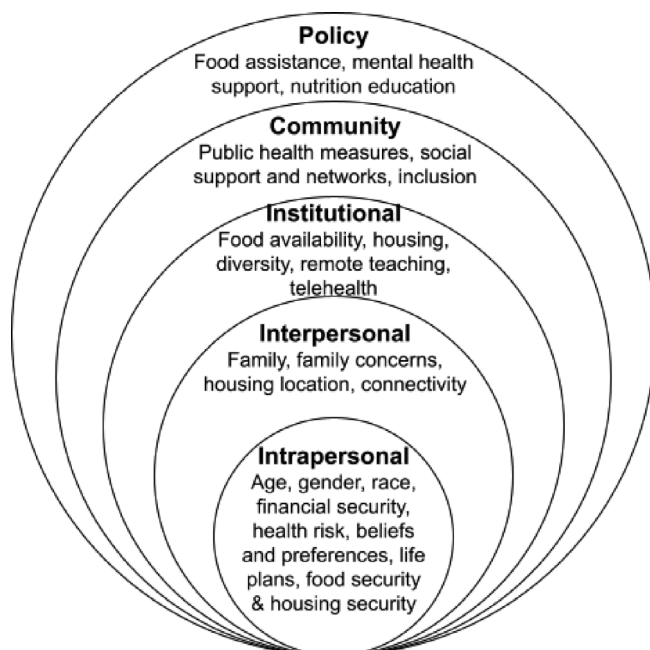
FIGURE 1 Socioecological resiliency model organization of variables affecting student mental health and well-being (adapted from Hiller et al., 2021)

the pandemic (Killgore et al., 2020). However, students with family members at high risk of COVID-19 induced mortality might have experienced additional psychological burden (Choi et al., 2020). This may be more likely if their loved ones' health risks resulted in increased social isolation of the student, including isolation from family members they were most concerned about (Choi et al., 2020; Schiff et al., 2020).

A bulk of research on education and resiliency focuses on precollege-aged children primarily on adolescents and grade-school children. A student's future orientation[2] improves their current period adaptability and resilience and is reflected in their future expectations and actions they carry out related to the future (Di Maggio et al., 2016). In the case of college students, their major and career-related aspirations (e.g., immediate work versus graduate or professional school) reflect their future orientation. Di Maggio et al. (2016) found both future orientation and resiliency measures were negatively correlated with pessimism. This and additional studies in this area suggest a future orientation improves individuals' abilities to deal with disruptions and have a more adaptive career outlook.

Undergraduate women in agriculture, career attrition, life satisfaction and mental health

Academic stress, especially among high-performing students pursuing graduate school, contributes to anxiety and depression among undergraduate students (Flatt, 2013; Norman & Ford, 2019). This is further exacerbated by financial burdens, food and housing insecurity, stresses of being away from home, technology, and isolation (Flatt, 2013). While these conditions have long existed, they were magnified by the pandemic (Lederer et al., 2021).

Gender inequities and discrimination can also be a significant source of mental health issues, particularly depression and lower life satisfaction (Hackett et al., 2019; Vargas et al., 2020). Even prior to the pandemic, undergraduate female students were twice as likely to exhibit signs of depression (Flatt, 2013). In academic fields with a lower proportion of female students, mental health may be adversely impacted and decline over the course of the degree program for female students (Scott-Young et al., 2020). These factors may have had a detrimental impact on the career pipeline for women in agriculture and were likely exacerbated during the pandemic. In agriculture, the number of women academically outperforming men has increased along with their presence in different disciplines (Borman et al., 2013; Thomas et al., 1991). Yet, the representation of women within certain programs, such as agricultural economics, remains relatively low (Brevik et al. 2018, Zepeda & Marchant, 1998).[3] Attrition of women increases post matriculation, and women continue to be severely underrepresented in professorial and industry leadership positions (Murray et al., 2011).

Increased academic stresses, as well as increased stresses on work–life balance, increases mental health concerns and can lower life satisfaction for women (Gibbons et al., 2019; Whitney et al., 2002), ultimately leading to the exit of women from these fields. Several recent studies have reported lower perceived well-being and greater mental health challenges for women relative to men during the pandemic (Croda & Grossbard, 2021; Escudero-Castillo et al., 2021). We contribute to this area of research by studying the association between the uncertainly in academic life caused by the COVID-19 pandemic and undergraduate students' mental health and well-being.

METHODS

Survey instrument and data collection

We conducted an online survey of undergraduate students in Colleges of Agriculture at six land grant universities from July to August 2020. The participating schools were geographically dispersed, located in 6 of the 10 USDA farm production regions (USDA ARMS, 2013). All participating schools were R1 or R2 universities. At the time of our data collection, these schools had a combined enrollment of 17,000 undergraduate students in their Colleges of Agriculture, representing an average of 11.6% and ranged from 5.5% to 24.0% of total undergraduate enrollment at the participating universities. The survey was distributed to students online via Qualtrics® prior to the beginning of the Fall 2020 semester or quarter. The Institutional Review Board at each participating university approved the study. The survey was administered by the authors or officials at each university, and the same survey instrument was distributed to the students across all universities.

The survey instrument was designed to collect information on the effect of COVID-19 on students' current and expected learning outcomes. Questions were asked specific to students' Spring 2020 academic experiences. This included questions about the nature of their remote instruction, learning perceptions and experiences, concerns about their personal and family's COVID-19-related health and safety, their perceived COVID-19-related health risks, experiences with racism and discrimination throughout their time at university, and information about their emotional and mental well-being since their university closed on-campus learning. Information concerning students' demographic characteristics, financial resources, and personal obligations that may affect their decision concerning Fall 2020 enrollment was also collected.

TABLE 1 Variable measures and scales from survey

Survey measure	Variable name	Scale	
		Low value	High value
Well-being (dependent variables)			
Mental health score[a] (0–27) Life satisfaction (5–35)		Better Worse	Worse Better
Personal resiliency			
Not worried about COVID-19 on own health	No worry for self	1 = *Strongly disagree*	5 = *Strongly agree*
Family COVID-19 health risk	Family health risk	1 = *Not worried at all*	5 = *Extremely worried*
Food insecurity	Food_insecure	1 = *Strongly disagree*	5 = *Strongly agree*
Housing insecurity	Housing_insecure	1 = *Strongly disagree*	5 = *Strongly agree*
Graduate school aspirations	Grad school	0 = *Plan to work after graduation*	1 = *Plan to pursue further education* (e.g., MSc, MBA, PhD)
Environmental resilience			
Felt connected to their community	Felt connected	1 = *Strongly disagree*	5 = *Strongly agree*
Experienced discrimination	Exp. discrimination	7 = *Strongly disagree*	1 = *Strongly agree*
Spring 2020 online class experience	Online spring exp.	1 = *Very poor*	5 = *Very good*
Political leaning	Liberal leaning	0 = *Not liberal*	0 = *Very or moderately liberal*

[a]Scores collected using an adapted version of the HANDS Survey instrument.

We collected data on items affecting personal and environmental resiliency. Personal resiliency was assessed by the extent of concern about concerns about one's own health, concern about family COVID-19-related health risk, whether the student had experienced food insecurity or housing insecurity, and what their plans are after graduation. This environmental resiliency factors considered in this analysis were measures of the student's feeling of connectedness to their community, whether they had been personally affected by discrimination,[4] their political affiliation,[5] and their experience with online learning during the Spring 2020 semester. Additional information about these variables and their measurement is included in Table 1.

Separate measures were used to assess each student's mental health and life satisfaction. The HANDS Mental Health Survey measures multiple dimensions of mental health and has been used as a screening instrument in clinical settings to identify individuals who are at low, moderate, or high risk of depression (Baer et al., 2000).[6] An adapted version of this instrument was included in this survey, which requested that rank nine statements on a four-point Likert scale.[7] The HANDS instrument scale and composite statements are presented in Table A1.[8] The

sum of the statement scores is used to assign a likelihood of depression to each participant with scores. Following Baer et al. (2020) scores of less than nine indicates a low likelihood of depression, a score between from nine and 16 indicates a moderate likelihood of depression, and scores higher than 16 was indicating a high likelihood of depression. Respondent life satisfaction was assessed using the widely adopted Satisfaction with Life Scale (SWLS; summarized in Table A2) (Diener et al., 1985). This instrument asks respondents to indicate their level of agreement to five statements concerning self-assessed well-being (as distinct from emotional well-being). This scale has been shown to be reliable for a wide array of people and settings.

Sample characteristics

A total of 2299 students completed most of the survey across all universities, with an average student response rate of 15%. Of these, 2028 completed survey responses were usable for regression analyses due to missing data. This provided substantial statistical power to analyze the effects of the pandemic across undergraduate students in agriculture. Select demographic characteristics and factors related to student resilience are summarized in Table 2. Data for most of the measures were captured using 5-point Likert scales. To allow for the statistical differences between male and female students to be more meaningfully compared, however, in this table (only), these results have been recoded as binary variables which, for most variables, compute the percent of respondents who indicated that they either "agree" or "strongly agree" with a statement.[9,10]

Seventy-four percent of the survey respondents were female students. This reflects enrollment trends across the colleges surveyed. Across all colleges surveyed, between 60% and 74% of all enrolled undergraduate students in the College of Agriculture were female in 2020. Twenty five percent of female and 12% of male students responded to the survey (see Table A3 for specific gender numbers by location). Over 65% of the sample was white, and the average age was 21 years. Women in our sample were more likely to be racially diverse. The majority of students were single (91%).

Less than half (43%) of students planned on pursuing a graduate or professional degree after completing their undergraduate program. Among these, however, there were significant differences between the number of female students (56%) and male students (34%) who had these aspirations ($p < 0.01$). A higher percentage of female students (40%) compared to male students (26%) had liberal political leaning ($p < 0.01$). Less than 9% of students reported being food insecure and 6% reported experiencing housing insecurity during campus closures. Student assessment of food insecurity did not differ significantly between genders, but assessment of housing insecurity was significantly different ($p < 0.10$).

We find statistically significant differences between several factors affecting environment and personal resilience between male and female students. Higher number of male students (64%) had fewer worries about t their own COVID-19-related health risk compared to 53% of female students ($p < 0.01$). In addition, 21% of women were concerned about their families' COVID-19-related health risk compared to 34% of men ($p < 0.01$). The mean measures of environmental resiliency revealed substantial differences across male and female students as well. On average, 26% of students indicated feeling connected with their community since their campus closed. However, only 34% of the male students indicated feeling connected compared to 24% of women ($p < 0.01$).

Descriptive statistics for the main outcome variables

We present descriptive statistics of mental health and well-being measures in Table 3 for the sample and disaggregated by gender. Both the mean of the primary mental health and life satisfaction scores and percent of students within each mental health response category are reported. Life satisfaction was reported using a five-item scale adapted from Diener et al. (1985) in which higher mental health scores indicate a higher likelihood of depression, while higher life satisfaction scores indicate more satisfaction with life.

Figures 2 and 3 illustrate the cumulative distribution of male and female mental health and life satisfaction scores. These results reveal female students had a statistically significant higher likelihood of depression as compared to male students ($p < 0.01$). Female students also had a statistically significant average lower life satisfaction score than male students ($p < 0.05$).

Empirical framework

We begin our analysis with a linear regression framework to explore the association between resiliency attributes and the two main outcome variables assess student mental health (mental health score) and well-being (life satisfaction score) using the following specification:

$$Y_i = \alpha + B_1 \text{Personal Resilience}_i + B_2 \text{Environmental Resilience}_i + B_3 \text{Demographic Factors}_i + \gamma_i + \varepsilon_i, \tag{1}$$

Y_i represents the main outcome variable of either mental health and life satisfaction score for respondent i. *Personal Resilience*$_i$ is a vector of variables capturing individual i's personal resiliency and includes food insecurity, level of concern about one's health, family member COVID-19-related health risks, and graduate school aspirations. The vector of *Environmental Resilience*$_i$ factors include political leaning, feelings of isolation, access to secure housing, online learning experience during the Spring 2020 semester, and if the student has experienced discrimination. *Demographic Factors*$_i$ considered in this analysis are gender, race, ethnicity, age, marital status, parental household income, and international student status, and whether they were living with children in their home. Dummy variables for each university (γ_i) are used to control for university policies, culture, and geographical region. ε_i is the error term.

A second set of analyses evaluates whether students were at risk of depression based on our previously identified independent variables. Here, the dependent variable is the ordinal variable derived from the individual HANDS survey questions, which categorize students as being at low, moderate, and high likelihood of depression. This ordered probit model is represented as follows:

$$y_i^* = \mathbf{x}_i'\beta + \varepsilon_i \tag{2}$$

where y_i^* is the categorical outcome variable representing the likelihood of depression, taking values of 1 (low likelihood), 2 (medium likelihood), and 3 (high likelihood). The vector of explanatory variables, $\mathbf{x}$, is comprised of the previously described resiliency and demographic variables. The error term, ε_i, has an assumed mean zero and is independently and identically

TABLE 2 Descriptive statistics of student sample characteristics

		All	Male	Female	Test of difference between male and female
Female		74.42%			
Race	White	64.81%	67.86%	63.76%	
	Black	2.81%	1.75%	3.26%	*
	Asian	20.10%	19.05%	20.46%	
	American Indian	1.90%	2.21%	1.81%	
	Multiple, other	10.38%	9.13%	10.71%	
Hispanic		13.08%	9.25%	14.81%	***
International student		4.26%	4.93%	4.03%	
Age (years)		20.74 (3.21)	21.13 (3.56)	20.16 (3.07)	**
Living with children		7.22%	5.27%	7.89%	**
Parental household income ($)		100,784.20 (71,468.94)	103,569.40 (78,562.89)	99,679.90 (76,560.03)	
Marital status—single		91.00%	88.10%	91.99%	**
Personal resiliency factors[a,b]					
	No worry for self	55.92%	63.95%	53.09%	***
	Family health risk	24.50%	33.73%	21.32%	***
	Food insecure	8.47%	8.85%	8.30%	
	Housing insecure	6.24%	7.29%	5.81%	*
	Grad school	43.20%	34.35%	55.99%	***
Environmental resiliency factors[a,b]					
	Felt connected	26.21%	33.92%	23.75%	***
	Experienced discrimination	32.15%	28.87%	33.23%	*
	Online spring experience	2.91 (1.17)	2.76 (1.20)	2.98 (1.15)	**
	Liberal leaning	30.78%	26.02%	39.45%	***
n		2299	588	1711	

Note: If the difference for the outcomes between the male and the female are statistically significant, they are denoted by
***$p < 0.001$, **$p < 0.05$, *$p < 0.1$ on the values in the column for female students.
[a]Personal and environmental resilience factors were measured on a Likert-type scale but were converted to binary variable reporting of descriptive statistics and to examine mean statistical differences between female and male students.
[b]For most measures, binary variables of the personal resilience factors were computing the percent of respondents who indicated that they either "Agree" or "Strongly Agree" with the statement. For measures concerning worry for self, felt connected to community, and housing insecurity, binary variables were constructed by computing the percent of respondents who indicated that they "Neither agree nor disagree" "Agree" or "Strongly Agree."

TABLE 3 Student mental health and life satisfaction outcomes variable characteristics ($n = 2028$)

	All	Male	Female
Mental health measure	7.71 (6.29)	5.87 (5.92)	8.36 (6.27)***
Life satisfaction index	16.83 (5.6)	17.20 (5.26)	16.69 (5.12)**
Mental health score 1: Low likelihood of being depressed	58.55%	69.05%	54.94%
Mental health score 2: Moderate likelihood of being depressed	29.40%	21.26%	32.20%
Mental health score 3: High likelihood of being depressed	12.05%	9.69%	12.86%

Note: Statistically significant differences between male and female students are denoted by ***$p < 0.01$ and **$p < 0.05$ and are reported in the column for female students. Mean reported for continuous variables and standard deviation reported in parentheses. Percentages reported for indicator variables.

distributed with cumulative normal distribution denoted by Φ and normal density function (Greene, 2003).

A student's self-reported likelihood of depression can be categorized in one of the three categories if $\mu_{n-1} < y^* < \mu_n$, where n = 1, 2, 3. The likelihood of depression is related to the latent variable y^* through the limit (threshold) values, μ_n $n = 1, 2, 3$, for defining each of the three likelihood of depression categories. We then have the following probabilities of belonging to one of the depression categories:

$$P(y = b|x) = \Phi(\mu_n - \beta x) - \Phi(\mu_{n-1} - \beta x). \tag{3}$$

All models were first estimated for the entire sample. Then, we estimated each model specification separately for male and female students to account for potential gender-based differences in resilience factors and unbalanced sample representation (e.g., stronger female survey participation).

RESULTS

Predictors of mental health status and level of life satisfaction measures

Our linear regression results analyzing potential predictors of mental health and life satisfaction scores are presented in Table 4.[11] The first three columns display results evaluating mental health scores, while columns four through six present results for the life satisfaction scores for the entire sample and male students and female students, respectively.

Mental health in relation to personal and environmental resiliency

The mental health variable was measured so that each additional increase in the mental health score was indicative of declining mental health. In first considering the full sample (column 1), many of the personal and environmental resiliency variables were statistically significant. Both personal and family COVID-19-related health risks significantly increased students' likelihood of depression and anxiety (by 0.57 points). Access to food and housing security similarly affected mental health outcomes. Students who expressed a one unit increase in food insecurity
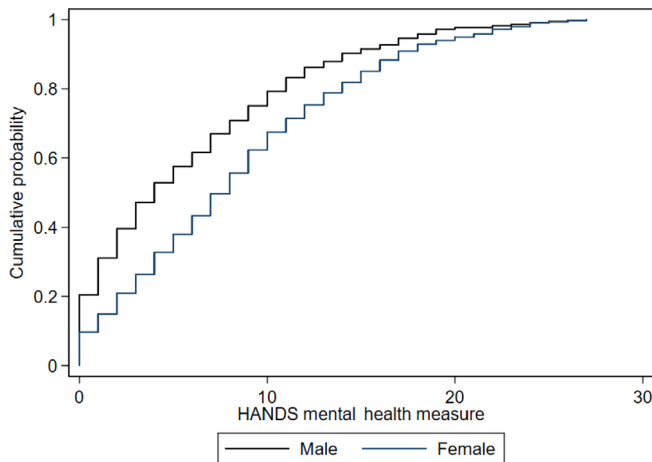
FIGURE 2 The cumulative distribution function for HANDS mental health measure [Color figure can be viewed at wileyonlinelibrary.com]
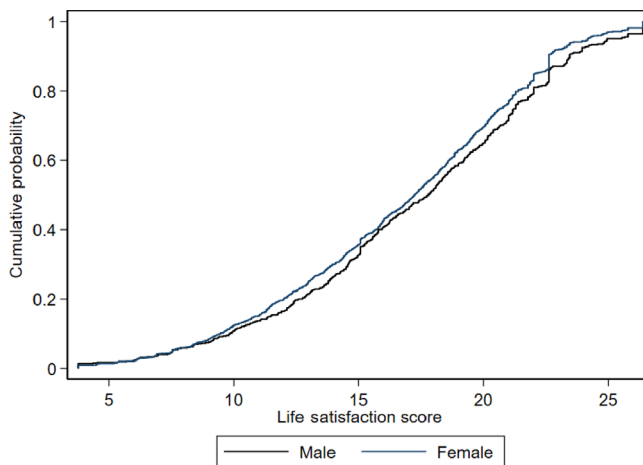

FIGURE 3 The cumulative distribution function for life satisfaction score [Color figure can be viewed at wileyonlinelibrary.com]

(on a scale of one to five) were, on average, at a higher risk of developing depression and anxiety (by 0.63 points). If their housing insecurity increased by one unit, their likelihood of depression increased by 0.88 points. The magnitude of these effects is notable, as previous research found that a point decrease in food security score is directly related to a 0.8 decrease in GPA scores, and it in turn has been found to reduce mental health score (Martinez et al., 2020). Similarly, previous research has found that, even prepandemic, over 5% of students have extremely unstable housing situations and students with housing instability perform poorly in their classes (Goldrick-Rab et al., 2015; Silva et al., 2017).

Environmental resilience factors also were found to be statistically significant in affecting student's mental health. Those students who had a positive online learning experience during the Spring 2020 semester had a lower likelihood of depression (0.96 points) relative to other

students. For each unit decrease in a student's self-reported feeling of isolation from their community, their likelihood of depression and anxiety decreased by 1.39 points. As individual's reported experiences with discrimination decreased, so did their mental health risk as well. On average, having been personally affected by racist acts, discrimination, or implicit bias increased the average student mental health score (0.34 points), indicating that those students who have experienced these forms of discrimination were more likely to experience a lower mental health status.

Importantly, however, when disaggregated by gender, we found several personal and environmental resiliency factors affected the mental health of male and female students differently. Concern about their own health, family members' COVID-19-related health risks, food insecurity, and housing insecurity were all personal resilience factors associated with a higher risk of mental health problems for female students. All of the environmental resiliency factors had a statistically significant effect on female students' mental health score. Female students that are more liberal leaning, feel more isolated, had a poor online learning experience in Spring 2020, and experienced discrimination had a higher risk of mental health problems.

Personal and environmental resiliency factors were also significantly related to the mental health of male students. Men with their own health concerns, family members with COVID-1-related health risks, and graduate school aspirations were associated with a higher risk of developing mental health problems. Those reporting positive online learning experience for the Spring 2020 term, experiencing a lower degree of discrimination and feeling connected to their community, were associated with less risk of depression.

There were noticeable differences in male and female students' relationship between their personal and environmental resiliency measures and mental health and life satisfaction outcomes. In the case of mental health outcomes, our regression estimates indicate that food insecurity is a significant predictor of a woman's mental health score, but not of male student's mental health score even though almost 9% of both male and female students indicated being food insecure. Similarly, female students with liberal political leanings had a statistically significant higher likelihood of having mental health problems. In contrast, self-reported political leaning did not explain variability in male students' mental health scores.

For male students experiencing discrimination, a one unit increase in the level of this variable related to male students' risk of depression increasing by 0.51 points. While this impact on mental health risk is higher than that reported by female students (an increase of 0.26 points), the difference in coefficients for male and female students is not statistically significant. Another important finding was that international male students were more likely to experience mental health challenges compared to domestic male students. As summarized by Brunsting et al. (2018) and Alharbi and Smith (2018), even under regular circumstances, international students are more prone than domestic students to depression. The pandemic may have further isolated international students due to monetary, informational, language, and cultural barriers (Chen et al., 2020, Chen & Tong, 2020), while at the same time, reducing their access to campus resources and social and cultural community support and engagement. Given this, it is perhaps more surprising that female international students did not have the same outcome.

Life satisfaction in relation to personal and environmental resiliency

The general explanatory tests of life satisfaction across all students are reported in Table 4 (columns 4–6). Several personal resilience factors consistently help explain life satisfaction

outcomes, but differences arise between female and male students. A students' concern about other family members' COVID-19-related health risks does not significantly affect female student's life satisfaction score, while it does for male students. For each one unit increase in severity of a male student's concern about their relative's health risk, their life satisfaction score declined by 0.52 points. Conversely, concerns about their own health had a statistically significant effect for female students but not for male students. For a one unit decrease in severity of a female concern about their own health risk, their life satisfaction score declined by 0.42 points. For both men and women, food insecurity was a statistically significant factor that decreases life satisfaction, while housing insecurity decreased life satisfaction and was only statistically significant for female students.

Environmental resiliency factors consistently played a significant role in explaining life satisfaction outcomes, especially for female students. As a female student's rating of her political leanings as liberal increased by one unit, her life satisfaction fell by 0.98 points. Female students with a lower self-reported experience of discrimination was more likely to have higher life satisfaction. For each single unit decrease in feelings of being isolated, the average female student's level of life satisfaction increased by 0.62 points. In contrast, the associations between feeling isolated and having more liberal political leanings with the level of life satisfaction was statistically insignificant for male students.[12] These findings are supported by previous research that women are more likely than men to report feeling lonely or isolated (Gierveld & Van Tilburg, 2010) and are also more vulnerable in isolation (Perrin et al., 2009). Interestingly, having experienced discrimination significantly lowered only female students' level of life satisfaction. A more positive experience during the Spring 2020 term increased life satisfaction for both male and female students.

Important differences were also revealed in the outcomes for international relative to domestic students. While, as previously noted, male international students did have an increased likelihood of experiencing depression, they were no differences when compared to domestic students when examining their self-assessed life satisfaction. For female students, however, the reverse is true—these students are do not have different mental health scores but have significantly more negative life satisfaction scores than either domestic female students or male students.

While this study does not offer insights into the cause of this important finding, the uniquely difficult challenges faced by international students during COVID-19 have been initially explored. Chen et al. (2020) note that in addition to the previously describe increased likelihood of isolation, the needs of international students were often neglected by their host universities in their COVID-19 responses. Decisions to fully or close campuses severely affected the housing security or food access for many international students. In addition, for those who were unable to return home due to reduced international flights or closed borders may have experienced additional unmet psychological needs from being away from their families and communities (Chen et al., 2020). Further, some international students may also find themselves dealing with "a fractured reality" where both the severity of illness and national response to COVID-19 differed significantly between their home country and where they are studying at a given point in time. As Hari et al. (2021) note, living in these two (or more) national contexts can bring additional complexity to international students in negotiating their response to the pandemic. Complicating matters, COVID-19 fueled a surge in microaggressions and discrimination against international (and domestic) students of Asian origin (Hahm et al., 2021; Maleku et al., 2021).

TABLE 4 Linear regression estimates for mental health and well-being outcomes

		Mental health score			Life satisfaction score		
		All (1)	Male (2)	Female (3)	All (4)	Male (5)	Female (6)
Personal resiliency	No worry for self	−0.569***	−0.628***	−0.549***	0.375***	0.222	0.416***
		(0.123)	(0.265)	(0.140)	(0.112)	(0.255)	(0.124)
	Family health risk	0.566***	0.708***	0.474***	−0.123	−0.517**	0.028
		(0.129)	(0.263)	(0.147)	(0.113)	(0.238)	(0.128)
	Food insecure	0.630***	0.365	0.710***	−0.862***	−0.883***	−0.858***
		(0.157)	(0.322)	(0.181)	(0.148)	(0.345)	(0.160)
	Housing insecure	0.876***	0.624	0.929***	−0.947***	−0.175	−1.230***
		(0.223)	(0.443)	(0.247)	(0.183)	(0.394)	(0.197)
	Grad school	0.155	1.113**	−0.069	0.057	−0.084	0.078
		(0.269)	(0.550)	(0.310)	(0.240)	(0.495)	(0.273)
Environmental resilience	Felt connected	−1.393***	−1.009***	−1.589***	0.525***	0.259	0.622***
		(0.121)	(0.227)	(0.144)	(0.113)	(0.229)	(0.130)
	Experienced discrimination	0.344***	0.509***	0.265***	−0.218***	−0.171	−0.230***
		(0.078)	(0.151)	(0.091)	(0.072)	(0.136)	(0.084)
	Online spring exp.	−0.957***	−0.838***	−1.000***	0.519***	0.678***	0.464***
		(0.120)	(0.235)	(0.141)	(0.104)	(0.216)	(0.122)
	Liberal leaning	1.155***	0.243	1.405***	−0.955***	−1.017	−0.975***
		(0.295)	(0.618)	(0.339)	(0.269)	(0.616)	(0.302)
Demographic characteristics	Female	1.333***	—	—	−0.273	—	—
		(0.291)			(0.272)		
	Race—white	−0.030	1.264	−0.487	0.805	0.542	1.077*
		(0.536)	(0.981)	(0.642)	(0.507)	(0.957)	(0.586)
	Race—black	−1.489	0.427	−1.961*	0.308	−0.308	0.585
		(1.009)	(1.756)	(1.170)	(0.911)	(2.341)	(1.006)

(Continues)

TABLE 4 (Continued)

	Mental health score			Life satisfaction score		
	All (1)	Male (2)	Female (3)	All (4)	Male (5)	Female (6)
Race—Asian	−0.894	−0.971	−0.893	0.254	−0.277	0.639
	(0.630)	(1.331)	(0.729)	(0.568)	(1.145)	(0.654)
Race—American Indian	1.366	0.526	1.672	0.200	2.063	0.020
	(1.050)	(1.775)	(1.268)	(0.834)	(2.234)	(0.900)
Age	−0.039	−0.029	−0.046	−0.035	−0.061	−0.034
	(0.040)	(0.056)	(0.052)	(0.042)	(0.068)	(0.052)
Hispanic	−0.182	−0.142	−0.017	0.596	−0.154	0.805*
	(0.478)	(1.119)	(0.525)	(0.431)	(0.956)	(0.485)
Living with small children	−0.235	−1.387	0.056	0.077	0.733	−0.060
	(0.500)	(1.026)	(0.573)	(0.501)	(0.956)	(0.588)
Parental household income	−0.045	−0.039	−0.047	0.124***	0.115	0.130***
	(0.045)	(0.083)	(0.054)	(0.042)	(0.084)	(0.048)
Marital status—single	0.324	0.050	0.220	−0.115	−0.584	0.344
	(0.435)	(0.763)	(0.532)	(0.445)	(0.728)	(0.570)
International student	−1.307*	−2.265*	−1.033	−2.276***	−0.471	−3.086***
	(0.676)	(1.203)	(0.864)	(0.679)	(1.412)	(0.761)
Constant	10.962***	13.052***	−1.000**	11.605***	16.642***	9.274***
	(2.582)	(5.205)	(0.141)	(2.376)	(4.578)	(2.787)
n	1616	412	1204	1632	418	1214
R^2	0.367	0.405	0.348	0.234	0.248	0.249
F-stat	40.75	12.60	28.15	21.79	6.32	19.17

Note: Standard errors are reported in parentheses and are corrected for heteroskedasticity. The coefficients reported are from a linear regression estimation. We control for university level effects in each specification.

*** $p < 0.001$, ** $p < 0.05$, * $p < 0.1$.

This literature does not, however, offer insight into why the mental health and life satisfaction findings may differ between male and female international students. In considering our findings, these differences may be largely driven by the nature of our respondents. A majority of international students in our sample were female and Asian. During the first waves of the pandemic, these students may have experienced significant disruption, concern, and helplessness from their inability to help their families at home, on top of the challenges faced by all students from campus pandemic responses. On a positive note, it does not appear that these challenges significantly impacted international female students' likelihood of mental health challenges, but it certainly decreased their life satisfaction. Furthermore, for these same students who were also largely intending to continue onto graduate studies; as is explored in the next section, this ambition adds additional pressures from having to maintain their academic standing.

Students experiences with discrimination

To further explore the characteristics of students who indicated experiencing discrimination, we used t-tests to evaluate whether differences exist between the means of male and female responses. Overall, 33% of female students and 29% of male students indicated that they experienced some form of discrimination ($p < 0.10$) *in their life*. Among these, 62% of female students compared to 50% of male nonwhite students reported they experienced some form of discrimination ($p < 0.05$).

We also specifically asked the respondents if they ever experienced discrimination *at their university*. Over 13.5% of male and 7.5% of female students agreed they experienced university-based discrimination. Among these, 45% were male minority students and 63% were female minority students; the lower survey participation of men compared to women may contribute to these differences.

Students with graduate school aspirations

To explore another dimension of the heterogeneity of our student population, we estimate Equation (1) separately for students aspiring to pursue graduate education. These results are presented in Table 5 with results for male students presented in columns one and three and results for female students in columns two and four, for both mental health and life satisfaction scores, respectively. Male graduate school aspirants with family members with COVID-19-related health risks were associated with a higher risk of developing mental health problems. Of the environmental resilience factors, male students who reported having a positive online learning experience in Spring 2020, feeling connected with their community, and reported experiencing less discrimination were associated with a lower risk of depression. When considering life satisfaction scores for male graduate school aspirants, only the environmental resilience factors had a statistically significant impact. Male graduate student aspirants with more liberal political leaning or who had experienced discrimination had lower life satisfaction scores, while those who had a positive experience with online learning during the Spring 2020 semester were associated with higher levels of life satisfaction.

Results for female graduate school aspirants' were similar to those in the baseline analysis (reported in Table 4). Many personal and environmental resiliency measures more adversely

TABLE 5 Linear regression estimates for mental health and well-being outcomes for graduate school aspirants

	(1) Mental health score		(3) Life satisfaction score	
	Male	**Female**	**Male**	**Female**
Personal resilience				
No worry for self	−0.356	−0.652***	−0.189	0.454***
	(0.430)	(0.183)	(0.435)	(0.170)
Family health risk	1.979***	0.612***	−0.572	−0.090
	(0.460)	(0.206)	(0.401)	(0.187)
Food insecure	0.318	0.567**	−1.004	−0.743***
	(0.519)	(0.243)	(0.554)	(0.223)
Housing insecure	−1.314***	1.035***	0.097	−1.376***
	(0.650)	(0.352)	(0.673)	(0.281)
Environmental resilience				
Felt connected	−1.530***	−1.485***	0.061	0.674***
	(0.485)	(0.205)	(0.379)	(0.173)
Experienced discrimination	0.621**	0.209*	−0.728***	−0.271**
	(0.278)	(0.121)	(0.244)	(0.118)
Online learning experience	−1.112**	−0.980***	0.801**	0.497**
	(0.502)	(0.191)	(0.395)	(0.169)
Liberal leaning	0.178	1.869***	−2.789***	−0.802*
	(1.022)	(0.466)	(1.005)	(0.412)
Demographic characteristics				
Race—white	1.441	−0.937	−1.451	1.685**
	(1.708)	(0.806)	(1.646)	(0.726)
Race—black	0.861	−3.387**	−2.470	1.428
	(2.648)	(1.410)	(4.261)	(1.251)
Race—Asian	−1.359	−1.635*	−2.448	1.516*
	(1.786)	(0.903)	(1.963)	(0.780)
Race—American Indian	2.086	1.787	3.374*	1.640*
	(2.395)	(1.400)	(1.828)	(1.027)
Age	0.218	0.023	0.047	0.079
	(0.178)	(0.094)	(0.117)	(0.090)
Hispanic	−0.894	−0.448	−1.911	1.281**
	(1.634)	(0.6760	(1.674)	(0.600)
Living with small children	−0.767	−0.085	−1.274	−0.583
	(1.943)	(0.073)	(1.219)	(0.891)
Parental household income	0.176	−0.085	0.160	0.167**
	(0.158)	(0.073)	(0.150)	(0.068)

TABLE 5 (Continued)

| | (1) Mental health score | | (3) Life satisfaction score | |
	Male	**Female**	**Male**	**Female**
Marital status—single	−0.078	−0.306	−1.131	1.367
	(1.355)	(0.745)	(0.973)	(0.880)
International student	0.047	−0.975	−1.924	−3.661***
	(1.792)	(1.026)	(1.893)	(0.945)
Constant	−2.075	9.627**	3.719	3.866
	(7.668)	(3.925)	(6.651)	(3.935)
n	127	642	129	645
R^2	0.514	0.374	0.26	0.45
F-stat	6.09	17.97	13.50	4.08

Note: Standard errors are reported in parentheses and are corrected for heteroskedasticity. The coefficients reported are from an ordered probit regression estimation. We control for university fixed level in the estimation.

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

impacted women's probability of developing mental health problems and life satisfaction when compared to those of men. Also, black and Asian female graduate school aspirants were more likely to be at higher risk of depression ($p < 0.1$), and the life satisfaction of female international graduate students aspirants was particularly negatively impacted. These findings are important and may have implications for the future likelihood that women in agricultural disciplines will decide to pursue graduate education.[13]

Predictors of likelihood of mental health problems

As described by the HANDS instrument, mental health scores can be categorized to reflect those with high, medium, or low probability of experiencing mental health problems. Using the same score cutoffs for each category as is used for the HANDS instrument, reach respondent was assigned to the appropriate category for their likelihood of depression (see Table A1).[14] Table 6 presents results for ordered probit models to understand which student factors may be related to these category assignments.

In considering results for all respondents, the personal and environmental resiliency factors that were positively associated with a higher likelihood of mental health problems were those, who have concerns about COVID-19 health risk for their family, those facing food insecurity, those experiencing housing insecurity, those who have experienced discrimination, and those with liberal political leaning. The resiliency factors associated with a reduced likelihood of mental health problems included feeling connected, fewer own-health concerns, and a positive Spring 2020 online learning experience. Aside from being a female or an international student, none of the other demographic factors were found to have a statistically significant effect in predicting the mental health outcome.

These aggregate results, however, mask important differences between factors which affect the mental health of male and female students. Factors associated with an increased likelihood

TABLE 6 Ordered Probit regression results for likelihood of mental health problem

	(1) All	(2) Male	(3) Female
Personal resilience			
No worry for self	−0.099***	−0.154**	−0.087***
	(0.030)	(0.074)	(0.034)
Family health risk	0.120***	0.108	0.112***
	(0.031)	(0.072)	(0.035)
Food insecure	0.155***	0.113	0.164***
	(0.034)	(0.074)	(0.039)
Housing insecure	0.134***	0.180	0.120**
	(0.046)	(0.090)	(0.052)
Grad school	0.018	0.204	−0.005
	(0.067)	(0.161)	(0.074)
Environmental resilience			
Felt connected	−0.306***	−0.251	−0.326***
	(0.039)	(0.082)	(0.045)
Experienced discrimination	0.064***	0.116***	0.045**
	(0.019)	(0.040)	(0.021)
Online spring Exp.	−0.206***	−0.247***	−0.212***
	(0.030)	(0.074)	(0.034)
Liberal leaning	0.206***	0.227	0.219***
	(0.071)	(0.165)	(0.080)
Demographic characteristics			
Female	0.267***	—	—
	(0.079)		
Race—white	−0.043	0.260	−0.104
	(0.124)	(0.259)	(0.145)
Race—black	−0.384	−0.280	−0.390
	(0.254)	(0.566)	(0.287)
Race—Asian	−0.146	−0.224	−0.093
	(0.147)	(0.355)	(0.165)
Race—American Indian	0.132	−0.529	0.336
	(0.244)	(0.496)	(0.282)
Age	−0.016	−0.012	−0.016
	(0.011)	(0.020)	(0.013)
Hispanic	0.037	0.050	0.079
	(0.110)	(0.289)	(0.118)
Living with small children	−0.006	−0.805	0.114
	(0.127)	(0.461)	(0.135)

TABLE 6 (Continued)

	(1) All	(2) Male	(3) Female
Parental household income	−0.020	0.009	−0.005
	(0.113)	(0.026)	(0.012)
Marital status—single	0.020	−0.046	0.034
	(0.113)	(0.206)	(0.131)
International student	−0.346*	−0.546	−0.314
	(0.190)	(0.417)	(0.226)
n	1616	412	1204

Note: Standard errors are reported in parentheses and are corrected for heteroskedasticity. The coefficients reported are from an ordered probit regression estimation. We control for university fixed effects in the estimation.

***$p < 0.001$. **$p < 0.05$. *$p < 0.1$.

of women developing mental health problems (column three) include family members with COVID-19-related health risks, food insecurity, housing insecurity, discrimination experiences, and liberal political leaning. Resiliency factors such as less worry for one's own health related to COVID-19, feeling connected to one's community, and a positive online learning experience during Spring 2020 decreased female students' likelihood of developing mental health problems. For male students (column two), relatively few of the examined factors were found to predict their mental health outcomes. As indicated by the descriptive statistics, relatively few men (36%) worried about their health due to COVID-19. For male students, decreased concern about their own COVID-19 risks related to lower risk of depression. Positive online experience in Spring 2020 and experiencing discrimination respectively decreased and increased the likelihood of a male student experiencing mental health problems, respectively. In the case of both men and women, no demographic characteristics were found to be significant in predicting likely mental health status.

Results of marginal effect estimations of resiliency factors related to each category of low, moderate, and high likelihood of depression are reported in Table 7. In columns one through three, we report the marginal effects for all students, while columns four through six and columns seven through nine separately report results for male and female students. Once more, a positive coefficient value indicates that an increase in the magnitude a resiliency factor increased a student's likelihood of experiencing a given category of depression. Overall, factors that tend to affect a medium or high likelihood of mental health problems were quite similar. The nature of the resiliency profile of those with a low likelihood of developing mental health problems differed notably from these groups.

When examining personal resilience factors, students who with few COVID-19 health risk concerns about themselves were more likely to be in the low depression category, and fewer concerns for one's health decreased the likelihood of being in the medium or high and higher depression categories. This result holds for both male and female students. Students with a family member with a COVID-19-related health risk, experiencing food insecurity, or experiencing housing insecurity had higher probability of being in the moderate- and high-depression categories. These results were primarily driven by female students, as marginal effects for these factors were not often significant for male students. Results show that more vulnerable students, or those with food insecurity, housing insecurity, or own or family related COVID-19-related

TABLE 7 Marginal effects of ordered probit regression for likelihood of mental health problems

	All			Male			Female		
	Low (1)	Moderate (2)	High (3)	Low (4)	Moderate (5)	High (6)	Low (7)	Moderate (8)	High (9)
Personal resilience									
No worry for self	0.030***	−0.016***	−0.014***	0.040**	−0.024**	−0.015*	0.028**	−0.014**	−0.014**
	(0.009)	(0.004)	(0.004)	(0.019)	(0.011)	(0.007)	(0.010)	(0.005)	(0.005)
Family health risk	−0.037***	0.019***	0.017***	−0.028	0.017	0.011	−0.036***	0.018***	0.018***
	(0.009)	(0.005)	(0.004)	(0.018)	(0.011)	(0.007)	(0.011)	(0.005)	(0.005)
Food insecure	−0.048***	0.025***	0.022***	−0.029	0.017	0.011	−0.053***	0.026***	0.026***
	(0.010)	(0.005)	(0.005)	(0.019)	(0.012)	(0.007)	(0.012)	(0.006)	(0.006)
Housing Insecure	−0.041***	0.022***	0.019***	−0.046**	0.028**	0.018*	−0.038**	0.019**	0.019**
	(0.014)	(0.007)	(0.006)	(0.023)	(0.014)	(0.009)	(0.016)	(0.008)	(0.008)
Grad school	−0.005	0.002	0.002	−0.053	0.032	0.021	0.001	−0.000	−0.000
	(0.020)	(0.010)	(0.009)	(0.041)	(0.025)	(0.016)	(0.023)	(0.011)	(0.011)
Environmental resilience									
Felt connected	0.095***	−0.050***	−0.045***	0.065***	−0.039***	−0.025***	0.105***	−0.052***	−0.052***
	(0.011)	(0.006)	(0.006)	(0.020)	(0.012)	(0.009)	(0.013)	(0.006)	(0.007)
Experienced discrimination	−0.020***	0.010***	0.009***	−0.030***	0.018***	0.011***	−0.014**	0.007**	0.007**
	(0.005)	(0.003)	(0.002)	(0.010)	(0.006)	(0.004)	(0.006)	(0.003)	(0.003)
Online spring exp.	0.064***	−0.033***	−0.030***	0.064***	−0.039***	−0.025***	0.068***	−0.034***	−0.034***
	(0.009)	(0.004)	(0.004)	(0.018)	(0.11)	(0.008)	(0.010)	(0.005)	(0.005)
Liberal leaning	−0.064***	0.033***	0.030***	−0.059	0.035	0.023	−0.070***	0.035***	0.035***
	(0.002)	(0.011)	(0.010)	(0.042)	(0.026)	(0.016)	(0.025)	(0.012)	(0.013)
n	1616	1616	1616	412	412	412	1204	1204	1204

Note: Standard errors are reported in parentheses and are corrected for heteroskedasticity. The marginal effects are only reported for the variables that are proxy for resilience. The marginal effects are for the ordered probit results from Table 6.

***$p < 0.001$. **$p < 0.05$. *$p < 0.1$.

health risks, had a higher risk of mental health problems. Our results are consistent with previous research findings showing food insecurity is related to lower mental health outcomes and lower academic performance (Martinez et al., 2020).

For environmental resilience factors, across male and female students, those students with a positive online learning experience during the pandemic had a lower probability of being in the moderate and high likelihood of depression categories, and higher probability of being in the low likelihood of depression category. Male and female students who reported experiencing discrimination had a lower probability of being in the low-depression category and higher probability of being in the moderate- and high-depression categories. These results hold for both male and female students when analyzed separately too. Primarily driven by female student results, female students with more liberal political leanings had greater likelihood of being in the moderate- or high-depression categories and a lower likelihood of being in the low-depression category. Feeling connected with your community increased the likelihood of being in the low-depression category for both male and female students.

DISCUSSION AND CONCLUSION

The pandemic shocked the higher education system in the United States, placing unforeseen stresses on student learning and personal well-being and, for some, disrupting education and career plans. We investigated elements of students' pandemic-resiliency and their impact on their mental health and life satisfaction during the pandemic's initial stages. Surveys of students in Colleges of Agriculture at six universities were used to collect data concerning student experiences during the first wave of the COVID-19 pandemic in the Spring 2020 semester. Across all students surveyed, self-reported mental health measures and life satisfaction scores were correlated with factors affecting personal and environmental resiliency, as well as demographic characteristics. Importantly, however, it was found that personal and environmental resiliency variables affected male and female students' mental health and life satisfaction differently. Concerns about familial health were more likely to affect mental health than life satisfaction across the sample. However, we found that certain personal resilience factors (e.g., less worry for oneself about COVID-19 health concerns, foods insecurity, and housing insecurity) and environmental resilience factors (e.g., feeling connected with your community, individual discriminatory experiences, Spring 2020 classroom experience and political leanings) had a significant impact on both mental health and life satisfaction across the sample, but there were differences between male and female students. More often, personal and environmental resilience factors had a statistically significant impact on female students as compared to male students.

To our knowledge, this is the first study linking agricultural students' experiences with discrimination to their mental health in the university setting. While past studies show students from minority and different ethnic backgrounds may have been more likely to suffer from depression and anxiety during the pandemic (e.g., Hoyt et al., 2021; Rudenstine et al., 2021), we show how personal experiences with discrimination may have contributed to differences in mental health outcomes associated with race or ethnicity. This finding is consistent with the Centers for Disease Control's and Prevention (CDC) recognition of racism as a public health risk and prepandemic research showing that discrimination is a psychosocial stressor that contributes to adverse mental health outcomes (CDC, 2021a, 2021b; Pachter et al., 2018; Woodford et al., 2014). Our findings support the notion that personal and environmental resiliency factors impacted student mental health during the pandemic. While our results align with previous work showing personal resilience was

correlated with lower rates of anxiety (Liu et al., 2020), we also extend this area of research show environmental factors also shape student mental health at the outset of the COVID-19 pandemic. Thus, universities may consider a multitiered policy approach to support students′ mental health and well-being during extreme shocks, such as the pandemic, to provide services and resources to support a safe and secure social and physical environment for students. Such approaches may also benefit students beyond times of crises and disruption.

This analysis also provides new insights into the impact of economic and resource considerations on student resilience and mental health during the pandemic. While other studies have consistently shown higher stress among low-income students, our work more specifically reveals the importance of food and housing security in augmenting or alleviating student mental distress. During the initial stages of the pandemic, many students lost employment and did not qualify for emergency assistance programs. Also, prior to and during the pandemic, many qualified students did not participate in food assistance programs, such as the Supplemental Nutrition Assistance Program (SNAP; Owens et al., 2020). As academic institutions and non-government organizations consider programs to support students in the wake of future environmental shocks, they may take account of options to establish or expand services made available through college food pantries (Zein et al., 2018) and provide guidance to students to access food and housing assistance through government and NGO programs (Owens et al., 2020).

Another dimension of the heterogeneity observed in student outcomes was related to gender. Across ethnic and racial groups, women incur heavier home and child-care responsibilities (Mooi-Reci & Risman, 2021). For many women, this created untenable work–life competition and an immediate need for institutional recognition and understanding from educators and employers. In the case of the COVID-19 pandemic, research has found that women's mental health outcomes were more adversely affected then those of men, especially if they had children below the age of 12 years (Hoyt et al., 2021). This points to opportunities for university administrators, faculty, and staff to recognize and, where possible, reduce obstacles to education for those students in caregiver roles for children, elders, or others.

The pandemic highlighted and created new health risks for individuals and demographic groups—affecting students social and familial networks. It brought attention to the need for university-based public health resources to better support students with high physical health (e.g., obesity, asthma, and diabetes) or mental health (e.g., isolation and anxiety) risks. Students may benefit from access to affordable mental health services, especially during extraordinary circumstances like the pandemic (Gulliver et al., 2010). Indeed, Jones et al. (2021) emphasize that meeting students′ basic needs is critical to ensuring their mental health and well-being.

As a possible suggestion to address this, universities may ensure access to needed mental health services, as well as provide and connect students with tele-mental health services on-campus and in the community.[15] This may diffuse the mental strain that students experience during adverse events and improve institutional adaptability. Such a policy may benefit students dealing with new isolation or health threats in particular (Jones et al., 2021). Also, institutions may consider providing virtual platforms and forums to encourage and facilitate student connections with each other to decrease their isolation during such events.

Student connection may also be improved, at least in part, through positive online learning experiences. Students′ overall mental health and life satisfaction were correlated with positive online learning experiences. Past research found difficulties with online learning increased the likelihood of depression among adolescents, but active and authentic learning in distance education increased life satisfaction among university students (Magson et al., 2021; Rehab, 2021). This finding contributes to a new perspective on the value of high-quality instruction, and

potential role instructors may play in reducing threats to student well-being and outlook through periods of adversity. Online learning provides an opportunity to tailor learning to users' needs and to include personalized interactions and effective communication with our students (Dhawan, 2020). Biwer et al. (2021) found that students who were better able to regulate their attention, time, and effort, as well as being more motivated prior to the pandemic experienced higher overall well-being. Their research indicates that effective instructional approaches and methods need to be multidimensional (using a mix of methods), tailored to meet students' differences and heterogenous needs, and ensure access to instructional materials and social interaction.

Our additional analysis of mental health and life satisfaction outcomes revealed postgraduate educational aspirations varied in its relationship to first-wave mental health outcomes across women and men. We found women were 22% more likely than men to have postgraduate or professional (e.g., MSc, or PhD) educational goals. When we analyzed postgraduate aspirants only (see Table 5), we found men and women with further educational plans were substantially more affected by the quality of online learning compared to the average male or female across the population. This suggests ample opportunities for further analysis on discriminatory experiences of undergraduate women considering further professional education.

This study provides a first and exploratory look at these complex issues with regard to agricultural students. Several new insights were revealed through this analysis which, in turn, have identified additional areas worth additional consideration. The findings concerning the very significant way the life satisfaction of female international students was adversely affected during the initial stages of the pandemic, but that male international student was not similarly affected, is noteworthy, and deserves further consideration. In addition, to analyze the impact of discrimination in detail, more data would need to be collected on the types, timing, and sources of discrimination students encounter in agricultural programs. Such detailed data collection and explicit focus were beyond the scope of this study and may be difficult to collect without burdening disadvantaged students.

Shortcomings of our research include its limited time horizon and limited selection of mental health measures. Given our focus on student's pandemic period experience, we do not have baseline measures of their previous mental health and life satisfaction status. Our prepandemic and pandemic experience measures rely on student self-perceptions and reporting. Further, students experiencing depression may have lower self-assessments of their learning experiences and social connection. We believe long-term tracking and analysis of such measures may help clarify whether such endogenous relationships exist.

Future research on this topic would therefore benefit from longitudinal studies of changes in mental health and life satisfaction across different student groups during times of crisis and normality both in the short and the long term. Such studies advance our understanding of impacts from demographic, socio-economic, and resiliency factors have on mental health and life satisfaction during a student's time in the academy. For example, such an analysis could more fully explore factors, such as discrimination, personal resiliency, and food insecurity its impact on female students' mental health and life satisfaction as well as on their subsequent career trajectory and likelihood of pursuing an agricultural career path.

ENDNOTES

[1] According to the WHO (2021), mental health is "a state of well-being in which an individual realizes his or her own abilities, can cope with the normal stresses of life, can work productively and is able to make a contribution to his or her community."

[2] While its use varies across psychological fields (Seginer, 2009), in general terms "future orientation" refers to how individuals perceive and prepare for their future.

[3] The proportion of female students is typically highest in animal science or pre-veterinarian disciplines (e.g., Jesse & Ellersieck, 2009).

[4] This information was collected through a survey question which asked respondent to indicate the extent they agreed with the statement "I have been personally affected by racist acts, discrimination, or implicit biases against racial groups or other minorities."

[5] The response options provided for this question were: Very Liberal, Moderately Liberal, Moderate or Middle of the
Road, Moderately Conservative, Very Conservative, Uninterested in Politics, Other, and Prefer not to respond. To
simplify analysis, these responses were recoded as a binary variable "Liberal Political Leaning" which =1 if respondents indicated they were either very or moderately liberal.

[6] The HANDS depression screening tool was designed to provide a short and reliable 10 item scale for depression screening. Item response analysis was used to select the 10 items in the scale from among 70 items from other depression screening scales. Nine of the items in the HANDS scale was shown to be individually predictive of determining a depressive episode between a control and treatment group. The HANDS scales has found to be as accurate as longer scales, but the HANDS cannot rule out symptoms similar to depression that may arise from other sources (e.g. drug use or medication) and is not able to indicate the severity of depression, just the likelihood (Baer et al., 2000).

[7] The points on the HANDS scale are defined as: 0 = "None of little of the time," 1 = "Some of the time," 2 = "Most of the time," and 3 = "All of the time".

[8] Our scale includes 9 items from the HANDS depression screening tool. We do not believe that this modified depression scale should result in a substantive difference in the likelihood of a person experiencing a depressive episode, given the established predictability and selection of the individual items used in the HANDS scale (see footnote 6). In addition, a shorter scale was also considered in Baer et al. (2000) but was lengthened for educational purposes. Administration of this instrument also differed from its use in a clinical setting. Typically, those completing this tool would be asked to reflect on which of these symptoms they had recently experienced—often in the past two weeks or since their last appointment. In this study, the survey was administered at slightly different times across the participating campuses in the summer of 2020—between a few weeks and up to 3 months after the semester ended.

[9] To be clear, unless otherwise stated, subsequent analyses includes these variables in their original form.

[10] Additional information concerning construction of these binary measures is includes in the Table 2 notes.

[11] The estimation results for the outcomes with only demographic variables in the specification are reported in Table A4.

[12] The coefficients for feeling isolated for male and female students were statistically different ($p < 0.1$).

[13] Indeed, academic advisors at one of the participating schools have already reported several instances of this occurring. Some female students who, prior to the pandemic, were intending to continue to graduate programs have now to either delay applying for at least a few years or entirely changed their mind about this career path. Students making this decision have generally indicated that they either: (1) "need a break" or are "too exhausted" to continue their studies at the moment, or (2) were not willing to pursue more school while there was the potential for continued/more restrictions or disruptions to academic life due to COVID-19. While male students may be making the same decisions, the academic advisors were not aware of any such cases.

[14] Given the difference between our scale based on nine questions from the HANDS survey and the original HANDS survey, which has 10 questions, some caution should be used when comparing our results to other studies using the HANDS survey. The use of the ordered probit model to examine the differences between the categories helps to control for some of this difference.

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APPENDIX A

Question number	Over the past 2 weeks, how often have you...
1	Been feeling low in energy, slowed down?
2	Had poor appetite?
3	Had difficulty falling asleep, staying asleep?
4	Been feeling hopeless about the future?
5	Been feeling blue?
6	Been feeling no interest in things?
7	Had feelings of worthlessness?
8	Thought about or wanted to commit suicide?
9	Had difficulty concentrating or making decisions?

Note: Students responded to each question using a 4-point Likert scale where 0 = "*None of little of the time*," 1 = "*Some of the time*," 2 = "*Most of the time*," and 3 = "*All of the time*." HANDS scores for an individual respondent are calculated by summing the value of responses across all questions. Respondents with scores between 17 and 27 are highly likely to be experiencing a major depressive episode; a major depressive episode is likely if the score is between nine and 16 and is unlikely for those with scores below 9 (Baer et al., 2000).

TABLE A2 Satisfaction with life scale

Item	Statement
1	In most ways my life is close to ideal.
2	The conditions of my life are excellent.
3	I am satisfied with my life.
4	So far I have gotten the important things I want in life.
5	If I could live my life over, I would change almost nothing.

Note: Life satisfaction was measured using the Satisfaction with Life Scale developed by Diener et al. (1985) to measure an individual's cognitive and judgmental self-assessment of their life satisfaction. Respondents indicate how much they agree or disagree with each statement using a 7-point Liker scale where 7 = "strongly agree" and 1 = "strongly disagree." As described by Diener et al. (1985), scores for each respondent are calculated by summing the value of responses for measure.

TABLE A3 Comparison of sample gender characteristics with target population

Location	University A West coast		University B Great Plains		University C West		University D Mid-West[a]		University E Southeast		University F East	
	n	*N*	*n*	*N*	*n*	*N*	*n*	*N*	*n*	*N*	*n*	*N*
Total	974	7485	660	2161	235	744	106	483	130	1240	194	3030
Men	190	2246	211	896	62	297	27	300	23	323	44	1183
Women	768	5240	446	1265	168	447	77	183	105	917	147	1847
%Women	79	70	68	59	71	60	73	38	81	74	76	61

Note: *N* refers to total undergraduate student enrollment in the College of Agriculture of each university. *n* is the number of completed responses.
[a]At this university, the survey was distributed to only student in the Department of Agricultural Economics.

TABLE A4 Linear regression estimates for mental health and well-being outcomes with demographic factors

	Mental health score life satisfaction					
	All (1)	Male (2)	Female (3)	All (4)	Male (5)	Female (6)
Female	2.082***	—	—	−0.321	—	—
	(0.286)			(0.244)		
Race—white	−0.210	−0.230	−0.032	1.463***	2.386***	1.181**
	(0.520)	(0.946)	(0.618)	(0.445)	(0.853)	(0.516)
Race—black	−0.173	1.332	−0.248	−0.312	0.041	−0.567
	(1.006)	(2.132)	(1.140)	(0.791)	(2.089)	(0.862)
Race—Asian	−0.607	−2.521	0.033	0.567	1.587	0.319
	(0.614)	(1.161)	(0.722)	(0.506)	(0.978)	(0.583)
Race—American Indian	1.583	−1.203	2.643*	0.653	3.549**	−0.291
	(1.140)	(1.811)	(1.406)	(0.863)	(1.809)	(0.976)
Age	−0.030	−0.094	−0.000	−0.043	0.018	−0.080
	(0.040)	(0.065)	(0.051)	(0.039)	(0.068)	(0.049)
Hispanic	0.449	0.181	0.651	0.143	0.824	0.022
	(0.486)	(1.046)	(0.545)	(0.400)	(0.803)	(0.450)
Living with small children	−0.144	−1.415*	0.238	0.216	0.824	−0.000
	(0.454)	(0.757)	(0.524)	(0.409)	(0.803)	(0.467)
Parental household income	−0.166***	−0.111	−0.182***	0.231***	0.252***	0.221***
	(0.045)	(0.084)	(0.053)	(0.037)	(0.074)	(0.043)
Marital status—single	0.119	−1.552*	0.996	−0.042	0.111	−0.140
	(0.496)	(0.809)	(0.608)	(0.417)	(0.702)	(0.522)
International students	−2.512***	−2.339**	−2.673***	−1.163***	0.392	−1.707***
	(0.647)	(1.116)	(0.803)	(0.557)	(1.105)	(0.641)
Constant	6.268***	8.390***	−7.006***	16.556***	14.231***	17.383***
	(1.292)	(2.073)	(1.569)	(1.151)	(2.005)	(1.390)
n	2216	566	1650	2237	573	1664
R^2	0.367	0.405	0.348	0.234	0.248	0.249
F-stat	15.14	6.05	6.57	10.80	5.99	7.49

Note: Standard errors are reported in parentheses and are corrected for heteroskedasticity. The coefficients reported are from a linear regression estimation. We control for university fixed effects in each specification.

***$p < 0.001$, **$p < 0.05$, *$p < 0.1$.